P.A. COLLEGE OF ENGINEERING

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PROCEEDINGS OF

ICEST 2024

INTERNATIONAL CONCLAVE ON
ENGINEERING SCIENCES & TECHNOLOGY

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PACE Conclave 2024

23 & 24 APRIL 2024

Partners

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ISBN-978-81-19905-39-3

ISBN-978-81-19905-39-3

PACE Conclave 2024

ICEST 2024
INTERNATIONAL CONCLAVE ON ENGINEERING SCIENCES & TECHNOLOGY

About ICEST

ICEST (International conclave on Engineering Sciences and Technology)is an international peer reviewed event to bring together academia, engineers, students, and researchers in the field of Engineering, Science and Technology, making it an ideal platform for sharing knowledge, fostering industry-academic collaborations, and evaluating emerging technologies from around the world. Participants will be able to exchange ideas in order to profit from each other's contributions, as well as learn about current research being conducted throughout the world. The conference's main purpose is to support research and development activities that will be needed in the future, with an emphasis on all potential and recent fields of Engineering. Several well-known professionals in the fields of Engineering will share their knowledge and experience with the attendees. This conference will serve as a global platform for the presentation of novel research findings, as well as the exchange and dissemination of creative and unique research experiences. The conference aims to enhance the state-of-the-art in all fields of Engineering by encouraging novel, high-quality research discoveries and innovative solutions to upcoming and challenging engineering problems.

Theme's for ICEST

Theme 1
Mechanical Engineering

Theme 2
Civil Engineering

Theme 3
Electronics & Communication Engineering

Theme 4
Computer Science & Engineering

Theme 5
Biotechnology

Theme 6
Basic and Applied Science

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PACE Conclave 2024

ICEST 2024
INTERNATIONAL CONCLAVE ON ENGINEERING SCIENCES & TECHNOLOGY

Theme 1 *Mechanical Engineering*

- Design and production
- Thermal sciences
- Manufacturing and machining
- Energy and environment
- Robotics and automation
- Materials and modelling

Theme 2 *Civil Engineering*

- Geotechnical and environment
- Building materials and construction
- Architecture and Planning
- Structural engineering
- Transportation and Traffic
- Water resources and irrigation

Theme 3 *Electronics & Communication Engineering*

- Communication & Networking
- Signal & Image Processing
- Circuits, Systems and Antennas
- Devices, Materials and Processing
- Energy and Power Electronics
- Robotics, Control, and Automation

Theme 4 *Computer Science & Engineering*

- Data Science and Machine learning
- Cloud and grid computing
- Blockchain
- Internet of Things (IOT)
- Security & Cryptography
- Computational sciences

Theme 5 *Biotechnology*

- Food technology
- Drug design & Nanobiotechnology
- Agricultural biotechnology
- Clinical research
- Environmental engineering
- Bioprocessing

Theme 6 *Basic & Applied science*

- Chemical sciences
- Materials chemistry & polymers
- Graph theory
- Fluid mechanics
- Nanotechnology
- Applied Physics

ISBN-978-81-19905-39-3

Message from Managing Trustee

Esteemed Guests, Distinguished Faculty Members, Scholars, Researchers, and Students,
It is with immense pleasure and pride that I extend my warmest greetings to each of you on the inauguration of the PACE Conclave-24: International Conclave on Engineering Sciences & Technology (ICEST-24).
I express heartfelt gratitude to the organizers, faculty, and staff for their tireless efforts in making this event a reality. Your dedication to fostering academic excellence and innovation in engineering is commendable.
ICEST-24 stands as a testament to our pursuit of knowledge and excellence. With six distinct conferences covering various engineering disciplines, this conclave serves as a platform for intellectual discourse and collaboration.
In today's rapidly evolving world, the themes of ICEST-24 offers an opportunity to engage with experts, explore trends, and chart the future of engineering.
I'm pleased to see the emphasis on publications and knowledge dissemination through conference proceedings and esteemed journals.
At this juncture, I would also like to emphasize the commitment of PACE Group to research and innovation and I'm delighted to see its impact through the presence of numerous faculty PhD holders from various research centers at PACE.
As we embark on this journey, I encourage active participation and collaboration. In it closing, I wish ICEST-24 success. May it catalyze innovation and positive change, leaving a mark on engineering education and research.

Warm regards,
Mr. Abdulla Ibrahim
Managing Trustee & GC Member
PAET, Mangalore

Message from Trustee

First of all I thank god almighty for blessing us to come together to discuss and deliberate on our current affairs and future progress. Know that this surely is a blessing.

During the Second World War, Einstein had to flee Germany to find peace so that he could continue with his work. Epidemics brought societies to survival mode.

A flood recently in the UAE unlike anything seen in the last 75 years had cut supplies of basic essentials like food and water. Even though there are high raise towers, there was no Electricity supply, Gas supply, Air conditioning, lift services and had compromised tap water supply. Even fuel was disbursed to vehicles in limited quantity in an oil rich nation. However, the people came together and did what makes us human, care for each other and contribute in whatever way we can. I myself have left my building and am staying in our family residence.

In short, only peace can enable progress and we have to continuously be grateful to God Almighty for the same.

Secondly, I would like to appreciate the host of this PACE conclave event headed by Abdulla Ibrahim, Ramis sir (other key names and categories of staff, participants and well wishers). The challenges of hosting a successful event requires contribution from everyone from top to bottom, in their respective capacities, which was shown throughout the two days. Our founder Chairman, may god rest his soul, was an enthusiast of both hosting intelligence and accommodating progress. Our actions only resonate his will.

To host this academic conclave which had a wide range of topics covered was our honor. Academia allows for discussions, debates and brainstorming beyond the confinements and limitations of financial implications.. a place where imagination has no limits.. a place that improves our lives, our planet and lives of our future generations to its fullest potential.

In this conclave we have discussed areas of biotechnology which include immunotheraputic approaches, food technology, drug design and nano biotechnology, agricultural biotechnology, bio processing, environmental engineering and innovative emulsification techniques for bio medical applications.

On the electronics and communications front, there were discussions on communication networks, energy and fuel cells.

On the engineering and tech front, discussions on deep learning, machine learning, data science, cloud and grid computing, blockchain, cryptography and security.

On the the basic science front, a deep dive into organic and inorganic chemistry..

On the civil engineering front, sustainable cities, transportation and geotechnological engineering, architecture, planning and construction technology, water resources, irrigation and environment engineering.

And finally, mechanical engineering which included design, production, thermal sciences, materials such as fiber reinforced plastic laminates, modeling and manufacturing.
All discussions and debates were about remarkable areas where our future surely lies.
However, always remember, that even in the heights of our scientific progress, when there was even a hint of arrogance in our capabilities. a pandemic had brought the world to a stand still making us redetermine our capacity. There always is much more to learn and achieve which can only be done with faith, humility, grace and caring for each other.
Today feels like we are on the edge of a new horizon. It feels so, due to changes experienced in various aspects of human life. From the pain of loosing loved ones during
the COVID pandemic to valuing relationships like never before. From disregarding our social commitments to becoming responsible global citizens. From knowingly or unknowingly damaging and depleting our planet's climate
and resources to enacting major initiatives towards climate change and a healthier planet. From dwelling on previous achievements to striving for effective governance. From technology making far reaching attempts to the break through invention of generative AI and others. Businesses creating innovative products, services and models to attract a new era and a renewed lifestyle. A horizon of oppurtunity.

I wish you all the best with hopes that such a conclave causes a ripple effect of goodness throughout our region and our world

Warm regards,
PA Zubair Ibrahim
Managing Trustee & GC Member
PAET, Mangalore

Message from Partnering University

In a captivating address at the international conclave on engineering, science, and technology, a comprehensive exploration into the interconnectedness of disciplines was eloquently presented. Soham from Infosys delivered a thought-provoking speech, drawing on the insights of A. M. L. Ruff to highlight the common ground shared by various fields through set theory. The event itself was commended for its organization, providing a platform beneficial for researchers, academics, practitioners, and students alike.

The discourse then delved into the realm of information technology, presenting a set of five pivotal elements: data, information, knowledge, intelligence, and wisdom. Each element was meticulously dissected, illustrating the journey from data accumulation to wisdom application. The significance of continuous learning and practical application in fostering intellectual progress was underscored, emphasizing the conclave's aim to cultivate wisdom among attendees.

A visionary outlook on the future of engineering was painted, foreseeing a departure from conventional disciplinary boundaries towards interdisciplinary collaboration. The necessity of integrating diverse disciplines and adopting a holistic approach to education was emphasized, particularly in shaping engineers capable of innovation across fields.

The transformative potential of artificial intelligence in engineering was showcased through a compelling example of community washing centers. By leveraging AI, these centers optimize water utilization, foster employment opportunities, and drive sustainable solutions. However, it was acknowledged that challenges outlined in Rajiv Malhotra's book must be addressed, particularly concerning economic development, power dynamics, and psychological implications of AI.

In conclusion, while the integration of artificial intelligence and engineering may disrupt existing paradigms, it also presents an opportunity for global unity and sustainable progress. Through informed discussions and collaborative initiatives, attendees were encouraged to leverage technology for the betterment of society and the planet.

The address concluded with gratitude for the attendees' participation and best wishes for the success of the conclave's upcoming events.

Warm regards,

Dr. P. Nagabhushan

Vice Chancellor

Vignan University, AP

Message from Partnering University

First and foremost, I extend my heartfelt gratitude to all the participants, researchers, scholars, and delegates who have contributed to the success of this International Conference on Engineering, Science, and Technology (ICEST-2), hosted by P.A College of engineering, Mangalore, conducted under the umbrella of PACE Conclave. Your dedication, hard work, and scholarly endeavors have undoubtedly enriched the academic discourse and propelled us forward in the pursuit of knowledge and innovation.

I would also like to extend my appreciation to the organizing committee, volunteers, and support staff who have worked tirelessly behind the scenes to ensure the smooth execution of this event. Your commitment to excellence and attention to detail have played a pivotal role in making ICEST-2 a resounding success.

Today marks a significant milestone for the graduating students who have completed their academic journey at Presidency University. Your hard work, determination, and perseverance have culminated in this moment of triumph, as you prepare to embark on new beginnings and contribute to the global community as responsible citizens and leaders in your respective fields.

As you step out into the world beyond these university walls, I urge you to uphold the values of integrity, compassion, and excellence that have been instilled in you during your time here. Remember that your education is not just a means to personal success but also a powerful tool for positive change in society.

I encourage you to embrace challenges with courage, curiosity, and a growth mindset, knowing that every obstacle is an opportunity for growth and learning. Stay true to your passions, follow your dreams, and never lose sight of the impact you can make in the world.

In closing, let us reflect on the significance of our collective efforts in advancing knowledge, fostering collaboration, and creating a brighter future for generations to come. As we bid farewell to ICEST-24, let us carry forward the spirit of inquiry, innovation, and inclusivity that has characterized this conference and continue to push the boundaries of human knowledge and understanding.

Thank you once again to everyone who has contributed to the success of ICEST-24, and I wish the graduating students all the best in their future endeavors. May you continue to strive for excellence and make a positive impact wherever your journey may take you.

Warm regards,

Dr. Surendra Kumar A. M.
Pro-Vice Chancellor
Presidency University
Bengaluru -560064

Message from Chief Guest

It is good to see PACE conduct International Conclave on Engineering Sciences & Technology (ICEST-24) and under the umbrella of ICEST-24, cover six different departments from Basic Sciences, Biotechnology, Computer Science, EnC, Civil Engineering and Mechanical Engineering.

Whatever be the field or whatever the current industry buzz/hot topic - like currently GenAI, AI/ML, Robotics or Fuzzy - students and academicians should focus on basic fundamentals. For example, GenAI is based on constructs from Set Theory from Mathematics and Statistics. Sticking to fundamentals and basics also gives a strong foundation in any subject, for example - someone who was good in machine design and gears ended up designing the most important component of rover-Pragyan on ISRO's moon mission Chandrayaan 3.

Wishing PACE conducts this multi-disciplinary conclave every year, to enthuse students and academicians think and construct beyond their regular academic curriculum.

Thanking PACE and Dr.Ramis & Team for inviting me to be chief guest, and wishing two day conclave a success.

Warm regards,
Mr. Sohan M.
Senior Project Manager
Infosys, Mangalore

Message from General Chair

Dear Esteemed Colleagues and Participants,

Welcome to the PACE CONCLAVE: International Conclave on Engineering Sciences & Technology – 2024 (ICEST-24).
It is with great pleasure and enthusiasm that we gather here, both physically and virtually, to share insights, exchange ideas, and collaborate towards advancing the frontiers of engineering sciences and technology. In today's interconnected world, where innovation drives progress, this conclave serves as a vital platform for fostering interdisciplinary dialogue and addressing global challenges.
This year's conference theme is multidisciplinary with six different themes including Mechanical Engineering, Civil Engineering, Computer Science, Electronics & Communication, Biotechnology and Basic Science, underscoring our commitment to pushing boundaries and exploring new horizons in engineering and technology. Through thought-provoking presentations, engaging discussions, and networking opportunities, we aim to inspire creative solutions and catalyze impactful change.
I extend my heartfelt gratitude to our distinguished keynote speakers, esteemed presenters, diligent organizing committee members, dedicated volunteers, and collaborated universities for their invaluable contributions in making this event possible. Your expertise, passion, and dedication truly embody the spirit of this conclave.
To all participants, whether seasoned researchers, budding scholars, industry professionals, or enthusiastic students, I encourage you to seize this opportunity to connect with peers, forge collaborations, and deepen your knowledge in your respective fields.
As we embark on this enriching journey together, let us embrace diversity, innovation, and the collective pursuit of excellence. May this conclave inspire us to not only envision a better future but also actively strive towards realizing it.

Thank you for your participation, and I wish you a fruitful and memorable experience at the ICEST-24.

Warm regards,
Dr. Ramis M. K.
Conference Chair
International Conclave on Engineering Sciences & Technology – 2024

Message from Convenor

Dear Esteemed Colleagues and Participants,

Welcome to the PACE CONCLAVE: International Conclave on Engineering Sciences & Technology – 2024 (ICEST-24).

As the Convenor of this prestigious event, it is my honor to extend a warm welcome to all attendees, both in person and virtually. The essence of this conclave lies in its ability to bring together brilliant minds from around the globe to engage in meaningful discourse, share cutting-edge research, and shape the future of engineering and technology.

Under the PACE CONCLAVE: ICEST-24, we are poised to explore the frontiers of innovation, uncover novel solutions to pressing challenges, and foster interdisciplinary collaborations that transcend boundaries. This conclave serves as a beacon of inspiration, igniting the spark of creativity and driving progress in our ever-evolving world.

I extend my sincere appreciation to our esteemed keynote speakers, distinguished presenters, dedicated organizing committee members, committed volunteers, and generous sponsors for their unwavering support and contributions. Your collective efforts have been instrumental in shaping this event into a platform of excellence.

To all participants, I encourage you to actively engage in the discussions, seize opportunities for collaboration, and leverage the wealth of knowledge and expertise present at this conclave. Your involvement is pivotal in shaping the outcomes and impact of our collective endeavors.

As we embark on this journey of discovery and innovation, let us embrace diversity of thought, harness the power of collaboration, and strive for excellence in everything we do. Together, we have the potential to effect positive change and drive progress on a global scale.

Thank you for your participation, dedication, and enthusiasm. I wish you all a rewarding and inspiring experience at the ICEST-24.

Warm regards,

Dr. Shareefraju J. Ukkund

Convenor

International Conclave on Engineering Sciences & Technology – 2024

ISBN-978-81-19905-39-3

PACE CONCLAVE

PACE Conclave is an initiative by P. A. College of Engineering, aiming to bring together academia, industry, and research personnel through a series of events. The International Conclave on Engineering Science & Technology 2024 (ICEST 24) is the inaugural event in this endeavor. Various conferences will be conducted under the umbrella of ICEST-24.

P. A. EDUCATIONAL TRUST (R.)

A remarkable cornerstone of this endeavor is the P.A. Educational Trust (PAET) Mangaluru, a vital subsidiary of the PACE Group. Founded by its Late Chairman, Dr. Ibrahim Haji, PACE Group currently manages 16 educational institutions with over 1,200 teaching staff, 500 non-teaching staff and over 30,000 students from 25 nationalities. Nestled within the 65-acre campus named, PACE KNOWLEDGE CITY, PAET, headed by Mr. Abdulla Ibrahim, manages 6 distinctive institutions, namely: P. A. College of Engineering, Centre for Management Studies & Research, P. A. First Grade College, P. A. Polytechnic, P. A. Institute of Pharmacy, and P. A. Institute of Physiotherapy.

P. A. COLLEGE OF ENGINEERING

P. A. College of Engineering (PACE), situated in PACE KNOWLEDGE CITY and established in the year 2000, offers diverse undergraduate programs, including Electronics and Communications Engineering, Artificial Intelligence & Machine Learning, Civil Engineering, Mechanical Engineering, Computer Science & Engineering, Biotechnology, and specialized Computer Science & Engineering (IoT, Cybersecurity, including Blockchain Technology). The Mechanical Engineering, Computer Science & Engineering, and Biotechnology programs are accredited by National Board of Accreditation (NBA). PACE also provides MBA and Ph.D. programs, reflecting its holistic educational approach.

VISION

PACE is envisaged as a centre of evolution for excellence in Technological, Management and Research Education. The institution aspires to spread universal knowledge through villages & cities enabling the expansion of human resources.

MISSION

- To provide career-oriented professional education to produce technically competent engineers and managers with moral and ethical values.
- To foster and promote an effective learning environment in the campus to be recognized as a place that encourages excellence and diversity in thoughts.
- To provide research and intellectual resources to address problems facing industries and the society while advancing the scopes of multidisciplinary applications.

ISBN-978-81-19905-39-3

PACE Conclave 2024

DEPARTMENT OF MECHANICAL ENGINEERING

Under the umbrella of

ICEST 2024

INTERNATIONAL CONCLAVE ON ENGINEERING SCIENCES & TECHNOLOGY

23 & 24 APRIL 2024

MECH-TECH

INTERNATIONAL CONFERENCE ON EMERGING TRENDS IN MECHANICAL ENGINEERING

PROCEEDINGS

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24 YEARS

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Partners

PRESIDENCY UNIVERSITY

VIGNAN'S UNIVERSITY

Near Mangalore University, Mangaluru, Karnataka, India - 574153

PACE Conclave 2024

ICEST 2024
INTERNATIONAL CONCLAVE ON ENGINEERING SCIENCES & TECHNOLOGY

MECH-TECH
INTERNATIONAL CONFERENCE ON
EMERGING TRENDS IN MECHANICAL ENGINEERING

Message from Conference Chair

Dear Esteemed Colleagues and Participants,

Welcome to the MECH-TECH 2024: International Conference on Emerging Trends in Mechanical Engineering

It brings me great joy and excitement to convene here, both in person and virtually, for the MECH TECH 24: International Conference on Emerging Trends in Mechanical Engineering. Our gathering today signifies a collaborative effort to exchange insights, share ideas, and propel the frontiers of Mechanical Engineering forward. In our interconnected world, where innovation is the driving force behind progress, this conference stands as a pivotal platform for nurturing interdisciplinary dialogue and tackling global challenges head-on.

With the theme of MECH-TECH 2024: International Conference on Emerging Trends in Mechanical Engineering, we reaffirm our unwavering commitment to pushing the boundaries and exploring new avenues within Mechanical Engineering. Through dynamic presentations, interactive discussions, and networking opportunities, our aim is to spark innovative solutions and catalyze meaningful change.

I extend my deepest gratitude to our esteemed keynote speakers, distinguished presenters, diligent members of the organizing committee, dedicated volunteers, and partner universities for their invaluable contributions in bringing this event to life. Your expertise, dedication, and passion epitomize the spirit of this gathering.

To all participants, whether seasoned researchers, emerging scholars, industry experts, or enthusiastic students, I encourage you to seize this opportunity to connect with colleagues, cultivate collaborations, and deepen your expertise in your respective fields.

As we begin this rewarding journey together, let's welcome diversity, innovation, and our shared quest for excellence. May this assembly motivate us not just to imagine a brighter tomorrow, but also to actively strive towards its realization.

Thank you for your participation, and I extend my sincerest wishes for a productive & memorable experience at the MECH TECH-24.

Warm regards,

Dr. Prashanth Pai M.
Chair- MECH-TECH – 2024
HoD, Dept. of Mechanical Engineering
PACE, Mangalore

PACE Conclave 2024

ICEST 2024
INTERNATIONAL CONCLAVE ON ENGINEERING SCIENCES & TECHNOLOGY

MECH-TECH
INTERNATIONAL CONFERENCE ON
EMERGING TRENDS IN MECHANICAL ENGINEERING

Message from Conference Convenor

Dear Esteemed Colleagues and Participants,

Welcome to the MECH-TECH 2024: International Conference on Emerging Trends in Mechanical Engineering.

As the Coordinator of this esteemed event, it is my privilege to extend a heartfelt welcome to all participants, both joining us in person or virtually. The essence of this gathering lies in its ability to unite brilliant minds from across the world, facilitating meaningful discussions, sharing state-of-the-art research, and shaping the future of engineering and technology.

At MECH-TECH 2024, we are poised to venture into the frontiers of innovation, discover fresh solutions to pressing challenges, and nurture interdisciplinary collaborations that transcend boundaries. This gathering serves as a guiding light, sparking creativity and propelling progress in our ever-changing world.

I express my sincere gratitude to our esteemed keynote speakers, distinguished presenters, dedicated members of the organizing committee, committed volunteers, and generous sponsors for their unwavering support and contributions. Your collective endeavors have been instrumental in shaping this event into a platform of excellence.

To all participants, I encourage active engagement in discussions, seizing opportunities for collaboration, and tapping into the wealth of knowledge and expertise present at this gathering. Your involvement is pivotal in shaping the outcomes and impact of our collective efforts.

As we embark on this journey of exploration and innovation, let us embrace diverse perspectives, harness the power of collaboration, and strive for excellence in all our pursuits. Together, we possess the potential to enact positive change and propel progress on a global scale.

Thank you for your participation, dedication, and enthusiasm. I wish you all a fulfilling and inspiring experience at MECH TECH-24.

Warm regards,

Dr. Abdul Razak
Convenor
MECH-TECH – 2024
Dept. of Mechanical Engineering
PACE, Mangalore

International Conclave on Engineering Science & Technology (ICEST 24)

MECH-TECH: INTERNATIONAL CONFERENCE ON EMERGING TRENDS IN MECHANICAL ENGINEERING

23rd April 2024 Tuesday – Day 1	
09:30 AM to 11:30 AM	Inauguration of ICEST-24 Inaugural address by **Mr. Sohan M.** Senior Project Manager – Infosys, Mangalore Keynote Address by **Dr. P. Nagabhushan**, VC, Vignan University, AP
11:30 AM to 11:45 AM	Refreshments
11:45 AM to 01:00 PM	Keynote address – I on topic "Interlaminar Fracture Toughness in FRP Composite Laminates -Future Scope and Applications" by **Dr. P. S. Shivakumar Gouda,** Associate Professor, Dept. of Mech., Engg., SDM College of Engg & Tech, Dharwad, India.
01:00 PM to 02:00 PM	Lunch Break
02:00 PM to 02:45 PM	Track 1 Oral presentation (Design and production)
02:45 PM to 03:30 PM	Track 2 Oral presentation (Thermal sciences)
03:30 AM to 03:45 AM	Refreshments
03:45 PM to 04:30 PM	Track 3 Oral presentation (Energy & Environment)
24th April 2024 Wednesday – Day 2	
09:30 AM to 10:30 AM	Track 4 Oral presentation (Materials and Modelling)
10:30 AM to 11:30 AM	Track 5 & 6 Oral presentation (Manufacturing and Machining)
11:30 AM to 11:45 AM	Refreshments
11:45 AM to 01:00 PM	Keynote address – II on topic " Importance of Industry 4.0 in an aerospace domain " by **Dr. Madeva Nagaral, Manager (Design)** Aircraft Research and Design Centre, Hindustan Aeronautics Limited Bangalore-560037, Karnataka-India
01:00 PM to 02:00 PM	Lunch Break
02:30 PM to 03:30 PM	• Valedictory of ICEST-24 • Valedictory address by **Dr. A. M. Khan,** Senior Professor, Dept. of Electronics & Director- Skill Development Centre Mangalore University Mangalore • Keynote Address by **Dr. Surendra Kumar**, Pro-Vice Chancellor, Presidency University, Bangalore
03:30 PM to 04:00 PM	Interaction & High Tea

COMPARISON OF THE TENSILE STRENGTH OF V-GROOVED BUTT-WELDED ALUMINIUM ALLOYS

Pai P M[1], Maruthi Prashanth B H[1], Pujar C V[1], Adithya P N[1*], Jithesh P[1], Fahad P A[1]

[1]Department of Mech. Engg., P. A. College of Engineering, Mangaluru, Karnataka, India.

*Corresponding Author: Adithya P N Email: adithyanagaraj32@gmail.com

Abstract:

Now-a-days shipping, aerospace and process industries commonly use aluminium and its alloys because of their valuable properties such as light weight, better corrosion resistance and weld-ability. This research investigates the influence of groove angle on the tensile strength of Tungsten Inert Gas (TIG) welded AA2024 and AA7075 alloy weldments. The work aims to examine the tensile-strength of V-grooved butt-welded specimens of AA2024 and AA7075 for different groove angles keeping bevel height constant. TIG welding is employed as it joins different materials with high quality in the presence of inert gas. AC power source ensures better cleaning action and avoids the high heat concentration on the material. Tensile strength of the joint is tested by the universal tensile testing machine. From the tensile test conducted on the V-grooved, butt-welded Al-alloys having varying groove angles, it is inferred that the 45˚ angle has the maximum ultimate tensile strength.

Key Words: Groove angle, V-groove, Butt-joint, Bevel height, Root opening, TIG welding, Ultimate tensile strength.

EFFICIENCY IMPROVEMENT OF VERTICAL AXIS WIND TURBINE BY USING MAGNETIC PROPELLING PHENOMENON

Sandesh Hegde[1]*, Ramachandra C G[2], Nagesh S N[3], Prashanth Pai M[4]

[1]Department of Mechanical Engg, Srinivas Institute of Technology, Mangaluru, Karnataka, India.

[2]Department of Mechanical Engg, Presidency University, Bangalore, Karnataka, India.

[3]Department of Mechanical Engg, Ramaiah Institute of Technology Bangalore, Karnataka, India.

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Abstract:

Presently utmost importance for the development of environmentally friendly and affordable alternative energy sources, as the modern civilizations require an affordable, abundant energy for growth. Since the surface of the globe is uneven, different parts of the planet get sunrays of varying intensity. This creates unequal heating of a surface, will results in differences in an environmental air pressure on the surface of the Earth, which causes wind. The wind turbine is a mechanical structure that converts kinetic energy of air into required mechanical form.

As the result of inclusion of features such as 'like polarity magnet repulsion', here the structure will perform even at lower wind speed condition; with greater efficiency. When these magnets are utilized as an additional power source to VAWT structure, they induce a repulsive force which adds kinetic power to the rotor, as they transform the wind kinetic power into the required form of mechanical movement. As a consequence, the Permanent Magnet Propelled VAWT can function at lower wind speed with higher efficiency. In this case, the authors have compared the effectiveness of a regular VAWT to that of its counterpart, the permanent magnet propelling VAWT.

Keywords-: Kinetic energy, repulsive force, VAWT, permanent magnet, efficiency.

FABRICATION AND CHARACTERIZATION OF EPOXY RESIN COMPOSITE MATERIAL REINFORCED WITH BIOFIBRE AND EGG SHELL POWDER AS FILLER MATERIAL

Pai P M[1], Maruthi Prashanth B H[1], Adithya P N[1*], Jithesh P[1], Fahad P A[1] and Muhammed Afreen[1]

[1]Department of Mech. Engg., P. A. College of Engineering, Mangaluru, Karnataka, India.

*Corresponding Author: Adithya P N Email: adithyanagaraj32@gmail.com

Abstract:

The identification of ecofriendly and sustainable fibres is paving the way for the creation of workable substitutes for various applications, particularly in the field of composites. The objective of this study is to investigate the development of hybridized epoxy-based polymer composites, using Banana leaf fibre and bio-fillers made from eggshells, adhering meticulously to ASTM standards during specimen creation and mechanical analysis. The resulting composites are have improved mechanical properties, such as increased strength and stiffness, which are essential for their use in high mechanical pressure and wear applications. Overall, this study aims to contribute to the growing body of research on sustainable materials by investigating the potential of using Banana leaf fibers and eggshell bio-fillers in epoxy-based polymer composites.

Key Words: Epoxy-based polymer composites, biofillers, composites, ASTM standards

THERMAL ANALYSIS OF THREE-TUBE HEAT EXCHANGER USING WATER & HYBRID NANOFLUID

Bhavish S Ail[1], Sheikh Mohammed Rahil[1], Muhammed Afsal C[1], Suheb Alam Khan[1], Abdul Razak[1*]

[1]Department of Mechanical Engineering, P. A. College of Engineering, Mangaluru, Karnataka-574153, India.

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Abstract:

Heat exchangers have a broad range of engineering applications and are crucial to many industrial processes. The development of efficient heat exchangers is a result of growing awareness of the efficient use of energy resources, minimizing operating costs, and maintenance-free operation. The triple fluid heat exchanger that is being shown here is a better double pipe heat exchanger in which two concentric straight tubes are separated by a helical tube. Using the three fluid combinations of hot water, normal water, and air, the impact of variations in fluid volume flow rates on heat transfer performance was examined. Subsequently, an analysis was conducted using nano fluids. It was discovered that using nanofluids improved heat transfer performance.

Key Words: Nusselt number, Heat Transfer, Three fluid heat exchanger.

NUMERICAL ANALYSIS OF CONJUGATE HEAT TRANSFER IN A TURBULENT FLOW

Suneel Mudeppanavar[1], Pradeep Shegani[1], S.G. Cholake[1]*

[1]Department of Mechanical Engineering, BLDEA's V. P. Dr. P. G. Halakatti College of Engineering and Technology in Vijayapura, Karnataka.

***Corresponding Author: S.G. Cholake** **Email:** mech.sgcholake@bldeacet.ac.in

Abstract:

Conjugate heat transfer in a turbulent flow will be solved numerically by using ANSYS Fluent the set of governing equation will be studied by Finite volume method (FVM). The Dirichlet type boundary condition will be used to solve flow and energy equation. Simulating will be performed for various cases of varying flow and material properties. For all the cases heat transfer rates will be studied and the variation of Nusselt number (Nu) with Reynolds number will be analyzed.

Key Words: Conjugate heat transfer, turbulent, FVM.

EVALUATION OF PHYSICAL AND MECHANICAL PROPERTIES OF CHICKEN FEATHERS AND WOOD APPLE SHELL POWDER REINFORCED BIO-DEGRADABLE HYBRID COMPOSITES

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Abstract:

Fabric Natural waste materials are gaining popularity as fillers in composites alternative to manufactured fillers due to their promise as a low-cost, environmentally friendly. Chicken feathers, a byproduct of the poultry business, are mostly made of keratin, a protein that can improve the mechanical characteristics of composites. Wood apple shells are a natural waste material that has gained popularity as a viable filler for composite materials due to its availability, low cost, and appealing properties. The lignocellulosic nature of wood apple shells gives them exceptional mechanical strength, thermal stability, and water resistance, making them an appealing option to synthetic fillers. In this study, an attempt was made to manufacture a composite material using wood apple shell and chicken feathers powder in varied amounts, and the resulting composites were examined for physical and mechanical qualities such as tensile and flexural strength. The study's findings demonstrated that the composite made from varied combinations of wood apple shell, and chicken feather powder may exhibit rather acceptable properties. The utilization of these natural materials can lessen the environmental impact of traditional plastic-based composites while also providing a cost-effective and sustainable alternative. The findings of this study can help to design environmentally friendly materials and promote a more sustainable future.

Keywords: Composite material, Wood apple shell, chicken feather, Mechanical testing.

EVALUATION OF MECHANICAL PROPERTIES AND CHARACTERISTICS OF BAMBOO FIBERS REINFORCED WITH POLYMER MATRIX COMPOSITE

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Abstract:

Polymeric material reinforced with synthetic fibers such as glass, carbon and aramid offer the advantages of higher stiffness and strength to weight ratio as compared to conventional construction material like wood, concrete and steel. Despite these advantages, the wide spread use of synthetic fiber reinforced to polymer composites has a tendency to decline because of their high initial cost and adverse environmental impact. In recent years the natural fiber composites have attracted substantial importance among the structural materials there has been a fast-growing interest in using the natural fibers as reinforcement in the composites, the attractive features of natural fibers are their low cost, lightweight, high specific modulus, renewability and bio-degradability. This work on the mechanical properties of sodium hydroxide (NaOH) treated and untreated bamboo fiber reinforced polymer matrix composites. The hybrid composites were prepared by traditional hand layup method at room temperature with an applied pressure for about 24hrs pressurization time. Mechanical properties like tensile strength, tensile modulus, flexural strength and flexural modulus have been measured according to ISO standards, for both treated and untreated fiber reinforced matrix composites.

Keywords: Polymer matrix composite, bamboo fibers, Mechanical testing.

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DESIGN AND FABRICATION OF AN AUTOMATED SOLAR GRASS CUTTER

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Abstract:

In today's world, automation is a very important part of innovation. It is an innovative and technologically advanced solution for lawn maintenance - an automated solar grass cutter featuring ultrasonic sensors for object detection and a vacuum system for efficient grass collection. By harnessing solar energy, this system reduces dependency on conventional power sources, while minimizing carbon emissions. The incorporation of intelligent algorithms, coupled with ultrasonic sensors, ensures precise grass cutting and reliable detection of obstacles. Simultaneously, the integrated vacuum system efficiently collects the cut grass. The design of the device prioritizes durability, complemented by essential safety. Through the integration of sustainable energy sources, ultrasonic sensors for object detection, and effective grass collection mechanisms, this solution promotes eco-friendly practices, enhances operational efficiency, and reduces environmental impact in lawn care.

Key Words: Solar Energy, Grass Cutter, Ultrasonic Sensor, Vacuum suction.

BIOSYNTHESIS OF SILVER NANOPARTICLES FROM AZADIRACHTA INDICA FOR ANTI-CORROSION ACTIVITY

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Abstract:

This study investigates the biosynthesis of silver nanoparticles (AgNPs) using Azadirachta indica (Neem) extract and evaluates their potential as anti-corrosion agents. The green synthesis method offers an eco-friendly and cost-effective approach for the production of nanoparticles. Characterization techniques such as UV-Vi's spectroscopy, Fourier-transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), and X-ray diffraction (XRD) were employed to analyze the synthesized AgNPs. The results revealed the successful formation of spherical AgNPs with an average size in the nanometer range. Furthermore, the anti-corrosion activity of the synthesized AgNPs was assessed using electrochemical impedance spectroscopy (EIS) and potentiodynamic polarization techniques. The findings demonstrate promising anti-corrosive properties of the AgNPs, suggesting their potential application in corrosion inhibition across various industrial sectors. This study contributes to the growing body of research exploring sustainable nanomaterials for corrosion mitigation and underscores the significance of utilizing natural resources for nanoparticle synthesis with beneficial industrial applications.

Key Words: Silver nanoparticles, Azadirachta indica, Anti-corrosion activity, green synthesis, Characterization

DESIGN AND FABRICATION OF FERTILIZER MIXING AND DISPENSING MACHINE

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Abstract:

Farming is often associated with hard physical labour, long hours, and uncertain income, which may deter younger generations who seek more stable and less physically demanding career paths. Also, rapid urbanization and changing lifestyles have led to disconnect between younger generations and rural life. Many young people are drawn to urban areas for education, employment opportunities, social activities, and access to modern amenities, which may lead them to pursue careers outside of agriculture. On field factors concerned, labour scarcity has emerged as one of the foremost challenges in farming. All the agro-farming affected, taking coastal region concerned; arecanut demands skilled labours thus affected much. Problems associate from manuring, watering and harvesting, mostly areca plants demand necessary minerals/compost and labourers are required to carry out this process in time. Problems of carrying, dispensing and commute inside the fields need to be addressed. Despite these challenges, there is growing recognition of the importance of attracting and retaining young people in agriculture to ensure the sustainability and resilience with the trend. Efforts to promote agriculture mechanization are the only options.

The project aims in design and development of fertilizer mixing and dispensing machine for areca and other allied farming activities. It is a combination of a hand cart, compost blending machine and compost dispensing machine. The unit is powered by a 160 cc Honda engine. The compost is dumped inside through the feed hopper leading to mixing chamber, wherein the mixing is done thoroughly. The machine also featured with quantifies dispensing technique added with IoT features. Field testing and ease of operation regardless of age and gender is focussed.

Key Words: Areca Farming, Automation, Mechanization, Compost, Dispensing.

DESIGN AND FABRICATION OF CHAFF CUTTER CUM FLOUR MILL, FOR SMALL FARMERS

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Abstract:

The optimization of a combined chaff cutter and flour mill machine involves enhancing efficiency and performance. This abstract focuses on refining the design, materials, and operational parameters to achieve maximum output and resource utilization. Through systematic experimentation and analysis, the study aims to identify optimal configurations, minimizing energy consumption while maximizing chaff cutting and flour milling capabilities. The results contribute to the development of a more sustainable and effective agricultural processing solution, catering to the needs of farmers and promoting resource- efficient practices in food production. The scope of chaff cutter focuses on the chopping of agricultural wastes such as coconut leaves, areca leaves, etc., and this chopped waste can then be used to prepare vermin compost, cattle feeds, and floor stuff for cattle huts. The scope of the flour mill is to grind the grains used for daily purposes. It uses combined blades for grinding. The friction generated between the blades and casing results in grinding the grains into powder. At last, it can be stored for the daily use.

Key Words: Fodder, Cutter, Uniform chopping, Grinding

AN EXPERIMENTAL INVESTIGATION ON RC BEAM RETROFITTING WITH A SUSTAINABLE NATURAL FRP HYBRID COMPOSITE SYSTEM TO IMPROVE SHEAR PERFORMANCE

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Abstract:

Nowadays, it's common practice to strengthen structural components in order to support the additional loads associated with adopting current structural standards and zonal adjustments. Therefore, rather than completely destroying and rebuilding the structure, which would not be cost-effective, it is important to strengthen the structural capacity of such buildings. In this experimental inquiry, natural fibre reinforced polymers (NFRP) have been employed as a wrapping member with 90° and 45° strip wrapping configurations to strengthen reinforced concrete beams. An example of this type of material is sisal-jute hybrid fabric (sisal:jute::80:20 ratio). The ultimate load bearing capacity and maximum deflection of the sisal-jute FRP-stirred RC beams were measured and compared with those of the unstrengthened RC beams. The results of the experiment showed that, when compared to control beams, the load bearing capacity of 90° and 45° strip wrapping had been significantly increased by around 30% and 15%, respectively. Compared to control beams, the deflection sustained by reinforced beams with 90° strip wrapped beams is 30% more. In addition, the water absorption, chemical and heat treatment, and fire resistance test in compliance with requirements have all been examined in relation to the damage and degradability of FRP material. It was demonstrated that sisal-jute fiber-reinforced polymer (FRP) strengthening has enormous potential as a structural strengthening material since it demonstrated a good increase in shear strengths, delayed the formation of cracks, and improved the load deflection behaviour in comparable magnitudes to that of control beams.

Keywords: RC beams, FRP system, Retrofitting, Ultimate load carrying capacity.

DESIGN AND FABRICATION OF A PARABOLIC TROUGH SOLAR COLLECTOR FOR WATER HEATING SYSTEM

Jafar Sadiq[1], Kiran[1], Mohammed Dildar Suhail [1], Likith Raj [1], Navaneeth. I.M[1], Kirankumar B[1], Abdul Razak[1*]

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Abstract:

The development and construction of a parabolic trough solar collector for water heating systems represent an innovative and efficient solution for utilizing solar energy to fulfill the heating requirements of residential, commercial, and industrial sectors. During the design phase of the parabolic trough collector, meticulous attention is paid to numerous factors to maximize its performance. A pivotal aspect involves selecting materials that exhibit high reflectivity, durability, and resistance to corrosion. Typically, materials such as highly reflective mirrors, reflective film coatings, or polished metal sheets are chosen. These materials facilitate efficient absorption of sunlight and minimize losses attributable to reflection or absorption by the collector surface. Other factors are also considered to improve the efficiency of the collector.

Key Words: Nanomaterial, Graphene oxide, Solar Energy.

THERMAL PERFORMANCE ENHANCEMNT OF A MINI RADIATOR USING HYBRID NANOFLUIDS

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Abstract:

The aim of this study is to investigate the enhancement of heat transfer in an automobile radiator by using a water-based graphene hybrid nanofluid as the coolant. Water serves as the base fluid, with nanofluid concentrations ranging from 0.2 percent to 0.6 percent volume concentration. The radiator utilized is of the cross-flow unmixed type. Analyses were conducted at various flow rates, and experimental readings were taken after achieving steady-state conditions under forced flow. Parameters such as Nusselt number, friction factor, pressure drop, and pumping power were examined to assess heat transfer efficiency. Results revealed that the convective heat transfer coefficient of nanofluids and the Nusselt number increase with mass flow rate, accompanied by rises in pressure drop and pumping power.

Key Words: Automobile radiator, forced flow, heat transfer, nanofluids, pumping power.

STRUCTURAL ANALYSIS OF BAMBOO REINFORCED COMPOSITE MATERIAL

Bhavish S Ail[1], Muhammed Afsal C [1], Sheikh Mohammed Rahil [1] Suheb Alam Khan[1], Praveen Suvarna[2], Chethan K M[1], Maruthi Prashanth[1].

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ABSTRACT:

For centuries, wood has been a staple material in construction worldwide. Alongside it, bamboo boasts a rich history in tropical and sub-tropical regions for its construction versatility. In today's climate-conscious era, bamboo emerges as a vital resource. Its remarkable carbon-sequestering properties make it an invaluable ally in mitigating greenhouse gas emissions and reducing carbon footprint. Bamboo stands out as a promising building material primarily due to its exceptional tensile strength and impressive weight-to-strength ratio. The natural bamboo may have tensile strength in the range of 80 to 120 N/mm^2. The present work aims to increase the tensile strength of bamboo by mechanical means. The composite material of bamboo is obtained by bundling the bamboo fibers using geo fabric thread in the presence of suitable epoxy resin (LY 556) and hardener (HY 951). The study also concentrates on finding the effect of different patterns of threading in the process of forming bamboo fiber roads. The study reveals closest forms of threading have given better results than the other forms of threading. This process is effective in increasing the tensile strength of bamboo composite material by 57 to 100%.

Key Words: Bamboo fiber, Epoxy Resin, Hardener, Tensile Strength.

PACE Conclave 2024

DEPARTMENT OF CIVIL ENGINEERING

Under the umbrella of

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INTERNATIONAL CONCLAVE ON
ENGINEERING SCIENCES & TECHNOLOGY

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Message from Conference Chair

Dear Esteemed Colleagues,

It is my honor to welcome you to the proceedings of the International Conference on Civil Engineering (IC-ICE). As the Chair of this prestigious event and the Head of the Department of Civil Engineering at PACE, Mangalore, I am delighted to witness the convergence of minds from around the globe to exchange insights, innovations, and advancements in our field.

This conference serves as a platform for researchers, scholars, and practitioners to collaborate, share knowledge, and foster partnerships that will shape the future of civil engineering. I extend my heartfelt gratitude to all participants for their contributions and dedication to advancing the boundaries of our discipline.

I am confident that the presentations, discussions, and interactions during IC-ICE will not only enrich our understanding but also inspire new avenues of research and development. Together, let us embark on this journey of exploration and discovery, driving progress and excellence in civil engineering.

Warm regards,
Dr. Palakshappa K.
Chair - IC-ICE
HoD, Dept. of Civil Engineering
PACE, Mangalore

PACE Conclave 2024

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Message from Conference Convenor

Dear Esteemed Colleagues and Participants,

Welcome to the IC-ICE-24: International Conclave - In Civil Engineering, under the umbrella of PACE CONCLAVE: International Conclave on Engineering Sciences & Technology – 2024 (ICEST-24).

As the Convenor of this esteemed event, it is my privilege to welcome all attendees, whether joining us in person or virtually. The essence of this gathering lies in its capacity to unite brilliant minds from across the globe, facilitating meaningful discourse, sharing cutting-edge research, and collectively shaping the future of engineering and technology.

Under the IC-ICE-24, we are poised to explore the frontiers of innovation, uncover novel solutions to pressing challenges, and foster interdisciplinary collaborations that transcend boundaries. This conclave serves as a beacon of inspiration, igniting the spark of creativity and driving progress in our ever-evolving world.

I extend my heartfelt gratitude to our esteemed keynote speakers, distinguished presenters, dedicated members of the organizing committee, committed volunteers, and generous sponsors for their unwavering support and invaluable contributions. Your collective efforts have been instrumental in shaping this event into a platform of excellence.

To all participants, I encourage you to actively engage in the discussions, seize opportunities for collaboration, and leverage the wealth of knowledge and expertise present at this conclave. Your involvement is pivotal in shaping the outcomes and impact of our collective endeavors.

As we embark on this journey of discovery and innovation, let us embrace diversity of thought, harness the power of collaboration, and strive for excellence in everything we do. Together, we have the potential to effect positive change and drive progress on a global scale.

Thank you for your participation, dedication, and enthusiasm. I wish you all a rewarding and inspiring experience at the IC-ICE -24.

Warm regards,

Dr. Praeen Suvarna
Convenor
IC-ICE-24
Associate Professor
Dept. of Civil Engineering, PACE, Mangalore

International Conclave on Engineering Science & Technology (ICEST 24)

IC-ICE 2024: INTERNATIONAL CONCLAVE - IN CIVIL ENGINEERING

23rd April 2024 Tuesday – Day 1	
09:30 AM to 11:30 AM	Inauguration of ICEST-24 Inaugural address by **Mr. Sohan M.** Senior Project Manager – Infosys, Mangalore Keynote Address by **Dr. P. Nagabhushan**, VC, Vignan University, AP
11:30 AM to 11:45 AM	Refreshments
11:45 AM to 01:00 PM	Keynote address – I on topic "Sustainable Smart Cities: What Lies Ahead? " by **Dr. Jagdish H Godihal,** Professor- CIVIL and Deputy Dean-Academic Research, Presidency University Bengaluru, Karnataka.
01:00 PM to 02:00 PM	Lunch Break
02:00 PM to 02:45 PM	Track 1 Oral presentation (Transportation and Geotechnical Engineering)
02:45 PM to 03:30 PM	Track 2 Oral presentation (Building Materials and Construction Technology)
03:30 AM to 03:45 AM	Refreshments
03:45 PM to 04:30 PM	Track 3 Oral presentation (Architecture and Planning)
24th April 2024 Wednesday – Day 2	
09:30 AM to 10:30 AM	Track 4 Oral presentation (Structural Engineering)
10:30 AM to 11:30 AM	Track 5 & 6 Oral presentation (Sustainability and Environmental Engineering & Water Resources and Irrigation Engineering)
11:30 AM to 11:45 AM	Refreshments
11:45 AM to 01:00 PM	Keynote address – II on topic "Sustainable Horizons in Civil Engineering" by **Dr H Ajith Hebbar,** Associate Professor & Head, Civil Engg. Alva's Institute of Engineering and Technology, Moodbidri
01:00 PM to 02:00 PM	Lunch Break
02:30 PM to 03:30 PM	• Valedictory of ICEST-24 • Valedictory address by **Dr. A. M. Khan,** Senior Professor, Dept. of Electronics & Director- Skill Development Centre Mangalore University Mangalore • Keynote Address by **Dr. Surendra Kumar**, Pro-Vice Chancellor, Presidency University, Bangalore
03:30 PM to 04:00 PM	Interaction & High Tea

TO DEVELOP A NEARLY ZERO ENERGY BUILDING USING BIM AND AR

Fathimath Hanna[1], Mahamad Asif S[1], Abdul Shaheed Kaiseeran[1], Aboobacker Muzammil[1], Praveen Suvarna[1*]

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ABSTRACT:

A Net Zero-Energy Building (NZEB) is a building with net zero energy consumption, meaning the total amount of energy used by the building on an annual basis is equal to the amount of renewable energy created on the site.There are only a limited number of buildings that use the concept of NZEB at present. The construction of NZEBs is becoming more and more feasible owing to advancements in building technology, renewable energy systems and academic research.The current project aims to conceptualise a residential building that uses the concept of NZEB. With the combination of BIM and AR technology, the concept of NZEB can be achieved in a maximum reasonable way.As we visualise the building, the energy optimisation of the building can be done in a better manner in the present and future than in the past due to the advancement in the technology like Building Information Modelling (BIM) and Augmented Reality (AR).Together BIM and AR can be used as tools to help in designing, constructing and operating the NZEB. By providing detailed visualisation, energy analysis and real-time data, BIM and AR helps in optimising the building performance and achieving the NZEB goals.

Key Words: Building Information Modelling, Augmented Reality. Net Zero Energy Building

STRENGTH PARAMETERS OF CONCRETE BY USING BIO-CEMENT

Praveen Suvarna[1*], Athmadev B[1]

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Abstract:

Concrete is the most consumed artificial cementitious material because of rapid urbanization. Modern concrete is not sustainable and is one of the biggest causes of anthropogenic greenhouse gas emissions. A possible technique to imitate nature's sustainability methods is through microbial precipitation of $CaCO_3$. In the present work, an attempt is made to create concrete using Bacteria by Microbial induced Calcite Precipitation (MICP) method. By using a certain species of bacteria from the order of Bacillales. In the present study, BacillusCohniibacteria is used.The test results indicate that in the presence of Bacillus Cohnii bacteria media is insufficient to create concrete only using GGBS and fly ash. The study indicates a minimum use of 30% of cement is obvious for making concrete using Bacillus Cohnii bacteria. The compressive test results shows Bacillus cohnii bacterial may contribute 2% to 4% increase in compressive strength of concrete. The compressive strength of the mixture with 30% cement, 50 % GGBS, and 20% Fly ash is nearly in the range of concrete using 100% cement.

Key Words: Bio-Cement, Microbial induced Calcite Precipitation, Bacillus Cohnii.

THE RATE OF POROSITY OF DIFFERENT TYPES OF SOIL IN KONAJE REGION

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Abstract:

Understanding soil porosity is crucial for agricultural productivity, water management, and environmental sustainability. This study investigates the rate of porosity across various soil types in the Konaje region, aiming to provide insights into soil quality and its implications for land use planning. The research employs a systematic sampling method to collect soil samples from different locations within the Konaje region. These samples represent diverse soil types prevalent in the area, including clayey, sandy, and loamy soils. Porosity measurements are conducted using standard laboratory techniques, including gravimetric and volumetric methods.Preliminary findings indicate significant variations in porosity levels among different soil types. Clayey soils exhibit lower porosity due to their fine particle size and high compaction, limiting water infiltration and root penetration. Sandy soils, characterized by larger particles and lower compaction, display higher porosity, facilitating better drainage but potentially leading to nutrient leaching. Loamy soils, with a balanced composition of sand, silt, and clay, demonstrate intermediate porosity levels, offering a favorable environment for plant growth and nutrient retention. This study contributes to the understanding of soil characteristics in the Konaje region and provides valuable information for agricultural practitioners. Further research is warranted to explore the long-term effects of soil porosity on crop yields, water availability, and ecosystem resilience in Konaje and similar agro-ecological contexts.

Keywords: Soil, Porosity, Konaje, Engineering properties, Agricultural

USAGE OF FILLER TILE OR MARUTHY TILE IN AND AS A PART OF CONCRETE

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Abstract:

Innovative and reasonably priced filler slab technology reduces the encumbrance of a slab by partially replacing the concrete with filler material. It describe the usage of filler tiles as a fundamental component of concrete slabs and their advantages and disadvantages. Filler slabs are added to concrete slabs to improve structural performance, aesthetic appeal and sustainability, among other benefits. Concrete slabs potential as a versatile building material can be fully realized by incorporate filler tiles into them.

This study examines the number of filler tile usage related topics - such as, appropriate tile type selection, Installation methods, and the effect of filler tile qualities on slab characteristics. This project aims to estimate amount of concrete and steel saved as a result of usage of filler in the RCC slab, study the structural behavior of the filler slab, and to compare the heat insulation properties of filler slab with conventional RCC.

According to the study's findings, filler tiles help the concrete slabs load bearing capacity,minimize its risk of crackingand improve the durability. Additionally infill tiles can improve the slab's aesthetic appeal by enabling customized designs and patterns.By minimizing the waste and utilizing the recycled or re purposed materials,the usage of filler tiles also encourages sustainable practices. Overall this research highlights the significance of using filler tiles as a practical way to improve structural performance, aesthetics, and sustainability in building projects.

Keywords: Filler slab, RCC, structural performance, sustainability load bearing capacity,

CLIMATE CHANGE AND ANTHROPOGENIC IMAPCTS ON WETLAND AND AGRICULTURE IN GURUPURA RIVER BASIN

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Abstract:

Climate change is identified as a major threat to wetlands. Altered hydrology and rising temperature can change the biogeochemistry and function of a wetland to the degree that some important services might be turned into disservices. This review paper assesses the potential response of natural wetlands (peat lands) and constructed wetlands to climate change in terms of gas emission and nutrients release. In addition, the impact of key climatic factors such as temperature and water availability on wetlands has been reviewed. The topic selected is "Estimating the Potential Evapotranspiration using Temperature and Runoff for wetland in Gurupura River Basin" Dakshina Kannada district, Karnataka. The hydrological data were collected from different government organizations and IMD (Indian metrological Department). The well observation data were collected for last ten years by taking the monsoon and non-monsoon water levels from ground surface. The Potential Evapotranspiration is estimated for those years. The objective of the research program is to be performing Evapotranspiration analysis, to estimating and finding the new numerical relationship between rainfall and temperature and Potential Evapotranspiration and Temperature.

Keywords: Evaluation, Temperature, Potential Evapotranspiration, Rainfall variation graphs.

VERMICOMPOSTING BY VERMIREACTOR IN PACE CAMPUS

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Abstract:

The traditional method of vermin composting has drawbacks in terms of processing time and space adaptation. By designing and building a rotary drum vermin composter, this study attempts to overcome these difficulties. By maximizing aeration and moisture distribution, the rotary drum's creative design speeds up the decomposition process by enabling the effective mixing of waste materials. By removing the spatial limitations that are frequently connected to traditional technologies, this small and transportable vermin composter offers a workable option for urban settings and small-scale waste generation. More people are adopting and learning about effective composting techniques due to the well-thought-out design and simple operation. The study yielded notable results, such as a notable reduction in composting time 25-30 days as opposed to 45-60 days for standard procedures, increased space usage, and greater waste management. After the composting is done, we get vermiwash and vermin compost as the end product which can be later used for gardening or vegetation, and can also increase the fertility of the soil.

Key Words: Vermicomposting, Rotary drum vermin composter, Aeration, Decomposition, Composting time reduction, vermiwash**.**

LAND BASED FISH FARMING BY RECIRCULATING AQUACULTURE SYSTEM TECHNOLOGY

Prof.Jameela[1*], Arfan Shabeeb [1], Mohammed Adnan[1], Mohammed Sharafath [1], Kadeejath Mizwana Shireena M [1].

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Abstract:

The fastest-growing industry for producing food in the world is aquaculture, which is the regulated or semi-controlled cultivation of aquatic animals and plants. so far, numerous technologies have been developed to improve the system. This research paper demonstrates the cultivation of fishes by Recirculation Aquaculture System (RAS). Due to the fact that aquaculture ponds produce little waste, the Recirculation Aquaculture System (RAS) is a far superior solution with little negative environmental effects .It is a method of raising aquatic creatures that relies on both mechanical and biological filters to reuse the water used in the production process. Along with reducing water use and disease risk, RAS also enhances feed conversion, shortens the production cycle, and serves as a water treatment system. Additionally, the farmer may gain from the application of RAS to clay ponds and natural systems.

Key words: Aqua culture, RAS, biological filter, mechanical filter, clay ponds

EFFECT OF JAMUN LEAVES AND BACTERIA ON THE COMPRESSIVE STRENGTH OF BIO BRICK

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Abstract:

Bio-bricks, also known as biological bricks or bio-based building materials, are innovative construction materials made from renewable and sustainable resources such as agricultural waste, plant fibers, or biopolymers derived from plants or microorganisms. These materials offer numerous advantages over traditional building materials, including lower environmental impact, improved energy efficiency, and reduced reliance on non-renewable resources.Bio-bricks are eco-friendly products where there is no harm to the environment. This study investigated the impact of incorporating Jamun leaves and bacteria on the compressive strength of bricks. Initially, minimal effects were observed due to the low percentage of both Jamun leaves and bacteria. However, as the percentage of these materials increased, a slight improvement in compressive strength was noted. Furthermore, the addition of Ground Granulated Blast Furnace Slag (GGBS) resulted in a notable increase of 1.33 N/mm^2 in compressive strength. These findings suggest that while the direct influence of Jamun leaves and bacteria was limited in phase 1, their effects became more pronounced with higher concentrations. Moreover, the incorporation of GGBS showed promising results in enhancing the compressive strength of the bricks.

Keywords: Bio Brick,Activators,JamunLeaves, Bacteria,GGBS.

BARRIERS IN USING PLASTIC AS FINE AGGREGATE IN CONCRETE

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ABSTRACT:

The integration of plastic waste as a substitute for fine aggregate in concrete holds significant promise for mitigating environmental concerns associated with plastic disposal while enhancing the sustainability of construction materials. However, despite its potential benefits, the widespread adoption of this innovation encounters several barriers. This research aims to identify and analyze these impediments through a multi-faceted approach. Initially, a comprehensive literature review was conducted to examine existing studies, methodologies, and challenges pertaining to the incorporation of plastic as fine aggregate in concrete. Subsequently, a pre-survey questionnaire was administered to industry experts, engineers, and researchers to gauge their perspectives and identify key concerns regarding the use of plastic in concrete. Based on the insights gained from the pre-survey phase, a main questionnaire survey was designed and administered to a broader sample population involved in the construction sector. The main questionnaire focused on assessing perceptions, regulatory hurdles, technical challenges, management level concerns and economic considerations related to the utilization of plastic as fine aggregate in concrete. Data collected from both the pre-survey and main questionnaire were analyzed using statistical techniques. The results of the research shed light on a spectrum of barriers inhibiting the widespread adoption of plastic as fine aggregate in concrete, including but not limited to concerns regarding material properties, structural performance, durability, regulatory frameworks, public perception, and economic feasibility. Furthermore, the study offers valuable insights into potential strategies and solutions to address these barriers.In conclusion, this research provides a comprehensive understanding of the challenges hindering the utilization of plastic waste in concrete production, thereby facilitating informed decision-making and guiding future research and policy initiatives aimed at promoting sustainable construction practices.

Key Words: Plastic waste, Concrete, Barriers, Challenges, Waste management, Sustainable development.

Partial Replacement of Fine Aggregate Using Glass Powder and Course Aggregate Using Crushed Concrete in Concrete Brick

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ABSTRACT:

Cement concrete is one of the most commonly used materials in modern buildings. The evolution of technology and contemporary living habits has caused a surge in the production and diversity of waste, resulting in a crisis in waste management. This research addresses the issue of waste originating from construction activities, such as discarded concrete and glass. To mitigate the accumulation of specific types of waste, there is a suggestion to repurpose some of these materials by integrating them as substitutes for a portion of the primary constituents in cement concrete blocks utilized in construction endeavors. This research investigates the feasibility of partially replacing fine aggregate with glass powder and coarse aggregate with crushed concrete in the production of concrete bricks. The study focuses on replacing fine aggregate with glass powder at 10% and 20% levels, and replacing coarse aggregate with crushed concrete at 10%, 20%, and 30% levels. The compressive strength of the resulting concrete bricks was evaluated to assess the feasibility and potential benefits of these substitutions. Experimental tests were conducted to measure the compressive strength of concrete bricks with varying replacement levels of glass powder and crushed concrete. The results indicate that the partial replacement of fine aggregate with glass powder and coarse aggregate with crushed concrete does not significantly compromise the compressive strength of the concrete bricks. Furthermore, the research demonstrates that replacing fine aggregate with glass powder and coarse aggregate with crushed concrete can potentially enhance the sustainability of concrete production by utilizing wastematerials.

Key Words: Concrete bricks, Fine aggregate, Glass powder, Coarse aggregate, Crushed concrete, Compressive strength, Sustainability.

DESIGN OF ROOFTOP RAINWATER HARVESTING FOR P. A. IBRAHIM HAJI MEMORIAL PHYSIOTHERAPY CENTER, NADUPADAVU, MANGALURU, DAKSHINA KANNADA DISTRICT, KARNATAKA

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Abstract:

Water is known as the elixir of life due to its importance in the lives of living creatures. The rapid increase in population, changed climatic conditions, frequent occurrences of floods, draughts, etc., caused the scarcity of water in many regions of the world. So, to fulfil the requirements of water supply for domestic purposes, there is great demand and scope for rooftop rainwater harvesting. In the present work, an attempt is made to design the rooftop rainwater harvesting system for Dr. P. A. Ibrahim Haji Memorial Physiotherapy Centre, Nadupadavu, Mangaluru, with the objective of harvesting the rooftop rainwater and using it for domestic purposes and groundwater recharge. The annual volume of water to be collected to be collected from the rooftop is obtained using the area of the rooftop and the average annual rainfall in the region. The sizes of the gutters and downpipes are provided based on the rooftop area, rainfall and intensity of rainfall as per the guidelines of IS 15797:2008. A provision is made for the first flush system and filtration to remove substances causing pollution of the water. Excess water flowing out of the tank is directed to flow into the infiltration pit, which helps to induce the groundwater recharge. The storage tank is designed, and a cost analysis is done. It is evident from the study that rooftop rainwater harvesting is a very viable, reliable, and economical method to supply water for domestic and groundwater recharge. Also, it is one of the ways forward for sustainable utilization of water resources.

Key Words: Rooftop, Rainwater harvesting, Gutters, Downpipes, Storage tank, Infiltration pit

STABILIZATION OF EXPANSIVE SOIL USING INCINERATOR HOSPITAL WASTE ASH

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Abstract:

Expansive soils pose significant challenges in geotechnical engineering due to their high swelling potential and low bearing capacity. This study investigates the effectiveness of utilizing incinerator hospital waste ash (IHWA) as a sustainable stabilizing agent for expansive soils. The IHWA, a byproduct of hospital waste incineration, is rich in pozzolanic materials and possesses potential for soil stabilization applications. In the present study, a biomedical waste incinerator ash and lime combination was proposed to stabilize expansive soil. Particle size analysis, Atterberg limits, free-swell, compaction, unconfined compression strength, and California bearing ratio tests were conducted on the natural soil and blended with 3%, 5%, 7%, 9%, and 11% biomedical waste incinerator ash (IHWA). The results indicate that the addition of IHWA leads to improvements in the plasticity characteristics, compaction parameters, and strength properties of the expansive soil. Furthermore, the incorporation of IHWA resulted in a reduction in the swelling potential of the treated soil, thus mitigating the detrimental effects of moisture variation. The microstructural analysis revealed the formation of pozzolanic reactions and cementitious compounds within the soil matrix, contributing to the enhancement of soil stability. Overall, the findings suggest that IHWA shows promise as an environmentally friendly and cost-effective alternative for stabilizing expansive soils, offering sustainable solutions for construction projects while addressing the challenges associated with hospital waste management.

Keywords: Expansive soil, Stabilization, Incinerator hospital waste ash (IHWA), Engineering properties, Sustainable construction.

HYDROPONICS FARMING: The technology towards sustainability

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ABSTRACT:

Hydroponic farming is experiencing a surge in global interest due to its ability to optimize resource utilization and produce high-quality crops. In contrast, traditional soil-based agriculture confronts a host of difficulties, including urban expansion, environmental catastrophes, shifting climates, and the overuse of chemicals, all of which contribute to soil degradation and fertility loss. This article explores different types of hydroponic setups, such as wick, ebb and flow, drip, deep water culture, and Nutrient Film Technique (NFT), detailing their functions, advantages, and drawbacks. It delves into their effectiveness in cultivating various crops like tomatoes, cucumbers, peppers, and leafy greens, while also highlighting water conservation achieved through this method. Notable benefits include accelerated crop growth compared to traditional methods, year-round production, reduced susceptibility to diseases and pests, and the elimination of tasks like weeding, spraying, and watering. The NFT technique has gained widespread adoption in commercial settings globally, proving highly effective in the production of leafy greens and various vegetables. It boasts impressive water savings, typically ranging from 70 to 90%, further underlining its significance in sustainable agriculture.

Key Words: Hydroponics, Vertical Farming, Agriculture, PH Control, Market cost.

TENSILE STRENGTH ENHANCEMENT OF BAMBOO FIBER USING MECHANICAL METHODS

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ABSTRACT:

For centuries, wood has been a primary material in global construction. In tropical and sub-tropical regions, bamboo has also played a significant role due to its versatility. In our current climate-conscious era, bamboo has emerged as a vital resource. Its exceptional ability to sequester carbon makes it invaluable in mitigating greenhouse gas emissions and reducing our carbon footprint. Bamboo is a promising building material due to its outstanding tensile strength and impressive weight-to-strength ratio. Natural bamboo can have a tensile strength ranging from 80 to 120 N/mm^2, making it an excellent choice for sustainable construction. The objective of this research is to enhance the tensile strength of bamboo through mechanical methods. The composite material is created by bundling bamboo fibers using geofabric thread, along with an appropriate epoxy resin (LY 556) and hardener (HY 951). The study also investigates the impact of various threading patterns on the formation of bamboo fiber composites. The results indicate that closely spaced threading patterns yield superior results compared to other threading patterns. This process effectively increases the tensile strength of bamboo composite materials by 57% to 100%.

Key Words: Bamboo fiber, Epoxy Resin, Hardener, Tensile Strength.

A REVIEW ON GIS BASED APPROACH OF URBAN TRANSPORTATION NETWORK ANALYSIS

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Abstract:

The Urban areas are widely spread with more connected road networks. There are many studies shows the impact of urban transportation on economic development of a country. Urban transport provide the mobility of people, goods and access to the public with their amenities, like hospital, education, employment, health, entertainment etc,. Many cities are not providing sufficient road network accessibility in India, these cause transportation problems. In India, many initiatives/polices are taken by Government to address the urban transportation problems. These problems are mainly related to safety, mobility and environment aspects. The implementation of local (state level) initiatives, improve the urban development and connectivity of road network. Since 2006, The National Urban Transportation Policy (UTP) was took a major role in urban road network, which focus on safe and secure transportation. The environmental monitoring and air pollution reduction policies also been prioritized in this initiatives. The implementation of electric vehicles with zero emissions, adopting and developing practice like hot line mobility are taken place. The GOI also implemented metro transportation in urban cities which decreases the traffic congestion. This paper studies transportation policies which are used in urban transportation planning. A part from transportation planning the road or transport accessibility is also important factor in urban studies. The factors influences the accessibility are mentioned in this study. Many studies show the level of urban road network accessibility is studied using Geographical Information System (GIS) software. The GIS integrated with transportation software's like package of GIS-T software and TransCAD software are used to organize the road implementation database, new transport designing and network planning. In transportation planning GIS software is a major tool to study the route network and analysis, urban impact assessment and visualization of route map to DSS for transport planning. In this paper the proprietary tools and open source tools of GIS in transportation are explained. This paper concludes that GIS software is a main strength in transportation planning

ENHANCING HIGH-STRENGTH CONCRETE PERFORMANCE WITH TREATED HEMP FIBER REINFORCEMENT

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Abstract:

Cellulosic fiber-reinforced concrete should maintain its functional and microstructural properties over an extended period, experiencing minimal degradation and remaining free from microorganisms.In this study, we focus on treating hemp fiber to preserve its functionality for a long time. The hemp fiber is treated with 2M sodium hydroxide (NaOH) and sodium silicate (Na_2SiO_3). The research investigates six different concrete mixes, including treated and untreated hemp fiber(1%) with silica fume. Density, water absorption, compressive strength, flexural strength, and resistivity tests were performed on manufactured samples.The 28-day tensile and compressive strength of treated hemp fiber-reinforced concrete was 16.9% and 10% higher than untreated hemp fiber-reinforced concrete. Additionally, the findings demonstrate that the addition of silica fume enhances early strength gain, while hemp fiber treatment contributes to an increase in durability characteristics. Among the various mix proportions tested, the combination of 10% silica fume and 1% treated hemp fiber yields the highest concrete strength.

Key Words: Fiber reinforced concretetreated hemp fiber, Silica fume, Sustainable construction, High-performance concrete.

SOFT COMPUTING TECHNIQUES FOR CALCULATING FLEXIBLE PAVEMENT THICKNESS USING PROGRAMMING LANGUAGE FOR INDIAN ROADS.

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Abstract: One of the most important or vital objectives of modern civilization is to connect each and every corner of the world through transportation engineering. Out of which one of the important ways is roadways. This connectivity of all the corners in all the directions over globe in modern civilization is the difference one can find over old civilization. Roadways are of two types of which one is rigid pavements and the other is flexible pavement. In flexible pavements of California Bearing Ratio as well as Traffic survey of number of vehicles are known, thus from IRC(INDIAN ROADS CONGRESS) -37 code book the flexible pavement thickness can be found. The three layers of flexible pavements are viz., Granular sub base, Granular base and wearing coat widths are known and thus cumulative width of pavement thickness is also known. To develop a decision support system (DSS) for the estimation of individual and overall thickness of flexible pavement layers are automatically displayed with the help of CBR (California Bearing Ratio) value and traffic volume data.

Keywords: Flexible pavement, Decision Support System(DSS) , California Bearing Ratio (CBR), Granular sub base, Granular Base , Wearing Coat , Indian Roads Congress (IRC) etc.,

NANOTECHNOLOGY REVOLUTIONIZING INFRASTRUCTURE: HARNESSING NANOMATERIALS FOR ADVANCED CIVIL ENGINEERING

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Abstract:

The article delves into the potential applications of carbon nanotubes, SiO_2, TiO_2, Fe_2O_3, CuO, ZrO_2, ZnO_2, Al_2O_3, $CaCO_3$, Cr_2O_3, and Ag nanoparticles in civil engineering. Many studies indicate that the addition of these nanomaterials in appropriate quantities enhances the strength and durability of cementitious composites, albeit at the expense of increased setting time and reduced workability. However, challenges such as high cost and concerns about environmental and health risks associated with nanomaterials remain unresolved. Consequently, comprehensive guidelines for the practical implementation of nanomaterials in construction are eagerly anticipated. Additionally, a study evaluating the corrosion resistance of graphene and nano-TiO_2-incorporated steel-reinforced cementitious composites has been conducted. Preliminary findings suggest a lower corrosion rate in nanoadmixed composites compared to uninhibited specimens during early stages. Nonetheless, further research over extended periods is necessary to validate the effectiveness of graphene and nano-TiO_2 as corrosion inhibitors.

Keywords*:* Nanomaterials, Civil engineering, Corrosion inhibition, Cementitious composites, Environmental risks

Nanomaterials in Construction: Expanding Applications and Opportunities

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Abstract:

The emergence of nanotechnology has revolutionized the building and infrastructure industry, offering unparalleled opportunities for structural reinforcements, enhanced electronic properties, and efficient energy harvesting. However, as the industry delves deeper into the realm of nanomaterials, concerns regarding manufacturing processes, health risks for workers, and environmental impacts have intensified. This paper presents a comprehensive discussion on the applications of nanotechnology in construction, spanning various materials and characterization techniques. While significant progress has been made, the field is still in its infancy, presenting both challenges and lucrative business prospects. It emphasizes the imperative of addressing health and environmental risks associated with nanomaterials, while also advocating for responsible innovation and risk management to ensure sustainable development in this dynamic sector.

Keywords: Nanotechnology, Construction, Nanomaterials, Applications, Risks

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Message from Conference Chair

Dear Distinguished Guests, Participants and Speakers,

Welcome to the International Conference on Digital Renaissance – 2024 (DIGITAREV-2024). I hope this message finds you well and brimming with anticipation for our conference – DIGITAREV-2024. As the chair of this esteemed gathering, I am exhilarated to extend a warm welcome to each and every one of you.

Our conference promises to be a vibrant platform for exchanging ideas, fostering collaborations, and exploring the latest advancements in the field of Computer Science and Engineering. With invaluable contributions from our participants, I am confident that we will create an atmosphere ripe for learning, inspiration, and growth.

Our esteemed speakers, their expertise and insights are the cornerstone of this event. Their presentations will undoubtedly enlighten and enrich our discussions, paving the way for innovative solutions and breakthroughs. Added to this, our young, knowledgeable and bright participants' presentations and experiences will ignite thought-provoking conversations, and fuel our collective journey towards progress.

As we embark on this exciting endeavour together, let us embrace the spirit of collaboration, open-mindedness, and companionship. Let us seize this opportunity to forge new connections, expand our horizons, and leave a lasting impact on our respective fields.

We are eagerly looking to engage in all the sessions, participate in the discussions, and seize every opportunity to network with our peers. Together, let us make this conference an unforgettable experience filled with learning, growth, and inspiration.

Once again, I extend my heartfelt gratitude to each of you for your participation and support. Together, let us make this conference a resounding success!

Warm regards,

Dr. M Sharmila Kumari

Conference Chair

International Conference on Digital Renaissance – 2024

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Message from Conference Co-Chair

Dear Participants,
Welcome to ICEST-24! I am delighted to extend a warm greeting on behalf of the DIGITAREV 2024. As co-chair, I am excited to witness the fusion of diverse expertise at the intersection of engineering sciences and technology. With a dedicated focus on Artificial Intelligence and Machine Learning (AIML), alongside Mechanical Engineering, Civil Engineering, Computer Science, Electronics &Communication, Biotechnology, and Basic Science, this conference offers a rich platform for exploration. Your active engagement in discussions surrounding AIML's integration into these fields will undoubtedly spark innovative solutions and drive transformative progress. Let's seize this opportunity to exchange insights and collectively pursue excellence. Thank you for your invaluable participation in ICEST-24.

Warm regards,
Dr. Manjula V.
Conference Co-Chair
DIGITAREV2024
HoD, Dept. of AIML, PACE Mangalore

PACE Conclave 2024

ICEST 2024
INTERNATIONAL CONCLAVE ON ENGINEERING SCIENCES & TECHNOLOGY

DIGITAREV 2024
INTERNATIONAL CONFERENCE ON
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Message from Conference Convenor

Dear Participants,

Welcome to DIGITAREV 2024

I'm delighted to convene this gathering of brilliant minds, both physically and virtually, focused on advancing computer science. Together, let's chart the course for innovation, tackle challenges, and forge collaborations within the realm of DIGITAREV 2024.

I extend my heartfelt gratitude to our esteemed keynote speakers, presenters, committee members, volunteers, and sponsors for their invaluable support. Participants, let's actively engage, collaborate, and leverage our expertise to drive transformative advancements in computer science.

Embracing diversity, collaboration, and excellence, let's propel DIGITAREV 2024 to new heights of success. Thank you for your unwavering dedication and contributions.

Wishing you all a rewarding and enriching experience at DIGITAREV 2024.

Warm regards,

Dr. Shamna N. V.
Convenor
DIGITAREV 2024
Associate Professor
Dept. of Computer Science Engineering

PACE CONCLAVE: International Conclave on Engineering Sciences & Technology – 2024 (ICEST-24)

DIGITAREV 2024: International Conference on Digital Renaissance

23rd April 2024 Tuesday – Day 1	
09:30 AM to 11:30 AM	Inauguration of ICEST-24 Inaugural address by **Mr. Sohan M.** Senior Project Manager – Infosys, Mangalore Keynote Address by **Dr. P. Nagabhushan**, VC, Vignan University, AP
11:30 AM to 11:45 AM	Refreshments
11:45 AM to 01:00 PM	Keynote Address-1 on topic "Decoding Deep Learning: From Theory to Application" by **Dr. B H Shekar,** Professor, Department of Computer Science, Mangalore University, Mangalore
01:00 PM to 02:00 PM	Lunch Break
02:00 PM to 02:45 PM	Track 1 Oral presentation (Data science & Machine Learning)
02:45 PM to 03:30 PM	Track 2 Oral presentation (Cloud &Grid computing)
03:30 AM to 03:45 AM	Refreshments
03:45 PM to 04:30 PM	Track 3 Oral presentation (Blockchain Technologies)
24th April 2024 Wednesday – Day 2	
09:30 AM to 10:30 AM	Track4 Oral presentation (Network security &Cryptography)
10:30 AM to 11:30 AM	Track 5 & 6 Oral presentation(Computational Sciences, Cyber Physical Systems)
11:30 AM to 11:45 AM	Refreshments
11:45 AM to 01:00 PM	Keynote address – II on topic "Cyber Security - Trends, Challenges and Solutions" by **Dr. Nagesh H R,** Principal, Canara Engineering College, Mangalore
01:00 PM to 02:00 PM	Lunch Break
02:30 PM to 03:30 PM	• Valedictory of ICEST-24 • Valedictory address by **Dr. A. M. Khan,** Senior Professor, Dept. of Electronics & Director- Skill Development Centre Mangalore University Mangalore • Keynote Address by **Dr. Surendra Kumar**, Pro-Vice Chancellor, Presidency University, Bangalore
03:30 PM to 04:00 PM	Interaction & High Tea

MULTI LABEL SENTIMENT ANALYSIS OF COVID HANDLING OF GOVERNMENT THROUGH TWEETS

Dr. Sayed Abdulhayan[1*], Mohammed Arshad[1], Mohammed Bashith Ali[1], Muhammad Ajmal P M[1], Irfaz Ahmed[1]

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Abstract:

Emotion can be expressed in many ways that can be seen such as facial expression and gestures, speech and by written text. Emotion Detection in text documents is essentially a content – based classification problem involving concepts from the domains of Natural Language Processing as well as Machine Learning. In this paper emotion recognition based on textual data and the techniques used in emotion detection are discussed.

Key Words: Textual Emotion Detection; Emotion Word Ontology; Human-Computer Interaction.

EYE BLINK GESTURE-BASED HOME AUTOMATION CONTROL SYSTEM

Dr. Sayed Abdulhayan[1*], Shihaab Hassan[1], Mohideen Nazim[1], Mohammed Rishaan Hassan[1], Mohammed Seyyed Safwan[1]

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Abstract:

The "Eye Squint Gesture-Based Home Automation Control System" is an innovative approach to home automation that utilizes forward thinking gestures to control various household appliances and devices. The system enables users to control devices without the need for physical interaction using a camera to capture and interpret the gestures made by users. This home automation system offers numerous benefits compared to traditional methods. One of the main benefits is that it is open to all clients, especially those with adaptability debilitations or handicaps. Additionally, the system offers a more natural and intuitive way to control devices, allowing users to interact with innovation such that feels more organic and familiar. The Eye Squint Gesture-Based Home Automation Control System is also exceptionally efficient and helpful, allowing users to control various devices on the double with a single gesture. This element makes the framework much quicker and more productive than customary techniques for controlling machines and gadgets in the home. The framework is equipped for controlling different gadgets, like lights, fans, climate control systems, and home theater setups, which can be tweaked by the client's inclination. This personalization feature enables users to create a customized climate that meets their individual needs. Although the Eye Squint Gesture-Based Home Automation Control System is still being developed, it holds great promise for what's in store. As the framework turns out to be further developed and refined, it can possibly change the way people communicate with advancement in their homes, offering a more open, natural, and effective method for controlling different family gadgets.

Key Words: Eye Squint Gesture, Home Automation, Control System, Sensors, household appliances.

FLORA-VISION: A QUALITY ASSURANCE SYSTEM FOR THE PHARMACEUTICAL INDUSTRY

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Abstract:

Flora-vision introduces an advanced quality assurance system developed particularly for the pharmaceutical sector, with a primary objective of closely inspecting medicinal leaves. Modern machine learning (ML) and deep learning (DL) methods, exact camera-based detection, user-friendly UI design, are all skillfully combined in this creative solution. Under a conveyor belt, high-resolution cameras quickly and precisely identify medicinal plants from a variety of sample sets. Users can quickly identify and separate samples of interest by using the user-friendly interface. The system carefully checks a subset of samples for authenticity and freshness, and it is skilled at identifying any signs of spoiling or outside pollutants. The system ensures that such problems are quickly addressed by alerting the user through audio notification as soon as it detects any irregularities. Additionally, a real-time

Key Words: Flora-vision, Medicinal leaves, Pollutants, camera-based detection.

EMPLOYEE BURNOUT PREDICTION USING DATA SCEINCE

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Abstract:

Nowadays employees face a lot of stress due to the workload and lack of leisure time, so it is the need of hour for having to predict and analyze employee burnout. One of the most important new concerns that organizations are grappling with is employee or job burnout. Workers in the manufacturing and service sectors who are frequently exposed to demanding work environments may become more stressed out at work, burn out, or even quit their jobs. Our research identifies the main causes of burnout by gathering and analyzing data from a variety of sources, such as performance indicators, questionnaires, and HR records.

The study makes use of machine learning models and statistical methods to find patterns and correlations in the data. Our goal is to forecast employee burnout occurrences by using predictivemodels, which will allow employers to take prompt action. To understand their impact on burnout, common contributing elements are investigated, including workload, job demands, interpersonal connections, and job satisfaction.

To identify trends and correlations in the data, the study uses statistical techniques and machine learning algorithms. Our objective is to use predictive models to anticipate employee burnout so that companies can respond promptly. The effects of typical contributing factors, such as workload, job demands, interpersonal relationships, and job satisfaction, on burnout are examined.

Key Words: Machine Learning, Burnout, prediction, Linear Regression, Ridge Regression,Lasso Regressor, catboost regressor.

CLEANSIGHT: WASTE DETECTION AND SORTING

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Abstract:

The process of segregating waste prompts the generation of energy out of waste, diminishing landfills, recycling, and reduction of waste. Erroneous disposal of waste leads to recycling contamination. Contamination is a tremendous issue to the recycling industry that can be alleviated with automatic computerized waste sorting. The presence of models or strategies which help people to sort trash has become extremely important in the right discard of that garbage. Even though there are various sorts of recycling categories, many people remain confused or cannot appropriately recognize how to decide the right trash bin to dispose of every trash. Waste management and systematic sorting of them have a significant role in ecological development around the world. Society needs to lessen waste by recycling and reusing discarded materials that result in reducing environmental problems. This project aims to create an automated waste detection system using a deep learning algorithm that will gather the waste images or videos from a camera with object recognition, detection & prediction, and categorize the waste materials like cardboard, glass, metal, paper, plastic, and trash so that the waste can be properly dumped in the recyclable and non-recyclable bin.

Key Words: keywords: Waste, Classification, Object recognition

HUMAN-COMPUTER INTERACTION SYSTEM: A SURVEY OF TALKING-HEAD GENERATION

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Abstract:

The proliferation of virtual human technology has revolutionized various industries, offering unparalleled opportunities for enhanced human-computer interaction (HCI). This paper presents a comprehensive framework for human-computer interaction, focusing on the generation of talking-head videos using virtual humans. Leveraging the rapid advancements in artificial intelligence, particularly in speech recognition, text-to-speech synthesis, dialogue systems, and virtual human generation, this framework aims to elevate user experience across domains such as personal assistance, intelligent customer service, and online education. Central to this framework is the classification of models for talking-head video generation within the virtual human deep generation paradigm. Through a systematic review of technological advancements and trends spanning the past five years, this paper identifies critical works and summarizes key datasets relevant to talking-head video generation. By integrating cutting-edge techniques and methodologies, this framework strives to push the boundaries of human-computer interaction, offering innovative solutions for real-world applications.

Keywords: Human-Computer Interaction, Virtual Humans, Talking-Head Video Generation, Artificial Intelligence, Speech Recognition, Text-to-Speech Synthesis, Dialogue Systems, Deep Learning.

CYBER ATTACK DETECTION SYSTEM FOR BIOMETRIC

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Abstract:

The proposed methodology addresses the issues related to design and development of methods for eliminating the vulnerabilities/cyber-attacks that would arise when biometric based authentication is used in any of the applications such as transfer of money through biometric authentication, entry into secured places, document processing, border crossing etc. Among the several biometric traits, in the proposed work, it is planned to consider cyber-attack detection system for face biometric due to its ease of access in majority of the applications that are currently being deployed. The system will be realized as a mobile app also, so that the suitability of the proposed system will be demonstrated for low-cost devices. It is proposed to develop a simple and robust system for addressing vulnerability/cyber-attacks in face-based authentication. It is noted from the literature that the existing systems explore complex computational models where the solution can as well be given with a simple two-stage convolution neural networks. The proposed system can also be deployed on miniature devices which is where the proposed system exhibits uniqueness.

Key Words: Biometric authentication, Cyber-attacks, Computational models, Convolution Neural Networks.

ENTERPRISE BLOCKCHAIN FOR VERIFYING PRODUCT AUTHENTICITY

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Abstract:

The proposed methodology focuses on the development and implementation of a decentralized Blockchain system aimed at revolutionizing supply chain management and combating product counterfeiting. Built upon the foundational principles of Blockchain technology, the methodology ensures the immutability and transparency of data within the supply chain ecosystem. Central to this approach is the utilization of decentralized ledgers, which serve as tamper-proof repositories for critical information regarding product provenance and authenticity. Through the integration of smart contracts and cryptographic hashing algorithms, the methodology enables trustless verification mechanisms, empowering consumers to independently validate the legitimacy of products without reliance on traditional intermediaries. Manufacturers are poised to benefit from this innovative system by leveraging it to deliver genuine products while optimizing operational efficiency and reducing costs associated with quality assurance. By facilitating seamless interaction and data exchange among stakeholders, the proposed methodology fosters a more resilient and transparent supply chain infrastructure, thereby safeguarding consumer interests and preserving industry integrity against the threat of counterfeit goods.

Key Words: Blockchain technology, Decentralized system, Supply chain management, Anti-counterfeiting, Genuine products, Merchants.

DEVCOM (DEVELOPERS COMMUNITY)

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Abstract:

The College relentless quest for information coupled with the wide array of questions and challenges faced by the workforce, teachers, and students demonstrates the imperative need for an interactive web-based platform that is college-exclusive. The Malayalam word, "Dev," comes as a new solution carefully designed to bring about smooth information sharing, collaborative learning, and effective problem-solving. By combining and going beyond text, audio, video, and AI-powered algorithms such as page rank, weighted sum, and natural language processing, Dev seeks to transcend normal boundaries in both education and communication. Dev seeks to enable the people in the collegiate ecosystem to uphold a culture of constant learning, engagement, and intellectual curiosity, guided by the necessity of the user.

Key Words: Multiple Answering System, Text, Audio, Video, Tech meetup, Natural Language Processing, PageRank Algorithm, Weighted Sum Algorithm, Information Access, Continuous Improvement.

SPEECH DENOISING BASED ON DNN USING MATLAB

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Abstract:

Denoising is the extraction of a signal from a mixture of signal and noise. Isolation is the main issue of segregating real voice from external clamour interferences, which may include non-discourse noise, speech interference or both, as well as space resonance. Traditionally, speech segregation is considered as a signal processing problem, but latest research shows discourse segregation as a superintend learning issue cantered on deep neural network (DNN), in which judicious discourse sample, orator and grumbles are deliberated from training data.

Here this work furnishes the summary of the analysis on supervised speech separation based on deep learning. Must compare two types of networks applied to the same task: fully connected and convolution. The adaptive noise cancelation strategy is robust for the clamours that are moving spatially. This research focuses on distinguishing speech from reverberation, using DNN-based deep learning. Deep Neural Network model improves speech performance and significantly improves system stability. Exploration of speech recognition uses a variety of techniques that seek to improve precision, one of which is the use of Deep Learning, but high-dimensional information problems are one of the problems that reduce the difficulty of discourse recognition.

Key Words: Non-Discourse Noise, Speech Interference, Space Resonance, Deep Neural Network.

BLADDER CANCER DETECTION USING DEEP LEARNING HYBRID MODEL

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Abstract:

Bladder cancer is a prevalent and potentially life-threatening condition with a high global incidence rate. Early detection is critical for effective treatment and improved patient outcomes. In recent years, deep learning techniques have shown promising results in medical image analysis tasks, including cancer detection. This study proposes a novel deep learning hybrid model for the early detection of bladder cancer using medical imaging data. The proposed model integrates convolutional neural networks (CNNs) and recurrent neural networks (RNNs) to effectively leverage both spatial and sequential information present in medical images, such as histopathology slides and radiological scans. The CNN component extracts relevant features from the input images, capturing spatial patterns indicative of cancerous regions. These features are then fed into the RNN component, which utilizes sequential information to further refine the detection process and enhance classification accuracy. Training and validation of the hybrid model are performed using a large dataset of annotated medical images obtained from diverse sources. Extensive experiments demonstrate the efficacy of the proposed approach in accurately detecting bladder cancer at an early stage, outperforming existing state-of-the-art methods. Furthermore, the model exhibits robustness to variations in imaging modalities and data quality, making it suitable for real-world clinical applications.

Key Words: Bladder Cancer, Convolutional Neural Networks, Recurrent Neural Networks.

STUDENT'S GRADE PREDICTION USING MACHINE LEARNING

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Abstract:

A serious menace to the community isalcoholism. Nowadays, there is a significant problem with student drinking. Poor academic performance instudents is a result of alcohol addiction. It has beensuggested that common risk factors such as unstablehomes, poor mental health, and unsupported families may make teenagers more likely to use alcohol and dopoorly in school. Excessive drinking among collegestudents is linked to several detrimental outcomes, such as teenage suicide, fatal and nonfatal injuries, violence, academic failure, sexually transmitted infections, rapeand assault, and unwanted pregnancy. A comparisonon predicting alcohol intake among collegestudents is described in the study.

Key Words: Alcoholism, grades, machine learning

H2O PRO-SMART WATER PURITY ASSURANCE AND MANAGEMENT SYSTEM FOR SMART CITY

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Abstract:

This project aims to develop an IoT-based smart water quality management system for households, facilitating efficient monitoring, billing, and maintenance. The proposed system integrates sensors to monitor Total Dissolved Solids (TDS) levels and detect impurities such as muddy water. Through Realtime data analysis, the system ensures water quality compliance, notifying administrators of any deviations from predefined standards. Additionally, it incorporates leak detection mechanisms to swiftly identify and mitigate water wastage within the household infrastructure. Furthermore, the system incorporates a billing module that accurately calculates water consumption, enabling transparent and fair billing practices. By leveraging IoT technology, users can access detailed consumption reports and billing information through a user-friendly interface, promoting water conservation and accountability. The development of this smart water management system not only enhances convenience for users but also contributes to sustainable water usage practices. Its ability to detect water quality issues, prevent wastage, and streamline billing processes offers a comprehensive solution for households seeking to optimize their water consumption and ensure the safety and cleanliness of their water supply.

Key Words: IoT Water Quality Management, TDS Monitoring, Leak Detection System, Smart Billing, Muddy Water Detection.

INTRUSION DETECTION OF IMBALANCED NETWORK TRAFFIC BASED ON MACHINE LEARNING AND DEEP LEARNING

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Abstract:

With the proliferation of network-connected devices and the increasing sophistication of cyber threats, the need for effective intrusion detection systems (IDS) has become paramount. Traditional rule-based approaches often struggle to cope with the evolving nature of cyber-attacks and the imbalanced distribution of network traffic. In this study, we propose a novel approach for intrusion detection specifically tailored to handle imbalanced network traffic using a combination of machine learning and deep learning techniques. The proposed framework leverages the strengths of both machine learning and deep learning algorithms to effectively detect intrusions in imbalanced network traffic. Initially, a preprocessing step is employed to address the class imbalance issue by applying techniques such as oversampling, under sampling, or synthetic data generation. Subsequently, a feature extraction phase extracts relevant features from the network traffic data, capturing both spatial and temporal patterns indicative of anomalous behavior. Machine learning algorithms such as random forest, support vector machines, and gradient boosting are utilized to model the extracted features and classify network traffic into normal and intrusive categories. Additionally, deep learning architectures, including convolutional neural networks (CNNs) and recurrent neural networks (RNNs), are employed to learn intricate patterns and dependencies present in the network traffic data for enhanced detection accuracy.

Key Words: Intrusion Detection Systems, Convolutional Neural Networks, Recurrent Neural Networks, Anomalous Behavior.

VISUAL QUESTION ANSWERING SYSTEM USING NLX-GPT

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Abstract:

An Artificial Intelligence system called a Visual Question Answering (VQA) System combines Computer Vision and Natural Language Processing to respond to queries asked about an image in natural language. The image is processed by the system to extract pertinent features, which are then used to decipher the contents of the image and provide a response. VQA systems have several uses, including in robotics, autonomous vehicles, and healthcare. Additionally, they are utilized in social networking, video material, and visual help in online buying. This system uses Deep Learning strategies and incorporates Firebase for sign-in and sign-up functionality, to sum up. It offers customers a quick, precise, and user-friendly way to ask questions about photographs and get precise responses in real time. As a result, the VQA model's high degree of accuracy as well as the usefulness and efficiency of the Firebase integration. Overall, this work adds to the expanding body of knowledge on VQA by highlighting the technology's potential to improve human-computer interaction and make information retrieval from visual content easier. This system gives consumers a safe and convenient experience that improves the overall usefulness by integrating Firebase for sign-in and sign-up features. This is continuing work into the development of VQA systems, with the goal of enhancing their performance and accuracy.

Key Words: Visual QA System, NLX-GPT, Flutter, Natural Language Processing.

EFFICIENT REAL-TIME TRAFFIC SIGNAL RECOGNITION FOR AUTONOMOUS CAR USING CNNS AND ARDUINO NANO

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Abstract:

Traffic signal recognition and detection systems are pivotal in modern transportation management, contributing significantly to road safety enhancement and traffic flow optimization. This research introduces a novel approach to tackle this challenge by harnessing Convolutional Neural Networks (CNNs) in conjunction with the Arduino Nano microcontroller. The proposed system aims to deliver an efficient and cost-effective solution for real-time traffic signal analysis. The system architecture comprises two main components: a CNN-based image processing module and a hardware implementation utilizing the Arduino Nano. The CNN module is tasked with detecting and recognizing traffic signals from images or live video feeds obtained from cameras installed on vehicles or traffic monitoring systems. Trained on an extensive dataset of annotated traffic signal images, the CNN module can accurately learn and identify various traffic signal patterns. This paper details the system architecture, the training process of the CNN model, and the hardware implementation on the Arduino Nano. Experimental results demonstrate the efficacy and efficiency of the system in real-world scenarios, underscoring its potential to enhance traffic management systems.

Keywords: Traffic signal recognition, Convolutional Neural Networks, Arduino Nano, Real-time analysis, Traffic management.

DEEPFAKE DETECTION SYSTEM

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Abstract:

In an era where deepfake technology threatens the credibility of multimedia content, this paper proposes a defense approach. We combine ResNext, a powerful pattern recognizer for video frames, with LSTM, a tool for understanding temporal dynamics. By merging ResNext's spatial analysis with LSTM's temporal modeling, our system effectively detects deepfake alterations that evade traditional methods. This integration of advanced AI techniques provides a promising means to combat manipulated multimedia content, preserving the integrity of digital media in an increasingly deceptive landscape. Amidst the rising threat of deepfake technology to the authenticity of multimedia content, this paper unveils a fresh defense tactic. Our strategy harnesses ResNext, known for its ability to decipher complex patterns in video frames, alongside LSTM, adept at understanding temporal changes. By blending ResNext's spatial analysis with LSTM's temporal modeling, our system proves robust in detecting deepfake alterations that often slip past conventional methods. This fusion of advanced AI techniques presents a potent avenue for countering manipulated multimedia content, thereby upholding the integrity of digital media in an era fraught with deception.

Key Words: ResNext, Long Short-Term Memory (LSTM), deepfake

OFFLINE UNIFIED PAYMENTS INTERFACE (UPI) MOBILE APPLICATION USING USSD CODE *99#

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Abstract:

This research paper delves into the development and implementation of an innovative solution for enabling offline Unified Payments Interface (UPI) transactions in areas with limited internet connectivity. Leveraging the USSD Code *99#, the paper explores the methodology behind the creation of an Offline UPI Transaction Application. Through a comprehensive analysis encompassing the workings of USSD technology, offline UPI transaction processes, security measures, and usability evaluations, this paper aims to assess the effectiveness and feasibility of the mobile application for the UPI transactions using USSD code *99# which is released by National Payments Corporation of India (NPCI). By presenting results and discussions on transaction effectiveness, user feedback, comparisons with other offline payment methods, and challenges encountered, the paper sheds light on the significance of USSD-based UPI transactions in advancing financial inclusion and digital payments accessibility.

Key Words: Offline UPI transactions, USSD Code *99#, Transaction, Digital payments, Mobile application.

VIRTUAL TRIAL ROOM USING AN AUGMENTED REALITY

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Abstract:

The ever-changing fashion industry is constantly overflowing with recent fads that a great deal of fashion enthusiasts like to evaluate on a regular premise. However, with the emergence of the Covid-19 pandemic, contacting things in broad daylight places without feeling the need of cleaning your hands has turned into a troublesome errand. Taking a stab at new clothing at stores can be truly challenging for individuals who are consistently cognizant about their well-being on such occasions. This has made individuals go online shopping however it likewise brings the issue of garments being excessively free or excessively close and clients need to return them frequently prior to tracking down the right size. This work targets this issue by presenting a virtual trial room, in which the clients can check their estimations impeccably and peruse various styles and perceive how they would thoroughly search in those garments utilizing Augmented Reality (AR) technology. AR-powered virtual trial rooms can be used in advertising and marketing campaigns, virtual trial rooms can provide enhanced customization options, enabling users to personalize and modify products to their liking The cutting-edge Augmented Reality Try-On system for clothing, leveraging the powerful combination of AR Foundation and Unity 3D. This work incorporates the advanced capabilities of AR Kit to track the user's body in real time, utilizing the rear camera of the device.

Keywords: Augmented Reality, Virtual fitting room, Online Shopping.

DETECTION OF PARKINSON'S DISEASE, ML APPROACH

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Abstract:

One of the most common diseases affecting the global public health, Parkinson's disease (PD) is getting worse every day and has already affected several nations. As a result, it is crucial to forecast it at a young age, a task that has proven difficult for experts because disease symptoms typically appear in middle-aged or older people. The model in this study is developed utilizing a variety of machine learning approaches, including adaptive boosting, bagging, neural networks, support vector machines, decision trees, random forests, and linear regression. It focuses on the speech articulation difficulties symptoms of PD affected persons. Various criteria, including accuracy, the receiver operating characteristic curve (ROC), sensitivity, precision, and specificity, are used to assess how well these classifiers perform.

Keywords: Parkinson's disease, Disease Detection, Random Forest.

BLOCKCHAIN BASED SUPPLYCHAIN MANAGEMENT

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Abstract:

Supply chain management (SCM) is a critical aspect of modern business operations, encompassing the flow of goods, information, and finances from raw material suppliers to end customers. Traditional SCM systems often suffer from inefficiencies, lack of transparency, and susceptibility to fraud and errors due to centralized control and manual record-keeping. To address these challenges, this paper proposes a novel approach utilizing blockchain technology to revolutionize supply chain management processes. Blockchain, a decentralized and immutable ledger technology, offers a transparent, secure, and tamper-proof platform for recording and verifying transactions across a distributed network of nodes. By leveraging blockchain in supply chain management, this research aims to enhance trust, transparency, and efficiency throughout the supply chain ecosystem. Key features of the proposed blockchain-based SCM system include transparency, traceability, security, smart contracts, and efficiency. Transparency ensures all participants have real-time visibility into the movement of goods, while traceability enables seamless tracking of product journeys. Security is maintained through the decentralized nature of blockchain, reducing the risk of counterfeit products and fraud. Smart contracts automate agreements between parties, streamlining processes such as payments and compliance enforcement. Efficiency is achieved by eliminating intermediaries and manual paperwork, reducing delays and costs. To validate the effectiveness of the proposed system, a proof-of-concept implementation will be developed and tested in a real-world supply chain scenario. The research will evaluate the system's performance in terms of cost reduction, process efficiency, and overall supply chain visibility. In conclusion, the adoption of blockchain technology in supply chain management holds the potential to revolutionize traditional practices, offering a secure, transparent, and efficient solution to address the complexities and challenges of modern supply chains. This paper contributes to the growing body of research in blockchain applications and demonstrates its practical implications in improving supply chain operations.

Key Words: Blockchain, Smart Contract, Decentralization, Distributed Network.

BLOCKCHAIN BASED MUSIC PLAYER

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Abstract:

We offer an innovative strategy for enhancing the music industry using blockchain technology. Here, we create tokens and cryptocurrency wallets that facilitate transactions between artists and fans using the Ethereum/Solana blockchain network. In this project, we use smart contracts to eliminate the man-in-the-middle problem and boost transparency. This allows for transparent, instantaneous, and direct exchanges between musicians and artists. Because the artists can set their own NFTS, the system functions in a more regal manner. This strategy will address the problems of unpaid invoices and granting artists their share of the rights.

Key Words: Ethereum/Solana, Crypto-Currency, Crypto-Wallets, Man- in-the middle, Smart Contracts, NFT

PERFORMANCE OF AGC FOR HYBRID POWER SYSTEM TUNNED WITH DIFFERENT TUNER USING FUZZY LOGIC CONTROLLER

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Abstract:

In this paper, load frequency control loop and Automatic voltage controller loop are studied to control the frequency for single area and two area hybrid power system. The present trend is to explore different sources of energy sources which may be integrated with the grid. In this work thermal, hydro, nuclear and diesel power sources have been integrated with the grid. The different fine tuners, considered to obtained better results, are PDF, PI, PIDF, and gain of these different controllers are enhance using MATLAB tuner. A fuzzy logic controller is used to sharpen the area control error. The simulation results obtained from series connected PIDF are found to be better than other controllers in respect of settling time, rise time, peak value, and peak time. MATLAB 2016 has been used throughout the study.

Keywords: Independent System Operator, Load Frequency Control, Power System Operator.

A STUDY ON THE INFLUENCE OF PRODUCTIVITY OF EMPLOYEE BASED ON EMOTIONAL INTELLIGENCE IN SERVICE SECTOR

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Abstract:

It is significant for service industry workers to have elevated levels of morale and emotional intelligence. Researchers employed an analytical approach to gauge participants' levels of accomplishment depending on their emotional intelligence. This research analyzes the influence of Emotional Intelligence (EI) on worker accomplishment in the service industry to deduce the implication of this structure in organizational studies. Questionnaires are used to gather information from workers in the service industry. There are six Emotional Intelligence (EI) elements that have a key role in the performance of employees, according to the report. To be productive, assessing once own abilities is pivotal to monitoring your own progress; act and inspired; empathize with others; and preserve your integrity. The researchers determined that raising workers' levels of emotional intelligence would have a positive impact on their output and efficiency.

Keywords: Emotional intelligence, Employee's Performance, Service sector.

NEUROCARE: A WEARABLE GADGET FOR HEADACHE RELIEF

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Abstract:

This project presents the development of a novel gadget aimed at alleviating various types of headaches, particularly migraines, through a combination of acupressure techniques and innovative hardware and software integration. The gadget, resembling a helmet, employs vibrating chips strategically placed to target specific pain areas identified by the user through a mobile application. The application not only facilitates personalized therapy but also records therapy duration and user data for disease prediction and holistic health recommendations. Additionally, the helmet's resizable feature ensures a comfortable fit for users of varying head sizes, enhancing usability and effectiveness. This expansion highlights the adjustable nature of the helmet, addressing user comfort and adaptability, which are crucial factors in ensuring the success and widespread adoption of the device.

Key Words: Headache relief, Migraine management, Acupressure therapy, Wearable device.

ECOTECH: AN AUTOMATED WASTE SEGREGATION SYSTEM

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Abstract:

This project aims to create an automated waste detection system using a deep learning algorithm that will gather the waste images from a camera with object recognition, detection & prediction, and categorize the waste materials like cardboard, paper and plastic bottles so that the waste can be properly dumped in the recyclable and non-recyclable bin. The presence of models or strategies which help people to sort trash has become extremely important in the right discard of that garbage. Even though there are various sorts of recycling categories, many people remain confused or cannot appropriately recognize how to decide the right trash bin to dispose of every trash. Waste management and systematic sorting of them are a significant role in ecological development around the world.

Keywords: Waste segregation, deep learning, CNN, Object recognition.

CYBERBULLYING MITIGATION IN SOCIAL NETWORKS

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Abstract:

Detecting Cyberbullying is essential owing to its harmful impact on mental health, potentially causing depression and low self-esteem, necessitating the advancement of automated tools for intervention. The project focusses on hate speech detection in social media ,employing a hybrid approach of natural language processing and ensemble machine learning .Data undergoes pre-processing steps like stemming ,token splitting, character removal, and infection elimination .Various classifier , such as support vector machine, decision tree , random forest ,relevance vector machine and Naïve Bayes are utilized .The objective is to create a language independent model capable of classifying code mixed post into hate speech, offensive language ,or non-hate speech. The ensemble technique enhances cyberbullying detection. The fine-tuned resulted with the highest F measure of 72.42 %. Our study determined that transfer learning embedded as the optional approach for achieving enhanced performance with reduced effort, due to elimination of feature engineering and resampling requirements.

Key Words: Cyberbullying Detection, Distil Bert, machine learning, pre-trained language models (PLMs), Transfer learning, Toxicity Features, AmiCa Dataset, LIWC, empath.

MEDIBOT: REVOLUTIONIZING HEALTHCARE WITH AN INTELLIGENT ONLINE MEDICINE ORDERING ASSISTANT

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Abstract:

The integration of AI (Artificial Intelligence) in healthcare has witnessed significant advancements, contributing to improved patient experiences. This study introduces an AI chatbot designed specifically for medicine ordering, aimed at enhancing accessibility, efficiency, and user satisfaction in the healthcare sector. The chatbot uses Natural Language Processing (NLP) to understand and respond to user needs related to medicine orders. By using a traditional relational database of pharmaceutical information, the chatbot provides accurate details on various available medicines. The chatbot offers a user friendly interface accessible via various platforms such as web applications, making it convenient for users to interact and place medicine orders. Users can efficiently place medicine orders through the chatbot interface, which facilitates a efficient ordering process. Additionally, the chatbot provides real time order tracking, keeping users informed about the status and tracking orders. By introducing an AI Chatbot for medicine ordering, this research aims to revolutionize the healthcare industry's approach to medication management. This research work represents the Chat flow, components of a chatbot, Implementation using Dialog flow.

Keywords: Chatbot, Artificial Intelligence, Dialog flow, Advantages.

MULTI-LINGUAL AI CHATBOT FOR WEB OPTIMIZATION

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Abstract:

In an increasingly digital world, the ability to efficiently navigate websites and access information is a fundamental aspect of user experience. This project presents the development of an AI-based chatbot designed to enhance website navigation by offering both audio and text interactions. The chatbot leverages advanced natural language processing and machine learning models to understand user intent, assist with searches, and guide users to relevant content or services. Its multimodal capabilities cater to user preferences, allowing them to communicate via voice or text, while personalization features enhance user engagement. Seamless integration with websites and scalable performance ensures a versatile and user-centric solution. As data is gathered and user feedback is collected, continuous improvements are made, making the chatbot an invaluable tool for enhancing the online user experience.

Key Words: Navigation, Chatbot, natural language processing, Website Integration

ATTENDANCE SYSTEM USING FACE RECOGNITION

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Abstract:

This paper presents a comprehensive analysis of the integration of Facial Recognition Attendance systems in educational institutions and organizations, with a focus on optimizing attendance tracking processes. The study emphasizes the transition from traditional paperwork-based methods to a more efficient and accurate digital system. To achieve seamless integration without disruptions, the paper recommends utilizing accessible programming tools like JavaScript and Django to develop a user-friendly facial recognition system. This system can capture images from various distances and store attendance data in an Excel sheet with timestamps for easy verification thereby ensuring accuracy and reliability. Ethical considerations and concerns regarding privacy, consent and data security are thoroughly discussed, keeping in mind the need for transparent policies, user permissions and robust security measures to safeguard sensitive information and prevent unauthorized access or misuse. The paper aims for a balanced approach that combines technological innovation with ethical awareness to ensure efficiency while respecting individual rights in educational environments, other organizations and beyond. Moreover, the paper delves into potential societal impacts and the importance of human oversight for accountability and fairness. By addressing these aspects, the paper aims to contribute to the responsible adoption of Facial Recognition Attendance systems.

Key Words: facial recognition, Attendance systems, Ethical considerations.

PREDICTING STAGES OF DIABETIC RETINOPATHY

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Abstract:

Diabetic Retinopathy presents a common challenge among individuals with diabetes, often resulting in irreversible vision loss if not detected early. Traditional diagnosis methods offer no cure once vision is compromised, underscoring the critical importance of early detection and treatment. To preserve patients' vision, ophthalmologists rely on fundus images, capturing the retinal details of patients' eyes. However, manual detection of abnormalities by human observers is time-consuming, costly, and prone to error due to individual variances among ophthalmologists.

To address these challenges, Deep Learning Technology holds promise in detecting diabetic retinopathy from fundus images. By leveraging computer-based diagnosis systems, the risk of misdiagnosis is reduced. Deep learning methods, particularly Convolutional Neural Networks (CNNs), are widely employed for accurate image recognition and feature detection, with ocular images serving as training data to achieve high diagnostic accuracies.

Key Words: Diabetes, Ophthalmologists, Convolutional Neural Networks, Fundus.

EMOTION RECOGNITION OF ELDERLY PEOPLE USING DEEP LEARNING

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Abstract:

Currently, many countries around the world are moving towards becoming an aging society. The mental health of the elderly is one of the key challenges in an aging society. An elderly population is a special group that needs to be taken care of closely. A key area of concern for the elderly is that of mental health and many technologies can be applied in this area. One possible tool is facial expression recognition (FER) that can be used to detect emotions of the elderly for the purpose of mental health care. Emotion recognition in the field of human computer interaction refers to that the computer has the corresponding perceptual ability to predict the emotional state of human beings in advance by observing human expressions, behaviors, and emotions, so as to ensure that computers can communicate emotionally with humans. This project proposes a reminder system to help patients or old people to take medication. It also helps the users to take appointments from the needy doctor and send notification about the appointment confirmation and notify the caretaker about the appointment date and time well in advance. This project recognizes the emotions of elderly people using deep learning techniques and sends the notification to caretaker so that care taker can respond to elder people very quickly. This project uses Django framework to build backend of the system and uses MySQL for persistent data storage. Android application enables a graphical user interface where end user will interact with application.

Key Words: Mental health, facial expression recognition, emotions, human expressions, detect emotions.

STOCK MARKET PREDICTION USING MACHINE LEARNING

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Abstract:

Predicting stock price movements remains challenging due to the dynamic and complex nature of financial markets. Traditional methods like technical analysis have limitations in capturing intricate patterns and adapting to changing market conditions. There is a need for innovative approaches that combine the insights of technical indicators with the learning capabilities of machine learning models. This proposed method aims to address these challenges by proposing a hybrid methodology for more accurate and adaptable stock market predictions. Within the area of stock market prediction, forecasting price values or movements is one of the most challenging issues. Because of this, the use of machine learning techniques in combination with technical analysis indicators is receiving more and more attention. To tackle this problem, in this work we propose a hybrid approach to generate trading signals. To do so, our proposal consists of applying a technical indicator combined with a machine learning approach to produce a trading decision. The novelty of this approach lies in the simplicity and effectiveness of the hybrid rules as well as its possible extension to other technical indicators. To select the most suitable machine learning technique, we compared the performances of Linear Model (LM), Artificial Neural Network (ANN), Random Forests (RF) and Support Vector Regression (SVR). As technical strategies for trading, the Triple Exponential Moving Average (TEMA) and Moving Average Convergence/Divergence (MACD) were considered. We tested the resulting technique on daily trading data from three major indices: Ibex35 (IBEX), DAX and Dow Jones Industrial (DJI). The Results achieved show that the addition of machine learning techniques to technical analysis strategies improves the trading signals and the competitiveness of the proposed trading rules.

Key words: Artificial Neural Network, Support Vector Regression, machine learning.

LIP READING: TRANSFORMING SPEECH INTO TEXT

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Abstract:

Lip reading, also known as speech reading, is a unique form of communication that involves understanding spoken language by visually observing the movements and expressions of a speaker's lips and face. This abstract provides an overview of lip reading, its importance, challenges, and applications in diverse fields. Lip reading is a valuable skill that serves as an alternative or complement to auditory perception, particularly for individuals with hearing impairments. It enables them to decipher spoken language by interpreting the visual cues provided by lip, tongue, and facial movements. Moreover, lip reading can be employed in situations where audio input is limited, such as noisy environments or when maintaining silence is essential. The practice of lip reading relies on the ability to recognize specific phonetic and linguistic features in lip and facial gestures. It demands a high degree of visual acuity, context awareness, and expertise, as the accuracy of interpretation can be influenced by factors like speaker variations, obscured or rapid lip movements, and limited visual cues. The applications of lip reading extend beyond accessibility for the hearing-impaired. It has potential in fields like human-computer interaction, surveillance, and security, where the ability to understand spoken language without audio input is advantageous. Integrating lip reading into automated systems and artificial intelligence holds promise for enhancing communication and improving the accessibility of information. These abstract underscores the significance of lip reading as a means of communication and highlights its potential in various domains. It emphasizes the need for ongoing research and development to improve the accuracy and practicality of lip-reading techniques, ultimately contributing to more inclusive and accessible communication solutions for diverse populations and applications.

Key Words: Lip reading, accessible communication, human-computer interaction.

COMPARATIVE ANALYSIS OF LIGHTWEIGHT AND HEAVYWEIGHT CRYPTOGRAPHIC TECHNIQUE

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Abstract:

This paper is about comparative studies of cryptographic algorithms traditional heavyweight and lightweight cryptographic algorithm. While transferring data security has to be maintained, security can be obtained by using different cryptographic algorithm. Asymmetric public key encryption algorithm RSA and lightweight public key encryption algorithm ECC (Elliptic Curve Cryptography) are analyzed here. Analysis is performed based on the key length and time complexity.

Key Words: Cryptography, Lightweight, heavyweight, RSA, ECC, time complexity.

AN ENHANCED LIGHTWEIGHT SECURE CRYPTOGRAPHIC ENCRYPTION AND DECRYPTION ALGORITHM USING NEW MERSENNE NUMBER TRANSFORM FOR IOT APPLICATIONS

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Abstract:

The main challenge in designing a security solution for IoT applications is due to its edge layer devices. They are very resource constrained. To build the security mechanism in the devices such as sensors, actuators, and Radio Frequency Identification devices (RFID) the requirement of lightweight cryptographic techniques is the obvious solution. Before becoming IoT so popular many lightweight cryptographic algorithms had been introduced. During that periods Lightweight cryptography was not much popular. But with the increasing development of IoT in this era lightweight cryptography is more important. Today's available lightweight cryptographic algorithms do not provide more security. The main aim of the already existing lightweight algorithm is to reduce the resource requirements of the algorithm in terms of its computational cost, memory requirements etc. Security becomes the secondary thing. But with the arrival of more IoT applications to make it more secure the proper balance between security and requirements should be maintained. The conflict between resource requirements and security should be reduced. The main aim of this paper is to design a secure Lightweight encryption algorithm suitable for IoT application. This proposed Lightweight Encryption and decryption algorithm uses New Mersenne Number Transform, which provides good diffusion property and employs a fast algorithm to compute the transform. Further, the hash function's New Mersenne Number Transform supports the powerful property of variable transform length (powers of two). These properties make New Mersenne Number Transform suitable for the design of new Lightweight hashing technique.

Key Words: IoT, Lightweight Cryptographic Technique, New Mersenne Number Transform

AI TRANSFORMING HEALTHCARE: A COMPREHENSIVE LOOK AT BIOMEDICAL APPLICATIONS

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Abstract:

Artificial intelligence (AI), encompassing machine learning and deep learning, is revolutionizing the analysis of large-scale biomedical datasets. These technologies play pivotal roles in disease diagnosis, prognosis, and treatment by effectively handling diverse data types such as medical images, genomic data, electronic health records, and clinical notes. Leveraging AI algorithms, medical imaging has witnessed enhanced precision and efficacy in disease detection, enabling early diagnoses of conditions like cancer, Alzheimer's, and cardiovascular disorders. Moreover, AI-driven image analysis facilitates personalized treatment plans and streamlines radiology workflows. In biomedical research, AI emerges as a transformative tool with immense potential across various sectors. This study provides an overview of AI's applications in biology, underscoring its diverse and impactful contributions.

Keywords: Keywords: Artificial intelligence (AI), Biomedical data analysis, Disease diagnosis, medical imaging, Personalized treatment

CI-AI FRAMEWORK: ENHANCING CHATBOT TRAINING AND EVALUATION FOR IMPROVED PERFORMANCE

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Abstract:

In this work we present the Chatbot Interaction with Artificial Intelligence (CI-AI) framework as an approach to the training of deep learning chatbots for task classification. The intelligent system augments human-sourced data via artificial paraphrasing to generate a large set of training data for further classical attention and language transformation-based learning approaches for Natural Language Processing. Human beings are asked to paraphrase commands and questions for task identification for further execution of a machine. The commands and questions are split into training and validation sets. We describe and validate a metric for estimating multi-class classifier performance based on cross-validation and adapted for improvement of small unbalanced natural-language datasets used in chatbot design. Our experiences draw upon building recruitment chatbots that mediate communication between jobseekers and recruiters by exposing the ML/NLP dataset to the recruiting team. Evaluation approaches must be understandable to various stakeholders and useful for improving chatbot performance.

Key Words: Chatbot Interaction with Artificial Intelligence, task classification, artificial paraphrasing, Natural Language Processing, multi-class classifier, recruitment chatbots, cross-validation.

IOT CLOUD FOR HYDROPONICS SYSTEM AND DATA MONITORING FOR AGRICULTURE

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Abstract:

Hydroponics systems are becoming increasingly popular in agriculture as they offer several advantages over traditional farming methods, such as the ability to conserve water and produce Higher yields. However, monitoring and controlling the various environmental parameters in hydroponics system can be challenging. In this project we propose a solution that leverages IOT technology to collect and analyse data from hydroponics system, including temperature, humidity, pH, light, and nutrient levels. The data is then transmitted to a cloud-based platform for analyses and visualisation, allowing farmers to make informed decisions about their crops. In addition to real-time monitoring, an IOT-enabled hydroponic system can also provide historical data on environmental conditions, enabling growers to identify trends and make informed decisions about future adjustments to the system. This system is designed to be scalable, flexible, and easy to use, allowing farmers to customize it to meet their specific needs. With the use of IOT technology, the system can also provide real-time monitoring and alerts, reducing the risk of crop failure and increasing productivity.

Key Words: Hydroponics, cloud-based platform, IOT technology.

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Message from Conference Chair

As the Conference Chair of the Semi-Comm Tech Summit, hosted by the Department of Electronics and Communication Engineering, it is my honor to extend a warm welcome to all attendees.

The convergence of technology and communication has become the cornerstone of modern society, reshaping industries, economies, and daily interactions. In this transformative landscape, our conference serves as a beacon, illuminating the latest advancements, fostering collaboration, and shaping the future trajectory of semi-communication technologies.

Throughout our event, esteemed speakers and participants from diverse backgrounds will converge to explore emerging trends, share insights, and cultivate innovative solutions. From keynote presentations to interactive workshops, each session promises to ignite inspiration and drive meaningful dialogue.

Your presence at this summit is not just a testament to your commitment to the field but also a catalyst for the exchange of knowledge and ideas that will propel us forward.

Together, let us seize this opportunity to forge new partnerships, challenge existing paradigms, and pave the way for a future where communication technologies enrich lives and empower communities.

Thank you for your participation, & I eagerly anticipate the engaging discussions & collaborations that will unfold at the Semi-Comm Tech Summit.

Warm regards,

Dr. Asif Hassan

Chair- SEMI-COMM TECH SUMMIT

Department of ECE, PACE, Mangalore

Message from Conference Convenor

It is with great pleasure and gratitude that I extend my warmest welcome to each and every one of you to the Semi-Comm Tech Summit conference.

Our world is undergoing rapid transformation, driven by advancements in communication technologies. These advancements have revolutionized how we interact, collaborate, and innovate. The Semi-Comm Tech Summit serves as a platform to explore the latest trends, exchange insights, and foster collaborations that will shape the future of communication technologies. Throughout this conference, you will have the opportunity to engage with thought leaders, industry experts, & visionaries who are at the forefront of driving change in semi-communication. Through keynote speeches, panel discussions, and interactive sessions, we aim to ignite discussions, spark creativity, and chart a course towards a more connected and inclusive future. Thank you for being part of this momentous occasion. I wish you all an enriching and inspiring experience at the Semi-Comm Tech Summit conference.

I am confident that the discussions and insights shared at this conference will inspire collaboration, spark innovation, and pave the way for a future where electronics & communication technologies empower us to create a more connected, intelligent, and sustainable world.

Thank you for being part of this momentous occasion. I wish you all an enriching and inspiring experience at the Semi-Comm Tech Summit conference.

Warm regards,

Warm regards,

Dr. Asia Hazareena

Convenor

SEMI-COMM TECH SUMMIT

Associate Professor

Department of ECE, PACE, Mangalore

International Conclave on Engineering Science & Technology (ICEST 24)

SEMI-COMM TECH SUMMIT: "INTERNATIONAL CONFERENCE ON EMERGING TRENDS IN ELECTRONICS AND COMMUNICATION"

23rd April 2024 Tuesday – Day 1	
09:30 AM to 11:30 AM	Inauguration of ICEST-24 Inaugural address by **Mr. Sohan M.** Senior Project Manager – Infosys, Mangalore Keynote Address by **Dr. P. Nagabhushan**, VC, Vignan University, AP
11:30 AM to 11:45 AM	Refreshments
11:45 AM to 01:00 PM	Keynote Address-1 on topic "Performance of an air breathing PEM fuel cell used in fuel cell vehicles from in-situ measurements of operational parameters" by **Dr. A. R. Vijay Babu**, Associate Professor Dept. of ECE, Vignan University.
01:00 PM to 02:00 PM	Lunch Break
02:00 PM to 02:45 PM	Track 1 Oral presentation (Communication networks and Security)
02:45 PM to 03:30 PM	Track 2 Oral presentation (Embedded System)
03:30 AM to 03:45 AM	Refreshments
03:45 PM to 04:30 PM	Track 3 Oral presentation (Signal Processing)
24th April 2024 Wednesday – Day 2	
09:30 AM to 10:30 AM	Track 4 Oral presentation (Electromagnetics and Antenna Design)
10:30 AM to 11:30 AM	Track 5 & 6 Oral presentation (VLSI and MEMS & Power and Energy Systems)
11:30 AM to 11:45 AM	Refreshments
11:45 AM to 01:00 PM	Keynote address – II on topic "Transformative power of Exponential and Emerging Technologies" by **Dr. B. Aziz Musthafa**, Professor, Department of Computer Science. Bearys Institute of Technology, Mangalore**.**
01:00 PM to 02:00 PM	Lunch Break
02:30 PM to 03:30 PM	• Valedictory of ICEST-24 • Valedictory address by **Dr. A. M. Khan,** Senior Professor, Dept. of Electronics & Director- Skill Development Centre Mangalore University Mangalore • Keynote Address by **Dr. Surendra Kumar**, Pro-Vice Chancellor, Presidency University, Bangalore
03:30 PM to 04:00 PM	Interaction & High Tea

TO DEVELOP A NEARLY ZERO ENERGY BUILDING USING BIM AND AR

Fathimath Hanna[1], Mahamad Asif S[1], Abdul Shaheed Kaiseeran[1], Aboobacker Muzammil[1], Praveen Suvarna[1*]

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ABSTRACT:

A Net Zero-Energy Building (NZEB) is a building with net zero energy consumption, meaning the total amount of energy used by the building on an annual basis is equal to the amount of renewable energy created on the site.There are only a limited number of buildings that use the concept of NZEB at present. The construction of NZEBs is becoming more and more feasible owing to advancements in building technology, renewable energy systems and academic research.The current project aims to conceptualise a residential building that uses the concept of NZEB. With the combination of BIM and AR technology, the concept of NZEB can be achieved in a maximum reasonable way.As we visualise the building, the energy optimisation of the building can be done in a better manner in the present and future than in the past due to the advancement in the technology like Building Information Modelling (BIM) and Augmented Reality (AR).Together BIM and AR can be used as tools to help in designing, constructing and operating the NZEB. By providing detailed visualisation, energy analysis and real-time data, BIM and AR helps in optimising the building performance and achieving the NZEB goals.

Key Words: Building Information Modelling, Augmented Reality. Net Zero Energy Building

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DESIGN AND SIMULATION OF PHASED ARRAY ANTENNA FOR 5G APPLICATION

Ujwal Bharadwaj[1], Chethan B R[1*], Krishnaraja Acharya[1], Sharanya S P[1], Suraj S[1], Sachita M[1]

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Abstract:

Modern mobile communication faces challenges due to limited frequency spectrum, driving the need for antennas that are simple, low-profile, and robust. Microstrip patch antennas and arrays are ideal choices due to their size, cost, and performance advantages. Polarization is crucial, especially in mobile and space communications where antenna misalignment requires constant reorientation. Rectangular microstrip patch antennas can help mitigate signal loss and multipath effects in such scenarios. Phased array subsystems are becoming essential in next-generation mobile communication for their ability to electronically steer antenna beams without physical movement. Previous methods for rectangular microstrip patch radiation using orthogonal modes with 90° time-phase difference resulted in poor axial ratio, gain, and return loss. These methods also used complex dual-feed excitation with an external 90° power divider and external phase shifters for beam steering. This thesis proposes a simpler approach using a corner trimming technique for radiation and progressive phase excitations at source ports for phased arrays. Design and optimization for 26 GHz operation are achieved using simulation-based modeling software, ANSYS HFSS, on substrates like FR4 epoxy and Rogers RT duroid 5880. The work includes the design and simulation of rectangular microstrip patches, as well as 1x2 and 1x4 linear phased arrays, to operate at 26 GHz.

Keywords: Antenna, Phased array antenna, rectangular patch antenna, Beamsteering, Mutual Coupling, 5G.

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Comparative Study of 32 –bit ALU in Different software tools

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ABSTRACT

The paper presents comparative study of design and Synthesis of 32- BIT Arithmetic Logic Unit (ALU) using different software tools. The different software tools like using VHDL Xilinx Synthesis tool ISE 9.1i and targeted for Spartan device. The Virtual Input/output (VIO) debug feature can both monitor and drive internal FPGA signals in real time. This feature is used when there is no possibility to access on physical input and output devices on the target hardware. and the next software tool is Vivado. The Vivado HLS is based on the transformation of high-level C language into a register transfer level implementation. This can be later interfaced using Xilinx FPGA.

Keywords— FPGA (Field Programmable Gate Array), HDL (Hardware Description Language), RTL (Register Transfer Level) design VIO (Virtual Input Output).

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WIRELESS BATTERY CHARGING DEVICE FOR ELECTRICAL VEHICLES

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ABSTRACT:

In response to the pressing need to reduce environmental degradation and reliance on fossil fuels, there has been a considerable increase in the adoption of electric cars (EVs) as a replacement for traditional combustion engine vehicles. This shift toward Evs is motivated by a shared desire to reduce the strain on our planet's ecology while also addressing concerns about air pollution and climate change. As the EV market expands, one of the primary challenges that consumers face is providing simple and effective charging options. Recognizing this issue, various charging methods are being explored and implemented to respond to the various requirements of EV users. However, an important barrier in increasing the use of Evs remains the establishment of a strong charging infrastructure that can support the growing demand. In this project, wireless charging systems (WCS) became known as a promising approach to improve EV charging ease of use. WCS provides a seamless charging experience using in order linked power transfer technology, eliminating the need for physical connections. This not only makes it easier for EV owners to charge their vehicles, but it also helps to keep the city surroundings clean. In addition, the move to plug-in electric vehicles (PEVs) is becoming more popular, especially in developed countries, due to a number of issues including rising fuel prices, running out of resources, and environmental concern. Consumers and government agencies are putting more and more pressure on manufacturers to use greener, more sustainable technology like plug-in hybrid electric vehicles (PEVs). However, in addition to environmental concerns, the wide use of PEVs also depends on profitability and technological improvements. Adoption rates are significantly influenced by consumer confidence in PEVs' dependability and performance, particularly with regard to their driving range and infrastructure for charging. A lot of work is being done to improve the efficiency and dependability of electric car charging stations, especially fast-charging stations inside the distribution system, in order to address these issues.

Key Words: Automobile, Electric vehicles, Magnetic coil, Wireless charging.

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IOT BASED AGRICULTURE PESTICIDE SPRAYING ROBOT

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Abstract:

India is an important agricultural country with three percent of its population engaged in agriculture. As the climate and other resources become available to them, farmers will grow more crops in their fields. However, in order to produce well and effectively, some skills and support are needed. Diseases in plants are considered changes or defects in the normal function of the plant that cause certain symptoms. Phytopathogens are generally defined as bacteria of any species.

Most of the disease symptoms appear on the leaves, stems and branches of plants. Therefore, detection of diseases and infections in crops is important for good and successful farming. This can be done by taking pictures of ideas with a camera and analyzing them using machine learning techniques. This indicates disease on leaves, stems or plants. It also indicates that the area is infected and estimates the pesticide effect caused by the specific pesticide sprayed on the infected area.

This is important for effective pesticide use. This will benefit the farmers as it can be controlled from anywhere without the need to work in the field and without access to pesticides. It is not affected by health.

Key Words: Phytopathogens, Machine Learning, Pesticide spraying, Disease diagnosis, Agriculture robot.

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SMART MEDICATION DISPENSER

Nidhi G Shetty[1], Fathimath Nusaiba[1], Khadeejathul Thasfiya Banu[1], LittiMol Mathew[1*]

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Abstract:

We all know at least one person who must take medication in the form of pills or tablets in order to live a healthy life in this day and age of modern medicine, when humans are mostly dependent on the use of pills or tablets. In this project, we're primarily concerned with ensuring that your loved ones, who may be elderly, experiencing memory loss, or struggling to remember their medication schedule, take their pills on time, all over the world, with the help of a smart medication dispenser that works on a schedule. This project involves designing and building the final product's body as well as its component pieces. We always want the people we care about to be fit and healthy. And what would happen if they fall unwell and neglect to take their medication on schedule? Surely we would be concerned? Reminding every patient to take their medication on time can be challenging in hospitals due to the large number of patients. In the past, people had to actively remind themselves to take their medications on schedule. it is not the case in the digital age, and we can accomplish it using machines. Smart Medicine Reminder has a very broad range of applications that physicians can utilize in hospitals, at home, and in many other settings. There are numerous approaches to reminding When it comes to prompting, there are numerous approaches to do so Put it on show, notify via phone or email, making use of mobile applications, The buzzer sounds, Using Wi-Fi and Bluetooth, receive a call, Remember the current time and the medication time for the following day.

Key Words: Medication Schedule, Reminder Methods, Digital Age, Healthcare, Smart Medication Dispenser

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MACHINE CONTROL USING POLY KINESICS CONTROLLER

Littimol Mathew[1*]

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Abstract:

This paper is aimed at designing a custom Microcontroller like device called Poly-Kinesics controller to easily handle and modify various body signals like EMG, ECG, EOG, EEG, etc. It can be programmed by the user in languages like C or Micro Python and does not require learning a completely new language. The controller hardware can be modified within the program, making it flexible for various applications. It will be used to control another machine like a robotic/mechanical arm using only skeletal muscles in a human arm. Movements of the arm muscles are detected and acquired, and the robotics arm can be controlled as per the user's program. The signals are first acquired, filtered and amplified before using it for other applications.

Key Words: Poly-Kinesics Controller, Micro Python

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Solar Based Wireless EV Charging Stations

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Abstract:

To achieve a pollution-free environment, electronic vehicles will soon replace conventional vehicles. Many scholars are now interested in studying electrified automobiles. Recently developed technology called Wireless Power Transfer (WPT) offers interesting applications. WPT is the technology that transmits electrical power with no direct connection utilizing magnetic resonance. The WPT uses the same fundamental principle as the conventional transformer, which is based on inductive power transfer. WPT can be applied on the electric vehicle (EV) for both charging system: stationary and dynamic chargers. This global system can integrate the photovoltaic systems in the charging stations which are built for the electric vehicles and the supervision base. A wireless network has been put up for the communication. In order to validate the theoretical calculations, an 8kW prototype for charging a 120 V battery was suggested. The overall system efficiency is~93%.The system can eliminate the load's impacts to provide a stable functioning. The simulations are to verify the theoretical analysis of the suggested WPT's effectiveness.

Keywords: Photovoltaic energy, stationary charging, wireless power transmission, inductive power transfer, electric vehicles (EVs), and DC-DC converters.

GYROSCOPE CONTROLLED WHEEL CHAIR FOR DISABLED PATIENTS

Mahammed Fozail P.[1], Ibrahim Inzaman[1], Joswin Crasta[1], Mohammed Zakir Bellary[1*]

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Abstract:

Utilizing useful, cutting-edge and reasonably priced equipment should improve the quality of life for patients and handicaps with physical disabilities. The physically impaired patients with an easily maneuverable wheelchair who had endured losing their extremities as a result of an accident, ageing, or illness. Due to losing both of their arms and legs, these individuals are unable to utilize an electric wheelchair with joystick or a manual wheelchair. The way this wheelchair moves is controlled by head movements. In the direction of the head, the wheelchair will move.

Keyword: MPU-6050, ATmega328p, l298n, ultrasonic sensor

Air Quality Monitoring System with Image Processing Application

Nayef Ahmed[1], Sahil Hamdan[1], Mohammed Muzaffer[1], Safra[1], Mohammed Zakir Bellary[1*]

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Abstract:

With the constant increase in the population there has always been a need to develop newer sources of work for the masses which has led to massive industrialization. Adding to the misery is the increased use of motor vehicles. This in turn has led to a worrying sight for us to witness which will be even worse for our future generations if not addressed to the earliest. Going forward a cheap and effective system is a small step in curbing this issue

The Air Quality sensing model based on IoT senses the level of gases such as CO2, NH3, NOx etc and sends a message signal when the safe level is breached. A similar approach is adopted for sensing the level of dust with the help of a dust sensor. In addition to this we would be including a feature to detect and display the temperature and humidity of that enclosure This application would be beneficial in the field of medical research and for conducting a survey on lung cancer patients being affected by pollution which is rare but equally harmful as the problem developed due to smoking. This would help us to take the necessary steps to minimize such a fatality with the future generations to come.

Key-words: IoT, temperature, Air Quality

GESTURE CONTROLLED WHEELCHAIR

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Abstract:

Contemporary wheelchairs, incorporating advanced robotic technologies, often remain inaccessible to millions of individuals with disabilities due to their prohibitive costs, technical constraints, and safety concerns. This paper introduces a novel solution: a gesture controlled smart wheelchair system integrated with an Internet of Things (IoT)-enabled fall detection mechanism aimed at addressing these challenges. By employing a Convolutional Neural Network (CNN) model alongside computer vision algorithms, the system can interpret gestures and autonomously maneuver the wheelchair accordingly. Additionally, it ensures user safety through IoT-based fall detection capabilities with emergency messaging systems, which promptly notify caregivers or emergency services in the event of a fall or accident. Furthermore, the smart wheelchair system is designed to be highly customizable, allowing users to tailor gesture controls to their individual preferences and needs. This customization extends to the user interface, which can be adjusted for users with varying levels of dexterity and cognitive abilities. The wheelchair's robust construction and durable materials ensure longevity and reliability, making it suitable for both indoor and outdoor use. In terms of affordability, the development cost of this comprehensive system is modest, totaling less than USD 300. This low cost is made possible by leveraging opensource hardware and software components, as well as off-the-shelf electronic components readily available in the market. Additionally, the system is designed with ease of maintenance in mind, minimizing long-term expenses associated with repairs and upgrades. Overall, the envisioned smart wheelchair promises to be both affordable and safe, facilitating independent mobility for individuals with physical disabilities while offering customizable features to enhance user experience and adaptability.

Keywords: Computer vision; hand-gesture control; fall detection; obstacle avoidance.

SOLAR POWERED SMART QUALITY OF WATER MONITORING USING IOT ENVIRONMENT

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Abstract:

Water quality monitoring remains a critical requirement in modern times. Traditional laboratory tests for monitoring water quality are complex and time-consuming. Additionally, existing systems typically rely on constant power supplied through cables, which necessitates monitoring of the monitoring systems themselves. To address these challenges, our proposed system leverages the advancements in technology, particularly in the domains of Internet of Things (IoT) and solar energy.

The objective of our project is to develop a cost-effective, standalone, robust, and intelligent water quality monitoring system. We achieve this by utilizing affordable microcontroller boards and readily available sensors in the market. The distinguishing feature of our project is the incorporation of solar panels to power the batteries that drive the entire system. This allows the system to operate independently without the need for a constant external power supply.

Key Words: Water Quality, Internet of Things (IoT), Solar Power

IOT-BASED AUTO-SPRINKLER SYSTEM TO MONITOR THE WATER LEVEL IN THE SOIL

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Abstract:

The designed system is developed to monitor the moisture content of the soil, we developed an IoT-based auto-sprinkler system in which we will monitor the water level in the soil using a soil sensor, carbon monoxide using an MQ7 sensor and methane gas using an MQ4 sensor. It also checks temperature and humidity using the DHT11 sensor. The motor automatically turns on and off based on the moisture content present in the soil.

Most importantly, we developed an application for our project which will continuously monitor the system and give alert messages to the sensors. The values of the sensors are displayed in this application which gets updated every 5 seconds. The hardware and software parts are connected using the Bluetooth module.Additionally, we are adding a feature to receive information on bank investments, and to sell the crops on application to the Farmers which is beneficial to both the farmers and the customers. This project will help the farmers by saving their time since this application continuously monitors what is happening in the field. This project targets the agricultural sector with a focus on making a cheaper and utility-based variant of the crop communicator in an alternative approach.

Key Words: Moisture, Internet of Things (IoT), Soil

RFID BASED BLIND AND DEAFBLIND ASSISTANT

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Abstract— Visually impaired people need assistance in detecting obstacles, to determine the location and getting the direction for the destination they intended to go. There are many devices in the market which will assist blind people for navigation. There are people with both visually impaired and with hearing disability who cannot be able to use those devices because most of the devices will have only voice playback for navigation. "RFID based blind and deaf assistance" helps to overcome this problem. The proposed model contains RFID tag which receives the location information from RFID emitter when he walks nearby a particular place. He will be notified by a vibrator that he has got some message. He will check the location information in braille display. The proposed model also contains sensor which alerts the individual when it detects the obstacle. He can also communicate with others through the braille key which will display the message in the LCD display.

Key Words: deaf, blind, obstacles.

AN EFFICIENT FEATURE EXTRACTION METHOD FOR COPD DETECTION USING ANN

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Abstract— Medical images are frequently generated by highly precision devices and analyzed by qualified doctors, health area is the major sector of human kind irrespective of cost everyone wants their health to be proper and if there are any abnormality early detection of the same will make the person to live longer. Unavailability of the doctors for the growing population there is 1000:1 ratio for a radiologist and patients in country like India. Due to more number of patients and lack of efficient devices it's hectic for available doctors to come to a proper decision and most of the examinations will fail. Our primary objective is to examine medical X-ray images using ANN and exploit images using MATLAB image processing toolbox, computer vision toolbox, neural network toolbox etc. To come to a conclusion of diseases like Atelectasis, Consolidation, Cardiomegaly, Edema, Effusion, Emphysema, Fibrosis, etc. For detection of diseases in early stage we come across some machine learning algorithms so that the machine will be trained in such a way it can reduce the work of the doctors by evaluating the disease based on the previous data given to the machine for training. Neural network plays an important role in classification, in this project we have considered feed-forward neural network as a classifier. Using the available features extracted from LBP algorithm the clinical data will be analyzed properly and results will be obtained using ANN.

Key word: ANN, LBP, Chest-Xray

CLOUD ASSISTED WASTEWATER MANAGEMENT IN SMART CITIES

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Abstract:

Rapid urbanization and increasing population in smart cities make it difficult to manage wastewater effectively. To solve this problem, a new system has emerged that combines air technology and smart city. This summary provides an overview of cloud-assisted wastewater management in smart cities, highlighting the advantages, components, and applications of this approach. Cloud- enabled wastewater management uses the power of cloud computing to increase the efficiency, reliability and sustainability of wastewater treatment and disposal in smart cities. It can monitor, analyse and improve various processes, manage wastewater in a timely manner, thanks to the integration of cloud-based platforms, data analysis, Internet of Things (IoT) devices and advanced sensors.

Key Words: Smart city, waste water management, cloud computing, IoT, Sensors.

ADVANCEMENTS AND FUTURE OUTLOOK OF FLEXIBLE GAS SENSORS UTILIZING FUNCTIONAL NANOMATERIALS - COMPREHENSIVE REVIEW

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Abstract:

Flexible gas sensors have emerged as a focal point in research, particularly for wearable electronics in diverse fields such as environmental monitoring, food quality assessment, and health tracking. The limitations of conventional gas sensors, including bulkiness and complexity, have spurred the development of flexible alternatives. This review explores the rapid progress in flexible gas sensor technology, emphasizing the utilization of nanomaterials. Detailed discussions cover the mechanisms of gas sensing, diverse flexible substrates, and the characterization of functional nanomaterials based on their physical and chemical properties. Each material's characteristics, including sensitivity, selectivity, response time, operating temperature, and flexibility, are thoroughly examined. Recent advancements in flexible gas sensors and their applications across various domains are highlighted. Furthermore, the review outlines future research directions, including morphology modification, functionalization, and size optimization, to enhance sensor performance and expand their applications.

Keywords: Flexible gas sensors, Nanomaterials, Wearable electronics, Sensing characteristics, Future prospects

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DENSITY BASED TRAFFIC LIGHT CONTROL SYSTEM

Mohammed Arshad Gubbi[1], Abdullah Mushaid B.N[1], Tasmiya G.S[1], Shoibha Afrin[1], Afshan N Sheikh[1], John Valder[1], Nandini S[1]*

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Abstract:

Traffic congestion is a growing concern in urban areas, and it has become crucial to explore innovative solutions to mitigate this problem. Density-based traffic signal control is a system that aims to optimize traffic flow by adjusting the timing of traffic lights based on real-time traffic density data. This paper proposes a density-based traffic signal control system that utilizes a combination of sensors and microcontrollers to monitor traffic density and adjust traffic signals accordingly. The proposed system incorporates a machine learning algorithm to predict traffic density and adjust signal timing in real-time. The system was simulated using MATLAB and Simulink and tested in a real-world scenario. The simulation results indicate that the proposed system effectively reduces traffic congestion and improves traffic flow. The proposed system has the potential to improve traffic flow in urban areas and reduce travel time, fuel consumption, and carbon emissions.

Keywords: Traffic management, Intelligent transportation systems, Internet of Things (IoT), Embedded systems.

INNOVATIVE NANOMATERIALS AND PRINTING TECHNIQUES FOR FLEXIBLE HYBRID ELECTRONICS

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Abstract:

Recent advancements in nanomaterial synthesis and printing technologies have opened new avenues for the development of flexible hybrid electronics (FHE) in various healthcare domains. Unlike traditional cleanroom-based nano-microfabrication processes, nanomaterial printing offers cost-effectiveness, high-throughput, reliability, and scalability. This review provides an overview of the latest nanomaterials, printing methods, and system integrations for the fabrication of advanced FHE in wearable and implantable healthcare applications. It outlines strategies to improve the resolution, uniformity, flexibility, and durability of nanomaterial printing and evaluates the sensitivity, functionality, and performance of printed electronics in wearable sensors, prosthetics, and implantable health monitoring systems. The paper highlights essential material properties, sensor mechanisms, and electronic functionalities to serve as a comprehensive guide in the field.

Key words*:* Functional nanomaterials; printing of nanomaterials; flexible hybrid electronics (FHE); wearable systems.

SPEECH DENOISING BASED ON DNN USING MATLAB

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Abstract:

Human is able to exchange information smoothly using voice under different situations such as noisy environment in a crowd and with the existence of multiple speakers It is desirable to detect the speech and recognize who is talking. In everyday life, speech doesn't arrive to our ears in a clean way but Human auditory system is remarkably capable of focusing on the target speech and separating it from noise. On the contrary artificial speech processing systems are designed to deal with clean, noise free speech. Denoising is the extraction of a signal from a mixture of signal and noise. Isolation is the main issue of segregating real voice from external clamour interferences, which may include non-discourse noise, speech interference or both, as well as space resonance. Traditionally, speech segregation is considered as a signal processing problem but latest research shows discourse segregation as a superintend learning issue centered on deep neural network (DNN), in which judicious discourse sample, orator and grumbles are deliberated from training data. This paper furnishes the summary of the analysis on supervised speech separation based on deep learning. Have to compare two types of networks applied to the same task: fully connected and convolution. The adaptive noise cancelation strategy is robust for the clamours that are moving spatially.

This research focuses on distinguishing speech from noise, using DNN-based deep learning. Deep Neural Network model improves speech performance and significantly improves system stability. Exploration of speech recognition uses a variety of techniques that seek to improve precision, one of which is the use of Deep Learning

Key words*:* Deep learning; DNN; MATLAB.

A NOVEL CLOCK GATING APPROACH FOR THE DESIGN OF LOW-POWER LINEAR FEEDBACK SHIFT REGISTERS

Mohammed Tufail Ahamed[1], Mohammed Raihan Ahad[1], Mohammed Zakir Bellary[1*], Ameenuddin P[1].

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Abstract:

Linear Feedback Shift Registers (LFSRs) represent a fundamental component in numerous digital systems, facilitating operations ranging from sequence generation to error detection and correction. However, the pervasive use of LFSRs comes with the inherent challenge of high-power consumption, particularly in battery-powered devices and energy-constrained environments. This study introduces an innovative method to address this issue by harnessing the advantages of a gated clock approach, aimed at significantly reducing power consumption while maintaining functionality. Our approach distinguishes itself from conventional gated clock strategies by focusing on two key aspects: an optimized logic gate implementation and strategic reduction of XOR gates within the feedback network. By carefully selecting and designing logic gates tailored to minimize power consumption, coupled with judicious XOR gate reduction, we achieve remarkable power savings without compromising performance or functionality. To rigorously evaluate the effectiveness of our proposed method, we conducted extensive transistor-level simulations using standard cells in a 45nm technology node. These simulations provide detailed insights into the power characteristics and performance metrics of our approach compared to conventional implementations. The simulation results demonstrate a notable reduction in power consumption, validating the efficacy of our approach in enhancing energy efficiency in LFSRs. Furthermore, comparative analysis against existing gated clock strategies showcases superior power savings, affirming the significance of our method in practical implementations.

Key Words: This research proposes a novel gated clock approach to cut power usage in Linear Feedback Shift Registers (LFSRs), validated through transistor-level simulations in a 45nm technology.

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Message from Conference Chair

Dear Esteemed Participants and Guests,

It is with great pleasure and profound gratitude that I extend my warmest greetings to each of you as we conclude the BIOTRENDCON: International Conference on Emerging Trends in Biotechnology, held on the 23rd and 24th of April. As the Chair of this esteemed gathering, it brings me immense satisfaction to witness the culmination of our collective efforts and dedication towards advancing the frontiers of biotechnology.

The Department of Biotechnology at PACE, Mangalore, takes pride in hosting BIOTRENDCON, providing a platform for scholars, researchers, and industry professionals to converge, exchange ideas, and foster collaborations. Biotechnology, as a field, is witnessing unprecedented growth and innovation, driven by the relentless pursuit of scientific excellence and the quest for solutions to global challenges.

Throughout the conference, we have been privileged to delve into a myriad of topics ranging from molecular biology and genetic engineering to bioinformatics and biomedical applications. The presentations, discussions, and interactions have not only enriched our understanding but have also paved the way for novel insights and breakthrough discoveries.

I extend my heartfelt appreciation to all the keynote speakers, session chairs, paper presenters, and attendees for their invaluable contributions, enthusiasm, and scholarly engagement. Your dedication and passion for advancing biotechnology are instrumental in shaping the future of our discipline.

As we embark on our respective journeys beyond this conference, let us carry forward the spirit of collaboration, innovation, and excellence. May the connections forged and knowledge shared during BIOTRENDCON serve as catalysts for transformative advancements in biotechnology, driving positive change for the betterment of society.

I extend my best wishes to all participants for continued success in your research endeavors. Let us remain committed to the pursuit of excellence and the advancement of biotechnology for the betterment of humanity.

Warm regards,

Dr. Krishna Prasad N.
Chair - BIOTRENDCON
Professor & Head, Department of Biotechnology
PACE, Mangalore

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Message from Conference Convenor

Dear Esteemed Colleagues, Researchers, and Participants,

It is my utmost pleasure and honor to extend a warm welcome to each of you as we mark the conclusion of BIOTRENDCON: International Conference on Emerging Trends in Biotechnology. As the Convener of this remarkable event, I am thrilled to witness the culmination of our collective endeavours in advancing the frontiers of biotechnology.

BIOTRENDCON, organized by the Department of Biotechnology at PACE, Mangalore, has served as a platform for scholars, researchers, and industry experts to converge, exchange ideas, and explore the latest developments in biotechnology. Over the course of two days, we have had the privilege of engaging in stimulating discussions, sharing ground-breaking research findings, and forging meaningful collaborations.

I would like to express my heartfelt gratitude to all the keynote speakers, session chairs, paper presenters, and attendees for their invaluable contributions and active participation. Your enthusiasm, expertise, and commitment have been instrumental in making BIOTRENDCON a resounding success.

I would also like to extend my gratitude to the organizing committee, volunteers, sponsors, and partners for their unwavering support and dedication in making this conference a reality. Your tireless efforts have ensured the smooth execution of the event and have contributed immensely to its success.

As we conclude BIOTRENDCON and reflect on the wealth of knowledge shared and connections made, let us carry forward the spirit of collaboration, innovation, and excellence. Let us leverage the insights gained and the relationships forged during this conference to drive impactful advancements in biotechnology and address the pressing challenges facing our world today.

I am confident that the discussions and collaborations initiated during BIOTRENDCON will continue to inspire and catalyze transformative changes in the field of biotechnology. I extend my best wishes to all participants for continued success in your research endeavours and endeavours.

Thank you once again for your participation and contribution to BIOTRENDCON. May the bonds formed and the knowledge exchanged during this conference continue to propel us towards a brighter and more sustainable future.

Warm regards,

Dr. Shareefraju J. Ukkund
Convenor
BIOTRENDCON
Assistant Professor, Department of Biotechnology
PACE, Mangalore

International Conclave on Engineering Science & Technology (ICEST 24)

BIOTRENDCON 2024: INTERNATIONAL CONFERENCE ON EMERGING TRENDS IN BIOTECHNOLOGY

23rd April 2024 Tuesday – Day 1	
09:30 AM to 11:30 AM	Inauguration of ICEST-24 Inaugural address by **Mr. Sohan M.** Senior Project Manager – Infosys, Mangalore Keynote Address by **Dr. P. Nagabhushan**, VC, Vignan University, AP
11:30 AM to 11:45 AM	Refreshments
11:45 AM to 01:00 PM	Keynote address – I on topic "Immunotherapeutic Approaches to Disease Treatment: Prospects and Challenges" by **Dr. Monika Sadananda,** Professor & Chairperson, Mangalore University, Mangalore
01:00 PM to 02:00 PM	Lunch Break
02:00 PM to 02:45 PM	Track 1 Oral presentation (Food Technology)
02:45 PM to 03:30 PM	Track 2 Oral presentation (Drug Design and Nanobiotechnology)
03:30 AM to 03:45 AM	Refreshments
03:45 PM to 04:30 PM	Track 3 Oral presentation (Agricultural Biotechnology)
24th April 2024 Wednesday – Day 2	
09:30 AM to 10:30 AM	Track 4 Oral presentation (Clinical Research)
10:30 AM to 11:30 AM	Track 5 & 6 Oral presentation (Bioprocessing & Environmental Eng.)
11:30 AM to 11:45 AM	Refreshments
11:45 AM to 01:00 PM	Keynote address – II on topic "Novel therapeutic green solvents based nanoemulsions by innovative membrane emulsification technique for biomedical applications" by **Dr. Syed Usman Taqui,** Post-Doctoral Researcher, King Abdullah University of Science & Technology – KAUST, Saudi Arabia
01:00 PM to 02:00 PM	Lunch Break
02:30 PM to 03:30 PM	• Valedictory of ICEST-24 • Valedictory address by **Dr. A. M. Khan,** Senior Professor, Dept. of Electronics & Director- Skill Development Centre Mangalore University Mangalore • Keynote Address by **Dr. Surendra Kumar**, Pro-Vice Chancellor, Presidency University, Bangalore
03:30 PM to 04:00 PM	Interaction & High Tea

STRONTIUM OXIDE NANOPARTICLE: GOOD PHOTOCATALYST, PROMISING ELECTROCHEMICAL SENSOR AND ANTIOXIDANT

Prakruthi[1], H. N. Deepakumari[2*]

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Abstract:

The SrO2 nanoparticle synthesis employing plant extract has offered ecofriendly method alternate for the industry. This is the first time we are reporting SrO2 nanoparticle using plant extract as reducing agent by a simple inexpensive easiest precipitation method. The characterization techniques used for synthesized SrO2 nanoparticles were X-ray diffraction analysis (XRD), Uv-vis, FT-IR SEM, BET analysis, Raman studies, elemental mapping, and EDS. Further, the photocatalytic activity was done by changing dye concentrations, catalyst concentrations and pH under both UV light and sunlight. We also did scavenger studies for the detection of OH radical and recyclability. These nanometal oxides demonstrated superior sensitivity in cyclic voltammetry when paracetamol was used as an analyte at scan speed (10mv/s to 50mV/s) and also evaluated antioxidant property.

Key Words: Agricultural biotechnology, nanoparticle synthesis, voltammetry.

PROCESS FOR LONG-TERM ADSORPTION OF ACID BLACK 52 OF NUTRACEUTICAL INDUSTRIAL FENNEL SEED SPENT FROM AQUEOUS SOLUTION

Syed Noeman Taqui[1*], Rayees Afzal Mir[2]

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Abstract:

With regard to a number of experimental parameters, including pH, initial dye concentration, adsorbent dosage, adsorbent dosage, adsorbent particle size, and temperature, the potential use of coriander seed spent, a by-product of the nutraceutical industry, It was evaluated how well Acid Black 52 (AB52) dye could be distant from aqueous solutions. Analysis of variance has showed how each parameter and parameter combination affects the system's overall adsorption capability (ANOVA). Four two-parameter and five three-parameter isotherm models were used to analyse equilibrium data. The dye uptake followed a kinetic expression of pseudo-second order. Intra-particle diffusion shown that external mass transfer regulated the adsorption mechanism more so than internal mass transfer. Endothermic and nearly spontaneous AB52 dye adsorption occurred on nutraceutical industrial fennel seed waste (NIFSS). SEM pictures show that the NIFSS has a fibrous matrix with a structure of porosity that is hierarchical. The presence of ligno-cellulosic and cellulosic materials, which imparts both hydrophilic and hydrophobic qualities, was confirmed by the FTIR analysis of the waste. The outcomes demonstrated that NIFSS effectively eliminates AB52 colour from wastewater and industrial textile effluent.

Key Words: Fennel seed spent, biosorption, acid black 52, adsorption isotherms, Modelling.

VALIDATED SPECTROPHOTOMETRIC METHOD FOR TADALAFIL DETERMINATION IN DRUGS USING ARSENAZO (III) DYE

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Abstract:

A simple, rapid, selective, and highly sensitive spectrophotometric method is described for the quantitative determination of a tricyclic antidepressant drug, Tadalafil (TD) in pure and in pharmaceutical preparations. The method is based on the bromination of TD with known excess of bromine and the unreacted bromine is determined based on its ability to bleach the dye Arsenazo (III) quantitatively at 530 nm. Beer's law was obeyed over the concentration range 0.0 – 15 µg/mL. The molar absorptivity value was found to be 1.445×104 L/mole/cm, with the corresponding Sandell's sensitivity values of 0.0224 µg/cm2. The limits of detection (LOD) and quantification (LOQ) are also reported for the developed method. Intra- and inter-assay precision and accuracy of the method was established according to the current ICH guidelines. Applications of the procedure to the analysis of various pharmaceutical preparations gave reproducible and accurate results. Further, no interferences were observed from excipients and the validity of the method was tested against reference method. Percent of relative recoveries values were 98.67% to 100.52%.

Key Words: Spectrophotometric, Tricyclic Antidepressant, Bromination, Molar absorptivity.

FOOD SPOILAGE DETECTION USING CURCUMIN IMPREGNATED SMART BUTTONS

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Abstract:

Food spoilage is a major concern in industry, affecting both consumers and producers. Our research proposes a reliable and efficient solution to identify food spoilage such as fish using portable sensor buttons impregnated with natural turmeric. The active ingredient curcumin isolated from Rhizomes of Curcumin longa is known to change color from yellow to deep red on changing the pH from acidic to basic. pH of most of the freshly caught seafood products such as Indian anchovy (*Stolephorus indicus*) is around neutral (pH 7), and during pre-rigor stage pH of the meat turns slightly acidic side (~pH 6.5) which takes around 3-5 hours, and during post rigor stages enzymatic degradation produces volatile bases that in turn changes the pH to alkaline side (~7.5-8). Hence pH shift in meat from acidic to alkaline is the indicator of spoilage, which also implies that the meat is more than 3-5 h of post-harvest storage. Hence, curcumin impregnated smart button is a potable, food grade, and affordable food spoilage indicator. This technology can also be extended to various other food products by using bioactive compounds from various other plant sources that are active at different pH ranges. There is a great scope of this product while procuring food products.

Key Words: Curcumin, Indian anchovy, Smart button, Food industry, Sensors.

EXTRACTION, IDENTIFICATION AND CHARACTERIZATION OF THE LEAVES OF MEMECYLON AMPLEXICAULE

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Abstract:

Memecylon amplexicaule, also known as Suckering Memecylon, belongs to the Melastomataceae family and is commonly found in the Western Ghats. It is a small to medium-sized tree reaching 10 to 15 m in height, with opposite leaves that clasp the stem, earning it the name Clasping-leaf Memecylon. The tree bears small, pale violet flowers in axillary clusters, followed by small spherical berries maturing from green to purple. Renowned for its medicinal properties, its bark and leaves are utilized in treating ailments like diarrhea, dysentery, inflammation, fever, and menstrual cramps, often consumed with milk and cumin seeds. Traditionally, they are applied topically for wound healing and inflammation reduction. Post-COVID, its leaves and bark were found to be effective against cough, cold, and bronchitis, prepared as decoctions or syrups. Economically, Memecylon offers mordants and yellow dyes extracted from its leaves, historically used in Thai silk dyeing and Buddhist monk ropes in Sri Lanka. Its edible fruits serve as spices, while its timber is valuable for construction. Decoctions from its root and heartwood have been used to treat ailments like chickenpox and measles.

Key Words: Memecylon amplexicaule, clasping leaf, pain relief, covid, Buddhist monks.

BIOBRICK PRODUCTION BY SOLID STATE FERMENTATION OF LATTERATE SOIL USING BIOPOLYMER GUM PRODUCING BACILLUS SUBTILIS

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Abstract:

There are many challenges faced by the modern brick industry, including cost, shortages of raw materials and environmental impacts of production. To meet this challenge, many research methods are followed around the world. This project is aimed at the production of bio bricks using laterite quarry waste powder, *Syzygium cumini* leaf extract and bacterium *Bacillus subtilis* through the process of Solid-state Fermentation. We had four different mixtures containing Soil and water, Soil and leaf extract, Soil-water and bacteria, Soil-leaf extract, and bacteria. The brick made of leaf extract and bacteria is expected to have more compressive strength, water absorption, hardness and bacterial count. Our method of creating bio bricks from laterite quarry waste powder, solid state fermenting them with *Syzygium cumini* leaf extract and *Bacillus subtilis*, binding them, and compressing them into blocks offers significant fuel, energy, and material conversion cost savings. It also requires a lower capital investment per ton of cement and offers an ecologically sound solution. “Bio-bricks” made with this technique could be a brand, effective, and more environmentally friendly building material.

Key Words: laterite quarry waste, Bio-bricks, *Bacillus subtilis*, *Syzygium cumini*.

NONINVASIVE POTENTIOMETRIC BIOSENSOR TO ASSESS MILK SHARK KEEPING QUALITY

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Abstract:

Milk shark (*Rhizoprionodon acutus*) is highly perishable due to the liberation of ammonia due to the degradation of urea by bacterial enzyme urease, hence maintenance and monitoring of urease degradation is of utmost importance in fish freshness. We have developed a urease biosensor to assess the quality of Milk Shark by immobilizing urease on a pH electrode using sodium alginate and calcium chloride solution. Enzymatic degradation of the urea into ammonia by immobilised urease results in change in the potentials across glass electrode that can be measure by a potentiometric transducer. Milk Shark stored at 30oC showed a linear relationship between the degree of urea, liberation of the ammonia, deterioration of the freshness and the development of potentials across the urease biosensor. Hence, urease biosensor is a reliable, simple, and rapid method for the measurement of freshness of the fish flesh with high urea.

Key Words: Milk shark, *Rhizoprionodon acutus*, potentiometric, biosensor, Urease.

CLEARSIGHT- ADVANCING EARLY GLAUCOMA DETECTION

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Abstract:

Glaucoma, a condition causing optic nerve damage and potential blindness, can be mitigated with early detection and treatment. Unfortunately, current diagnostic methods are often time-consuming and uncertain. To address this, a cost-effective Glaucoma detection system utilizing AI algorithms has been proposed. This computer-based technology swiftly identifies and classifies healthy and Glaucoma-afflicted eyes. By employing artificial intelligence, the system autonomously delineates optic cup and disc boundaries, generating segmented fundus images for accurate Glaucoma identification. The investigation delves into AI-enabled Glaucoma detection frameworks focusing on segmented fundus images, evaluating CNN, SVM, ANN, and Random Forest algorithms for image extraction, segmentation, and classification within the region of interest. This innovative approach offers a rapid and precise means of Glaucoma diagnosis, crucial for early intervention and preventing irreversible vision loss.

Key Words: Segmented fundus images, Optic cup and disc boundaries, Support Vector Machine, Artificial Neural Network, Convolutional Neural network, Random Forest, Region of Interest.

INFLUENCE OF MEMBRANE BIOREACTOR (MBR) UNIT DESIGNED USING LOCALLY AVAILABLE MATERIALS FOR THE RURAL RESIDENTIAL DISPOSAL

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Abstract:

The study investigates the impact of Membrane Bioreactor (MBR) units designed using locally available materials on rural residential waste disposal. The introduction outlines the importance of waste management, especially in rural areas where conventional methods may not be suitable. It introduces the Membrane Bioreactor (MBR) as an innovative solution combining biological treatment with membrane filtration for high-quality effluent. This research focuses on utilizing materials readily accessible in rural areas to construct and operate MBR units, addressing the challenges of infrastructure limitations and cost-effectiveness. The objective is to physico-chemical analysis of residential wastewater collected at waste water disposed area of residential building, design of Membrane Bioreactor (MBR) using locally available material unit for purification of the residential waste water, relevance of the designed MBR unit in quality enhancement of soil and water of residential area. The experimental procedure describes the setup using locally available materials like grass, sand, charcoal, and geotextile in different configurations to treat kitchen wastewater. The functions of these materials include phytoremediation, slow sand filtration, adsorption, and aiding in filtration and treatment. Results show improvements in soil and water quality, supporting the effectiveness of locally designed MBR units for rural waste disposal. The study's conclusion emphasizes the viability and benefits of MBR technology in improving wastewater management in rural areas.

Key Words: Membrane Bioreactor (MBR), wastewater treatment, locally available materials, sustainability.

INNOVATIONS IN ARTIFICIAL INTELLIGENCE FOR ADVANCING PHARMACEUTICAL AND BIOMEDICAL SCIENCES

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Abstract:

This paper delves into the transformative role of artificial intelligence (AI) in revolutionizing pharmaceutical and biomedical research. AI technologies, including machine learning and deep learning, have reshaped various aspects of drug discovery, development, and biomedical analysis. Leveraging vast amounts of data, AI algorithms enable predictive modeling, drug target identification, virtual screening, and optimization of drug candidates. Additionally, AI-driven approaches facilitate precision medicine by analyzing patient data to tailor treatments and predict disease outcomes. This review provides an overview of recent advancements in AI applications in pharmaceutical and biomedical studies, highlighting their potential to accelerate innovation, improve therapeutic outcomes, and address healthcare challenges.

Keywords: Artificial intelligence (AI), Pharmaceutical research, Biomedical studies, Machine learning, Drug discovery

EXPLORING THE VERSATILITY OF GOLD NANOPARTICLES (GNPS) IN BIOMEDICAL AND CLINICAL CONTEXTS: AN IN-DEPTH ANALYSIS

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Abstract:

This review highlights the extensive utilization of gold nanoparticles (GNPs) across diverse fields, including environmental detection and biomedicine. GNPs possess unique characteristics like tunable surface properties and surface plasmon resonance (SPR), making them invaluable in therapy and diagnostics. Their ease of synthesis and compatibility with various ligands enhance their utility in biomedical applications, particularly in cancer treatment, antiviral, and antibacterial therapies. Additionally, GNPs serve as molecular imaging agents and contrast agents due to their optical properties. The article explores GNPs' contributions to various biomedical fields such as nuclear medicine, vaccine development, diagnostics, biosensing, and lab-on-chip applications. It delves into their size-dependent biocompatibility, biodistribution, and excretion in vivo. Furthermore, GNPs show promising potential in modern therapeutic technologies, with ongoing clinical trials highlighting their efficacy. Challenges in regulatory approval and recent insights into GNP toxicity are also discussed, paving the way for future research directions in GNP-based biomedicine.

Keywords: Gold nanoparticles (GNPs), Biomedical applications, Surface plasmon resonance (SPR), Cancer treatment, Toxicity

FRONTIERS IN BIOMEDICAL NANOTECHNOLOGY: ADVANCED HYBRID MATERIALS: A SYSTEMATIC REVIEW

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Abstract:

This review explores the growing demand for highly functionalized biomaterials in biomedical engineering, focusing on the development and application of novel organic/inorganic hybrid biomaterials. These hybrids possess multiple chemical, physical, and optical properties, making them versatile in various biomedical applications. We classify advanced organic/inorganic hybrid nanomaterials as nanoparticles and nanocomposites, detailing their structures, characteristics, and advantages. Additionally, recent trends in smart organic/inorganic hybrids and nanocomposites in medical applications are outlined. Finally, we discuss the future direction of these materials, considering current technology and limitations. Functional organic/inorganic hybrids hold great promise as advanced biomaterials for diagnosing and treating human diseases efficiently across various biomedical fields.

Keywords: Hybrid biomaterials, Nanoparticles, Medical applications, Smart materials, Future directions.

DECODING COVID-19: ANALYZING A WORLDWIDE HEALTH CRISIS

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Abstract:

The emergence of Coronavirus Disease 2019 (COVID-19) has marked the second pandemic of the twenty-first century, with staggering global implications. Originating from the Coronaviridae family, the novel strain named Severe Acute Respiratory Distress Syndrome Coronavirus-2 (SARS-CoV-2) has rapidly spread worldwide, causing immense morbidity and mortality. This review delineates the key characteristics of COVID-19, tracing its lineage within the coronavirus family and highlighting its pathogenic features, including the spike glycoprotein. Predominantly transmitted through respiratory droplets, the virus poses a significant threat to vulnerable populations, particularly the elderly and immunocompromised, leading to a spectrum of clinical manifestations ranging from flu-like symptoms to severe respiratory distress and multiorgan dysfunction. Effective preventive measures such as hand hygiene, social distancing, and mask usage are paramount in curbing transmission. Treatment strategies have evolved, with emphasis on supportive care, anticoagulation, and targeted therapies like dexamethasone, remdesivir, and tocilizumab. Furthermore, rapid advancements in vaccine development and distribution have been instrumental in mitigating the pandemic's impact. This review offers a comprehensive synthesis of the global response to COVID-19, encompassing public health measures, therapeutic interventions, and vaccination campaigns, aiming to provide insights into the multifaceted challenges and strategies in combating this unprecedented global health crisis.

Keywords: COVID-19, SARS-CoV-2, Pandemic, Therapeutic interventions, Vaccination efforts

ENHANCING SENSITIVITY: EXPLORING SILICON NANOWIRE FIELD EFFECT TRANSISTOR (SINW-FET) BIOSENSORS IN BIOMEDICAL APPLICATIONS- A SYSTEMATIC REVIEW

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Abstract:

Silicon nanowires (SiNWs) represent a promising class of one-dimensional semiconductor nanomaterials with significant potential in biomedical sensing applications. Their exceptional electronic properties offer enhanced detection sensitivity in biosensors. When combined with field-effect transistors (FETs), SiNWs form a unique biosensing platform characterized by high sensitivity and target selectivity in real-time and label-free detection. The burgeoning interest in SiNW-FETs for biomedical detection is evident. This review critically examines the progress of SiNW-FETs, with a particular focus on reversible surface modification methods. Additionally, we provide a comprehensive overview of SiNW-FET applications in DNA, protein, and microbial detection, elucidating their working principles and technical approaches. Through this review, we aim to address the challenges and opportunities in the future development of SiNW-FETs for biomedical sensing applications..

Keywords: Silicon nanowires (SiNWs), Field-effect transistors (FETs), Biosensors, Biomedical sensing, Surface modification

NANOMATERIALS IN FOCUS: A COMPREHENSIVE REVIEW OF APPLICATIONS, TOXICITY, ENVIRONMENTAL IMPACT, AND FATE

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Abstract:

In the current era, nanotechnology has emerged as a pivotal component, revolutionizing technology, engineering, and medical advancements through the utilization of nanomaterials. These materials offer unique physical, chemical, and biological properties, distinct from their bulk counterparts, rendering them indispensable in various domains. Nanomaterials are categorized based on size, shape, composition, origin, and toxicity, underscoring their diverse applications. However, the escalating utilization of nanomaterials in industry necessitates a thorough investigation into their toxicity and environmental risks. This review critically examines the applications, behavior, and toxic impacts of nanomaterials on humans, animals, and the environment. Additionally, it addresses the fate, challenges, and future imperatives for the development of safe nanotechnology to ensure sustainable progress.

Keywords: Nanotechnology, Nanomaterials, Applications, Toxicity, Environmental impact

NANOTECHNOLOGY APPLICATIONS IN CANCER DIAGNOSIS AND THERAPY: A COMPREHENSIVE OVERVIEW

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Abstract:

The application of nanoparticles (NPs) has significantly enhanced traditional cancer diagnosis methods, offering improved efficiency and speed. NPs boast exceptional properties, including larger surface area, higher volume proportion, and enhanced targeting capabilities. Their minimal toxicity to healthy cells further enhances their bioavailability and half-life, enabling functional penetration of epithelium and tissues. NPs have garnered attention across multidisciplinary fields, emerging as promising materials in various biomedical applications, particularly in disease diagnosis and treatment. Presently, numerous drugs are either formulated with or coated by nanoparticles, facilitating direct targeting of tumors or diseased organs while sparing normal tissues and cells. Metallic, magnetic, polymeric, metal oxide, quantum dots, graphene, fullerene, liposomes, carbon nanotubes, and dendrimers represent some of the nanoparticle types with potential applications in cancer diagnosis and treatment. Notably, nanoparticles have demonstrated intrinsic anticancer activity through antioxidant mechanisms and inhibition of tumor growth. Moreover, they enable controlled drug release, enhancing drug efficacy while minimizing side effects. Nanomaterials like microbubbles serve as molecular imaging agents in ultrasound imaging. This review comprehensively explores the various nanoparticle types commonly utilized in cancer diagnosis and treatment.

Keywords: Nanoparticles, Cancer diagnosis, Cancer treatment, Drug delivery, Anticancer activity

EXPLORING ANTIMICROBIAL NANOMATERIALS: AN IN-DEPTH REVIEW

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Abstract:

Microbial colonization on various surfaces poses significant health and economic risks, exacerbated by the threat of global pandemics. The integration of antimicrobial nano compounds into materials has emerged as a promising strategy to mitigate microbial adhesion and proliferation. Despite the growing interest in antimicrobial surface coatings, there remains a lack of systematic research in this domain. This article provides a thorough overview of nanomaterials-based antimicrobial coatings aimed at halting contamination spread on surfaces. The review encompasses various approaches, including simple nanomaterial deposits, embedded nanomaterials, as well as nanostructures such as nanotubes, nanowires, nanocolumns, nanofibers, nanoneedles, and bio-inspired designs.

Keywords: Antimicrobial coatings, Nanomaterials, Surface contamination, Biofilm prevention, Nanocompounds

MOLECULAR PHYLOGENY OF CONUS BILIOSUS AND THEIR VENOM (CONOPEPTIDE) BIOPROSPECTING

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Abstract:

Conidae are very diversified predatory marine gastropods known for their highly potent peptidic venom. They exhibit a remarkable range of structural and functional diverse conotoxins which are significantly having distinctive potency and specific profiles for a range of neuronal targets as a research tool with therapeutic approaches. Our study aims to identify the *Conus spp.* in Karnataka Coast and illustrate the bio-activity of therapeutically significant conopeptides, this is also specific to evolutionary questions such as measuring divergent in venomics and genetic distance. Molecular phylogeny was estimated based on mitochondrial partial gene cytochrome C oxidase subunit I (COI), 16S ribosomal RNA (16S rRNA), and 12S ribosomal RNA (12SrRNA) sequences. And venom was analysed using venom gland extract from *Conus biliosus*, subjected to proteomics analysis using LC/ESI-MS methods. Several proteins, notably disulfide isomerases, peptidases and cysteine rich venom peptides have been identified, using closely related conus species from uniport proteins database. One novel single disulfide nonapeptide hormone, derived from the conopressin/conophysin precursor sequence, have been mass spectrometrically characterized in the organic extract from venom ducts of *Conus biliosus*.

Key Words: *Conus biliosus*, Mitochondrial genes, Molecular phylogeny, Proteomics, LC/ESI-MS.

PACE Conclave 2024

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Message from Conference Chair

Dear Participants, Keynote Speaker, Students, and Coordinators,

It gives me immense pleasure to welcome you all to ICIBS 2024: the International Conference in Basic & Applied Sciences. This year, we are privileged to have such a distinguished gathering.

Your presence enriches our discussions and contributes to the exchange of ideas crucial for advancements in science. To our esteemed keynote speakers, your expertise and perspective are invaluable. We eagerly anticipate your address and the insights you will share with us.

Dear students, you are the future of science, and your enthusiasm and curiosity are truly inspiring. Use this conference as an opportunity to learn, network, and grow.

To the coordinators, thank you for your hard work and dedication in organizing this event. Your efforts have made this conclave possible, and we are grateful for all that you do.

I am confident that the next two days will be filled with engaging discussions, fruitful collaborations, and memorable experiences. Let us make the most of this opportunity to learn from each other and contribute to the advancement of science.

Once again, welcome to ICIBS 2024. Let us make it a truly remarkable conclave.

Warm regards,

Prof. Ismail Shaffi A. M.

Chair- ICIBS 2024

Head, Dept. of Physics

Message from Conference Convenor

Dear Esteemed Colleagues and Participants,

Welcome International Conference in Basic & Applied Science 2024 (ICIBS-24) held under the umbrella of PACE CONCLAVE: International Conclave on Engineering Sciences & Technology – 2024 (ICEST-24).

As the Convenor of this prestigious conference, it brings me great pleasure to greet all of the participants, both in person and virtually. The key feature of this conference lies its ability to bring together brilliant individuals from all over the world to discuss innovative studies, engage in significant conversations, and influence the direction of science and technology.

During ICIBS-24, we are in a unique position to explore the boundaries of innovation, discover new solutions to critical issues, and develop multidisciplinary cooperation.

I would like to express my appreciation to our excellent keynote speakers, distinguished presenters, committed volunteers, enthusiastic members of the organizing committee, and kind sponsors for their unwavering support and efforts. Your collective contributions have been essential in transforming this event into an exemplary platform.

I urge each and every person to participate fully in the conversations, take advantage of the many chances for teamwork, and make the most of the wealth of information and experience available at this conference.

As we embark on this path of exploration and invention, let us embrace diversity of thought, harness the power of collaboration, and strive for excellence in everything we do. Together, we have the potential to effect positive change and drive progress on a global scale. Thank you for your participation, dedication, and enthusiasm. I wish you all a rewarding and inspiring experience at the ICIBS-24

Warm regards,

Dr. Supriya Bangera
Convenor
ICIBS-24
Associate Professor
Dept. of Chemistry

PACE CONCLAVE: International Conclave on Engineering Sciences & Technology – 2024 (ICEST-24)

ICIBS 2024: INTERNATIONAL CONFERENCE ON BASIC AND APPLIED SCIENCES

23rd April 2024 Tuesday – Day 1	
09:30 AM to 11:30 AM	Inauguration of ICEST-24 Inaugural address by **Mr. Sohan M.** Senior Project Manager – Infosys, Mangalore Keynote Address by **Dr. P. Nagabhushan**, VC, Vignan University, AP
11:30 AM to 11:45 AM	Refreshments
11:45 AM to 01:00 PM	Keynote Address-1 on topics "Elastic properties of liquid crystals" by **Dr. CHANDRA SHEKHAR SHETTY T,** Associate Professor, Department of PG Studies in Physics, St. Aloysius (Deemed to be University) Mangalore
01:00 PM to 02:00 PM	Lunch Break
02:00 PM to 02:45 PM	Track 1 Oral presentation
03:15 PM to 03:30 PM	Refreshments
03:30 PM to 04:15 PM	Track 2 Oral presentation
24th April 2024 Wednesday – Day 2	
09:30 AM to 11:00 AM	Track 3 Oral presentation
11:00 AM to 11:15 AM	Refreshments
11:30 AM to 01:00 PM	Keynote address – II on topic "Organic display materials " by **Dr. B. K. SAROJINI,** Professor, Industrial Chemistry, Mangalore university, Mangalagangotri, Mangalore
01:00 PM to 02:00 PM	Lunch Break
02:30 PM to 03:30 PM	• Valedictory of ICEST-24 • Valedictory address by **Dr. A. M. Khan,** Senior Professor, Dept. of Electronics & Director- Skill Development Centre Mangalore University Mangalore • Keynote Address by **Dr. Surendra Kumar**, Pro-Vice Chancellor, Presidency University, Bangalore
03:30 PM to 04:00 PM	Interaction & High Tea

INHIBITIVE ACTION OF MA SYNTHESIS AND PHOTOLUMINESCENCE PROPERTIES OF $Ca_2MgWO_6:xEr^{3+}$ PHOSPHORS

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Abstract:

In the present paper, we have successfully synthesized phosphors with the composition $Ca_2MgWO_6:xEr^{3+}$ (x = 0.5, 1, 2, 3, and 4 mol%) via the solid-state reaction method. Accurate weighed $CaCO_3$, MgO, WO_3, Er_2O_3, and the flux MgF_2, were ground for 1 hour and subjected to heating for 5 hours at 600^0C. After cooling, the mixtures were ground again and heated at 1200^oC for 5 hours. The XRD patterns of the phosphors were obtained, upon comparing the XRD patterns with the standard XRD peaks, the successful synthesis of desired phosphors was verified. In addition, Rietveld refinement was carried out to determine the lattice parameters as well as the bond lengths. Using photoluminescence spectroscopy, optimum concentration for the concentration quenching was determined and it was found to be 2 mol%. The Diffused Reflectance spectra were employed to ascertain the band gap as well as the nature of the band gap of the material. In totality, our findings revealed that the optimized phosphor possessed remarkable optical properties, positioning it as a promising candidate for various optoelectronic applications.

ADVANCING SOLID POLYMER ELECTROLYTES: HYDROXY PROPYL METHYL CELLULOSEAND MAGNESIUM SALT SYSTEMS FOR ENERGY STORAGE

Jayalakshmi K[1], Shreeganesh Subraya Hegde[2], Ismayil[1]*, Badekai Ramachandra Bhat[2], Shreedatta Hegde[3]

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Abstract:

The present work focuses on the microstructural analysis of two different magnesium ion conducting solid polymer electrolytes based on Hydroxy Propyl Methyl Cellulose and studying their suitability for energy storage systems. Two electrolyte systems were prepared using magnesium nitrate [Mg(NO3)2.6H2O] and magnesium acetate salt [Mg(CH3COO)2.6H2O] by employing the solution casting method. XRD and FTIR analysis account for structural modification of the films upon incorporation of salt. Both systems exhibited a maximum room temperature ionic conductivity of the order of 10^{-4} S/cm. Temperature-dependent analysis of impedance accounted for the ion transport mechanism. Electrochemical Stability Window values of both systems were found to be more than 3V, indicating the efficiency of the prepared systems. Primary battery and Electric double-layer capacitor (EDLC) have been fabricated using the highest conducting electrolyte systems, and their characteristics have been analyzed.

Key Words: Solid polymer electrolytes, Magnesium ion conducting, Ionic conductivity, Arrhenius behaviour, Energy storage devices.

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METRO DOMINATION NUMBER OF MOBIUS LADDER GRAPH

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Abstract:

A subset D of the vertex set V of the graph $\mathbf{G(V, E)}$ is said to be a dominating set if every vertex in $\mathbf{V - D}$ is adjacent to at least one vertex in D. The minimum cardinality of the dominating set is called the domination number. The metro domination number is the order of a minimum dominating set which resolves as a metric as a metric set. It is denoted by $\boldsymbol{\gamma_M(G)}$. In this paper we determine on the metro domination number of Mobius ladder graph.

Keywords: Fan graph, Fire cracker graph, Dominating set, Domination number, Metric dimension, Metro domination.

CHEMICAL MODIFICATION OF TAMARIND SEED GUM FOR THE ADSORPTIVE REMOVAL OF CATIONIC DYES FROM AQUEOUS SOLUTIONS

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Abstract:

Synthesis of a hydrogel, TG-g-PAMPS by the chemical modification was achieved from the polysaccharide, tamarind seed gum (TG) using 2-acrylamido-2-methyl-1-propane sulfonic acid (AMPS) as a comonomer and N,N′-methylene-bis-acrylamide (MBA) as a crosslinking agent, through the free radical graft copolymerization technique. The newly synthesized hydrogel was characterized by field emission scanning electron microscopic technique. The efficiency of the gel was evaluated for the removal of dyes from aqueous solution, using cationic dyes, crystal violet (CV) and methylene blue (MB) as model dyes. Isothermal studies revealed that the adsorption process follows the formation of a monolayer adsorb ate on the adsorbent, confirming the Langmuir isotherm as the best fit. Additionally, the systems followed a pseudo-second-order kinetic model. Remarkably, the hydrogel demonstrated the ability to adsorb up to 9.77mg/g of CV and 13.97mg/g of MB from the dye solution with a concentration of 10mg/L. Thermodynamic studies of the adsorption process unveiled its endothermic nature. Furthermore, the negative value of Gibb's free energy confirmed the spontaneity of the adsorption process. The hydrogel demonstrated a remarkable ability to undergo five cycles of successful recyclability, as evidenced by the desorption studies.

Key Words: Hydrogel, Adsorption, Crystal Violet, Methylene Blue, Desorption.

INHIBITIVE ACTION OF MACARANGA PELTATA LEAVES (MPL) EXTRACT FOR THE CORROSION OF ALUMINIUM IN ACIDIC MEDIA

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Abstract:

The purpose of this work is to assess the inhibition effect of Macaranga peltata leaves (MPL) for aluminium corrosion in 1 M HCl solution. Both weight loss and electrochemical methodologies were utilized to investigate the corrosion inhibition properties of MPL extract in 1 M hydrochloric acid. Results demonstrated that the extract effectively retards the corrosive impact of the acid on aluminium. Furthermore, inhibition efficiency was observed to rise with escalating concentrations of the extract. Adsorption studies revealed that Langmuir adsorption isotherm is the best adsorption model applicable to the adsorption on aluminum surface. Fourier transform infrared spectroscopy was employed to identify the functional groups within the MPL extracts. Scanning electron microscopy was utilized to investigate the surface morphology of aluminum. Additionally, activation parameters such as activation energies, activation enthalpy, and activation entropy were deduced from the impact of temperature variations on both corrosion and inhibition processes. The inhibitory efficacy was correlated with the molecular structure of active components found in the extract using the density functional theory model.

Key Words: Aluminium, Corrosion, Adsorption, Scanning electron microscopy, HCl.

STRUCTURAL, THERMAL AND MECHANICAL PROPERTIES OF COPPER OXIDE DOPED PVA/PVP BLEND

Rajesh K[1], Vincent Crasta1[1]*, Rajesh Kumar P C[1], Olivia Sequeira[1]

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Abstract:

Using solvent casting technique, blends of polyvinyl alcohol (PVA) and polyvinylpyrrolidone (PVP) (50/50) have been synthesized and varying amounts of copper oxide (CuO) nanofiller (0, 2, 4,8,12, and 16 wt. %) were added to the blend. The films structural validity is done through XRD studies. The thermal properties of the selected nanocomposite films studied using Differential Scanning Calorimetry (DSC) technique indicates the enhancement in the thermal properties of the blends upon addition of CuO nanofillers. The mechanical properties of the films studied using Universal Testing Machine (UTM) indicates the improvement in Youngs modulus of the films with the addition of Nanoparticles.

Key Words: Nanocomposite, thermal properties, CuO nanofiller, mechanical properties.

INFLUENCE OF FUNCTIONAL GROUPS ON SECOND HARMONIC GENERATION AND STRUCTURAL PROPERTIES OF CHALCONE DERIVATIVES

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Abstract:

The chalcones 1-(4-notrophenyl)-3-(2,3,5-trichlorophenyl) prop-2-en-1-one(NTP) and1-(4-bromophenyl)-3-(2-methoxy,5-bromophenyl) prop-2-en-1-one(MBB) are synthesized using Claisen-Schmidt reaction method. These chalcones are tailored by differed functional group substitutions such as -OCH_3, -SCH_3, -Cl, -Br and NO_2. The FT-IR spectra are used for structural confirmation of these compounds. The Kurtz powder method has been employed to measure the SHG efficiency. The powder XRD is carried to evaluate the crystalline properties of these chalcones. The SGH efficiency of NTP is 0.04 and powder XRD confirms that it has crystalline structure. MBB has SHG efficiency of 0.5 and XRD study reveals that it is amorphous in nature. The influence of functional groups such as -OCH_3, -SCH_3, -Cl, -Br, and NO_2 on the SHG efficiency and crystalline properties of NTP and MBB have been analyzed. The study gives a very intriguing insight into the design of chalcone derivatives based on functional substitution.

Key Words: Chalcones, FT-IR, XRD, SHG.

ISOLATION AND CHARACTERIZATION OF ACID-SOLUBLE PISCEAN COLLAGEN FROM SEA FISH MORONE AMERICANA

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Abstract:

The main connective tissue protein, collagen, comprises three polypeptide strands known as alpha chains. Gly-Pro-X and Gly-X-Hyp are the two most prevalent motifs in the amino acid sequence of collagen. There are many different organisms from which collagen can be extracted. Due to the bovine spongiform encephalopathy and transmissible, cattle use as the primary source of collagen has been reexamined, while collagen of porcine origin is increasingly disfavored due to religious concerns. The collagen can also be extracted from marine sources as an alternative. To increase the utilization of fish waste from the fish industries and to focus on the natural raw materials in cosmetics as they are less harmful to the skin, we used the Indian white perch tiger which is one of the common fish found in the fish waste to extract Acid soluble collagen (ASC) from it and investigated some biochemical properties. The yield of isolated ASC was found to be 0.521%. The Sodium dodecyl-sulfate-polyacrylamide gel electrophoresis (SDS-PAGE) study showed that the isolated collagen was type-I and consisted of two α subunits 1 and 2 respectively with a molecular weight of approximately 148kDa. The ultraviolet (UV) absorption spectrum of collagen showed absorption at 226nm. The Fourier transform infrared spectroscopy (FT-IR) spectrum of ASC showed the peaks for Amide-I, II, and III corresponding to functional groups of the protein. The high absorption peak was observed at 226nm which corresponds to C=O, COOH, $CONH_2$ from the Ultraviolet spectrometer.

UNRAVELING THE POTENTIAL OF NANOSTRUCTURED MATERIALS FOR OVERCOMING CHALLENGES IN LITHIUM-ION BATTERY DEVELOPMENT: A SCIENTOMETRIC REVIEW

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Abstract:

Lithium-ion batteries (LIBs) hold immense promise for revolutionizing energy storage, provided technical hurdles such as capacity loss, material stability, safety, and cost are effectively addressed. The recent integration of nanostructured materials to mitigate limitations inherent in conventional LIB components presents a hopeful trajectory. This review meticulously traces the trajectory of research advancements concerning nanomaterials for LIBs spanning the last three decades. Through a comprehensive scientometric analysis encompassing over 100,000 publications, exponential growth in nano-LIB research since the 1990s is unveiled. Notably, China and the USA emerge as frontrunners in nano-LIB publications, with the USA dominating nano-LIB patents. In addition to scientific articles, patents are scrutinized, with USA entities leading in filed, granted, and published patents in the nano-LIB domain. The technical review scrutinizes progress and opportunities across nanostructured anodes, cathodes, electrolytes, separators, and thermal management. Nanoparticles integrated into electrolytes and separators aim to enhance conductivity and strength, while nanofluids and nanocomposite phase change materials aid in thermal regulation. Overall, nanostructures hold significant potential for optimizing LIB components, yet a comprehensive analysis encompassing all elements is imperative. Critical future endeavors must navigate the intricate tradeoffs between cost, performance, and stability to facilitate sustainable nano-LIB commercialization.

Key Words: Nanostructured materials, Lithium-ion batteries (LIBs), Scientometric analysis, Battery components, 5. Commercialization challenges

MULTIDIMENSIONAL NANO MATERIALS: SYNTHESIS TECHNIQUES AND DIVERSE APPLICATIONS

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Abstract:

Grains serve as the foundational units of numerous materials, each composed of multiple atoms. The visibility of grains is contingent upon their sizes, with conventional grain sizes typically falling within the sub-millimeter to centimeter range. Conversely, nanomaterials boast average grain sizes of less than 100 nm, facilitating property enhancements such as reduced weight and heightened strength. Serving as a crucial link between atomic/molecular and bulk systems, nanomaterials offer avenues for novel or augmented size- and shape-dependent properties, rendering them pivotal in diverse applications spanning electronics, medicine, and military defense. A paramount concern lies in the development of convenient methods for the selective functionalization of nanostructures to optimize their utility. This chapter delves into the conceptual framework, significance, properties, and synthetic methodologies of 0D, 1D, 2D, and 3D nanostructured materials (NSMs), followed by insights into their functionalization and applications in defense sectors.

Key Words: Grains, Nanomaterials, Nanostructured materials (NSMs), Functionalization, Defense applications

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ADVANCING CORROSION PROTECTION: A REVIEW OF NANOCOMPOSITE COATINGS

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Abstract:

Corrosion presents significant economic and safety challenges across various industries. In response, the utilization of nanocomposite coatings for steel corrosion protection has garnered considerable attention among researchers. This review examines the potential of nanocomposite coatings in mitigating corrosion. Recent advancements in corrosion inhibition research are surveyed, with a focus on factors influencing nanocomposite performance, including types of nano-materials, size, concentrations, mixing, and additives. Specifically, alkyd resin, epoxy resin, and polyurethane composites are highlighted. Additionally, novel materials for nanocomposite coating design are discussed, along with future research directions.

Keywords: Corrosion, Nanocomposite coatings, Steel protection, Corrosion inhibition, Material design

NANOTECHNOLOGY IN WATER PURIFICATION: A COMPREHENSIVE REVIEW OF NANO-ENGINEERED ADSORBENTS

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Abstract:

This comprehensive review delves into the realm of nanotechnology in water purification, focusing specifically on nano-engineered adsorbents for the removal of contaminants, particularly dyes. As water pollution continues to pose a significant global challenge, nanotechnology offers promising solutions due to its unique properties and capabilities. The review provides an in-depth exploration of various nano-engineered adsorbents employed in water purification, highlighting their structures, synthesis methods, and mechanisms of action. Additionally, the efficacy of these adsorbents in removing dyes from water is evaluated, considering factors such as adsorption capacity, selectivity, and regeneration potential. Furthermore, the review discusses the potential challenges and future directions in the development and application of nano-engineered adsorbents for water purification. Through this comprehensive analysis, the review aims to contribute to the advancement of nanotechnology-driven solutions for addressing water pollution issues worldwide.

Keywords: Nanotechnology, Water purification, Nano-engineered adsorbents Dye removal, Contaminant removal

INVESTIGATION OF CORROSION INHIBITION BEHAVIOUR OF MILD STEEL IN HYDROCHLORIC ACID BY CARBOTHIOAMIDE BASED PYRAZOLINE DERIVATIVE USING EXPERIMENTAL AND COMPUTATIONAL APPROACHES

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Abstract:

A new compound N-methyl-3,5-diphenyl-4,5-dihydro-1H-pyrazole-1-carbothioamide (NDDP) was synthesized and analyzed using FTIR, ^{1}HNMR, and mass spectrometry. The electrochemical impedance spectroscopy and potentiodynamic polarization techniques were utilized to assess the effectiveness of NDDP as a corrosion inhibitor for mild steel. The study found that the corrosion inhibition increased as the concentration of NDDP increased, while it decreased with an increase in temperature. The highest inhibition efficiency of 82.28% was reported at a temperature of 303 K with a concentration of 50 ppm of NDDP. Statistical thermodynamic calculations were done to determine activation and adsorption parameters. Surface investigation of the metal in the presence of NDDP was conducted using SEM, AFM, and EDX techniques. Quantum chemical computations confirmed the superior anticorrosive properties of NDDP as demonstrated by electrochemical studies.

Keywords: Electrochemical impedance, Potentiodynamic polarisation, Activation, Quantum calculations.

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23rd April 2024 Tuesday – Day 1	
09:30 AM to 11:30 AM	Inauguration of ICEST-24 Inaugural address by **Mr. Sohan M.** Senior Project Manager – Infosys, Mangalore Keynote Address by **Dr. P. Nagabhushan**, VC, Vignan University, AP
11:30 AM to 11:45 AM	Refreshments
11:45 AM to 01:00 PM	Keynote address – I on topic "Interlaminar Fracture Toughness in FRP Composite Laminates -Future Scope and Applications" by **Dr. P. S. Shivakumar Gouda,** Associate Professor, Dept. of Mech., Engg., SDM College of Engg & Tech, Dharwad, India.
01:00 PM to 02:00 PM	Lunch Break
02:00 PM to 02:45 PM	Track 1 Oral presentation (Design and production)
02:45 PM to 03:30 PM	Track 2 Oral presentation (Thermal sciences)
03:30 AM to 03:45 AM	Refreshments
03:45 PM to 04:30 PM	Track 3 Oral presentation (Energy & Environment)
24th April 2024 Wednesday – Day 2	
09:30 AM to 10:30 AM	Track 4 Oral presentation (Materials and Modelling)

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10:30 AM to 11:30 AM	Track 5 & 6 Oral presentation (Manufacturing and Machining)
11:30 AM to 11:45 AM	Refreshments
11:45 AM to 01:00 PM	Keynote address – II on topic " Importance of Industry 4.0 in an aerospace domain " by **Dr. Madeva Nagaral, Manager (Design)** Aircraft Research and Design Centre, Hindustan Aeronautics Limited Bangalore-560037, Karnataka-India
01:00 PM to 02:00 PM	Lunch Break
02:30 PM to 03:30 PM	• Valedictory of ICEST-24 • Valedictory address by **Dr. A. M. Khan,** Senior Professor, Dept. of Electronics & Director- Skill Development Centre Mangalore University Mangalore • Keynote Address by **Dr. Surendra Kumar**, Pro-Vice Chancellor, Presidency University, Bangalore
03:30 PM to 04:00 PM	Interaction & High Tea

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COMPARISON OF THE TENSILE STRENGTH OF V-GROOVED BUTT-WELDED ALUMINIUM ALLOYS

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Abstract:

Now-a-days shipping, aerospace and process industries commonly use aluminium and its alloys because of their valuable properties such as light weight, better corrosion resistance and weld-ability. This research investigates the influence of groove angle on the tensile strength of Tungsten Inert Gas (TIG) welded AA2024 and AA7075 alloy weldments. The work aims to examine the tensile-strength of V-grooved butt welded specimens of AA2024 and AA7075 for different groove angles keeping bevel height, root opening, voltage and current constant. TIG welding is employed as it joins different materials with high quality in the presence of inert gas. AC power source ensures better cleaning action and avoids the high heat concentration on the material. Tensile strength of the joint is tested by the universal tensile testing machine. From the tensile test conducted on the V-grooved, butt welded Al-alloys having varying groove angles, it is inferred that the 45˚ angle has the maximum ultimate tensile strength.

Key Words: Groove angle, V-groove, Butt-joint, Bevel height, Root opening, TIG welding, Ultimate tensile strength.

1. Introduction

AA 2024 is an Al-alloy containing Cu as the major alloying constituent. Its applications call for the situations involving high strength-to-weight ratio, good fatigue resistance and average machinability. Friction welding is used to weld this Al-alloy. To protect from corrosion, it can

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often be covered with Al, even though it may affect the fatigue strength. This Al-alloy is heat treatable and finds it applications majorly in aircraft industry.

AA7075 is also heat treatable, extensively used in aircraft industry and possesses high toughness to fracture in addition to high resistance to stress corrosion cracking. It maintains strength even in thicker sections, possesses lower sensitivity for quenching and hence is suitable for heavy plate applications. Aerospace components such as fuselage, frames, wing skins, etc. make use of this Al-alloy.

Literature survey of various works on welding of AA 2024 and 7075 is conducted. From the survey, process parameter that affects the weld strength are studied in detail. It is observed that the groove angle has significance importance on the strength of weld. G Venkateshwarlu et al. [1] have conducted the experiment on the assessment of mechanical properties of AA 6061. The standard cylindrical specimens of the alloy prepared as per ASTM E9 were subjected to compression on UTM at room-temperature. The strength and strain hardening coefficient are recorded to be 562.5 and 0.5487 respectively. Micro hardness obtained was 66.35-68.63 (HV). Study of microstructure witnessed uniform dispersal of the grain sizes in the alloy.

Brotzu et al. [2] have studied a cracked component made of Al 7050 alloy, emphasized that different kinds of intermetallic phase formed during solidification and hot-rolling probably do not disturb the mechanical resistance of the alloy, but appear to determine crack formation during material removal processes. Hence it is very important to establish an in-process check and after the shaping process, the components.

R. Balasubramanian et al. [3] compared the mechanical properties of non-heat treatable aluminum alloy AA5083 and heat treatable Aluminum alloy AA7020 using TIG welding. Mechanical tests like tensile, impact, flexure and hardness tests were conducted and the results were tabulated. Microstructural and SEM fractographic studies were conducted and correlated. The results witnessed better mechanical and metallurgical properties for AA 5083 as compared to AA 7020.

B.V.R.Ravikumar et al. [4] studied AA5083 and AA6082 TIG welds, using AA 5356 filler wire with non-pulsed current and pulsed current at different pulse frequencies. Non-destructive testing was done to study the porosity and surface cracks. The mechanical tests to study the

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ultimate tensile strength, yield strength and parentage elongation were carried out. The studies concluded that the pulse current produces more tensile strength than non-pulse current.

Baiju Sasidharan et al. [5] conducted a comparison study on tensile and microstructural features of joints prepared from Direct Current Straight Polarity (DCSP) TIG welding and Friction Stir Welding (FSW) on AA2219. The tensile strength of TIG welded and FSW joint was found to be 257.48MPa and 287.9MPa respectively. Elongation (%) for FSW joint was found to be more than that of parental metal. It was concluded that FSW offers efficient-joining of AA2219.

Arun Narayanan et al. [6] studied the best-combination of welding-parameters like current and flow rate of gas in TIG welding of AA 5083. Numerous tests for tensile behaviour, microhardness, macro and microstructure studies were conducted on the welded-specimens. The test results shows that AA 5083 gives better results at 200A current and 15 l/min gas flow rate.

2. Experimental Procedure

2.1 Material Selection

The materials procured are AA2024 and AA7075 plates having dimensions 300x300x8 mm. The aim is to compare the strength (tensile) of V-grooved, butt-welded AA2024 and AA7075 alloys using TIG welding method. Single V-grooved, butt-welded joints are prepared by varying groove angles from 0 to 60 degrees (0, 30, 45 and 60 degrees for both alloys). As included angle increases, the contact area also increases, and hence strength also increases. Figure 1 and 2 show the plates of AA 2024 and 7075 procured from Bangalore.

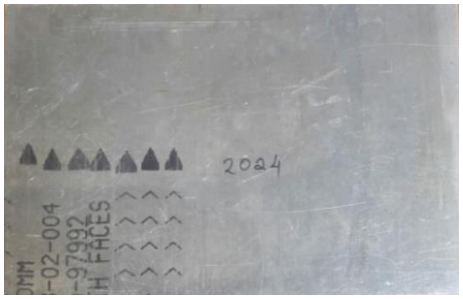

Figure 1. Procured AA 7075 alloy

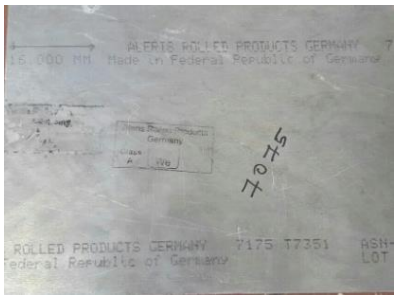

Figure 2. Procured AA 2024 alloy

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2.2 Machining Process

In machining, the raw material is finished into a desired final shape and size by controlled material removing process. The machining was done at Mangalore, using a universal milling machine as presented in Figure 3, the material is shaped to required dimensions. The figures 4 and 5 show the machined materials of dimensions 40*160mm.

Figure 3. Universal Milling Machine

Figure 4. Machined Al 7075

Figure 5. Machined Al 2024

2.3 Machined and Welded Workpieces

By using a milling machine, the workpieces are machined to 40*160mm. The final specimens are produced with the application of machining and TIG welding, having V-grooved,

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butt-welded joints with 0°, 30°, 45° and 60° groove angles and 0mm, 1mm, 1mm and 1mm bevel height.. The specimens of AA 7075 are shown in Figures 6. Process of TIG welding is presented in Figure 7. The materials are then machined to final shape according to ASTM standards. The final machined tensile test specimen is displayed in the Figure 8.

Figure 6. Final Specimens of AA 7075

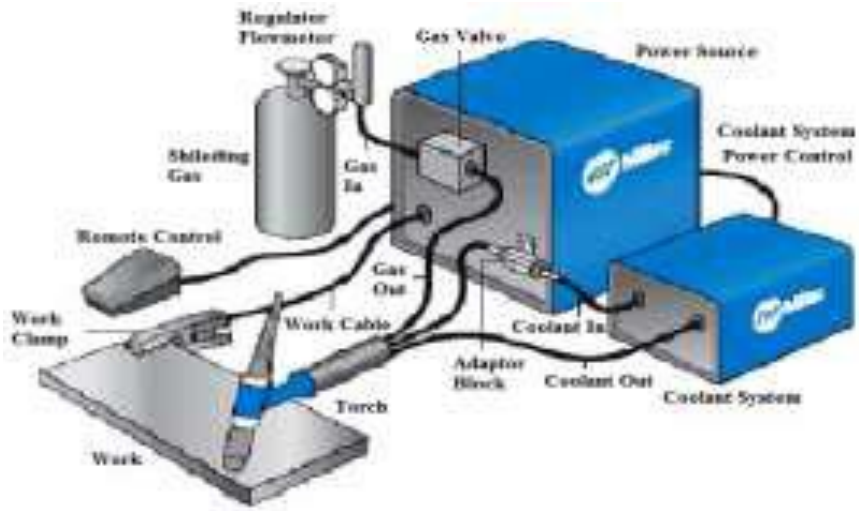

Figure 7. Process of TIG welding

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Figure 8. Tensile test specimen

2.4. Experimental testing

The specimen for tensile testing is positioned between the grippers of the UTM and provision of an extensometer automatically records the gauge length changes while testing. In the absence of an extensometer, the displacement can be recorded by the machine, between its crossheads where the test-specimen is fixed. After starting of the machine, a gradually-increasing load is applied on the specimen. The control system with installed software records the load and extension/compression of the test-specimen throughout the test duration. Figure 9 shows the process set-up for tensile test.

Figure 9. Tensile test – process set-up

3. Findings of the Study and Discussion

3.1 For Aluminium 2024 Alloy

The results are obtained from the tensile test conducted on AA 2024 alloy. The groove angles are 0º, 30º, 45º, & 60º. The bevel height is zero for 0º groove angle & 1mm for all other varying

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groove angles. Ultimate Tensile Strength (UTS) values observed to be 394MPa, 158.31MPa, 223.44MPa & 158.345MPa respectively. The graph is plotted as tensile strength vs groove angle. At 45° groove angle and 1mm bevel height, tensile strength (maximum) is obtained for AA 2024 alloy. Tensile test results of all specimens for AA2024 are presented in Table 1 and Figure 10.

Table 1: Tensile test results of all specimens for AA2024

Sl. No.	Sample Name	Groove Angle (Degree)	Bevel Height (mm)	Materials	UTS (MPa)			Failure location
					I	II	Avg.	
1	AA	0^0	0	AA2024	396	392	394	Unwelded
2	V1	30^0	1	AA2024	158.60	158.02	158.31	In weld
3	V2	45^0	1	AA2024	223.40	223.48	223.44	In weld
4	V3	60^0	1	AA2024	158.60	158.09	158.345	In weld

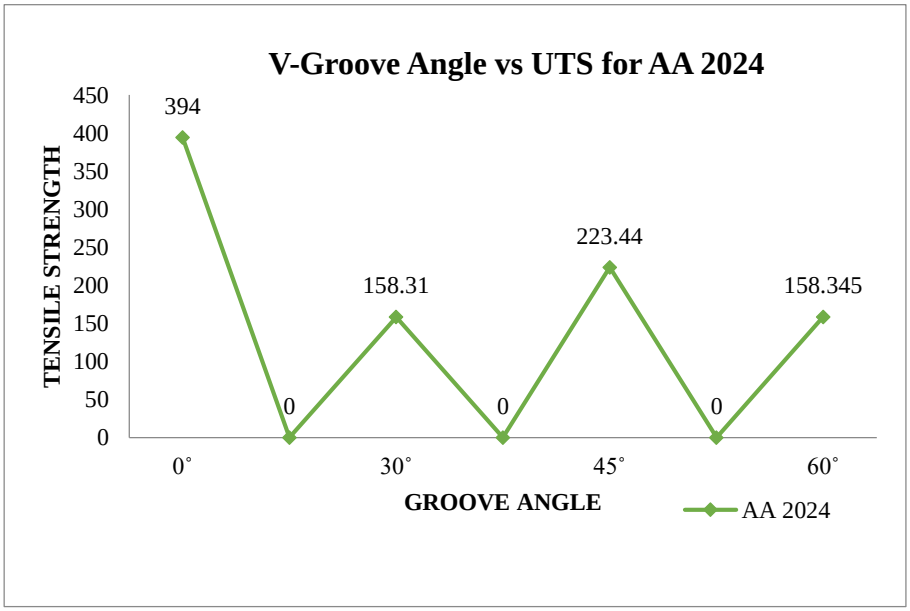

Figure 10. V-Groove Angle vs UTS for AA 2024

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3.2 Alumnimum 7075 Alloy

The results are obtained from the tensile test conducted on AA 7075 alloy. The groove angles are 0^0, 30^0, 45^0, & 60^o. The bevel height is zero for 0^0 groove angle & 1mm for all other varying groove angles. Ultimate Tensile Strength (UTS) values found to be 601MPa, 219MPa, 265.29MPa & 155.14MPa respectively. The graph is plotted as tensile strength vs groove angle. At 45° groove angle and 1mm bevel height maximum tensile strength is obtained for AA 7075 alloy. Tensile test results of all specimens for AA7075 are shown in Table 2 and Figure 11.

Table 2: Tensile test results of all specimens for AA 7075

Sl. No.	Sample Name	Groove Angle (Degree)	Bevel Height (mm)	Materials	UTS (MPa)			Failure location
					I	II	Avg.	
1	BB	0	0	AA7075	601	603	602	Unwelded
2	V4	30^0	1	AA7075	217	221	219	In weld
3	V5	45^0	1	AA7075	265.04	265.54	265.29	In weld
4	V6	60^0	1	AA7075	154.06	156.22	155.14	In weld

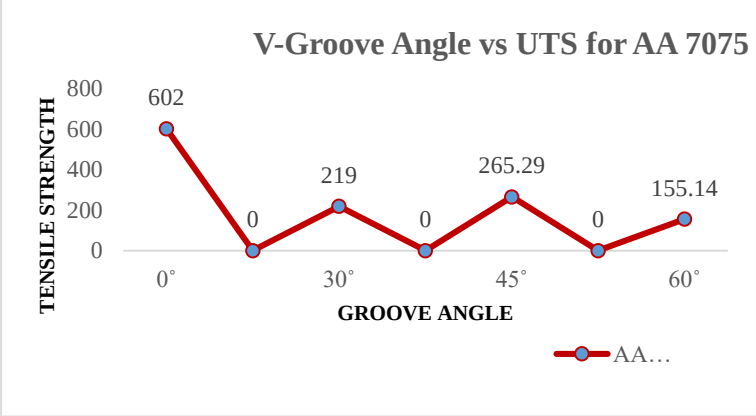

Figure 11. V-Groove Angle vs UTS for AA 7075

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After comparing the tensile strength values of both Al-alloys with varying V-groove angles, the comparison plot is drawn as presented in Figure 12. It is evident from Figure 13 that 45° groove angle produces maximum tensile strength for both alloys at 1mm bevel height.

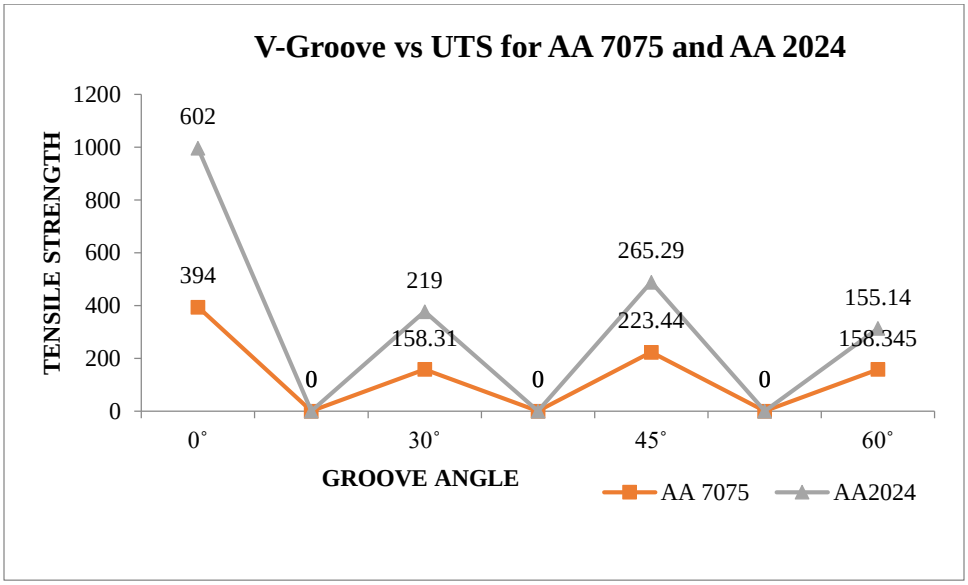

Figure 12. V-Groove Angle vs UTS for AA 7075 and AA 2024

4. Conclusion

This work is aimed to compare the UTS of V-Grooved, butt-welded AA 2024 and AA 7075 alloys with varying groove angles and same bevel height. The findings of this work as follows:

- From the tensile tests conducted on the two Al-alloys with varying groove angles and same bevel height, it is noticed that the tensile strength increases upto 45˚ groove angle and then it decreases. Both the alloys show maximum strength at 45^0 groove angle. Hence 45° groove angle is considered to be an optimum groove angle for both the alloys.
- Both the alloys in unwelded condition show the maximum tensile strength.
- From the above experimentation, it is determined that AA7075 is having good tensile strength compared to that of AA 2024.

ISBN-978-81-19905-39-3

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ISBN-978-81-19905-39-3

ICEST_ME_011

DESIGN AND FABRICATION OF CHAFF CUTTER CUM FLOUR MILL, FOR SMALL FARMERS

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Abstract:

The optimization of a combined chaff cutter and flour mill machine involves enhancing efficiency and performance. This abstract focuses on refining the design, materials, and operational parameters to achieve maximum output and resource utilization. Through systematic experimentation and analysis, the study aims to identify optimal configurations, minimizing energy consumption while maximizing chaff cutting and flour milling capabilities. The results contribute to the development of a more sustainable and effective agricultural processing solution, catering to the needs of farmers and promoting resource- efficient practices in food production. The scope of chaff cutter focuses on the chopping of agricultural wastes such as coconut leaves, areca leaves, etc., and this chopped waste can then be used to prepare vermin compost, cattle feeds, and floor stuff for cattle huts. The scope of the flour mill is to grind the grains used for daily purposes. It uses combined blades for grinding. The friction generated between the blades and casing results in grinding the grains into powder. At last, it can be stored for the daily use.

Keywords: Fodder, Cutter, Uniform chopping, Grinding

1. Introduction

Small-scale agriculture plays a crucial role in feeding populations and supporting rural economies worldwide. Among the various challenges faced by small farmers, efficient livestock feed

ISBN-978-81-19905-39-3

management is of paramount importance. Chaff cutters, simple yet indispensable machines, are commonly used by small farmers to convert crop residues into livestock feed. Optimizing chaff cutters for small-scale agriculture is essential to enhance productivity, reduce labor, and improve the overall livelihood of these farmers. In the olden days, chaff cutting was done manually or by non-motorized machine which would consume more time and also less on the safer side. But today chaff chaff-cutting machines are available in various sizes and construction from manual-operated to engine-driven machines. Chaff cutters are mechanical devices designed to cut and shred crop residues, such as straw, hay, and stalks, into smaller, more manageable pieces for livestock consumption. These machines are especially beneficial for small farmers who rely on livestock for their livelihood, as they help ensure animals receive proper nutrition while minimizing waste.

Optimizing chaff cutters for small-scale farming involves addressing several key aspects:

Cost-Effectiveness: Affordability is an important issue for most small farmers who run their establishments on limited budgets. Chaff cutters ought to be cheap in terms of their acquisition, operation as well and maintenance for the sake of making more farmers afford them.

Energy Efficiency: Most of these smallholder farmers depend on human manpower or diesel engine-driven machine cutters. Instead, optimized designs might use cheap energy alternatives like wind and biomass among others, to reduce the total operating cost and eco-footprint of facilities.

User-Friendly Design: It should also be easier to use chaff cutters for those who don't have any technical backgrounds. Small farmers will only adopt and be successful in using such machines if they have user-friendly designs and clear instructions.

Durability: Maintenance and repair services are hard to come by for small-scale farmers who sometimes operate under harsh conditions. Chaff cutter optimization should provide robustness against adverse conditions minimizing stoppages and maintenance expenses.

Output Quality: The quality of the chopped feed is also crucial. Cutting must lead to constant and regular results which are significant in livestock wellness and the whole farm efficiency.

Adaptability: This residue is diverse and usually depends on various crops cultivated by small farmers. Well-optimized chaff cutters must have the ability to work with various crop species and different crop residues.

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Local Sourcing: The availability of spare parts and after-sales service is also a very important factor. Encouraging local manufacturing and support chains could provide small food producers with the ready availability of inputs necessary for production and development.

Training and Education: Small farmers should be properly trained on the usage of chaff cutters and also provided with other relevant educational materials to enable proper usage and realization of all advantages of chaff cutters.

Optimizing chaff cutters for small-scale farming is not only a technological endeavor but also a socioeconomic one. It involves understanding the specific needs and challenges faced by small farmers and designing solutions that empower them to improve their livestock management practices, increase crop utilization, and enhance their overall economic sustainability. By addressing these key factors, we can contribute to the well-being of small farmers and the global food supply chain, promoting a more sustainable and efficient agricultural system. Therefore, by concentrating on all the key factors mentioned in the above paragraphs, we planned to fabricate a budget-friendly & easily-handled chaff cutter and it should cut both wet and dry livestock.

2. Literature Review

Farming is one of the foremost vital segments of the Indian economy. In arrange to encourage the creation of this sector, technological help may be a much-required calculation. Since there are boundless issues related to agrarian preparation the farmers are ruined each day. To overcome such issues, ranchers must be energized to embrace innovation that suits their cultivation. Agro waste and agro-products administration is one such region, which is slacking due to the nonappearance of mechanical help. So, a mechanized feed master will be the radiant response for this difficult issue.

Mahadev et al. [2], designed and developed a Shredder machine focusing on chopping agricultural wastes such as coconut leaves, areca leaves, etc. Fabricated equipment was successfully tested and was much better resulting in chopping the wastes as per requirement. Compared to safety which gives a very smooth working operation with no hazards to the operator. Based on work, a conclusion was made this machine can operate with a low feed rate and manual feed operation only. It also required high power for the operation.

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Kankal et al. [3], the experimentation was carried out on a fodder cutter energized by electrical power. Fodder-cutter machines are used every day by farmers and their families in India for the preparation of fodder for the livestock they own. This paper discusses the procedure of the testing of fodder cutter machines. From the study, it can concluded that the performance of the chaff cutter is better in high moisture-holding crops.

Sarak et al. [4], carried out a performance study on an existing chaff cutter and modified the existing chaff cutter to overcome the problems that arise while using the old machine. During the study, they found that chaffed food also saves chewing energy which will increase the rumination process. So this machine is affordable and beneficial for small farmers. It gives better results, uniform cutting size, and works well with less effort.

Sankpal et al. [5], developed the machine from the basic machine into a commercial standard machine that can be electrically driven to achieve various lengths of cut of chaff as per the preference. The new chaff cutter machine is modified for its compactness and to avoid blockage of grass.

From the above discussion, it can be concluded that, while designing the machine concentration should be given to the parameters such as power required, productivity to be achieved, and the cost of the machine. Using very little power input will not result in chopping action and at the same time using high power to cause chopping makes the process to be very costly. Hence an optimum power has to be selected so that it satisfies the chopping action and makes the process economical. Therefore, this project aims to solve these issues and gaps by developing and evaluating a dual-purpose forage machine for chopping and crushing operations to achieve both operations more efficiently and at a lower cost.

3. Objectives of the project

The following are the objectives which are to be achieved by the completion of the project.

1. The primary objective of this project is to fabricate of Chaff cutter machine to provide a practical and efficient tool for local farmers.
2. Optimizing the machine performance to achieve Improve the quality of feed, and save labour time compared to the manual cutting method.

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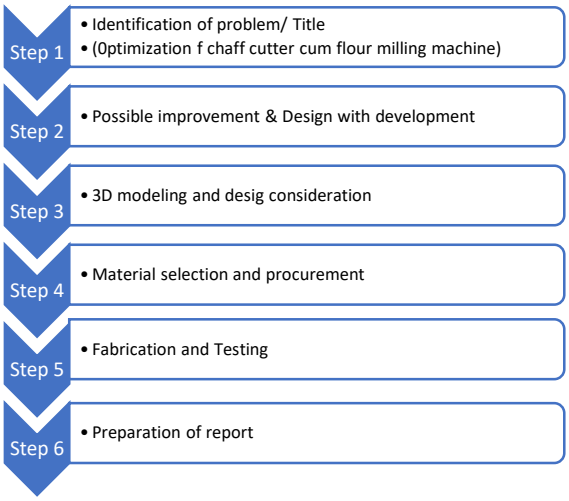
3. The Secondary objective of this project is to fabricate flour making machine that is to be operated with the help motor of a chaff cutter machine.
4. More productivity than the present machine with less power input has to be obtained by optimizing the existing machine by changing the cutting blade, its material, and the position of the cutting blades.
5. Both machines should contribute significantly to agricultural and food processing practices, impacting both livestock nutrition and human food preparation.

4. Project plan



Stage 1:

After the initial selection and screening of title and work, it was decided to take up an improvement on the existing chaff cutter machine

Stage 2:

Stage second, discussion was done on the possible improvement that could be made on existing chaff cutter, and making it to meet our expectation. Accordingly, the rough drawing of the machine was done.

Stage 3:

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Here the 3D modeling of chaff cutter with milling machine was done considering the required objectives and finalizing the appropriate design.

Stage 4:

For the fabrication selection of material, in which cost effective, light weight and durable type of material finalized and purchasing of suitable motor, blade & electronic components are done.

Stage5:

By the reference of the 3D model & dimensions, fabrication process is done . After the final assembly, the machine was done with testing for several time. Some of modifications are done here.

Stage 6:

After the all procedure, final report were done under the mentorship of our guide. Here we maximized the information our project.

5 Design Calculations

RPM of Cutting Blade:

Motor rpm, N_1= 2800 rpm

Diameter of smaller pulley = d_1= 5 cm

Diameter of bigger pulley =d_2= 13 cm

Relationship between pulley diameter and rpm:

$N1/N2=d2/d1$

Rpm of cutting blade, $N_2= [d1/d_2]\times N_1$

$N_2 = (5/13)*2800$

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N_2 = 1077 rpm

Input Power of Motor:

Efficiency of motor = 85 %

Input power = (output power)/(efficiency)

= (torque *speed/9.55)/(0.85)

= (4.94*1440/9.55)/(0.85)

Input power = 0.876 KW

Chaff Cutter Calculation:

For 1 hour: 200 to 500 Kg

For 1 minute: ((200+500)/2)/60 = 5.8 ≈ 6 Kg

Power consumption for an hour: 0.746 KW

= 0.746 KW × 1 hr = 0.746 KW/hr = 0.746 units

Flour Mill Calculation:

For 1 hour: 20 to 25kg

For 1 minute: ((20+25)/2)/60 = 0. 400kg

Power consumption for an hour: 0.746 unit

6. Design of the machine

The model is design educing Solid works. This model is just an idea made into 3-D, therefore the fabricated one has a lot of changes due to feasibility of the design.

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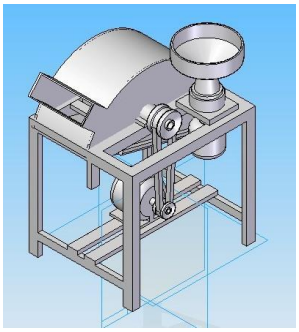

Fig 1. 3D model of proposed project (with casing)

This is the proposed design. The machine frame is made up of rigid mild steel. Based on the design calculations and literature survey following CAD models are made, which is as shown in Fig1. The 3 dimensional view of the proposed project and its blade as shown in Fig 2. The required CAD model was developed using 3-D modelling software (i.e. Solid Edge V18).

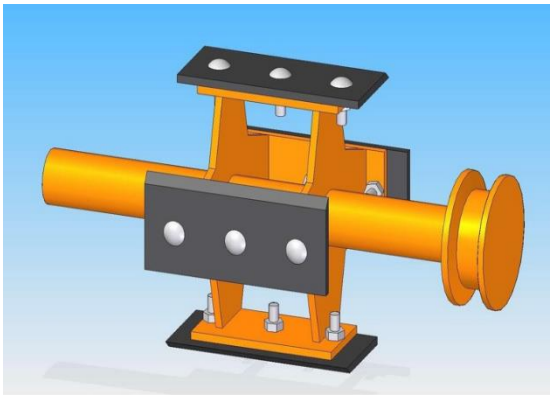

Fig 2. 3D model of cutting blade assembly

7. Machining & Fabrication Processes Undertaken

Machining Processes Undertaken:

The cutting and drilling operations are used to give the shape and dimension. The welding and fasteners are used to join two surfaces together. The finishing operation is used to give the required surface finish to the machine. These operations are discussed briefly below,

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Cutting:

Cutting is a collection of processes wherein material is brought to a specified geometry by removing excess material using various kinds of tools to leave a finished part that meets machine specifications. The net result of cutting two products is the waste or excess material and the finished part.

Drilling Process:

Drilling is a cutting process that uses a drill bit to cut or enlarge a hole in solid materials. The drill bit is a multipoint end cutting tool, which cuts by applying pressure and rotation to the workpiece, which forms chips at the cutting edge. By drilling proper-sized holes in the frame as well as on other components, the parts are assembled with the help of fasteners.

Fasteners:

Fasteners are used to fix the base to the frame, hopper to the base and plumber block to the base. Since the welded joints form permanent assembly, fasteners are used to form temporary assembly. The main advantage of fasteners is that the assembly can be easily dismantled.

Arc Welding Process:

Welding is a fabrication process that joints two metals by causing coalescence. This is often done by melting the workpiece and adding a filler material to form a pool of molten metal that cools to form a stronger joint, with or without pressure in conjunction with heat, or by itself to produce the weld.

Grinding Operation:

Grinding is an abrasive machining process that uses a grinding wheel as the cutting tool. Grinding practice is a large and diverse area of manufacturing and tool making. It can produce very fine finishes and very accurate dimensions. Grinding is a subset of cutting, as grinding is a true metal-cutting process. Each grain of abrasive functions as a microscopic single-point cutting edge. A

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grinding wheel is an expendable wheel used for various grinding and abrasive machining operations. The fabricated model is shown in below Fig 3.

Fig 3. Fabricated Model

8. Components

Chaff Cutter

1. Motor
2. Plummer Block
3. Bearings
4. V-Belt
5. Pulley
6. Shaft
7. Hopper
8. Cutting Blades
9. Supporting Frame

Flour Mil

10. Grain Hopper
11. Stone Burr
12. Power Switch

9. Working principle and procedure

Working Principle: An electric motor drives the main shaft with the help of a belt drive. Pulleys and blades are mounted on the main shaft. The main shaft drives the blade mounted on it. Fodder

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is entered through the hopper to the feeding roller. The feeding roller moves the fodder to the cutting blades. Blades cut the fodder into small pieces and throw the final product through the fodder collector. The Fig 4 shows the view of blade in chaff cutter. We use a good, effective, properly designed closed bag to collect the small pieces of fodder minimizing the possibility of major dust and pieces of fodder explosion.

Fig 4. Inner View of Blade and stone Burr

Working Procedure:

Supply power source to an electric motor: In this machine, we are using a single-phase power supply with a single-phase 1 H.P. motor. The input speed of our electric motor is 2800rpm. To rotate the fodder-cutting blades we have to rotate them by using power drives.

For the Flour Mill, a small 0.5HP motor is attached to the chaff cutter machine to reduce time while changing the belt from the chaff cutting side to the flour mill side. To rotate the stone burr we have to rotate them by using the direct coupling technic.

Power transmission through V belt-pulley drive: Selected a belt & pulley mounted on the shaft as a power drive to transmit the power. This pulley belt arrangement is coupled to cutting blades by using a coupling shaft. Hence rotation of cutting blades occurs.

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Feeding of food material: The feed is fodder through the hopper. The designed fodder provides a guide to fodder and grass materials like dry wheat stalk, corn straw, and grass, which reduce the manual work of the farmer and help to increase fodder production. Fig 5. shows the chopped grass in chaff cutter.

For the flour mill, feeding is done through a hopper from the top end. It will guide the grains towards a stone burr for the grinding purpose.

Fig 5. Finely chopped grass

Collect fodder and powder: When we feed fodder through the hopper, the rotating blades can cut the supplied fodder into small pieces as per requirement and throw them away from the fodder.

In the flour mill, as soon as the grains are grounded, they will fall on the mesh where it is sieved to a fine size and comes out from the outlet of the mill. The Fig 6. shows the grinded rice flour.

Fig 6. Rice Flour

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10. Results and Discussion

To study the performance of newly fabricated machine. The machine is introduced into chaffing work and milling works, under various conditions. Based on performance results, the discussions were made in this chapter. The below Table 1 and Table 2 shows the results of the machines.

Table 1. Experiment on chaff cutter

Wet grass	Kg/Min
Jowar	4
Napier	6
Elephant grass	5

Table 2. Experiment on flour mill

Grains	Kg/Min
Rice	0.450
wheat	0.300
Corn	0.350

1. In this fabricated machine, the human effort consumed is less
2. It can be easily carried from one place to another
3. The fabricated machine can be easily cleaned
4. The fabricated machine is a simple mechanical system, which can be easily repaired and maintained
5. Detail the daily or hourly production capacity of the flour mill and how it compares to expectations
6. Describe the quality of the flour produced, including factors like fineness.
7. The efficiency of the milling process, considering factors such as energy consumption, wastage and milling.

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11. Conclusion

The chaff cutter cum flour mill combines two functions into one machine, offering convenience and efficiency for farmers or small-scale millers. Its conclusion would depend on factors like its performance, cost-effectiveness, durability, and user satisfaction, which could vary based on individual experiences and specific models on the market. In addition to its dual functionality, the chaff cutter cum flour mill may offer benefits such as space-saving design, reduced labour requirements, and potential cost savings compared to purchasing separate machines for cutting chaff and milling flour. However, its effectiveness would also depend on factors like maintenance requirements, power consumption, and the quality of output. Conducting thorough research and considering user reviews would be crucial in determining the overall suitability and value of this machine.

ISBN-978-81-19905-39-3

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ISBN-978-81-19905-39-3

ICEST_ME_015

STRUCTURAL ANALYSIS OF BAMBOO REINFORCED COMPOSITE MATERIAL

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Abstract:

For centuries, wood has been a primary material in global construction. In tropical and sub-tropical regions, bamboo has also played a significant role due to its versatility. In our current climate-conscious era, bamboo has emerged as a vital resource. Its exceptional ability to sequester carbon makes it invaluable in mitigating greenhouse gas emissions and reducing our carbon footprint. Bamboo is a promising building material due to its outstanding tensile strength and impressive weight-to-strength ratio. Natural bamboo can have a tensile strength ranging from 80 to 120 N/mm2, making it an excellent choice for sustainable construction. The objective of this research is to enhance the tensile strength of bamboo through mechanical methods. The composite material is created by bundling bamboo fibers using geofabric thread, along with an appropriate epoxy resin (LY 556) and hardener (HY 951). The study also investigates the impact of various threading patterns on the formation of bamboo fiber composites. The results indicate that closely spaced threading patterns yield superior results compared to other threading patterns. This process effectively increases the tensile strength of bamboo composite materials by 57% to 100%.

Key Words: Bamboo fiber, Epoxy Resin, Hardener, Tensile Strength.

1. Introduction

The most widely used fibers for composite manufacturing are generally manufactured with non-renewable resources, including carbon, steel, glass, and polymer materials. The manufacturing of these traditional fibers can lead to concerns about unsustainable development and environmental

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pollution. To resolve these issues, the researchers are considering replacing traditional fibers with renewable plant fibers for composite reinforcement. Apart from its sustainability, low weight, wide availability, and biodegradability, plant fibers have comparable or superior mechanical performance compared to that of the commonly used fibers, including high vibration absorption capability , high fracture toughness , high specific strength, and high flexibility. All these properties indicate that plant fibers can be utilized as a potential alternative to traditional fibers. Bamboo fiber, in particular, has relatively greater mechanical strength among all plant fibers.The tensile strength and modulus of the bamboo fibers can reach 600 MPa and 46 GPa, respectively. In contrast, the elongation, the tensile strength, and Young's modulus of single bamboo fiber are superior to some other plant fibers such as bagasse, flax, and coir So embedding bamboo fiber into cement and resin as reinforcement has various application prospects. Bamboo fiber can be used as a viable substitute for glass and polymer fiber as well as a green and sustainable fiber reinforcement. Furthermore, the use of bamboo fiber in building materials reduces the carbon footprint.

Studies on short bamboo fibers and their composites have widely been conducted and showed that the short bamboo fiber as a reinforcing material could significantly enhance the tensile and impact strengths of composites. Bamboo species, fiber content, extraction methods, modification treatments, matrix type, and fiber–matrix interface affect the reinforcing performance. However, the related investigation on long plant fibers is relatively limited. Previously, it was found that unidirectional long fiber reinforcement is essential to fully utilize its strength capacity. More research into high-performance long bamboo fiber-reinforced composites is required. Therefore, this review paper focuses on evaluating the characteristics of long bamboo fibers and their composites. These characteristics are essential for the effective design and use of fiber-reinforced composites. This study begins with a multi-scale structure of the bamboo fiber prior to reviewing its cell wall structure.

A summary of the mechanical properties of long bamboo fiber composites is then provided. In addition, water absorption and fire retardancy of bamboo fiber composites are reviewed, followed by bamboo fiber-based cement and concrete composites. Lastly, the mechanical and interfacial bonding compatibility of bamboo fiber-reinforced composites is comprehensively reviewed. The review finishes with some concluding remarks and suggestions for future works.

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The studies by Khan, Yousif, Chandra Mohan, and Yanglun and Huang all investigate the properties of bamboo and natural fiber-reinforced composites, focusing on enhancing mechanical performance through different treatments and material combinations. Khan and Yousif's research on bamboo fiber-reinforced epoxy composites determined that treating fibers with 6% NaOH significantly improved tensile strength and interfacial adhesion, confirmed through experimental and Finite Element Analysis (FEA) using ABAQUS. Chandra Mohan's study tested natural fiber particle-reinforced polymer composites under ASTM standards and found that hybrid composites outperformed single fiber glass-reinforced composites in terms of tensile, flexural, shear, and impact strength in both moist and dry conditions. Yu and Huang's research on bamboo fiber bundle-reinforced composites (BFCs) highlighted a significant enhancement in strength and modulus due to high densification achieved by filling intercellular spaces and cell cavities with phenol-formaldehyde resin, resulting in mechanical properties that were more than double those of raw bamboo. Overall, these studies underscore the importance of fiber treatment and composite structure in optimizing the mechanical properties of bamboo and natural fiber-reinforced composites.

The articles by Bahrum Prang Rocky, Kai Zhang, Fuli Wang, and Jyun-Kai Huang and Wen-Bin Young explore various aspects of bamboo fiber production and the enhancement of bamboo fiber-reinforced composites. Rocky’s research emphasizes the complexity of producing high-quality spinnable bamboo fibers, highlighting the necessity of combining mechanical, chemical, and enzymatic processes, including delignification treatments, to achieve fibers suitable for spinning. Zhang’s study confirms the effectiveness of treating bamboo fibers with 6 wt.% NaOH, significantly improving the flexural, fracture, and thermal properties of bamboo fiber-reinforced epoxy composites. Wang investigates bamboo's tensile properties and radial organizational structure, demonstrating how its multi-layered composite structure at different scales—microscopic, miso, and macroscopic—contributes to its superior mechanical properties and functionally graded material characteristics. Huang and Young examine the mechanical and interfacial strength of continuous bamboo fiber-reinforced epoxy composites, showing that alkali treatment, despite reducing fiber strength, improves tensile strength due to enhanced interfacial bonding between the fibers and epoxy resin. Collectively, these studies underscore the importance

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of treatment methods and structural analysis in optimizing bamboo fiber properties for composite applications.

The studies by P. Lokesh, Kong Fah Tee, Nabanita Banik, Kefei Liu, and Assima Dauletbek collectively highlight the diverse applications and properties of bamboo fiber composites. Lokesh's research focuses on the mechanical properties of bamboo fiber-reinforced polymer composites, noting that while NaOH-treated fibers enhance tensile, flexural, and impact strength, too many fibers can reduce mechanical properties due to poor bonding with the matrix. Tee's study emphasizes the improved physical-mechanical properties of bamboo fibers treated with a 10% NaOH solution, which significantly enhances tensile strength, making them suitable for various applications traditionally dominated by synthetic fibers. Banik explores the industrial potential of bamboo composites as eco-friendly alternatives to hardwood, suggesting that bamboo's strength and stiffness make it a viable substitute in structural applications, reducing reliance on timber resources. Liu investigates bamboo fiber's performance as reinforcement in asphalt mixtures, highlighting its crack resistance and reinforcing capabilities. Lastly, Dauletbek reviews laminated bamboo lumber (LBL), noting that while LBL's environmental performance is lower than conventional materials like wood and plywood, it remains a valuable material for structural applications due to its mechanical properties. Collectively, these studies underscore bamboo's versatility and potential as a sustainable, high-performance material in various engineering and industrial applications.

2. Material used

2.1 Natural Bamboo Fiber

Bamboo fiber is a natural material derived from bamboo plants as shown in Figure 1.

Figure 1: Natural bamboo fiber

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Bamboo is a fast-growing and renewable resource, holds significant cultural, economic, and environmental importance in India. This report explores the diverse range of bamboo species native to India, their characteristics, and their various applications.

2.2 Epoxy Resin (Ly 556) And Hardener (Hy 951).

For the study LY556 (HERENBA BRAND) epoxy, cobalt polyester and HY951 Hardener was used in this research as shown in Figure 2.

Figure 2: Epoxy resin and hardener

Epoxy resin LY 556 is a versatile, high-performance material widely used in industrial and commercial applications. It's known for its strong adhesive properties, excellent chemical resistance, and durability. LY 556 is commonly used for bonding, coating, encapsulating electronic components, and creating composite materials.

Hardener HY 951 is typically used in conjunction with epoxy resin LY 556 to initiate the curing process. It's designed to react with the epoxy resin to form a strong, durable bond. HY 951 hardener can influence the curing time, viscosity, and final properties of the epoxy resin system, making it crucial to achieve the desired performance characteristics for specific applications.

2.3 Geofabric Thread

Designed to withstand heavy loads, environmental stress, and mechanical strain, making it suitable for applications like geotextiles, landscaping, and construction. Geofabric thread is a specialized type of thread used in geotextiles for various civil engineering and environmental applications. It's

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typically made from synthetic materials like polyester or polypropylene, which offer durability and resistance to environmental factors like moisture, chemicals, and UV radiation. This thread is designed to provide strength and stability to geotextile fabrics used in construction projects such as roadways, retaining walls, erosion control, and landscaping. It enhances the overall performance and longevity of geotextile products by ensuring they can withstand the stresses and pressures of the environment they're placed in.

2.4 Preparation of Bamboo Fibre Rod

The process begins by crafting bamboo rods with varying diameters of 6mm, 8mm, and 10mm. These rods are meticulously prepared to ensure uniformity and structural integrity. Once fabricated, the rods undergo a tensile test, a critical procedure that evaluates their mechanical properties under tension. To prepare bamboo sticks for construction, begin by selecting straight and uniform sticks of the desired length and thickness. Clean them thoroughly to remove any dirt or debris, and allow them to dry completely to prevent moisture retention. This drying process is crucial in preparing the bamboo sticks for use. Once dried, apply a layer of resin evenly over the surface of the bamboo sticks using a brush or roller, ensuring complete coverage to enhance the strength and durability of the sticks. Next, wrap geofabric thread around the resin-coated bamboo sticks in a spiral pattern, ensuring that the wrapping is tight and uniform to provide additional reinforcement. Finally, allow the resin to cure fully to ensure the bamboo sticks are ready for use in construction. The process involved is depicted in Figure 3 to Figure 5.

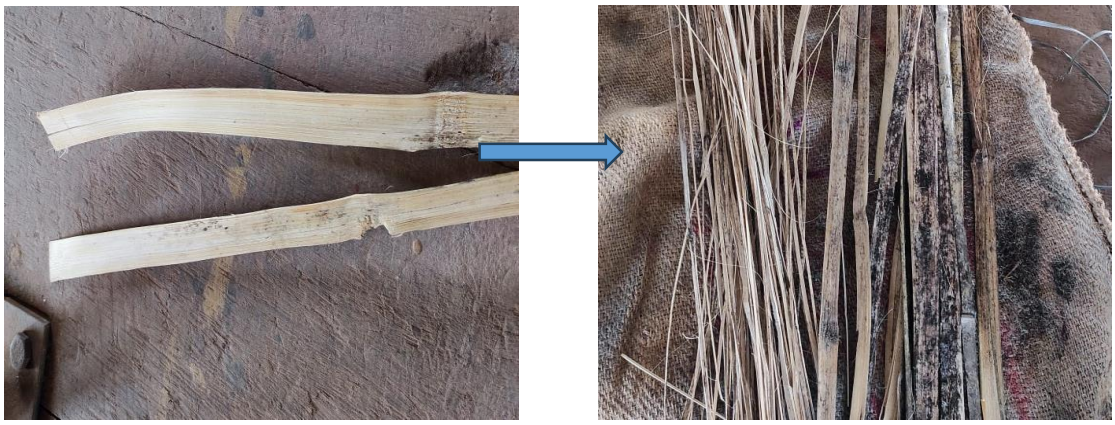

Figure 3: Preparation of Bamboo into thin Sticks

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(a) (b)

Figure 4: Resin and Hardener mixing

(a) (b)

Figure 5: Preparing Threads

3. Results and Discussions

3.1 Tensile Strength Test

The tests on both composite and regular bamboo using a Universal Testing Machine (UTM) following IS: 1786 standards.

CASE-1

The tensile stress of normal bamboo rods with varying diameters was investigated, as detailed in Figure 6. The rods tested had diameters of 6 mm, 8 mm, and 10 mm. The results showed

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that the tensile stress experienced by these bamboo rods was relatively consistent across different diameters, with a slight variation.

Figure 6: Normal Bamboo Rod

Table 1: Normal bamboo rod Tensile stress result

Thread Pattern	Diameter in mm	Tensile stress in N/mm^2
Normal Bamboo	6mm	98 N/mm^2
Normal Bamboo	8mm	97 N/mm^2
Normal Bamboo	10mm	101.3 N/mm^2

The tensile stress values in Table 8.1 indicate that normal bamboo rods, regardless of diameter, have a tensile stress close to 100 N/mm^2. This suggests that bamboo's inherent material properties offer consistent strength across different sizes.

CASE -2

The tensile stress of close thread bamboo rods with diameters of 6 mm, 8 mm, and 10 mm was analyzed. The results demonstrated a variation in tensile stress values depending on the rod diameter.

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Figure 7: close thread Bamboo Rod

The tensile stress of normal bamboo fiber rods with varying diameters was investigated, as detailed in (Fig. 8.4).

Table 2: Close Thread bamboo fiber Tensile stress result

Thread Pattern	Diameter in mm	Tensile stress in N/mm^2
Close Thread	6mm	162 N/mm^2
Close Thread	8mm	159 N/mm^2
Close Thread	10mm	102 N/mm^2

The tensile stress values in Table 2. Indicate that close-thread bamboo rods exhibit higher tensile stress at smaller diameters (6 mm and 8 mm), with a noticeable decrease at a diameter of 10 mm. This variation suggests that the threading pattern influences the mechanical properties of bamboo rods, with smaller diameters providing higher tensile strength

CASE -3

The tensile stress of helical pitch thread bamboo fiber rods with diameters of 6 mm, 8 mm, and 10 mm was examined. The results indicated a significant variation in tensile stress depending on the diameter of the rod (Figure 8).

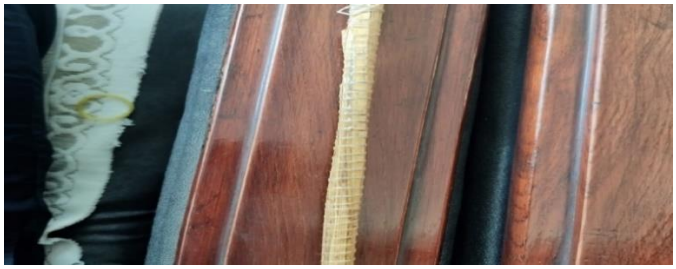

Figure 8: helical pitch thread Bamboo Rod

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Table 3: Helical Pitch Thread bamboo fiber Tensile stress result

Thread Pattern	Diameter in mm	Tensile stress in N/mm^2
Helical Pitch Thread	6mm	207 N/mm^2
Helical Pitch Thread	8mm	132 N/mm^2
Helical Pitch Thread	10mm	98.4 N/mm^2

The tensile stress values in Table 3. show that helical pitch thread bamboo rods have the highest tensile stress at a diameter of 6 mm, which decreases significantly as the diameter increases to 8 mm and 10 mm. This suggests that the helical pitch threading pattern enhances the tensile strength more effectively in smaller-diameter rods.

CASE -4

The tensile stress of reverse helical pitch thread bamboo rods with diameters of 6 mm, 8 mm, and 10 mm was investigated. The results revealed varying tensile stress values depending on the diameter of the rod.

Figure 9: Reverse helical pitch thread bamboo rod

Figure 9 provides a visual representation of the reverse helical pitch thread bamboo rods used in the study

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Table 4: Reverse Helical Pitch Thread bamboo fiber Tensile stress result

Thread Pattern	**Diameter in mm**	**Tensile stress in N/mm^2**
Reverse Helical Pitch Thread	6mm	173 N/mm^2
Reverse Helical Pitch Thread	8mm	133 N/mm^2
Reverse Helical Pitch Thread	10mm	108 N/mm^2

The results (Table 4) showed that the tensile stress values varied across different diameters of the rods. Specifically, the tensile stress decreased as the diameter of the rod increased, with the highest stress observed in the 6 mm diameter rod (173 N/mm²), followed by the 8 mm diameter rod (133 N/mm²), and the lowest stress in the 10 mm diameter rod (108 N/mm²).

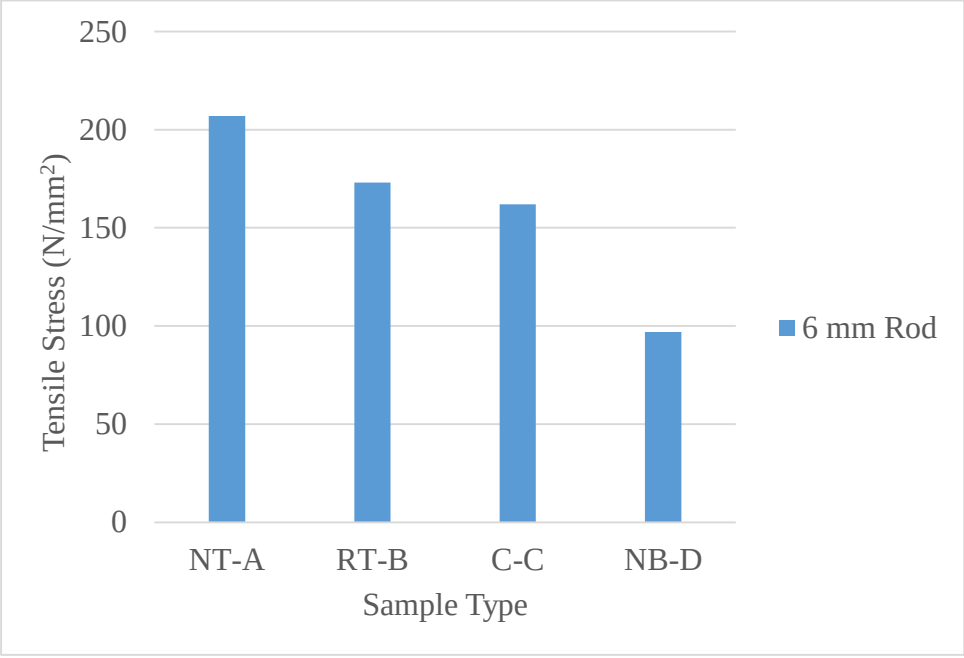

Figure 10: Tensile stress characteristics of 6mm diameter rods

The above Figure 10 tensile stress characteristics of 6mm diameter rods which consists of tensile stress versus different patterned bamboo rods. Horizontal axis of the chart lists the various types of rods being compared, while the vertical axis shows the tensile strength values.

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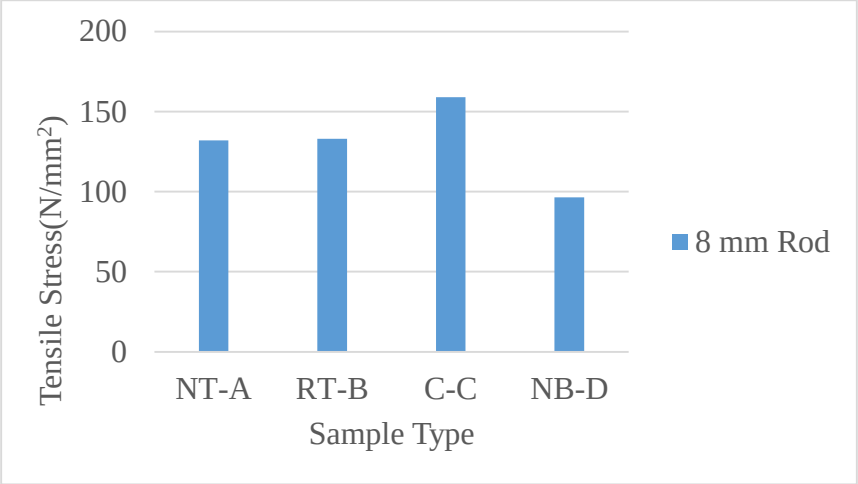

Figure 11: Tensile stress characteristics of 8mm diameter rods

The above Figure 11 tensile stress characteristics of 8mm diameter rods which consists of tensile stress versus different patterned bamboo rods. Horizontal axis of the chart lists the various types of rods being compared, while the vertical axis shows the tensile strength values.

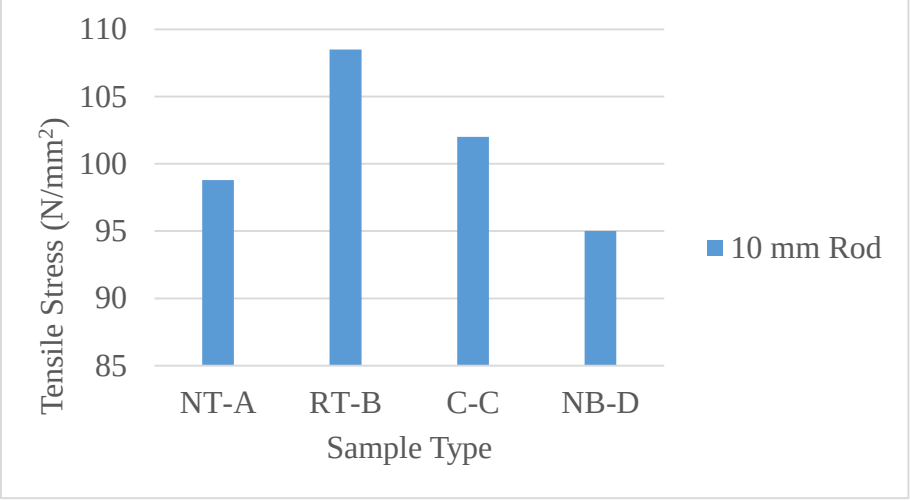

Figure 12: tensile stress characteristics of 10mm diameter rods

The above Figure 12 tensile stress characteristics of 8mm diameter rods which consists of tensile stress versus different patterned bamboo rods. Horizontal axis of the chart lists the various types of rods being compared, while the vertical axis shows the tensile strength values

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3.2 Comparison of Normal Bamboo and Composite Bamboo Fiber Rods

The study illustrated in Figure 13 demonstrates that composite bamboo fiber rods have significantly higher tensile strength compared to regular bamboo samples. Regular bamboo showed an average tensile strength of 60-100 MPa, whereas composite bamboo fiber rods exhibited a tensile strength of 120-180 MPa. This indicates that composite bamboo is stronger and more suitable for load-bearing and durable applications in construction and manufacturing.

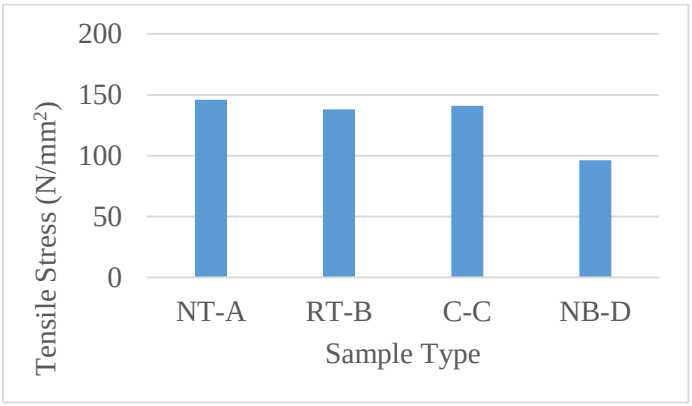

Figure 13: Normal bamboo and Composite bamboo fiber rods

3.3 Flexural Strength Test-Concrete Beam

The below figure 14 shows the flexural strength of the sample tested. The results indicate the effectiveness of Composite Bamboo Reinforcement (CBR) in enhancing the flexural strength of concrete beams. The beam with normal bamboo reinforcement (BRB) exhibited an 8% increase in flexural strength compared to the plain concrete beam (NB). In contrast, the beam with composite bamboo reinforcement (CBRB) showed approximately a 20% increase in flexural strength.

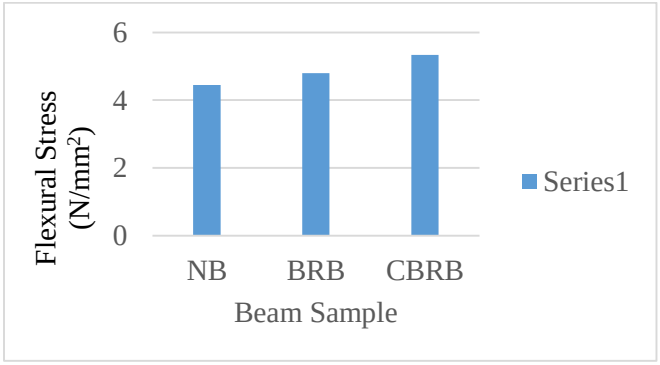

Figure 14: Flexural strength test-concrete beam

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4.0 CONCLUSION

The present study demonstrates the superior performance of Composite Bamboo Reinforcement (CBR) over regular bamboo reinforcement in both tensile and flexural strength applications.

Tensile Strength Comparison:

- Regular Bamboo: Exhibited an average tensile strength of 60-100 MPa.
- Composite Bamboo Fiber Rod: Showed a significantly higher tensile strength of 120-180 MPa.
- Implication: Composite bamboo is considerably stronger than regular bamboo, making it more suitable for load-bearing and durable applications in construction and manufacturing.

Flexural Strength Enhancement:

- Normal Beam (NB): Baseline flexural strength.
- Beam with Regular Bamboo Reinforcement (BRB): Displayed an 8% increase in flexural strength compared to the normal beam.
- Beam with Composite Bamboo Reinforcement (CBRB): Achieved approximately a 20% increase in flexural strength over the normal beam.

These findings confirm that Composite Bamboo Reinforcement (CBR) not only significantly enhances the tensile strength of the material but also improves the flexural strength of concrete beams more effectively than regular bamboo reinforcement. Therefore, CBR is a promising material for use in construction and other structural applications, offering improved performance, durability, and load-bearing capacity.

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ISBN-978-81-19905-39-3

ICEST_ME_016

DESIGN AND FABRICATION OF TILTING SOLAR PANEL

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Abstract:

Solar energy is rapidly advancing as an important means of renewable energy resource. Solar tracking enables more solar energy to be generated because the solar panel is able to maintain a perpendicular profile to the sun's rays. Though initial cost of setting up a solar tracking system is high, this project report proposes a cheaper solution. Design and construction of a prototype for solar tracking system with single degree of freedom, which detects the sunlight using Light Dependent Resistors (LDR) is shown in report. Tilting solar panel is done for improving the efficiency of the PV panel output power using stepper motor-controlled tracking system. Solar energy is rapidly becoming an alternative means of electricity source. This is a system that controls the movement of a solar array so that it is constantly aligned towards the direction of the sun. The prototype is designed using Arduino microcontroller which controls the tracking system by communicating with the LDR's and stepper motor driver based on the movement of the solar radiation. The performance and characteristics of solar tracker system is monitored and compared with the conventional method.

Key Words: Solar energy, solar radiation, Light Dependent Resistors.

ISBN-978-81-19905-39-3

1. Introduction

In solar thermal technology, solar energy is harnessed into thermal energy for domestic and/or commercial applications such as drying, heating, cooling, cooking, etc. However, on the industrial scale, concentrated solar thermal (CST) technologies are being used to fulfil such heating requirements while concentrated solar power (CSP) technologies are being employed to generate electricity. Maximum power point tracking (MPPT) controllers play an important role in photovoltaic systems. They maximize the output power of a PV array for a given set of conditions. Saleh et al. [1] presents an overview of the different MPPT techniques. Each technique is evaluated on its ability to detect multiple maxima, convergence speed, ease of implementation, efficiency over a wide output power range, and cost of implementation. Programmable Logic Controller (PLC) solar panel tilting system is designed and proposed by Krishnamoorthi et al. [2]. By using this system, we can obtain uniform and higher power generation when compared to solar panels placed in fixed position. Solar panel frame is majorly affected by the various factors such as wind force, rain, fog etc., among them the major factor affecting the solar panel frame is the high wind force. Generally various frame structures are designed and analyzed by subjecting it against various wind force to select the suitable frame structure which withstands for maximum wind force with less deflection. Design and construction of a prototype for solar tracking system with single degree of freedom, which detects the sunlight using Light Dependent Resistors (LDR), is discussed by Ankit et al. [3]. The control circuit for the solar tracker is based on an ATMega16 microcontroller. This is programmed to detect the sunlight through the LDRs and then actuate the stepper motor to position the solar panel where it can receive maximum sunlight. Compared with any other type of motor, the stepper motor is more controllable, more energy efficient, steadier and has high tracking accuracy and suffers little environmental effect. Theoretical analysis and research results have been shown in this paper to advocate that the designed system realized precise automatic tracking of the sun and can greatly improve the utilization of solar energy.

2. Experimental Procedure

Tilting solar system: The working of the system is illustrated through the above block diagram. The block diagram (Fig. 1) is divided into two parts. The first part is the tracking section. The

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second part is the converter and inverter section. In the block diagram of the tracking section, the first block is Light Dependent Resistor. It is connected to the Arduino microcontroller board.

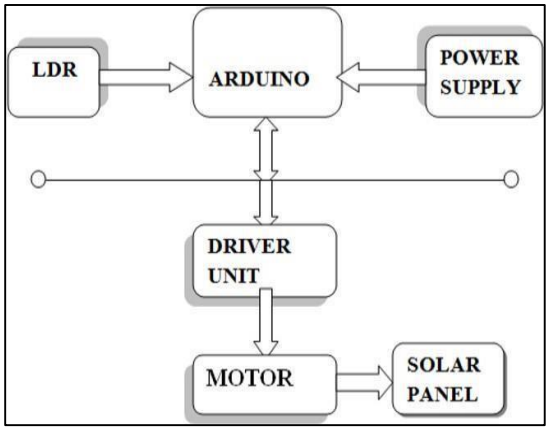

Fig. 1: Block diagram of tracking section

The controller is interfaced with driver unit for driving the stepper motor. Depending on the signals from the LDR the motor rotates either in clockwise or anti-clockwise direction. Three LDR's are used in which one LDR is permanently mounted in east direction. The other one LDR's are fixed in a straight line or at the center and another one is mounted in the west direction such that depending on the intensity of each LDR the stepper motor rotates the panel in counterclockwise direction. When the sun is in east direction the first LDR senses the light that will have high intensity compared to other two LDR's. At that time the panel is rotated in clockwise direction and braking operation is performed when second LDR intensity goes high compared to first and third LDR. The panel is rotated from west to east during sunrise depending on the intensity of first LDR. The data from the LDR are collected and according to that data the stepper motor is made to rotate all this is done by the microcontroller called arduino. The arduino is programmed in such a way that it has to compare the LDR's and the motor is to be rotated accordingly. The flowchart of the programme is given below.

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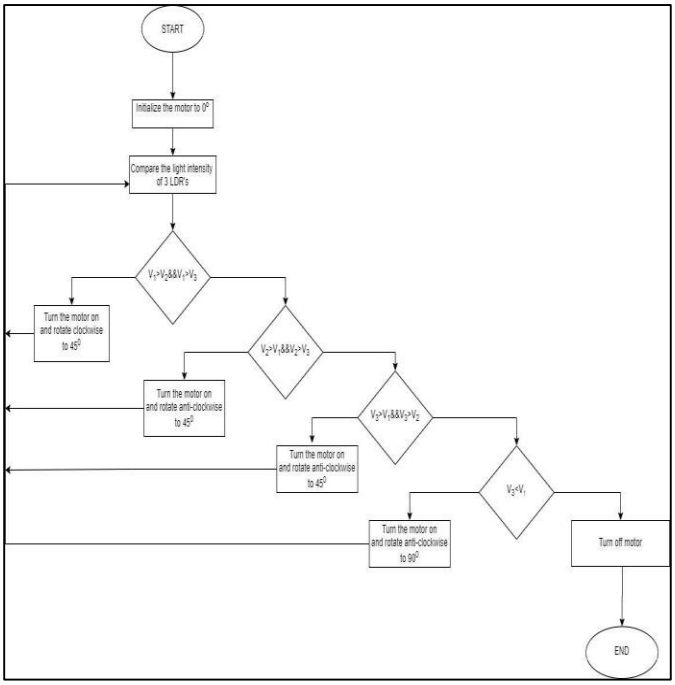

Fig 2 polycrystalline PV panel

The polycrystalline PV panel will efficiently collect the solar radiation and convert into electric current. This electric power is collected and stored in a lead acid battery with the help of solar charge controller. The solar charge controller has a small inbuilt inverter which will also help to convert the DC current which is produced by the solar panel and stored in battery into AC current for the load or for other external use.

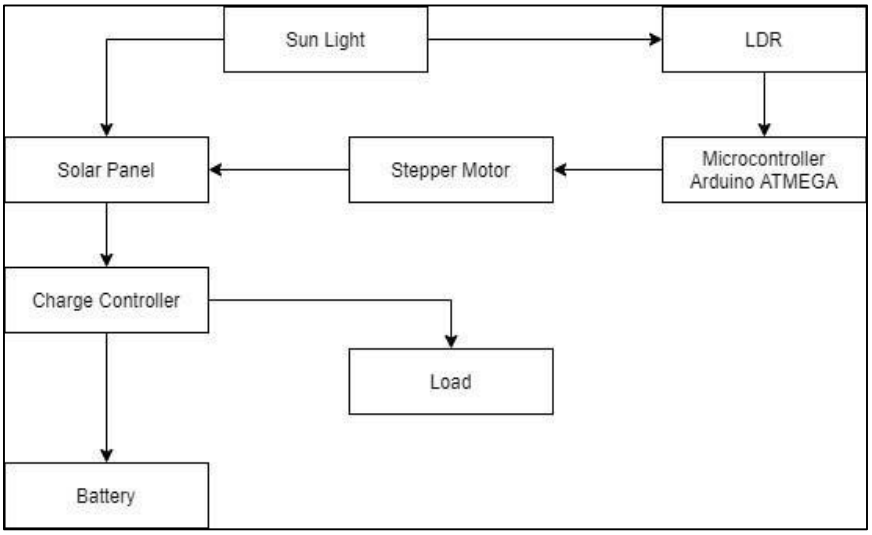

Fig. 3: Overall block diagram of tilting solar panel

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Results and Discussion

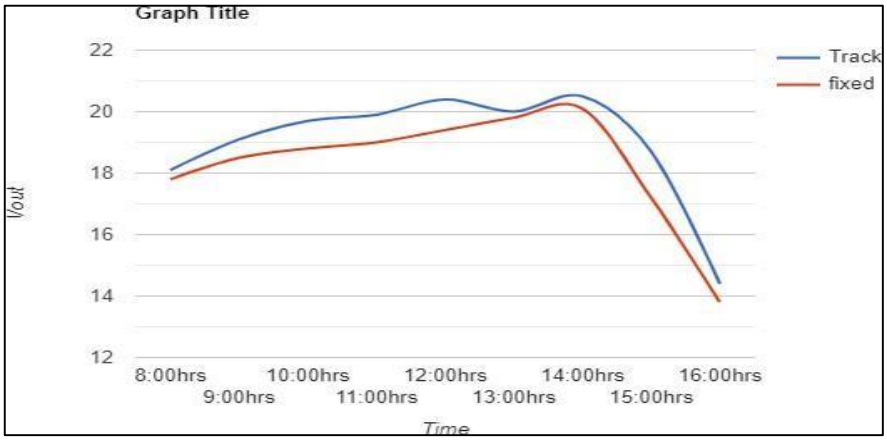

Fig. 17: Comparison of Voltage O/P between fixed solar panel and tilting solar panel

The above line graph representation in Fig 17shows comparison between output voltage of a fixed solar panel and a tracking solar panel at every 1hrs interval shown on X-axis and Vout in volts on the Y-Axis

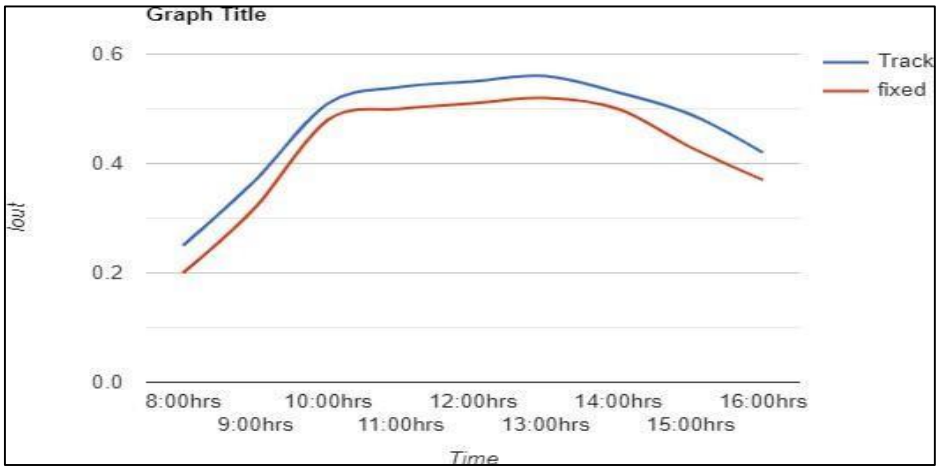

Fig. 3: Comparison of Current O/P between fixed solar panel and tilting solar panel.

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The above line graph representation in Fig 18shows comparison between output current of a fixed solar panel, and a tracking solar panel, at every 1hrs interval shown on X-axis and Iout in Amperes on the Y-Axis.

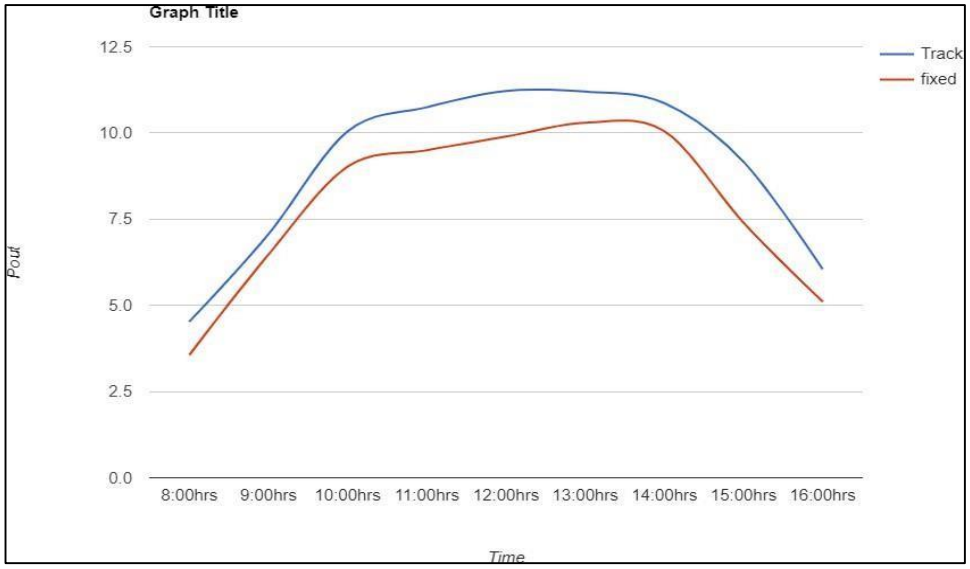

Fig 3 Comparison of Pout between fixed solar panel and tilting solar panel

The average increase in percentage of power output is = 14.78%. So that we are able to obtain almost 30% power output from the tracking solar system. While comparing to the fixed solar system an increase of almost 15% of power out was achieved [4-5].

Conclusion

From our research we were able to come up with many important conclusions and suggestions which will profit the future advancement of solar system. From our results we were able to recommend new design aspects to improve the system and efficiency. Inefficient solar radiation was the huge impact getting the required power output because of the monsoon season.

Implementation of stepper motor-controlled tilting solar panel is an efficient and feasible means of obtaining optimal solar energy from the sun. By constantly aligning the photovoltaic panel with the sun, it directly receives sunlight falling on its surface thereby utilizing maximum energy. The design and construction of Stepper motor controlled solar tracking system implemented is capable of tracking the maximum intensity of light. The power producing ability

ISBN-978-81-19905-39-3

is not restricted to the angle of sun rays on the panel.Also it is easy to maintain and installed in remote or dusty or rainy place to develop electrical energy or to produce heat energy for different applications.

It is clear that the solar tracking system plays an important role to guarantee the maximum solar energy generation from dawn until dusk. As solar power production is used in large scale worldwide so, even an increment in efficiency by 1% than stationery plane will increases the net power production by large amount. Hence, no matter by how much tracker increases efficiency it is always welcomed.

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ISBN-978-81-19905-39-3

ICEST_ME_017

INVESTIGATING ON THE INFLUENCE OF BORON CARBIDE REINFORCEMENT ON Al-2014-B_4C METAL MATRIX COMPOSITE FOR AEROSPACE APPLICATION

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Abstract:

The experiment aimed to assess how incorporating B4C reinforcement affects various properties of Al-2014 alloy, including hardness, tensile strength, compressive strength, and wear resistance of these composites. These aluminum metal matrix composites, whether with single or multiple reinforcements, are gaining traction across aerospace, automotive, space, marine, and transportation sectors. The study focused on analyzing the properties of these composites by adding varying proportions of boron carbide to the Al-2014 matrix through stir casting. K_2TiF_6 was introduced as a wetting agent during fabrication. Examination of the fabricated AMCs through SEM and EDS revealed a uniform dispersion of B4C particles within the matrix. The analysis of hardness indicated a positive correlation with increased reinforcement levels. Similarly, tensile and compressive strengths exhibited enhancement with higher B4C reinforcement levels.

Key Words: B4C, Reinforcement, Stir Casting.

ISBN-978-81-19905-39-3

I. Introduction

Traditional monolithic materials, such as metals and their alloys, ceramics, or polymeric materials, are unable to meet certain requirements, such as the high combination of quality, solidity, sturdiness, and thickness needed in the majority of the current creative applications. As a result, this has become a notable obstacle to their widespread usage in a variety of applications, such as high temperatures and various conditions, such as erosive and corrosive media. It is necessary to develop new materials in order to address these deficiencies and the constantly growing demand for cutting-edge innovation for superior materials. This is crucial because basic materials typically have low densities, sensibly improved quality, are solid, scraped spot and impact-safe, stable at high temperatures, and are not easily ingested. These materials are being used increasingly prominently in the aviation, power generation, and sports games industries. [1]

II. Composite Materials

A. *Matrix*

The matrix material serves as the reinforcement's connector, shield, and aids in efficiently transferring load from the reinforcement [1]. The selection of the matrix is based on the wettability, reactivity, application, and processing method used to create the composite. The matrix should typically be lightweight to reap the full benefits from the reinforcements concerning the characteristics. While ceramic creations have excellent bore and quality but are weak, metals generally offer stability and quality with reasonable adaptation.

B. *Reinforcement*

The stage of reinforcing delivers updated features, such as quality and solidity. The support is stiffer, more grounded, and tougher all around than the matrix. Typically, fibres or other particulates serve as reinforcement [2]. Estimates for particle composites are typically proportional in both directions. The reinforcing particle could be spherical, plate-shaped, or have another typical or peculiar geometric shape.

C. *Interface*

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The interface is a retaining surface or area where a defect occurs, irrespective of whether mechanical, physical, compound or others. It possesses qualities that are not represented in either of the pieces taken separately. For a composite to have desirable qualities, the linked load must be successfully transferred from the matrix to its filaments via the interface. This indicates that the interface between the matrix and the filaments must be wide and exhibit a strong grip. The fibre must be "wet" by matrix material to achieve this. "Wetted" filaments increase the surface area of the interaction all around. Sometimes, coupling specialists are utilised to improve wettability.

Classification of Composites

The composites are additionally divided into the following classes [3] based on the matrix material:

A. Polymer matrix Composites (PMCs)

Polymer Matrix Composites are known as FRP - Fiber Reinforced Polymers (or simply Plastics). These materials use a sap made of polymers as the matrix and a variety of strands for reinforcement, including glass, carbon, and aramid.

B. Metal matrix Composites (MMCs)

Metal Matrix Composites primarily find their uses in the fields of aeronautics and even the automobile industry. These materials may be made from a metal, such as aluminium, as the grid and infused with fibres, shards, or particles, such as silicon carbide.

C. Ceramic matrix Composites (CMCs)

Fired or ceramic Matrix Composites are utilized in the components that are employed in a high-temperature environment. These materials, like those constructed of boron nitride and silicon carbide, utilise an inventive network to strengthen them with small strands or flourishes.

D. Metal Matrix Composites (MMCs)

The name implies that the matrix is a substance because of MMCs. Compared to their base metal counterparts, these materials can be used at substantially higher operating temperatures.

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Additionally, the reinforcement may improve dimensional stability, scraped area resistance, particular robustness, and quality. These materials' advantages versus polymer matrix composites include things like higher operating temperatures, incombustibility, and greater resilience to deterioration by natural liquids.

E. Aluminum Metal Matrix Composites (AMMCs):

Aluminum is frequently employed as a matrix material because of its low weight, high strength, great resistance to wear, high melting point, relatively simple for making composites, and its availability in abundance. AMMCs have been processed using aluminium alloys that consist of aluminum-magnesium-silicon, aluminum-silicon, aluminum-zinc-magnesium, aluminum-copper, as well as aluminum-copper-magnesium.

III. Literature Survey

These study based on the ISI database by searching for the terms metal matrix composites, titanium-based composites, iron-based composites, magnesium-based composites, aluminum-based composites, lead-based composites, etc. This revealed that 2109 papers on aluminum-based composites (AMC) out of a total of 4,210 (roughly) publications on MMCs. Similarly, almost 150 of the approximately 275 patents on MMCs include a connection to AMMCs. In recent decades, metal matrix composite has drawn more attention as a building material. A composite material is produced by presenting ceramic components into a metal matrix. This material has an attractive combination of physical and mechanical qualities [4–14] that cannot be achieved with solid alloys. Compared to solid alloys, MMCs offer better qualities at elevated temperatures, reduced thermal extension, and improved wear resistance. They additionally possess higher strength-to-thickness and solidness-to-thickness proportions. Because of their wide range of custom-made physical, mechanical, and tribological qualities, metal matrix composites offer a lot of potential for use in aircraft and vehicle applications [15]. A few scientists have studied the characteristics of metal matrix composites using the matrix materials copper, magnesium, and aluminium.

Baradeswaran et al., [16]studied the hybrid Al7075-Al2O3-Graphite composites' mechanical and wear characteristics. The experiment demonstrates the possibility of graphite

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consolidation in the composite for minimizing wear. Liquid metallurgy was used to create the composites. The Al 7075-Al2O3-Graphite mixed composite was constructed using 2, 4, 6, and 8 wt.% Al2O3 and 5 wt.% graphite expansion. It has been found that the increased weight rate of the clay stage expands the hardness, flexibility, flexural quality, and weight quality of mixed composites. The wear characteristics of the graphite-containing half-breed composites demonstrated their unmatched wear resistance qualities.

Suresh et al., [17]announced the mechanical and wear behaviours of the blended cast Al-TiB2 composites. By using the blend casting technique, Al6061-TiB2 composites were created. Investigations were conducted into mechanical behaviours such as hardness, elasticity, and tribological behaviour. As the TiB2 content in the Al6061 alloy grew, the mechanical characteristics also increased. TiB2-reinforced composites had improved wear resistance.

Rajmohan et al., [18]specialised in the mechanical and wear characteristics of composites with aluminium and other metals. A356 alloy composites strengthened with mica and SiC particles were created using the mix casting technique. Investigations were done on the mechanical and wear characteristics of cross-breed composites. Al-10SiC-3 Compared to base alloy, mica half-breed composites had better mechanical and wear performance.

IV. Problem Definition

The mechanical characteristics for Al2014 reinforced using Boron Carbide particles have been prepared, characterised, and evaluated in our current work reveals. This has been done using stir-casting techniques.

The following are the work's main objectives.

A. This involved the synthesis of Al2014- B_4C metal matrix composites using the stir casting method, and the weight percentage of B_4C was varied in steps of 0g, 30g, 60g, and 90g for 1000g of Al2014.

B. Three-step addition of reinforcement increases the incubation period by improving hardness.

C. SEM and optical microscopy analysis of the mentioned composites to determine the uniformity of the particle dispersion in the matrix.

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D. A few of the mechanical qualities that are employed, such as ultimate tensile strength, hardness, percentage elongation, and compression strength, are evaluated.

V. Methodology

By using a stir casting technique, fluid metallurgy fabricated Al2014- B_4C composites.A cast press in consistent form is one of the fundamental components that make form the throwing technique, an impeller made of steel covered in zirconium, and an electrical resistance heater. Here, an electrical heater with a 60kw power rating will be used. Here, a temperature threshold of 1200 degrees Celsius is used as the highest possible. To survive high temperatures and prevent the passage of ferrous particles into the Al2014 compound breakdown, zirconium will be utilised to cover the mechanical stirrer being used to blend the liquid mixture during the preparation of composites.

The impeller was rotated at a speed of 300 rpm while being lowered to a depth of 60% of the height required to allow the metallic liquid to liquefy. B4C nanoparticles that have been preheated in a heater that reaches 500 °C will do this before entering the vortex. Stirring continues until wetness results from the interactions between the matrix with fortification particle interfaces. At that point, the Al2014-0, 3, 6, as well as 9 weight percent B4C mixture, is added into a permanent cast iron framework that is 125mm long and 15mm in diameter. The test composites' microstructural examination was finished using optical and scanning electron microscopy. Samples from the casting are thoroughly cleaned and cut into a diameter of approximately 10 mm. Samples are scratched with Keller's reagent. Additionally, in accordance with ASTM standards, pressure strength, yield strength, ultimate stiffness, and degree of hardness are evaluated based on microstructural factors.

VI. Experimental Setup

A. Aluminium-2014 alloy

Due to its low thickness, excellent isotropic mechanical qualities, outstanding erosion resistance, and affordable price, aluminium alloys are chosen as a framework. Due to its excellent quality, weldability, consumption resistance, susceptibility to stresses and erosion splitting, and warm

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treatability, 2014 is an aluminium composite that is typically used for auxiliary applications. Framing promotes quality expansion at the expense of significantly lessened pliability.

Table 1: Chemical composition of Al 2014

Components	Al	Si	Fe	Cu	Zn	Mg
Amount (wt %)	Balance	1.2	0.7	3.9	0.25	0.8

B. Reinforcements

One of the known hardest materials is boron carbide, ranking third in hardness after precious stones like cubic boron nitride. This material is considered to be one of the toughest things and is produced in tonnes. Borosilicate was first discovered in the middle of the 19th century, being a byproduct of the metal boride period, but it was not until 1930 that it was given serious thought. Carbon and B2O3 processes in electric arc furnaces, carbothermal diminishment, and gas phase reactions are the principal methods used to produce boron carbide powder. B_4C powders typically need to be processed and then refined to remove metallic contamination before being used commercially. [19].

VII. Results And Discussions

A. Microstructure Evaluation

Figures show the microstructures of a sizable number of tests, including as cast, 3, 6, and 9 weight percent of B_4C. Figures 1 and 2 a-d show, independently, the examination of electron magnifying devices for Al-2014 composite as cast and Al-2014 composite reinforced with 0, 3, 6, and 9 wt% of B_4C. The homogeneous dispersion of B_4C particles in the matrix could be seen in optical micrographs taken of Al-2014 mix composites; no voids or discontinuities were visible. Porosity and shrinkages, which are fundamental to providing faults, were not visible in the micrographs. The interfacial holding of the Al-2014 compound matrix and the B_4C particles was not very terrible. The secondary phase particles are distributed uniformly throughout the Al-2014 alloy matrix, as seen in the scanning electron images. All the images demonstrate the strong interfacial connection formed by B_4C and the aluminium alloy matrix, further enhancing the alloy's

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characteristics. In the Al-2014-9 wt.% B_4C composites examples, there are more particles in the Al-2014 matrix, demonstrating the alloy's excellent castability and wettability when reinforced with ceramic materials.

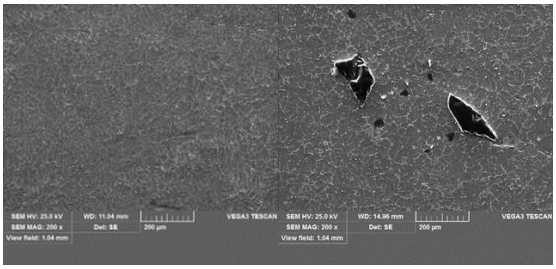

Fig 1: (a) As cast Al2014 alloy
(b) Al2014-3 wt. % B_4C composite

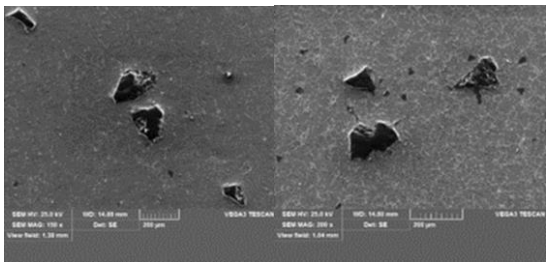

Fig 2: (c) Al2014-6 wt. % B_4C composite and
(d) Al2014-9 wt. % B_4C composite

B. Evaluation of hardness

The degree of hardness of cast Al-2014 along with Al-2014-B_4C composites with (0, 3, 6 and 9 wt. %) is determined by making use of ball indenter at an attached heap about 100kgf in abide time 5 seconds for every specimen at various areas. It is obvious that the composite's hardness is higher in comparison to that within its cast matrix, and the charts also demonstrate how the hardness is highest when the expanding weight percentage results in B_4C. Figure 3 depicts an increase in hardness when the B_4Creinforcement material is added. The B_4Cparticles' hardness, which is hard distributed and contributes to the composite's increased hardness by acting as obstacles to the motion of dislocations inside the matrix, is the cause of this increase in hardness. For 9 weight percent of B_4C composites, the hardness increased from 46.46 HRC to 64.56 HRC due to the B_4C

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particles' greater hardness than the matrix metal. The findings made and the results attained are in line with those of other researchers. Numerous researchers [20] have found an increase in the hardness of composite materials reinforced with hard particles.

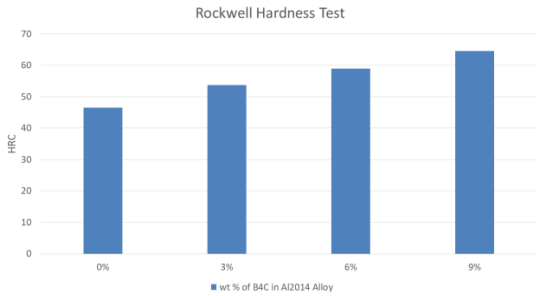

Figure 3: showing hardness of Al-2014-B_4C composites

C.Evaluation of tensile properties and Ultimate tensile strength

The ability of an alloy to resist dislodging movement on a smaller scale is crucial to the quality attributes of metallic materials.

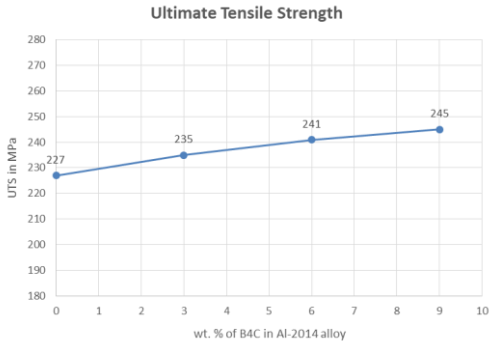

Figure 4:Showing the tensile strength of different composites prepared under study.

The results for the tests for tensile strength at ambient temperature are presented via the outputs with various weight % for B_4C particulates. The findings indicate that the ultimate tensile strength (UTS) rises as the overall percent weight fraction of reinforcing particles increases.

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D. Compression Strength

Uniaxial compression load is consistently applied to the majority of elements of structures, machinery, or gadgets. Compression behaviour is the way a material reacts to straightforward uniaxial compression. Compression testing is the term used to describe the procedure used for this.

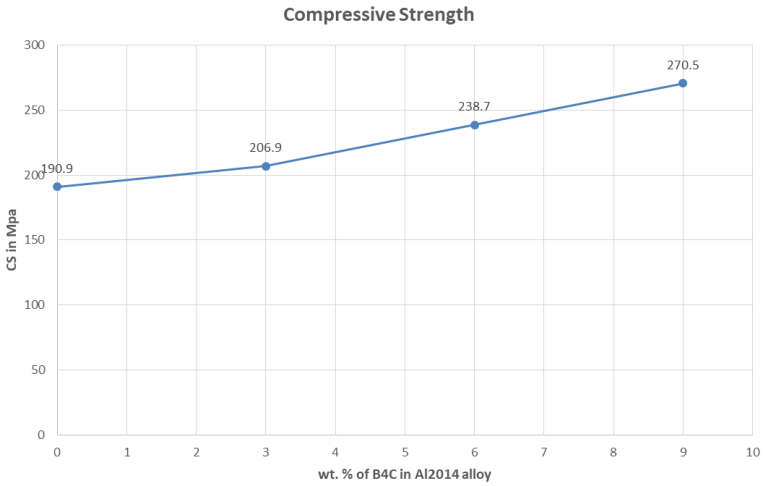

Figure 5: showing the compression strength of different composites prepared under study.

The figure 5 demonstrates the compression strength of Al-2014 alloy as well as various wt. % of B_4C composites. As can be seen from the graph, compression strength increases as B_4C reinforcement weight percentage rises from 0 to 9 wt.%. The high compression strength of ceramic particles [21–23] is the primary cause of this increase in compression strength. By introducing 9 weight percent of B_4C particles into the matrix, the compression strength of the Al-2014 alloy rose from 190.9 MPa to 270.5 MPa.

VIII. Conclusion

The present study shows that the approach used as a stir casting technique has been effectively utilized in the making of Al-2014-B_4C composites. The consistent distribution of B_4C particles throughout the Al-2014 alloy matrix system was visible in EDS as well as Scanning Electron Micro images. Increasing the weight percentage of B_4C particles enhanced the hardness of the Al-2014

ISBN-978-81-19905-39-3

alloy. With an increase in B_4C concentration, the ultimate tensile strength also increases. The improved strength of composites is often attributed to the reinforcing material's and matrix's strong bonding greater than that of the unreinforced alloy Al-2014.

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ISBN-978-81-19905-39-3

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FABRICATION OF FERTILIZER MIXING AND DISPENSING MACHINE

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Abstract:

In recent years, labour scarcity has emerged as one of the foremost challenges in farming. One of the crops that has been most affected by this is the arecanut. It is important to provide a plant with necessary minerals/compost and labourers are required to carry out this process as the weight of the compost is heavy and the arecanut plots are usually large. This project is a combination of a handcart, compost blending machine and compost dispensing machine. The unit is powered by a 160cc Honda engine. The compost is poured inside the mixing chamber and mixing is done inside, blending of compost is carried out. The cart is portable and dispensing is achieved with the help of this setup.

Keywords: Farming, compost, handcart, minerals.

1. Introduction

Agriculture has been the backbone of the Indian economy and it will continue to remain so for a long time. It is the most important enterprise in the world. As India is a developing country about 70% population lies in rural region. These people in rural region are independent on agriculture as their main occupation. It is very essential to develop modern technologies to increase the productivity. While implementing modern technology some factors should also be considered such as – the agricultural equipment's should be provided to farmers at feasible rates, etc. The concept of this machine design is based on the current phenomenal of fertilization methods used in today's agricultural field. The amount of fertilizer required to fertilize the plants is the key element for the

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plant to grow healthy. Our project is to design and manufacture a versatile composite mixer and dispenser that are designed to solve the traditional hand mixing of various fertilizers to prepare fertilizer and help farmers to reduce manual work. Fertilizer Mixing and Dispensing Machine is mainly made for arecanut plantation, since this type of plantation require large amount of fertilizer to be dispense onto the crops which is complicated for the farmers. Fertilizer Mixing and Dispensing Machine serves for various problems like moving from one place to another, requires less space and is less bulky. The working of Fertilizer Mixing and Dispensing Machine is to mix various fertilizers and dispense it accordingly to the plants in required. Blend the measured contents to prepare an accurate composite mixture. Once the fertilizer is ready, fertilizer is fed to the crops. This properly blended fertilizer mixer will increase the productivity and quality of crops. Fertilizer Mixing and Dispensing Machine is portable, power driven & fitted with wheels for ease of movement in the farm. It is low cost and durable fertilizer machine with minimal maintenance.

2. Literature Review

Ramappa et al. [1], has done a case study of Shivamogga district, to know the Economics of Areca nut cultivation in Karnataka and he concluded that Karnataka stands first both in terms of area and production of Areca nut, also the area under Areca nut cultivation has increased rapidly in Shivamogga district. Joshua et al. [2], have worked on solar operated pesticide sprayer. Most of the increase in the area of irrigated land in the world has been through the increasing use of engine-driven pumps. However, the increasing price of oil-based fuel has reduced the margin to be gained by farmers from irrigation, since food prices have generally been prevented from rising in line with energy costs. Bhojane et al. [3], have designed a manually operated machine for fertilizer spreading by taking into consideration the user group & their needs. The project design divided in to three level, top level, middle level, bottom level. Top level consists a hopper. Middle level consists a gear arrangement, chain drive and spreader disc. The bottom level consists wheel they have taken help of this to understand how mechanization can solve the problem and what can be done more so that mechanization is possible for every farmer. Adamade et al. [4], worked on mechanization is recognized as the necessary major means needed to accelerate agricultural production and create a period of surplus in Nigeria. Indeed, food sufficiency can only be attained in Nigeria by encouraging and promoting local designs and manufacture of implements and

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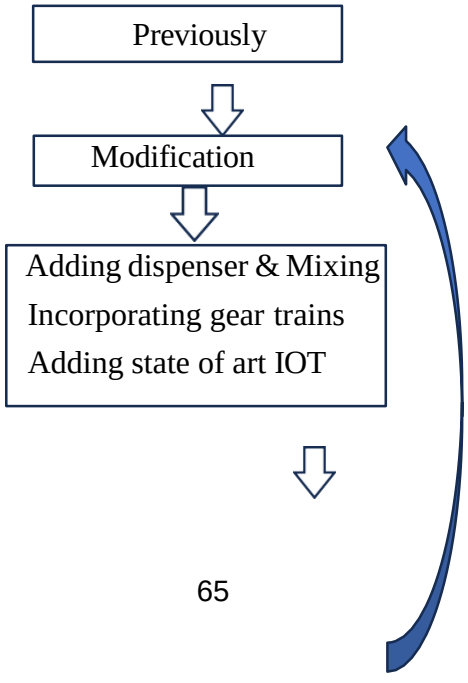
equipment at low cost. We have taken the useful data from this research paper. Laghari et al. [5], focuses on beneficial uses of fertilizer in agriculture. Soil contains various micro and macro elements which are essential for plant growth and yield. It is necessary to save important nutrient elements like nitrogen, phosphorus and potassium by application of chemical fertilizers. For certain situations broadcast applications can be an inefficient method of application because there is much greater soil to fertilizer contact in more fixation or tie-up of nutrient. Narode R. R et al. [6], have generated a method to spread the fertilizer uniformly over a fallow land by dropping the fertilizer over the impeller disc. The system consists of three wheels, two at the front and one at the back. These two wheels at the front are used to impel the fertilizer. The two hoppers are used to store the fertilizer; these hoppers are placed at some height from the wheel axle so that the fertilizer falls on to the impeller. The hopper is provided with flow control mechanism. In fertilization, the flow maintenance is necessary. Generally, every crop should get sufficient amount of fertilizer. This condition is satisfied by Spring Mechanism.

3. Methodology

With a due interest on helping society and farmers, we were exploring for project. In this regard we have come across previous literatures on “Fabrication of Fertilizer Mixing and Dispensing Machine”. We have thoroughly gone through literature and we could see the possibility of improving the performance and other related design criteria to optimize the submitted project. Following is the Methodology adopted to complete the project (Fig. 1).



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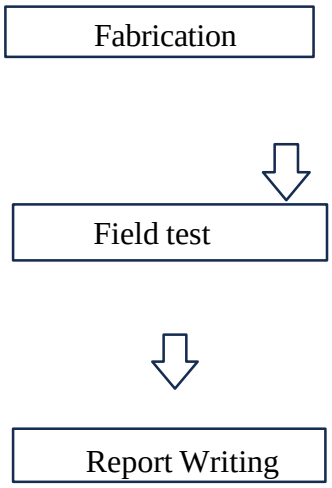

Fig. 1. Flow Chart of Methodology

4. Objectives and Design

Objectives of the project include design and fabrication of a portable, power driven, easily movable machine which facilitates fertilizer mixing and dispensing to the plants in required proportion, thus helping farmers to reduce manual work. 3D model of the fertilizer mixing and Dispensing machine is shown in the Fig. 2. It is a power-driven machine such that the power at the engine shaft has been transferred to the mixer inside the container through pulley belt arrangement. The shaft of the mixer is then coupled with another set of pulleys on the other side of the shaft that is then connected to the pulley at the rear wheel through belt. An intermediate pulley that act as an idler pulley to control acceleration of the machine**.**

Fig 2. 3D Model of the machine

4.1 RPM & Torque of Driven Pulley

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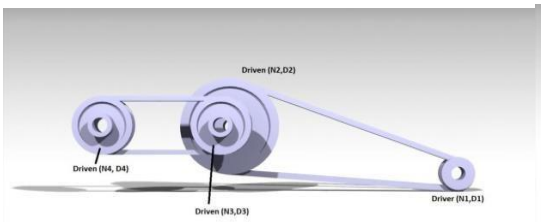

Fig 3. Compound Pulley arrangement

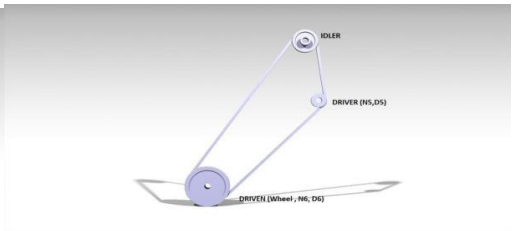

Fig 4. Belt Drive to the Wheel

Driver pulley RPM, N1 = 2000 rpm

Driver pulley Diameter, D1 = 2 inch

Driven pulley Diameter, D2 = 8 inch

Driven pulley Diameter, D3 & D4 = 4 inch

Velocity Ratio of Pulley 1 & 2, VR = N2/N1 = D2/D1 ---------- (1)

Velocity Ratio of Pulley 3 & 4, VR = N4/N3 = D3/D4 ---------- (2)

(N2/N1) *(N4/N3) = (D1/D2) *(D3/D4)

N2/N1=D1/D2 (N4=N3 because D3=D4)

N2 = (2/8) *2000

N2 = 500 rpm = N3 =N4

From Fig. 3,

T2/T1 = D2/D1

T2/8.92 = 8/2

T2 = 35.68 Nm = T3 = T4 (Because N2=N3=N4)

4.2 Speed of the Machine

Wheel RPM = 156.25 rpm

Speed = (π*D*N)/60

Speed = (π*0.254*156.25)/60 (Wheel dia = 10 inch = 25.4 cm = 0.254 m)

Speed = 2.07 m/s

Speed = 7.5 kmph

4.3. RPM & Torque of the Driven Pulley at the wheel

N5 = 500 rpm, T5 = 35.68 Nm (Pulley 2, 3 & 5 are mounted on the same shaft)

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Diameter of Driver Pulley, D5 = 2.5 inch

Diameter of Driven Pulley, D6 = 8 inch

N6/N5 = D5/D6

N6/500 = 2.5/8

N6 = 156.25 rpm

Torque T6, T6/T5 = D6/D5

T6/35.68 = 8/2.5

T6 = 114.17 Nm

5. Results and Discussion

- Manual fertilizing method consumes more time and energy compared to the machine that does both the job of mixing and dispensing. In case of manual method manpower required to mix the fertilizer properly and also to carry the mixed fertilizer to the field where the crops are grown.
- The mixing capacity of the Fertilizer Mixing and Dispensing Machine is 10kg and dispenses 400g for each plant.
- 1 acre land can have approximate of 550 plants. Average grown Areca plant requires 100g of Urea, 150g of Potash, 150g of Rock Phosphate. Therefore, Total comes out to be 400g of blended mixture.
- At one time 10kg of fertilizer can be used to fertilize 10000g/400g = 25 plants.
- By the help of this machine, it requires 10 seconds to fertilize one plant. For 1 acre containing average 550 plants, to fertilize these plants using this machine requires 1hour 52 minutes.
- At single time of filling the 10kg of fertilizer covers 25 areca plants, therefore time required to fertilize 25 plants is 7 minutes (approx.).
- The amount of fertilizer needed in total, 10kg For 25 plants, 220 kg of fertilizer needed to cover 1 acre of plantation.

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- The container should be refilled with fertilizers for 22 times to fertilize 1 acre of areca plants. Also refill time can reduced by increasing the container capacity with increasing the capacity of the engine as well.

6. Conclusion

The aim and vision of this project is to inculcate a holistic approach of fertilizer creation to the farmers which removes hardships that come across while fertilizing. With this project the farmers have to harvest high yield of crops with this precise mixing technique of raw materials, along with ease of movement of the machine in the land due to the wheel mechanism, and low investment and minimal maintenance machine which will not burden the farmer in long term. This strive to achieve growing non-pesticide and non-chemical food and staples, and encourage farmers to use organic fertilizer and leverage technology & knowledge which is modern yet simple.

ISBN-978-81-19905-39-3

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ISBN-978-81-19905-39-3

ICEST_ME_019

AN AFFORDABLE AND INNOVATIVE DUAL COCONUT DEHUSKING MACHINE

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Abstract:

Coconut, scientifically known as Cocos nucifera, is a versatile and tropical fruit widely cultivated for its myriad uses. Revered for its distinct combination of refreshing water, nutrient-rich meat, and oil-rich kernel, the coconut plays a pivotal role in various cultures and industries. Several machines are employed for the de-husking of coconuts, each designed to streamline and automate the traditionally labor-intensive process. Some common machines include, manual coconut de-husker, motorized coconut de-husker, industrial Coconut de-husking machine. These machines vary in terms of scale, complexity, and automation level, catering to diverse needs in coconut processing based on the scale of operations. These machines have several limitations that are: regular maintenance, required high skilled labor, high initial cost also and more time consumption in some machines. In this project work a semiautomatic dual coconut de-husking machine is being fabricated which will overcome these above limitations. By using this machine two coconuts can be de-husked at a time. The machine will be driven by using a 0.5HP motor and the power to the de-husking tools will be provided through a reduction gear box. Approximately 12 coconuts can be de-husked by using semiautomatic dual coconut de-husking machine, thus increasing productivity. The machine is fabricated with low cost so as to make it affordable to all.

Keywords: Coconut, de-husker, semi-automatic, low cost.

ISBN-978-81-19905-39-3

1. Introduction

Coconut (Cocos nucifera) is one of the world's most useful and important perennial plants with multiple uses for thousands of years, Coconut has considerable significance in the national economy of Nigeria in view of rural employment and income generation. It belongs to the family areca cease Philippines are the world largest producers of coconut. It is found in the tropic and subtropic areas. Coconuts are large, dry drupes, ovoid in shape, up to 381mm long and 305mm wide. The coconut is smooth on the outside greenish or yellowish in color. Within the outer shell is a fibrous husk 25-50mm thick. The inner shell is brown and hard, surrounding the white coconut meat. The coconut husks have to be removed for the usage of coconut The coconut husk is made up of coir which is light weight, elastic, strong and has high durability. Coconut plays an important role in the economic, social and cultural activities of millions of people in our country. India is a major producer of coconut in the world Traditional areas of coconut cultivation in India are the states of Kerala, Tamil Nadu, Karnataka, Pondicherry, Andhra, Goa, Maharashtra, Odessa, West Bengal, Gujarat, islands of Lakshadweep and Andaman & Nicobar. Coconut provides food, edible oil, industrial oil and health drink to humanity. All parts of coconut tree are useful in one way or other and the crop profoundly influences the socioeconomic security of millions of farm families.

2. Literature Review

Rahul Sabale et.al [1], said that, there are many farms equipment's which are developed for the post harvesting operations. The de-husking of a coconut is regarded as the most time consuming, tiring, and difficult operation to perform. Traditionally this task of de-husking was performed by using different hand tools. By hand tools the de-husking depends on the skill of worker and involves training. The mechanized or the power operated machines are also developed to eliminate the drawbacks of manual tools. Such a tools and machines are developed all over the world and a very few have become popular, rest got vanished due to their limitations.

Sharanbasappa et.al [2], said that, by and large coconuts are de-husked physically utilizing either a cleaver or a spike. These techniques require talented workers and are tiring to utilize. Attempts made so far in the improvement of de-husking instruments have been just mostly fruitful and not compelling in supplanting manual techniques.

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Abishek.D et.al [3], said that, the Motorized type of remover for agriculture is a Mechanical gadget which is generally utilized in agricultural works. The Motorized coconut husk remover for agricultural needs reduces the time and labour in evacuating the husk. The purpose behind the improvement and the presentation of the motorized coconut husk remover in agricultural is explained briefly in further cases of literatures.

Vijay Kumar G Tile et.al [4], said that, the fundamental goal of this machine is to evacuate the coconut shell and to dispense with the talented work associated with de-husking. The coconut external shell is a stringy husk one to two inches thick. This paper manages the structure and creation of pneumatic worked coconut de-husking machine. This venture is planned for delivering a proficient and progressively affordable machine for coconut industry. One conventional strategy utilized for coconut de-husking is utilizing a cleaver. This is finished by utilizing human vitality.

Shrinivas et.al [5], in 2012 said that, the reason for this machine is to avoid people engaged with de-husking the coconut and to totally computerize the de-husking and crown evacuating process. Despite the fact that coconut de-husking machines have just been exhibited in the work and furthermore in some little scale ventures, the procedure is either manual or self-loader.

H Azmi et.al [6], said that, A coconut de-husking machine contains two rollers with spikes, chain drives, presser, clearers, shafts and belting framework was created for little scale generation in provincial territories. Execution test investigation indicated that the machine de-husks coconut edible part with no nut breakage or on the other hand bending of the separated fibre length.

K.P.Kolhe et.al [7], said that, all the parts of coconut like coconut husk, shell, copra, coconut water are valuable. The de-husking unit will have a couple of tube-shaped rollers with tines (cutting pins) on its surface. These rollers will pivot in inverse bearing with various speeds so the tines will enter into the husk and tear it away from the shell. The proper tearing of husk from shell occurs when the coconut offers good mesh with the tynes and it depends on the depth of insertion of nut into rollers and profile of tynes. Also, the suitable profile of tynes is required for effective de-husking.

ABI Varghese et.al. [8] In this research paper author given that De-husking of Coconut is the most difficult post harvesting operation relevant to coconut. A big problem associated with coconut processing was its de-husking. All Manually operated husking tools Make Use of a combination of Principles i) a Wedge and ii) Lever. The earliest of the modern coconut husking

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tools is a Foot operated coconut husking Machine. In this machine two wedges are used one in movable. Movable wedge operated with the help of lever which de-husk the nut.

3. Methodology

Project work starts with study of research papers and collection of information about the project as shown in the above flow chart. After collecting all the relevant information's and short coming of previous work designing of semiautomatic dual coconut de-husking machine was made with the help of CAD software using Solid Edge.

The material used for the fabrication of the project whole project is mild steel along with the help of motor and gearbox system. The motor is connected to the reduction gear box with the help of belt. The shaft is connected to gearbox and in this machine two coconut de-husking tools are connected to the shaft with the help of chains. When motor drives the gear, coconut de-husking process takes place. The methodology flow chart is as shown in Fig. 1.

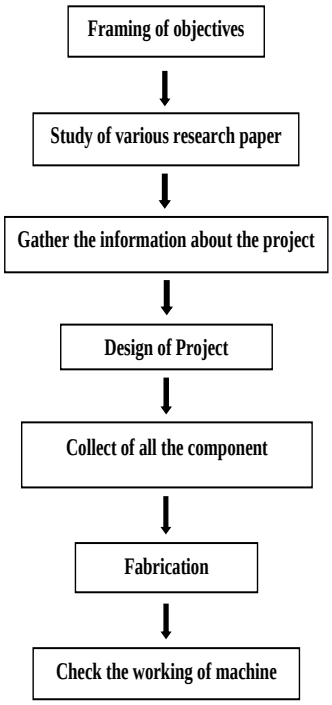

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Fig. 1. Flowchart of Methodology

4. Design

Solid Edge is powerful and comprehensive Computer-Aided Design (CAD) software that empowers engineers and designers to bring their ideas to life. Solid Edge offers robust 3D modeling capabilities, allowing users to create complex parts and assemblies.

It supports parametric modeling, which enables the creation of intelligent models with defined dimensions and relationships. Users can create 3D shapes using a variety of tools, including extrusion, lofting, sweeping, and more. The 3D and 2D Models are shown in Fig. 2 & Fig. 3

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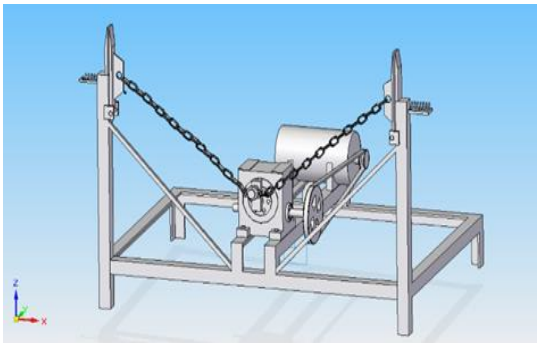

Fig. 2. 3D Model

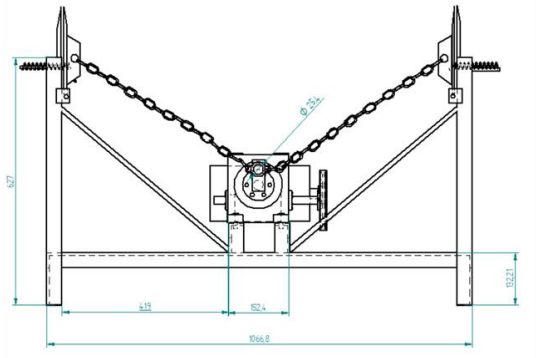

Fig. 3. 2D Model

1) Reduction gear box speed = n1/n2

n1= Motor speed

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n2= Gear box input speed

(1440/30) = 48rpm

2) Velocity of belt:

V= (πdn/60000)

V= ($\pi * 150 * 1440/60000$) = 11.30m/sec

3) Power Capacity:

T=(9.55*106*P)/n

P= Motor power in KW

N = Motor speed in RPM

T= (9.55*106*0.372)/1400 = 2.53KNm

4) Equivalent pitch diameter:

de= d*kd

d= The small diameter factor

kd= pitch diameter of the small pulley

(50*1.4) = 57mm

5) Power capacity:

KW= $(0.61 * V - 0.09 - (26.68\ de) - 1.04 * 10{-}4 * v\ 2)\ 0.7335 * v$

V= Velocity of belt

de = Equivalent pitch diameter

KW= $(0.61 * 11.30 - 0.09 - (26.68\ 57) - 1.04 * 10{-}4 * 11.302)\ 0.7335 * 11.30$ KW

= 2.83 KW

6) No. of belt required:

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N=(P*Ks)/(Kl*Ka)

P= 0.372 Kw

Ks=Correlation factor 1

Kl= Correlation factor length

Pitch length of belt = 2C+1.57(D + d) +(D − d) 2 /4C

C= Center distance of two pulley

D= Major diameter pulley

d= Minor diameter pulley

KL= 2*4000 +1.57(150 + 50) +(150 − 50) 2 /4*400= 1007.82m.m

Kl=0.88

Ka = Correlation factor for arc of Contact

θs = 2 sin −1 (D − d)/2C

θs = 2 sin −1 (150 − 50)/2 ∗ 400 =179.43°

Ka = 0.75 N= (0.372*1)/ (0.88*0.75) =0.95≈1

7) Spring Stiffness calculation:

K = (W/δ)

W= Load in kg

δ = Deflection = (Final length − initial length in m.)

K= (9.81)/ (185-150)*10−3 = 280.28 N/m

K= (19.62)/ (235-150) *10−3 = 230.82 N/m Average= (230.82+280.28)/2= 255.82 N/m

Major Components:

1. ½ HP Motor
2. Reduction Gear Box

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3. V-belt
4. Pulley
5. Metal Mesh
6. Extension Spring
7. Metal Chain
8. GI Sheet Metal
9. L Angular Bar
10. Bolts and Nuts

5. Working principle

The Semi-automatic Dual Coconut De-Husking Machine can be operated with the help of motor and gear box system. At the heart of the coconut de-husking machine's operation lies the motor and gearbox assembly, which provides the necessary mechanical power and torque to drive the de-husking mechanism. The motor converts electrical energy into rotational motion. The gearbox is a crucial component that helps regulate the speed and torque output from the motor to the de-husking mechanism. It consists of a series of gears that transmit power from the motor to the de-husking mechanism while adjusting the speed and torque as needed. The machine is loaded with coconuts by the laborer for de-husking. The coconuts are manually placed on the tip of the tool. When motor drives the gear, the speed will be reduced to required ratio. The shaft which is connected to the gearbox will rotate and chain connected to the gearbox shaft and tip of tool will also rotate along and due to this the tool moves forward & in backward motion. The tools alternatively will de-husk the coconut simultaneously. Once the de-husking process is complete, the husk of the coconut which is collected at the base of the machine is removed or put aside.

6. Results and Discussion

In this portion, the project's outcomes are presented in a clear and concise manner. This involves the use of tables, graphs, or any other appropriate visual representations to convey the data effectively.

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A. De-husking Efficiency

The efficiency of the de-husking coconuts was evaluated by measuring the percentage of successful de-husking. A total of 100 coconuts were subjected to the de-husking process. Output is 50% more than manual de-husking. This indicates that the semi-automatic dual coconut de-husking machine is more efficient compared to manual de-husking.

B. De-husking Time

The time required to de-husk a coconut using the Semi-automatic system was compared to the traditional manual de-husking method. In 30 minutes, we can de-husk 200 coconuts by semi-automatic machine but manually de-husking process it will take 60 minutes. This indicates that the semi-automatic dual coconut De-Husking machine significantly reduced the de-husking time, making the process more efficient

C. Husk Removal

After de-husking, the effectiveness of the removing the husk completely from the coconut was assessed. Visual inspection and manual examination of the de-husked coconuts revealed that process achieved a high level of husk removal. Only minimal traces of husk remained on the coconut, which could be easily removed by hand or through further processing steps

The time required for de-husking 100 coconuts

1) Semi-automatic machine = 30 minutes

2) Manually = 60 minutes

Efficiency = ((60-30)/60) *100 = 50%

Productivity is 50% more than manual de-husking based on operational time.

Efficiency and Productivity of Manual and Semi-automatic Machine

From the below chart, manual de-husking is typically less efficient due to the physical effort and skill required. It can be slower and vary depending on the individual's experience. Productivity with manual de-husking depends on the worker's skill and endurance. Experienced workers can process more coconuts, but the overall productivity is generally lower compared to semi-automatic methods as shown in Fig. 4 and also Table 1.

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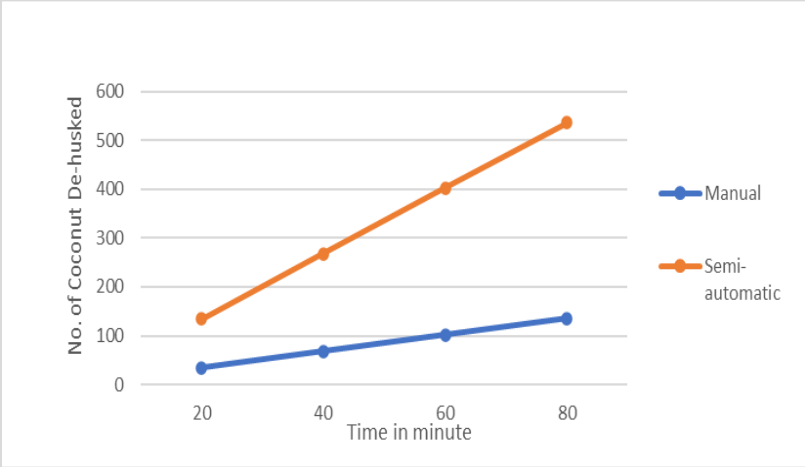

Fig. 4 Productivity v/s Efficiency

Below Table 1 shows the comparison between manual de-husking and Semi-automatic de-husking machines for 1 hour.

Sl. No.	Method of De-husking	No. of Coconut De-husked	Time Required (minutes)
1	Manual	136	60
2	Semi-automatic	400	60

Efficiency and Productivity of Pneumatic tupe and Semi-automatic Machine

From the below chart again, it is concluded that semi-automatic dual coconut de-husking machine is more efficient than pneumatic type de-husking machine. In this semi-automatic machine two workers can work at a time and produces 7-8 coconuts per minute. Hence, for 8 hours, 3200 coconuts can be produced and consumes 3units of power. But in the case of pneumatic type, 3-4 coconuts can be de-husked per minute. Hence for 8 hours 1900 coconuts can be produced. Mainly it requires large quantity of power because of using compressor and it consumes 9units of

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power. Overall compared to pneumatic type, semiautomatic dual coconut de-husking machine is more efficient and consumes less power as shown in Fig 5.

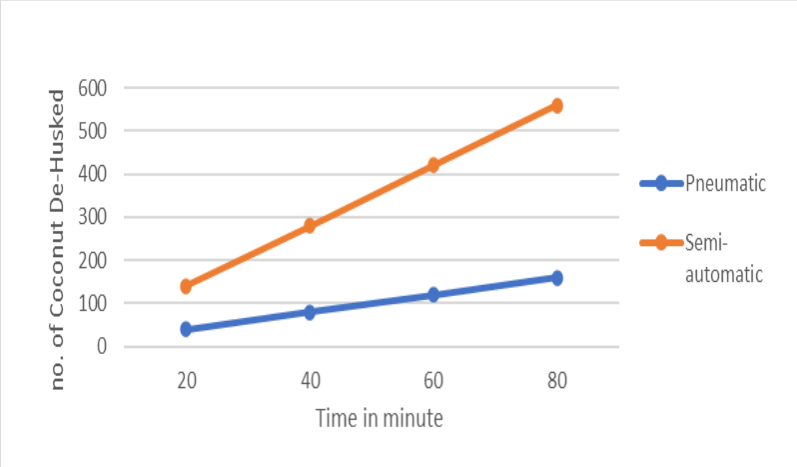

Fig. 5 Productivity v/s Efficiency

6. Conclusion

In conclusion, the development and implementation of the semi-automatic dual coconut de-husking machine with a gearbox and motor represent a significant advancement in the field of agricultural machinery. Through this project, several key objectives were achieved, including increasing efficiency, reducing manual labor, and improving safety in coconut de-shelling operations. The integration of a gearbox and motor system into the design of the machine has proven to be highly effective in achieving these objectives. Additionally, the use of a gearbox and motor has allowed for precise control over the speed and torque of the de-shelling mechanism, ensuring consistent and reliable performance.

One of the primary benefits of the semi-automatic coconut de-shelling machine is its ability to reduce manual labor and associated health risks for workers. Traditionally, coconut de-husking has been a labor-intensive task, often requiring workers to use sharp tools and exert significant force to remove the husk from the coconut. This process can lead to injuries such as cuts, strains, and repetitive motion injuries. By automating this process, the machine helps to minimize the physical strain on workers and create a safer working environment.

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Furthermore, the successful implementation of semi-automatic coconut de-husking machines relies on effective training and support for operators. Proper training is essential to ensure that operators understand how to safely and effectively operate the equipment and troubleshoot any issues that may arise. By using the coconut de-husking machine it has significantly reduced the time and effort required to process coconuts, thereby increasing overall productivity.

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09:30 AM to 11:30 AM	Inauguration of ICEST-24 Inaugural address by **Mr. Sohan M.** Senior Project Manager – Infosys, Mangalore Keynote Address by **Dr. P. Nagabhushan**, VC, Vignan University, AP
11:30 AM to 11:45 AM	Refreshments
11:45 AM to 01:00 PM	Keynote address – I on topic "Sustainable Smart Cities: What Lies Ahead? " by **Dr. Jagdish H Godihal,** Professor- CIVIL and Deputy Dean-Academic Research, Presidency University Bengaluru, Karnataka.
01:00 PM to 02:00 PM	Lunch Break
02:00 PM to 02:45 PM	Track 1 Oral presentation (Transportation and Geotechnical Engineering)
02:45 PM to 03:30 PM	Track 2 Oral presentation (Building Materials and Construction Technology)
03:30 AM to 03:45 AM	Refreshments
03:45 PM to 04:30 PM	Track 3 Oral presentation (Architecture and Planning)
24th April 2024 Wednesday – Day 2	
09:30 AM to 10:30 AM	Track 4 Oral presentation (Structural Engineering)
10:30 AM to 11:30 AM	Track 5 & 6 Oral presentation (Sustainability and Environmental Engineering & Water Resources and Irrigation Engineering)
11:30 AM to 11:45 AM	Refreshments

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11:45 AM to 01:00 PM	Keynote address – II on topic "Sustainable Horizons in Civil Engineering" by **Dr H Ajith Hebbar,** Associate Professor & Head, Civil Engg. Alva's Institute of Engineering and Technology, Moodbidri
01:00 PM to 02:00 PM	Lunch Break
02:30 PM to 03:30 PM	• Valedictory of ICEST-24 • Valedictory address by **Dr. A. M. Khan,** Senior Professor, Dept. of Electronics & Director- Skill Development Centre Mangalore University Mangalore • Keynote Address by **Dr. Surendra Kumar**, Pro-Vice Chancellor, Presidency University, Bangalore
03:30 PM to 04:00 PM	Interaction & High Tea

ISBN-978-81-19905-39-3

ICEST_CV-001

TO DEVELOP A NEARLY ZERO ENERGY BUILDING USING BIM AND AR

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Abstract:

A Net Zero-Energy Building (NZEB) is a building with net zero energy consumption, meaning the total amount of energy used by the building on an annual basis is equal to the amount of renewable energy created on the site. There are only a limited number of buildings that use the concept of NZEB at present. The construction of NZEBs is becoming more and more feasible owing to advancements in building technology, renewable energy systems, and academic research. The current project aims to conceptualize a residential building that uses the concept of NZEB. With the combination of BIM and AR technology, the concept of NZEB can be achieved in the maximum reasonable way. As we visualize the building, the energy optimization of the building can be done in a better manner in the present and future than in the past due to the advancements in technology like Building Information Modeling (BIM) and Augmented Reality (AR). Together BIM and AR can be used as tools to help in designing, constructing, and operating the NZEB. By providing detailed visualization, energy analysis, and real-time data, BIM and AR help in optimizing the building performance and achieving the NZEB goals.

Keywords: Building Information Modeling, Augmented Reality, Net Zero Energy Building

1. INTRODUCTION

The pursuit of sustainable building practices has catalyzed the emergence of Net Zero-Energy Buildings (NZEBs), representing a paradigm shift in the construction industry. These buildings aspire to achieve a delicate equilibrium between energy consumption and renewable energy generation on-site, thereby significantly reducing their environmental footprint [1]. Despite

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their potential to mitigate climate change and resource depletion, NZEBs remain relatively rare in today's construction landscape. However, recent advancements in building technology, renewable energy systems, and academic research are steadily making NZEB construction more attainable. This report is dedicated to the conceptualization of a residential building that not only embraces but exemplifies the principles of NZEBs. At its core, the project seeks to harmonize the innovative potential of Building Information Modelling (BIM) and Augmented Reality (AR) technologies to revolutionize the design, construction, and operation of NZEBs [2]. By seamlessly integrating BIM and AR into the project workflow, the aim is to empower stakeholders with comprehensive insights and tools for informed decision-making. The utilization of BIM offers a sophisticated platform for collaborative design and data-driven decision-making, enabling stakeholders to visualize the building's performance parameters, simulate energy consumption scenarios, and optimize design elements for maximum efficiency. Augmented Reality, on the other hand, enhances the design process by overlaying digital information onto the physical environment, facilitating real-time visualization and immersive experiences. Together, BIM and AR represent transformative tools that can revolutionize the traditional approach to building design and construction. However, despite the promise of NZEBs and the potential of BIM and AR technologies, several challenges persist [3]. These include limited adoption and integration of NZEB principles and technologies, as well as barriers related to education, training, and policy incentives. Addressing these challenges requires a concerted effort from industry stakeholders, policymakers, educators, and researchers to foster interdisciplinary collaboration, develop robust training programs, and incentivize the adoption of sustainable building practices. In conclusion, this report aims to contribute to the on-going discourse on sustainable building practices by advocating for the widespread adoption of NZEB principles and the utilization of BIM and AR technologies. By embracing innovation and collaboration, we can realize the vision of NZEBs as standard practice in the built environment, paving the way for a more sustainable future for generations to come [4].

Reddy and Jagadish (2001) [1] highlight the significant energy consumption involved in manufacturing and transporting building materials, especially cement and steel. They demonstrate that using energy-efficient or alternative materials, like soil-cement blocks, can reduce energy use in load-bearing masonry buildings by up to 50%. Notably, transportation energy for materials like bricks accounts for 5-10% of manufacturing energy. Ortiz et al. (2015)

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[2] emphasize the importance of life cycle assessment (LCA) in evaluating nearly zero-energy buildings (NZEBs), particularly regarding waste management. They recommend integrating LCA tools with Building Information Modeling (BIM) and Augmented Reality (AR) to optimize waste management. Chastas et al. (2016) [3] review the shift from operational to embodied energy dominance in residential buildings as they become more energy-efficient, highlighting the need for standardized protocols and further research. Chel and Kaushik (2017) [4] advocate for designing buildings with nearly zero energy consumption and using low-energy materials. They stress the importance of energy-efficient equipment and renewable energy technologies to minimize environmental impact and CO_2 emissions. Coimbra (2021) [5] demonstrates the environmental and economic benefits of sustainable construction using a case study of a 100-year-old building. The study highlights the use of recycled materials and efficient equipment to reduce energy consumption and operational costs. Wie and Harrison (2021) [6] explore various technologies for Net-Zero Energy Buildings, emphasizing the importance of renewable energy sources and energy-efficiency measures tailored to local climates and building codes. Allouhi et al. (2022) [7] propose a Hybrid Renewable Energy System (HRES) for multi-family buildings, focusing on solar and wind power combined with hydrogen generation and storage to enhance efficiency and cost-competitiveness [8]. Hussain et al. (2022) [9] examine how smart bins connected to the Internet of Things (IoT) can improve waste collection efficiency. Their study in Al Rayyan, Qatar, shows that continuous monitoring through IoT reduces waste collection costs, CO2 emissions, and route completion times. Lin and Chen (2022) [10] introduce a comprehensive framework for designing and validating Net-Zero Energy Buildings, integrating both passive and active solutions. Their case study demonstrates the practicality of NZEBs in reducing energy consumption and provides valuable guidance for future building projects.

Wilberforce et al. (2023) [11] focus on reducing electricity usage and minimizing the environmental impact of homes through zero-energy buildings (ZEBs). They identify barriers to commercialization, such as lack of incentives and limited policies, and suggest technological advancements and government incentives to promote ZEB adoption. Huo et al. (2023) [12] highlight the energy-saving potential of external Venetian blind shading (EVBS) in nearly zero energy buildings (NZEBs), using a model to optimize shading for different climates. Wang et al. (2023) [13] explore microbial-induced calcite precipitation (MICP) for creating bio-cement, emphasizing its low-cost, environmentally friendly nature despite limitations with fine sands

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or soils. Liu et al. (2021) [14] advocate for using domestic organic residues (DOR) to boost soil organic carbon (SOC), enhancing soil health and supporting sustainable agriculture. Li et al. (2023) [15] recommend combining Building Information Modeling (BIM) and Augmented Reality (AR) to visualize and optimize construction sequences, reducing energy use and improving efficiency in NZEB projects. Park et al. (2023) [16] discuss integrating BIM with energy simulation and cost estimation tools to help designers make informed decisions, emphasizing the role of AR in enhancing understanding and collaboration on-site. These studies collectively underscore the importance of innovative technologies and sustainable practices in construction to achieve energy efficiency and environmental benefits.

Agarwal (2015) [17] explores the use of Augmented Reality (AR) in civil engineering to minimize construction errors. AR projects architectural and structural drawings in actual scale on-site, enabling real-time 3D comparisons with ongoing construction, which helps quickly identify and rectify errors. Despite current practical challenges, further research could lead to effective AR tools for construction management, design, and marketing. Hernandez and Brioso (2018) [18] examine the integration of Building Information Modeling (BIM), AR, and Lean Construction, highlighting benefits such as quicker decision-making and improved project monitoring. Their review points to a need for deeper research on these technologies' combined use, particularly in automating workflows and enhancing design, control, and flow processes. Diao and Shih (2019) [19] emphasize the importance of AR in Architectural and Civil Engineering (ACE) education, advocating for careful AR system selection, objective grading standards, and markerless systems. Collaboration between academia and industry is deemed essential for advancing AR deployment in ACE education. Machado and Vilela (2019) [20] focus on the need for real-time data in construction site monitoring. They highlight the potential of integrating BIM and AR for improved visualization and information processing. Their review identifies key technologies like fiducial markers, GIS/GPS, laser scanners, and photogrammetry for automatic data capture, and discusses challenges such as precision, calibration, and occlusion. Future work should validate a comprehensive BIM-AR integrative model and assess AR's impact on work performance.

2. OBJECTIVES AND METHODOLOGY

The objective of the present study is to develop a Nearly Zero Energy Building and an AR Model. The methodology adopted is depicted in Figure 1.

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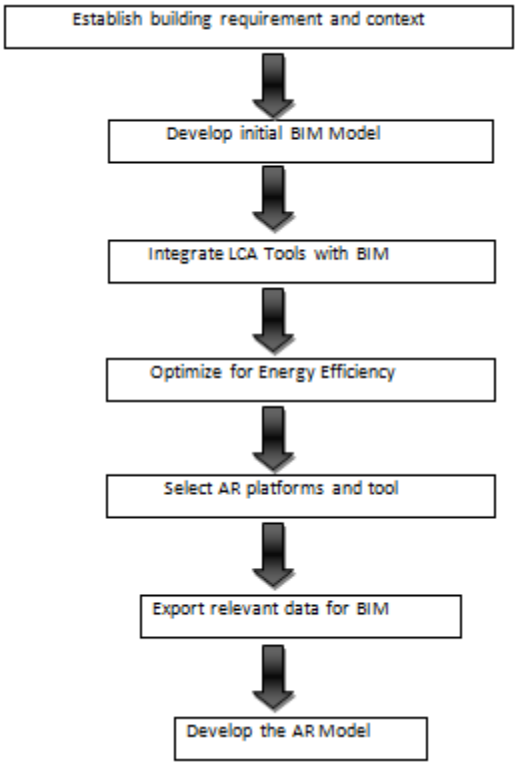

Figure 1: Methodology

3. SUSTAINABLE MATERIAL

Some of the sustainable materials are Reclaimed wood, reclaimed metal, Precast concrete, Bamboo, Cork, Shipping container, Rammed-earth tyres, Earth bag, Recycled steel, Ferrock, Timber Crete, Grass Crete, Paper Crete, Hemp Crete, Plant based Polyurethane Rigid Foam, Straw Cable and Recycled Plastic. Innovative sustainable building materials offer a wide array of options for environmentally conscious construction projects. Reclaimed wood and metal not only lend unique aesthetic appeal but also reduce demand for virgin resources. Precast concrete minimizes on-site waste and energy consumption during production. Bamboo, known for its rapid growth and durability, provides a renewable alternative to traditional building materials. Cork, harvested from the bark of cork oak trees, offers excellent insulation properties while promoting sustainable forestry practices. Shipping containers repurposed into modular structures exemplify adaptive reuse and reduce construction time and costs.

Rammed-earth tires and earth bags utilize natural materials like soil and tires, reducing the carbon footprint and promoting eco-friendly building techniques. Recycled steel finds new life in construction projects, diverting waste from landfills and conserving energy compared to

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virgin steel production. Ferrock, a ground-breaking cement alternative, not only utilizes waste materials but also actively sequesters carbon dioxide, mitigating its environmental impact.

Timber Crete and Glass-Crete showcase innovative approaches to utilizing waste materials and renewable curing methods, further reducing the ecological footprint of construction projects. Additionally, plastics, often vilified for their environmental impact, offer potential as building materials when recycled properly. From PET bottles to polystyrene, advancements in recycling technology enable the reuse of plastics in construction, promoting circular economy principles and reducing reliance on finite resources. These diverse materials collectively demonstrate the potential for sustainable building practices to shape a more environmentally friendly and resilient built environment.

4. SOLAR ENERGY:

Solar energy is hailed as the most abundant natural resource, with the potential to meet many times the current global energy demand. In India, the average intensity of solar radiation received is around 200 MW per square kilometer, translating to a vast capacity potential of 5000 trillion kilowatt-hours per year incident over land area, with most regions receiving 3-5 kilowatt-hours per square meter per day. Leveraging this abundant solar resource and available land, the assessed potential of solar power in the country stands at an impressive 750 gig watts peak (GWp), highlighting the significant opportunity for solar energy to play a pivotal role in meeting energy needs while reducing reliance on fossil fuels and mitigating environmental impacts. The concept of adopting the solar in the present work is show in Figure 2.

Figure 1: Image of Solar Energy from our model

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5. ROOFTOP RAINWATER HARVESTING:

Rooftop rainwater harvesting involves capturing rainwater from building rooftops, storing it in tanks, or directing it to recharge systems. This method, known for its simplicity, eco-friendliness, and affordability, serves various domestic and commercial needs, including toilet flushing, laundry, gardening, and more. By replenishing groundwater and enhancing its quality, rooftop rainwater harvesting contributes to sustainable water management, mitigating water scarcity challenges and fostering resilience in communities' water supply systems. The concept view of Rainwater Harvesting is shown in Figure 3.

Figure 3: Schematic diagram of Rainwater Harvesting

6. Waste Reduction/Recycling (Biogas Plant)

A green approach to construction not only diverts waste from landfills through the use of sustainable materials but also extends to the operational phase of buildings, where waste reduction measures can significantly impact resource conservation. Waste recycling, including wastewater recycling, presents opportunities for conservation, whether through on-site waste management practices like garbage separation and composting or centralized wastewater treatment systems that reuse water from dishwashing or laundry. While larger-scale solutions may pose cost and energy challenges, smaller steps such as installing low-power showerheads or implementing biogas plants to convert wastewater to fertilizer offer viable alternatives. A biogas plant is a facility that produces biogas through the anaerobic digestion of organic materials such as agricultural waste, food scraps, sewage, or other biomass. Anaerobic digestion is a natural process where microorganisms break down organic matter in the absence of oxygen, producing biogas as a byproduct. Typical concept of biogas plant is show in Figure 4.

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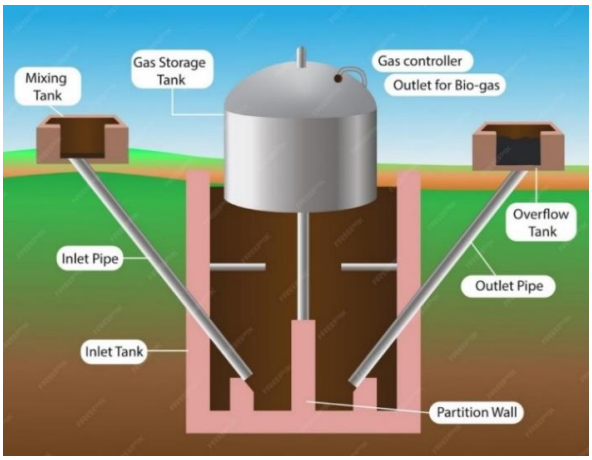

Figure 4 Typical biogas plant (freepik.com)

7. Building Modelling

Considering factors such as the size of the house, number of rooms, layout preferences, and budget constraints, initial plans were worked out.

The final rendered 3D model is shown in Figure 5.

Figure 5 Rendered View of 3D Model

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8. Develop An Augmented Reality (AR) Model

The implementation of Augmented Reality (AR) to convert Revit software design into a real-time model by using “Blender” Blender is a versatile and open-source 3D creation suite used for modeling, animation, rendering, compositing, and more. It offers a comprehensive set of tools for creating high-quality 3D content, making it popular among artists, designers, and animators. The sample of the AR model created in the project is shown in Figure 6. Due to limitations in loading the Revit file into Blender, the complete AR model, as depicted in Figure 5, was not fully captured.

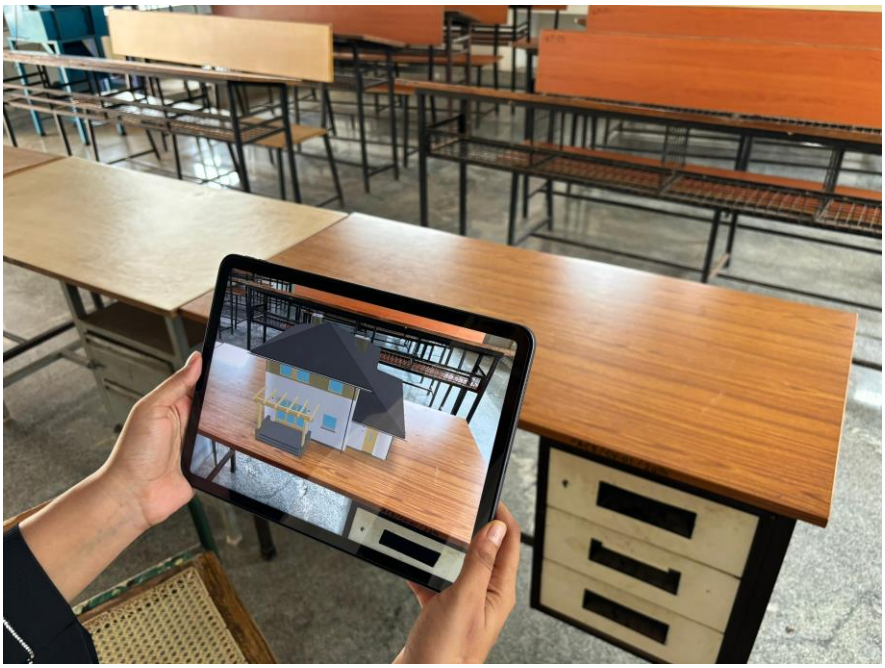

Figure 6 Augmented Reality of a house using Blender

9. Results and Discussion

7.1 Optimizing NZEB Design

Through the integration of Building Information Modeling (BIM) technology, our project successfully optimized the design process of Net-Zero Energy Buildings (NZEBs). By leveraging BIM's capabilities, such as 3D modeling, parametric design, and energy analysis tools, it was able to create more efficient and sustainable building designs. The use of BIM facilitated comprehensive energy simulations, allowing us to assess the energy performance of different design iterations and identify areas for improvement.

7.2 Enhancing Construction Accuracy

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Our project demonstrated the effectiveness of BIM in enhancing construction accuracy for NZEBs. By generating detailed digital models of the building components and incorporating precise construction information, such as dimensions, materials, and sequencing, BIM helped streamline the construction process and minimize errors. This resulted in improved construction efficiency and reduced waste, contributing to the overall sustainability of the project.

7.3 Ensuring Optimal Building Performance

The integration of BIM and AR technologies enabled us to ensure optimal building performance throughout the lifecycle of the NZEB. By visualizing building data and performance metrics in real-time through AR interfaces, stakeholders could monitor energy consumption, indoor environmental quality, and other key parameters. This enhanced visibility empowered decision-making and facilitated proactive maintenance, ultimately maximizing the building's energy efficiency and operational performance.

10. CONCLUSION

In conclusion, our project illuminates the transformative impact of merging Building Information Modeling (BIM) and Augmented Reality (AR) technologies in revolutionizing the construction landscape, particularly in the realm of Net-Zero Energy Buildings (NZEBs). By seamlessly integrating BIM and AR, our research showcases how architects, engineers, and construction professionals can leverage advanced digital tools to streamline design processes, improve construction precision, and ensure the operational efficiency of NZEBs.

Despite encountering hurdles such as technological complexities, our study underscores the pivotal role of ongoing innovation and collaborative endeavors in realizing sustainable building practices. Looking ahead, it is imperative to channel further research and development efforts towards refining existing design tools, expanding access to renewable energy sources, and advocating for regulatory frameworks conducive to NZEB construction. Embracing this holistic approach will not only propel the evolution of sustainable architecture but also contribute significantly to mitigating environmental impact and advancing the global transition towards a carbon-neutral future.

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ISBN-978-81-19905-39-3

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STRENGTH PARAMETERS OF CONCRETE BY USING BIO-CEMENT

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Abstract:

Concrete is the most consumed artificial cementitious material because of rapid urbanization. Modern concrete is not sustainable and is one of the biggest causes of anthropogenic greenhouse gas emissions. A possible technique to imitate nature's sustainability methods is through microbial precipitation of $CaCO_3$. In the present work, an attempt is made to create concrete using Bacteria by Microbial induced Calcite Precipitation (MICP) method. By using a certain species of bacteria from the order of Bacillales. In the present study, Bacillus Cohnii bacteria is used. The test results indicate that in the presence of Bacillus Cohnii bacteria media is insufficient to create concrete only using GGBS and fly ash. The study indicates a minimum use of 30% of cement is obvious for making concrete using Bacillus Cohnii bacteria. The compressive test results shows Bacillus cohnii bacterial may contribute 2% to 4% increase in compressive strength of concrete. The compressive strength of the mixture with 30% cement, 50 % GGBS, and 20% Fly ash is nearly in the range of concrete using 100% cement.

Key Words: Bio-Cement, Microbial induced Calcite Precipitation, Bacillus Cohnii.

1. Introduction

Around the world, the building sector has a significant impact on social and economic growth. However, it has a significant carbon footprint because it uses a lot of energy during every stage of manufacturing, from gathering raw materials to building structures. This quickens the process of global warming, ice cap melting, and the subsequent rise in sea levels. The population of the world is suffering because of this environmental issue. The building materials that release the most carbon dioxide (CO_2) during the production of burnt clay brick, concrete, and cement mortar. The traditional binding powder for the creation of mortar and

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concrete is cement. Cement production contributes significantly to the world's CO_2 emissions, accounting for about 2.4 percent of all CO_2 emissions from energy and industrial sources. Calcium plays an important role in the concrete. In the present study, the Microbially induced calcium carbonate precipitation method is used to produce calcium. MICP is the use of microbial metabolism to induce the production of calcium carbonate ($CaCO_3$) by mineralization. Microbially induced calcium carbonate precipitation (MICP), enzyme-induced calcium carbonate precipitation (EICP), and microalgae-induced calcium carbonate precipitation are the three fundamental construction biotechnology approaches (MAICP). All the methods use urea and $CaCl_2$ as common ingredients and bacteria, urease enzymes, or microalgae for MICP, EICP, and MAICP, respectively, to produce calcium carbonate ($CaCO_3$) precipitation. The bio-cementation method makes use of the calcium carbonate that is deposited by specific organisms. One of the essential components for accomplishing bio-cementation and accelerating bio-mineralization is urease. Therefore, the bio-cementation technique can be divided into Microbially Induced Carbonate Precipitation (MICP) and Enzymatically Induced Carbonate Precipitation (EICP) depending on various urease sources. The bacteria used in the project is Bacillus Cohnii. Hence, the present study is focused on finding the use of bacteria in the process of production of cement.

Many researchers like Achal et al. (2009) [1], Muynck et al. (2010) [2], and Kaur et al. (2013) [3] worked on the use of bacteria in concrete. They concluded that the presence of bacteria will increase the compressive strength of concrete. Karunagaran (2014) [4] and Azadi et al. (2017) [5] worked on the use of bacteria in the making of soil bricks and soil stabilizations respectively. Qian et al. (2018) [6], Chandrasiri et al. (2019) [7], Irfan et al. (2019) [8], and Nething et al. (2020) [9] explore the use of bacteria for the creation of bio-cement.

Nething et al. (2020) [9], have studied that that a new sustainable technology is the replacement of Portland cement used in the manufacture of building materials with bio-cement made from microorganisms. Bricks and other bio-cemented building materials have been manufactured in molds where bacteria-containing aggregates solidify when treated with a cementing solution, limiting the size of the component. These restrictions may be removed with the aid of additive manufacturing techniques. In the current work, an automated method for creating spatial structures has been devised. Sand and calcium carbonate powder that is urease active were placed in certain locations inside a print volume and then treated with a cementing solution. In the powder-containing sections, this technique created the right circumstances for calcite

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precipitation. The 3D-printed construction had well defined limits and was geometrically stable. Testing for compressive strength on cylinder specimens revealed that the powder-sand mixture utilized may produce high-strength bio-cemented materials. The current work shows how bio cement can be used in an additive manufacturing method to create building components that are resource-efficient and sustainable.

Kala and Lakshmi (2022) [10] have studied that concrete by its nature contains microcracks, which weaken structures. The toxicity and other shortcomings of the techniques utilized to manage microcracks prevent them from being fully effective. When bacteria are utilized in fresh concrete, calcite precipitates in the voids, increasing the strength and decreasing the permeability of the concrete. Bacillus pasteurii 5%, urea, and calcium lactate 95% are the ingredients that make up bio-cement. In this investigation, compressive strength and flexural strength values for M25 grade concrete were measured after 7 and 28 days of curing by adding 0, 0.5, 1, and 2% Bio-cement by weight of cement.

Wang et al. (2022) [11] Due to its high compressibility and poor strength, calcareous sand is commonly found in coastal areas all over the world and is typically regarded as a weak and unstable material. A method for enhancing soil is microbial-induced calcium carbonate precipitation (MICP). The widely used bio-augmented MICP method is less natural soil environment friendly than other approaches, nevertheless. Therefore, the bio-stimulated MICP technique is the main focus of this investigation since it is thought to be more effective and is likely to prolong the dominance of ureolytic bacteria. This paper's main goal is to examine the compressibility of calcareous sand that has been treated using a bio-stimulated MICP technique. A series of one-dimension compression tests on bio-cemented sand made through bio-stimulation with various initial relative densities were carried out in the current study.

2. OBJECTIVE

The objectives of this study are,

1. To determine the effect of using calcium and urea for the formation of bio concrete.
2. To determine the effect of the curing period on the compressive strength of bio-concrete.

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3. METHODOLOGY

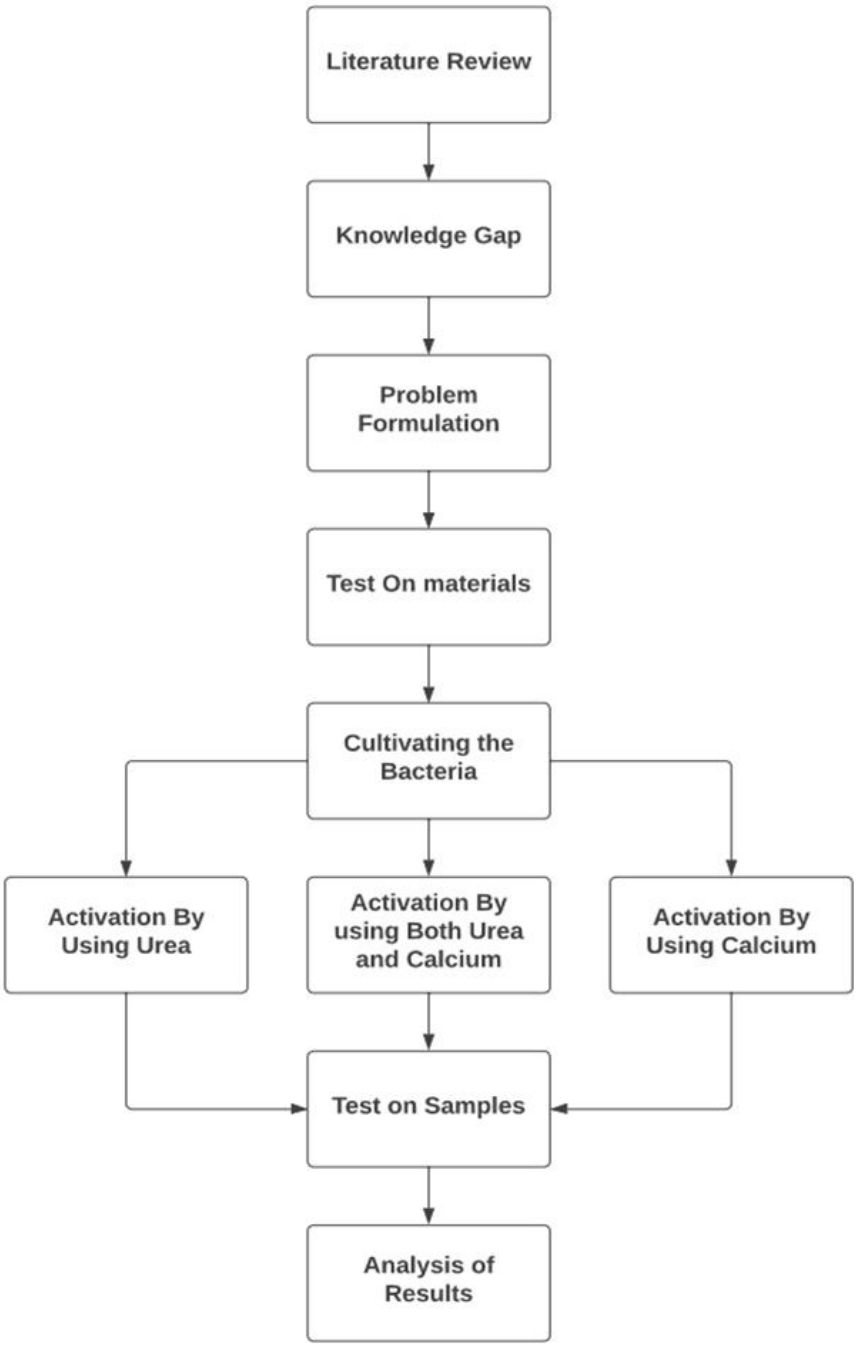

Figure 1: Methodology

4. RESULT AND DISCUSSIONS

4.1 MATERIALS

- Bacteria: Bacillus Cohnii.
- Fine Aggregate (Sand): Passing through 4.75mm sieve.

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- Coarse Aggregate: Passing through 20mm sieve.
- Ground Granulated Blast-furnace Slag.
- Fly Ash.

4.2 BACTERIA

- Full Scientific Name: Bacillus Cohnii Spanka and Fritze 1993
- Species: Bacillus Cohnii
- Domain: Bacteria
- Phylum: Firmicutes
- Class: Bacilli
- Order: Bacillales
- Family: Bacillaceae
- Genus: Bacillus

4.3 BACTERIA MEDIA

- Culture Medium: Alkaline Nutrient Agar
- Culture Medium Composition: Alkaline Nutrient Agar . After sterilization add sterile 1M Na-sesquicarbonate solution (1 ml in 10 ml) to achieve a pH of 9.7 Na-sesquicarbonate solution: $NaCHO_3$ anhydrous 5.3g Distilled water 100ml
- Temperature: 30° (optimum)
- Temperature Range: Mesophilic

4.4 PROCESS OF MEDIA PREPARATION

The media (liquid) considered for the culturing the bacteria was constituted by adding 5.00 g of peptone to 3.95 g of calcium acetate and 3.00 g of meat extract in 1 litre of distilled water. The resultant mixture constituted the liquid medium per stock culture.

Sterilization of the mixture was carried out by autoclaving at a temperature of 121°C.This was done for 20 minutes. This mixture was then cooled to room temperature. The media (liquid) considered for the culturing the bacteria was constituted by adding 5.00 g of peptone to 3.95 g of calcium acetate and 3.00 g of meat extract in 1 litre of distilled water. The resultant mixture constituted the liquid medium per stock culture. Sterilization of the mixture

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was carried out by autoclaving at a temperature of 121°C. This was done for 20 minutes. This mixture was then cooled to room temperature.

4.5 PREPARATION OF LIQUID CULTURE

Bacillus cohnii bacterial culture was transferred to 50 mL falcon tubes (Fig 10). Each falcon tube was centrifuged at 10,000 rpm for 10 min to separate bacterial cells, the supernatant was disposed of, and bacterial cells (pellets) were harvested for re-suspension in physiological solution (NaCl, 9 g/L). The required concentration of 105 cells/mL was adjusted by checking with a calorimeter at 600nm. Then, the bacterial cells were suspended in a nutrient solution containing calcium nitrate (20 g/L), urea (20 g/L) and yeast extract (2 g/L) of cement mass. The solution was then mixed to avoid precipitation. The concentrations of calcium nitrate, urea, and yeast extract were 2%,2%, and 0.2%, respectively.

5. EXPERIMENTAL WORK

An experimental investigation was performed to find the effect of using Bacillus Cohnii to produce concrete. In the present work, concrete cubes are cast using a mold of size 150×150×150 mm. To find the effect of bacteria and its related strength experiments are conducted in seven different trials. The each trial had varying quantities of GGBS, Fly ash, and Bacteria. Variation for bacteria was taken as 50% and 10%. For compression, a trail mix of 1:1.5:3 was adopted. The water and (GGBS+ Fly ash) ratio was taken as 0.5.

5.1 PHASE 1

An initial trial was conducted by using sand and coarse aggregate without any GGBS, Fly ash or Cement. Sand and coarse aggregate were taken in equal proportions. The liquid culture was added to the mixture of the sand and coarse aggregate and subjected to curing.

After 7 days of curing, it was observed that there was no bonding between the fine and coarse aggregate. Hence, the initial trial failed to achieve any bonding between the aggregated and the bacteria did not show any signs of bonding or calcium precipitation.

5.2 PHASE 2

Since phase 1 fails to achieve desired compression strength. The phase 2 is performed using GGBS and Fly ash. In each trial, an attempt is made to use 10% and 50% of bacteria. The percentage of the materials used is given in the table below.

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Table 1: Trail mix for Phase 2

	GGBS (%)	FLYASH (%)
TRAIL A	30	70
TRAIL B	70	30
TRAIL C	50	50

After the cubes were cast with 10 and 50% bacteria the cubes were left to cure. There were 18 cubes (9 with 10% bacteria and 9 with 50% bacteria) cast for each trial. After 7 days it was observed that the cubes failed to create any bonding between the ingredients. Hence, the cube crumbled as it was being removed from the mold resulting in zero compressive strength.

From this phase, it can be concluded that the GGBS and Fly ash did not have any bonding strength nor did the bacteria have any effect on it.

5.3 PHASE 3

As phases 1 and 2 were failed, it was decided to use a small portion of cement to create initial bonding between the aggregates. The percentage of Fly ash was set as 20%. In the Phase 3 10% and 50% of bacteria was used. The cubes were cast and cured for 7 and 14 days and was tested for compressive strength.

Table 6.2 shows the proportions of the materials taken for the current setup.

Table 2: Trail mix for Phase 3

	GGBS (%)	FLYASH (%)	CEMENT (%)
TRAIL D	50	20	30
TRAIL E	30	20	50
TRAIL F	0	0	100

The following are the results of the test conducted on the cubes that were casted.

Table 3: Seven days of curing and 10% bacteria

SAMPLE	AVERAGE COMPRESSIVE LOAD (KN)	STRENGTH (N/mm2)
D1	430	19.111
E1	420	18.667

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F1	440	19.556

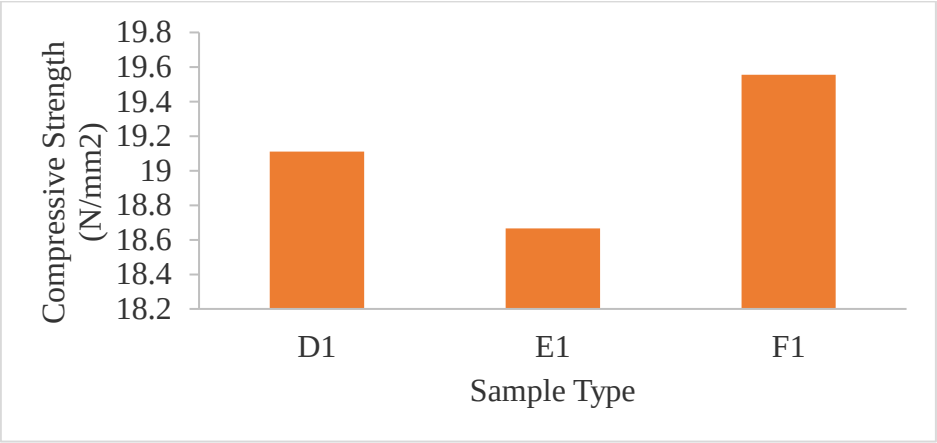

Figure 2: 7 days of compression strength with 10% bacteria – Phase 3

Table 4: Fourteen days of curing and 10% bacteria

SAMPLE	AVERAGE COMPRESSIVE LOAD (KN)	STRENGTH (N/mm2)
D1	460	20.444
E1	450	20
F1	470	20.889

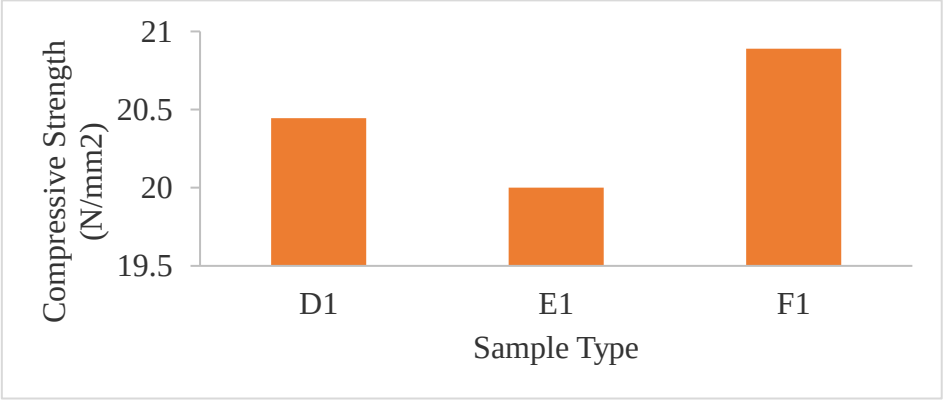

Figure 3: 14 days of compression strength with 10% bacteria - Phase 3

Table 5: Seven days of curing and 50% bacteria

SAMPLE	AVERAGE COMPRESSIVE LOAD (KN)	STRENGTH (N/mm2)
D1	440	19.556
E1	430	19.111

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F1	450	20

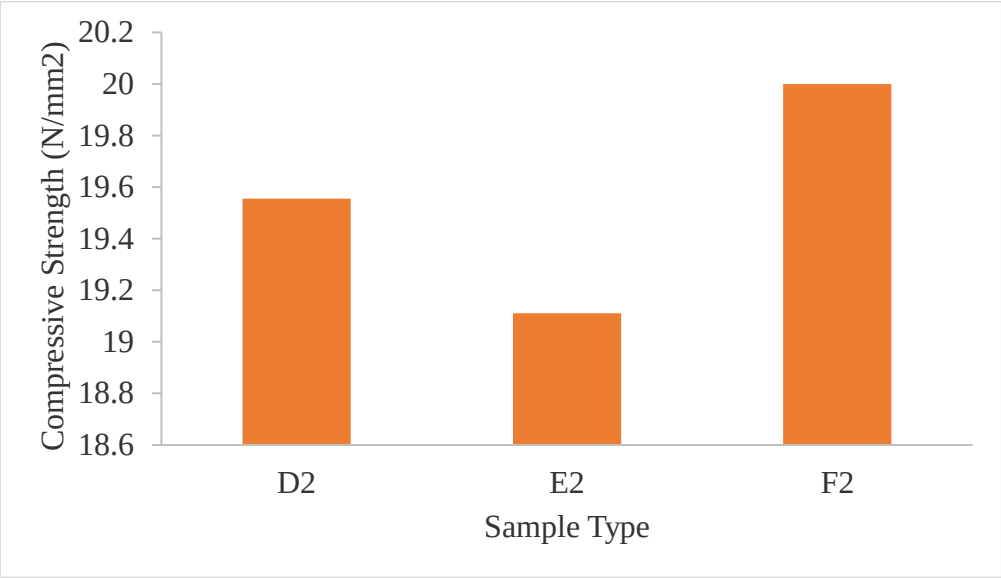

Figure 4: 7 days of compression strength with 50% bacteria - Phase 3

Table 6: Fourteen days of curing and 50% bacteria

SAMPLE	AVERAGE COMPRESSIVE LOAD (KN)	STRENGTH (N/mm2)
D1	480	21.333
E1	460	20.444
F1	490	21.778

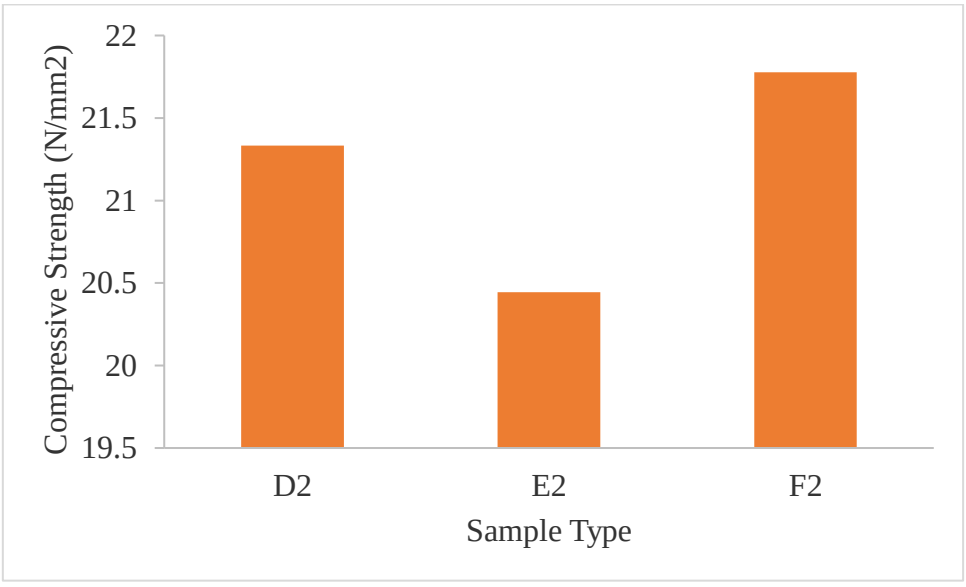

Figure 5: 14 days of compression strength with 50% bacteria - Phase 3

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5.4 COMPARISION

The following are the figures representing the compressive strengths of the cubes with 10% and 50% of bacteria used.

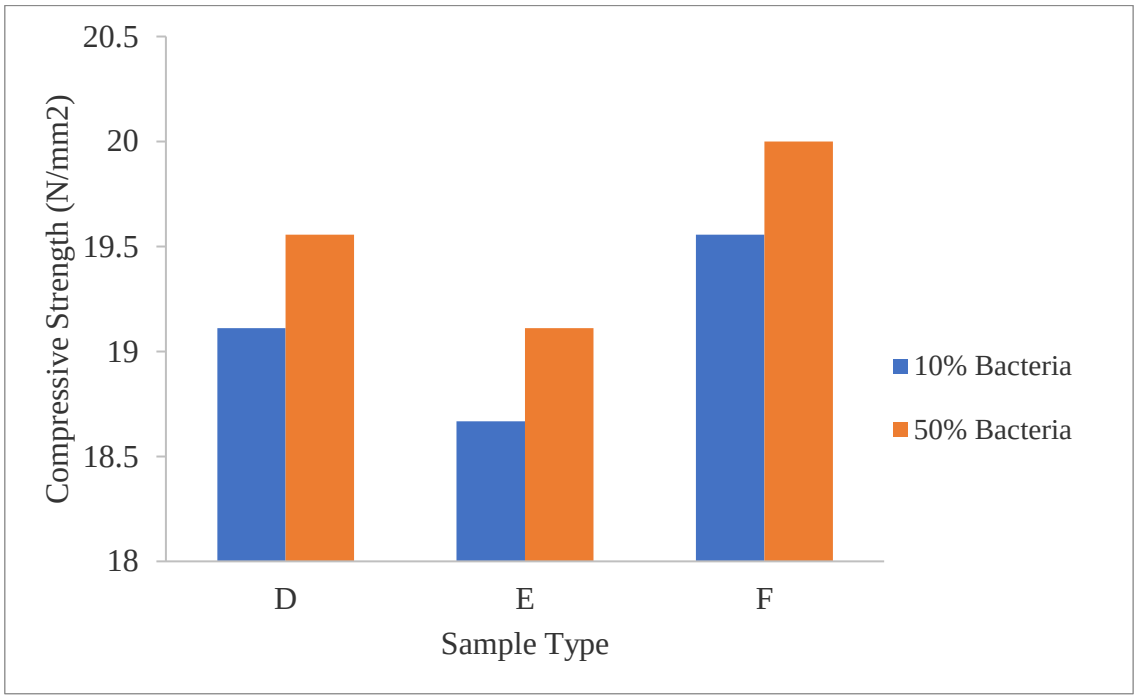

Figure 6: Effect of bacteria on 7 days compression strength

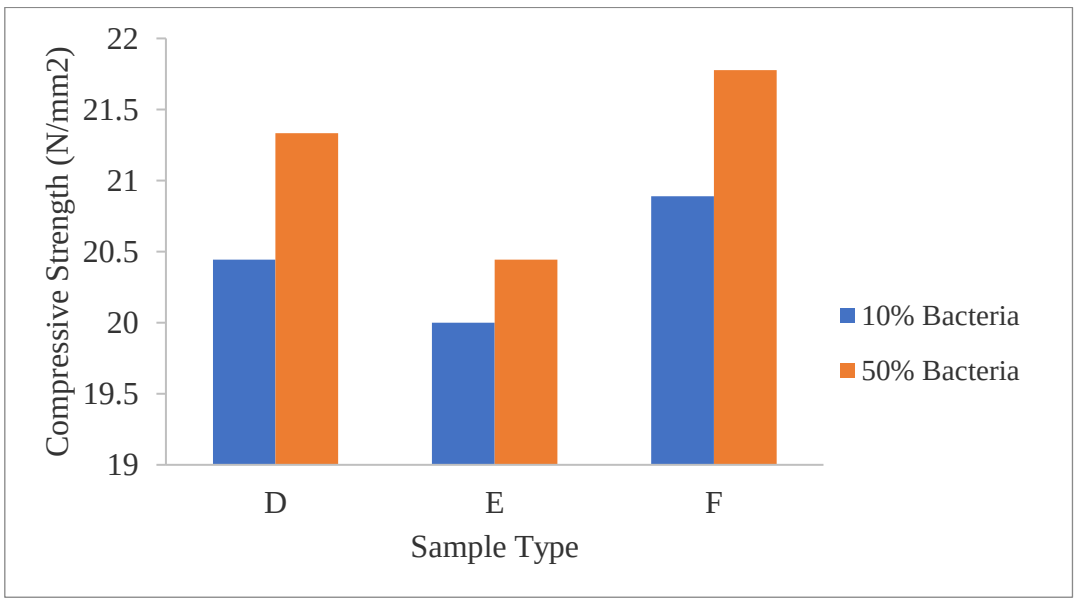

Figure 7: Effect of bacteria on 14 days compression strength

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6. CONCLUSION

Based on the present study following conclusions were made,

- There was no effect of bacteria on cubes cast using GGBS and Fly ash.
- A minimum of 30% cement is required to act as binding material.
- Bacillus cohnii bacterial may contribute 2% to 4% increase in compressive strength.
- The compressive strength of the mixture with 30% cement, 50 % GGBS, and 20% Fly ash is nearly in the range of concrete using 100% cement.

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ISBN-978-81-19905-39-3

ICEST_CV-004

USAGE OF FILLER TILE OR MARUTHY TILE IN AND AS A PART OF CONCRETE

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Abstract:

Innovative and reasonably priced filler slab technology reduces the encumbrance of a slab by partially replacing the concrete with filler material. It describes the usage of filler tiles as a fundamental component of concrete slabs and their advantages and disadvantages. Filler slabs are added to concrete slabs to improve structural performance, aesthetic appeal and sustainability, among other benefits. Concrete slabs potential as a versatile building material can be fully realized by incorporate filler tiles into them.

This study examines the number of filler tile usage related topics - such as, appropriate tile type selection, Installation methods, and the effect of filler tile qualities on slab characteristics. This project aims to estimate amount of concrete and steel saved as a result of usage of filler in the RCC slab, study the structural behavior of the filler slab, and to compare the heat insulation properties of filler slab with conventional RCC.

According to the study's findings, filler tiles help the concrete slabs load bearing capacity,minimize its risk of crackingand improve the durability. Additionally infill tiles can improve the slab's aesthetic appeal by enabling customized designs and patterns.By minimizing the waste and utilizing the recycled or re purposed materials,the usage of filler tiles also encourages sustainable practices.

Overall this research highlights the significance of using filler tiles as a practical way to improve structural performance, aesthetics, and sustainability in building projects.

Keywords:

Filler slab, RCC, structural performance, sustainability load bearing capacity, durability, heat insulation property, customized designs and patterns.

ISBN-978-81-19905-39-3

1. Introduction

Innovative and reasonably priced filler slab technology reduces the encumbrance of a slab by partially replacing the concrete with filler material. Since all the concrete in the tension zone does not contribute to the tensile qualities, the idea behind the usage of filler-slab technology is to eliminate a sizeable amount of that concrete. Without sacrificing the quality and structural integrity of the construction, this concrete is replaced with a lightweight, inert, and affordable filler [1]. The filler slab is based on the concrete portions and instead of placing filler material there and is one of the most cost-effective roofing system present in the current scenario. It is one of the ancient time technologies which saves labor and material cost to a large extend. Due to the use of low-cost, less-heavy filler materials such as clay pots, and broken pieces of cement blocks, the filler slab consumes less concrete and steel as compared to the conventional RCC slab [2]. The replacement of inoperable cement concrete with lighter filler materials, encumbrance of the slab is diminished considerably. The reduction in weight as much as 20 to 30% enhances thermal comfort inside the building due to heat-resistant caliber of filler materials and the gap between two burnt clay tiles. A technique to reload the concrete in the tension zone is the filler slab [3].

As a result, the filler material is not a structural component of the slab. The cost of the roof is decreased in such a way that along with maintaining the strength of the customary slab by decreasing the quantity and weight of the material. The roofing tile is one of the popular filler materials. The building uses less cement and steel and is a good heat insulator in comparison. As long as using the filler slab is concerned the critical zone does not uplift the tensile properties but it increases the concentration of concrete below the neutral axis. Without compromising the structure's quality or structural integrity, this concrete is replaced with a lightweight, affordable, inert filler.

Cost lucrativeness is one important aspect because it costs less than the cost of the concrete being replaced.

Panchal and Marathe [1] For a G+30 storied commercial project that is constructed in an earthquake zone, they weigh the advantages and drawbacks of steel, steel concrete composite, and R.C.C. options. The experimental work-up indicates that the ecumbrance of a steel-framed structure is reduced by thirty two percentage when compared to a R.C.C. frame structure, and that of a composite-framed structure is reduced by thirty percentage when compared to a R.C.C. frame structure. Shear forces in secondary beams are typically increased in steel structures by

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83.3% and decreased in composite structures by 10% when compared to R.C.C. framed structures, while shear forces in main beams are typically increased in steel structures by 131% and decreased in composite structures by 100%.

Suryawanshi [2] the study surrounded near the nodal displacement in a particular steel structure. The study summarized that the nodal displacements in steel composite structures using both seismic analysis methods are lower than those in R.C.C. structures in all three global directions. Renavikar [3] by including an analogous R.C.C structure the experiments compared the cost of steel concrete composite and equivalent R.C.C structure. The RCC and steel-concrete composite of various mentioned story structures such as (G+9, G+12, G+15, G+18) that are located in Pune's earthquake zone III and have a 43 m/s wind speed were compared in this study. The study employed the Equivalent Static Method for analysis.

Shweta, Waghe [4] Using the ETABS 2013 software, four different multi-story commercial buildings (G+12, G+16, G+20, and G+24) were examined. By using MS-Excel programming for design and cost estimation, a comparison between R.C.C. and composite structures is made based on the results. The composite structure was found to be roughly twice as strong as the R.C.C. structure, yet within acceptable limits. When compared to composite structures, R.C.C. structures have higher shear and axial forces.

Umesh and Suryanarayana [5] a comparison of the G+ 15-storey RCC and composite structures was observed and compared in the experimental study. The Software which was designed for this purpose was ETABS 2013. In a zone three earthquake zone of medium soil both the RCC and composite structure have swampy storey at the ground level. The Analysis was made using the equivalent static and response spectrum approach. The criteria taken into consideration are storey drift, self-weight, bending moment, and shear force. Finally after the whole experiment it was concluded that when compared to RCC, composite structure performed better.It was determined that the storey drift in soft storey levels is 10% less in composite models than in RCC. Storey drift is reduced by 70% in other storeys that use a similar static situation. Murat and Bünyamin [6] in this research, both parametric studies and actual buildings were used to examine the effect of solid and lightweight hollow block slabs on construction costs. A solid slab in concrete structure can be described as the one in which a typical slab is supported by beams and columns and has loads are transferred to them. Solid slab systems are known to modify structural ductility and affect the findings of modal analyses due to their high diaphragm firmness, necessary lateral resistance, and translational rigidity. It's really important

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to securely resist the pressures that the loads cause. The building must also be cost-effective. Slabs are either two-way or one-way spanning systems. They are referred to as lightweight when lightweight material fills the area between the beams.

Rifat [7] the study comes to a conclusion by comparing the minimal cost variation caused by the conversion of the chosen solid and lightweight hollow block slab types. In every example that was looked at, the structure with the lightweight hollow block slabs was more expensive than the building with the solid slabs. It has been determined that structures using thin hollow block slabs were able to reach higher periods and shearing force values. It is anticipated that the structure's relative storey displacements and period will increase when the floor weight of the hollow block slab rises.

2. Materials used

1) Filler tiles
2) Cement
3) Coarse aggregate
4) M-sand
5) Reinforcement steel

3. RESULTS AND DISCUSSIONS

B. Comparison of the heat insulation properties of filler slab with conventional rcc

TABLE 1

DIGITAL THERMOMETER READINGS

Temperature	Filler slab	Rcc slab
Day 1	28°c	32°c
Day 2	27°c	31°c
Day 3	28°c	32°c

C. Design procedure of filler slab

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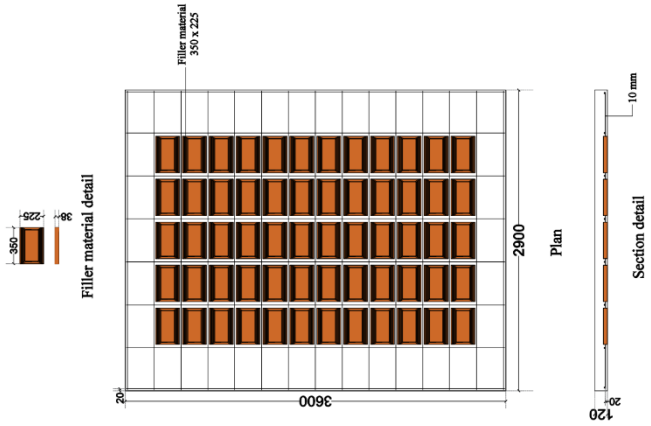

Fig. 2: AutoCad drawing of filler slab

Load calculation

self weight = 3 kn/m^2

floor finishing load = 1.0 kn/m^2

live load = 1.5 kn/m^2

total load = 5.5 kn/m^2

ultimate load = 7.3 kn/m^2

effective span= 2.7 m

maximum midspan moment = 7.5kn/m^2

diameter of the bar = 10mm

$$lx/d = 20$$

$$3600/20 = 20$$

$$d = 180$$

reduced to 120

from table 27 of is456-2000

for ly/lx = 1.228

αx = 0.084

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αx = 0.093

by interpolation

αx = 0.088

αy = 0.059

αy = 0.055

by interpolation

αy = 0.057

∴αx = 0.0885 and αy = 0.057

mux = αx·wlx^2

= 0.0885 × 7.3 × 2.7^2

= 4.709 kn/m

muy = αy·wlx^2

= 0.057 × 7.3 × 2.7^2

= 3.03 kn/m

by interpolation

αy = 0.057

mux = 0.87fyast x d(1-fyast/ fck b · d)

4.709 x 10^6 = 0.87 x 450 x ast x 120 (1-450 x ast/

20 x 1000 x 120)

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ast = 110.81 mm^2

using 12mm φ

$\pi d^2/4$

$\pi 12^2/4$ = 102.06 mm

muy = 0.87fyast x d(1-fyast/ fck b · d)

3.03 x 10^6 = 0.87 x 450 x ast x 120 (1-450 x ast/ 20 x 1000 x 120)

ast = 70.801 mm^2

using 10mm φ

$\pi d^2/4$

$\pi 10^2/4$ = 110.93 mm

D. Site work

laying the filler tiles

1) Understanding the inner room size.
2) Arrangement of inner tiles in a required quantity.
3) Deciding the main bar and distribution bars direction with respect to the room size.
4) Proper laying of filler tiles in a way that main bars should come nearby.
5) Adjusting the tile edges with respect to the wall and using cut pieces if needed.

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Fig. 3: E.Wiring

1) It is better to prepare the electric drawings before the slab works.
2) Wiring through filler tiles.
3) Fixing the fan points and giving provision to the switchboards (on walls).
4) Providing electric conduits from each room to the distribution box through the filler tiles.

Fig.4: *F. Concrete works*

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1) Extraction of steel bars @ 14x10 inches at the adjacent of tiles.

2) Extraction of second layer steel @ 14x10 inches over the filler tiles so that steel rebar is @ 5x7 inches.

    a. Preparing of concrete, pouring and compacting.

Fig.5: Preparation of Concrete

4. CONCLUSION

1) Filler slab has shown better heat insulation than conventional RCC slab
2) The filler tile is kept below the neutral axis, the part below the neutral axis does not bear any compression so it does not make any changes.
3) We have designed a filler slab and compared to the steel area of conventional RCC and noticed that we have saved 30% of steel area.

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ISBN-978-81-19905-39-3

ICEST_CV-006

VERMICOMPOSTING BY VERMIREACTOR IN PACE CAMPUS

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Abstract:

The traditional method of vermicomposting has drawbacks in terms of processing time and space adaptation. By designing and building a rotary drum vermicomposter, this study attempts to overcome these difficulties. By maximizing aeration and moisture distribution, the rotary drum's creative design speeds up the decomposition process by enabling the effective mixing of waste materials. By removing the spatial limitations that are frequently connected to traditional technologies, this small and transportable vermicomposter offers a workable option for urban settings and small-scale waste generation. More people are adopting and learning about effective composting techniques due to the well-thought-out design and simple operation. The study yielded notable results, such as a notable reduction in composting time to 25-30 days as opposed to 45-60 days for standard procedures, increased space usage, and greater waste management. After the composting is done, we get vermiwash and vermicompost as the end product which can be later used for gardening or vegetation, and can also increase the fertility of the soil.

Key Words: Vermicomposting, Rotary drum vermicomposter, Aeration, Decomposition, Composting time reduction, Vermiwash.

1. Introduction

There are various ways of managing organic waste and turning it into useful fertilizer. Composting is the most widely accepted option for organic waste management due to its simplicity in producing high-quality fertilizer. Vermicomposting, the traditional method, usually takes around 45-60 days. However, the vermireactor rotary drum composting process

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can complete the organic waste decomposition process in just 25-30 days, making it an effective approach.

Jain et al.[1] The aim was to improve the efficiency of vermicomposting by modifying the conventional vermireactors. A modified vermireactor design was developed, replacing the thick vermibed at the bottom with a thick moist cloth to allow a larger quantity of organic waste to be processed. Laboratory studies were conducted to compare the performance of modified vermireactors with conventional ones.

Gajalakshmi et al. [2] The study focuses on optimizing vermireactors for epigeic earthworms (Eudriluseugeniae, Eisenia fetida, Perionyx excavatus) that dwell in humus and leaf litter in natural environments with shallow borrows. Researchers simplified the design by eliminating layers of gravel, sand, and soil typically used for other earthworm types in vermireactors. Instead, they introduced a moistened cotton cloth at the base of the vermireaction tank, providing a moisture-rich layer beneath the compost feed, resembling the natural habitat of these epigeic earthworms.

Aalok and Tripathi [3] The study aimed to assess the nutrient quality variation in compost and vermicompost derived from different plant species' leaf litters mixed with municipal solid waste (MSW) and investigate Eisenia fetida's potential in composting these litters. The experiments demonstrated substantial changes in pH, C/N ratio, and nutrient content during vermicomposting, with notable increases in total nitrogen, phosphorus, potassium, calcium, and magnesium. The earthworms showed a preference for cow dung, followed by different leaf litters mixed with MSW, indicating varied feeding efficiencies.

Das et al. [4] The study investigates the effects of various biodegradable organic wastes (BOWs), such as cattle manure, paddy straw, weeds, and municipal solid waste (MSW), used as earthworm feed in vermicomposting. Additionally, lime and microbial inoculants are introduced into the process to explore their impact on secondary nutrient status and heavy metal content in the resulting vermicompost.

Sujatha and Bhat [5] The study aims to evaluate the impact of vermicompost derived from arecanut waste on soil fertility in the context of the laterite soil ecosystem. By focusing on monitoring changes in soil fertility resulting from the application of vermicompost, the research intends to provide insights into the efficacy of organic waste recycling as a sustainable means to enhance soil fertility. This initiative aligns with the broader goal of sustainable agricultural practices

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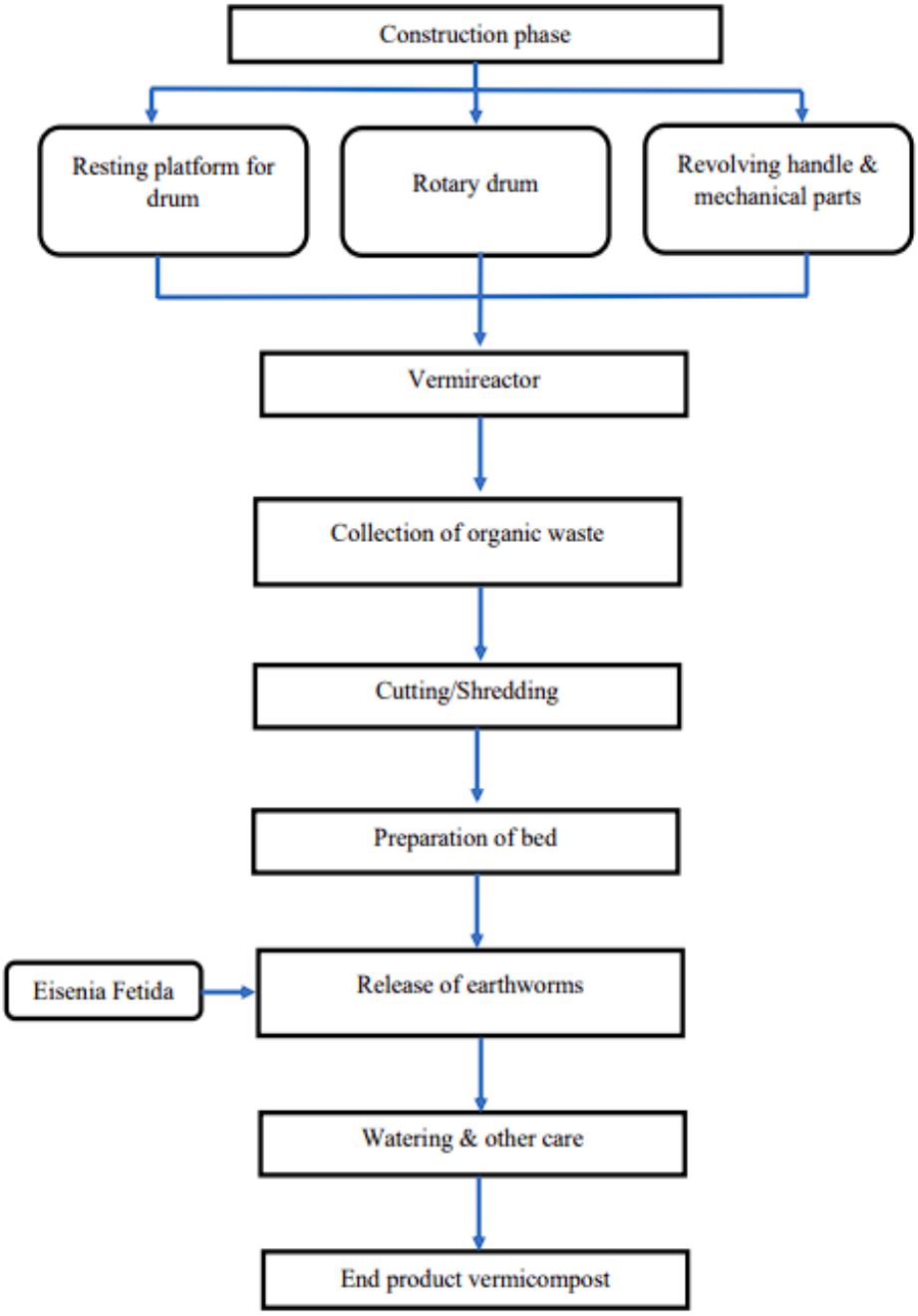
Jayakumar and Sakthivel [6] The study highlights the process of vermicomposting, a non-thermophilic and biodegradative method involving earthworms and associated microbes. This process yields vermicompost, a biofertilizer known for its finely divided, peat-like structure with exceptional qualities such as high porosity, good aeration, water holding capacity, and microbial activity. Vermicompost is rich in nutrients and possesses buffering capacity, making it conducive to soil fertility and plant growth.

2. METHODOLOGY



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2.1Materials Used

- Kitchen waste.
- Eggshell powder.
- Paper/Cardboard and other degradable waste.
- Red Soil.
- Eisenia fetida.
- Coco peat.

2.2 Process of Vermicomposting

- The Vermi reactor unit should be in a cool, moist, and shady site.
- Bio-waste from the cafeteria, college canteen, and hostel mesh are collected for preparing compost. The waste accumulated on the campus is also used like dry leaves, shredded paper waste, cardboard, etc.,
- Now prepare bedding by adding dried leaves and other biodegradable waste collected.
- The raw materials are filled till the capacity of the vermi reactor.
- Red earthworms should be released on the upper layer of the bed.
- Water should be sprinkled immediately after the release of worms.
- The Vermireactor should be turned once after every 2 days to maintain aeration and for proper decomposition.
- Proper temperature should be maintained throughout the process.
- Compost gets ready in 25-30 days.The finished product is 3/4th of the raw materials used.

2.3 Preventive Measures

- The floor of the unit should be compact to prevent earthworms' migration into the soil.
- organic wastes should be free from plastics, chemicals, pesticides, metals,etc.
- Aeration should be maintained for proper growth and multiplication of earthworms.
- Optimum moisture level (30-40 %) should be maintained.

18-25°C temperature should be maintained for proper decomposition.

2.4 WORKING WITH WORMS

Bedding - A stable habitat that serves as a hospitable environment for worms to live, feed, and grow is known as bedding. An ideal bedding material protects, provides protection, and

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moisture, and allows the flow of oxygen. The mixture of Organic waste with this bedding material accelerates decomposition.Bedding materials can easily be selected as per the local availability. Some common bedding materials include dry leaves, shredded paper, cardboard, newspaper, dust, etc. The efficient bedding should be highly porous as the soil's high porosity favors these creatures through their skin. If a worm’s skin dries out, it dies.

Worm Food -Under ideal conditions, a worm can consume food excess to its body weight per day. However, the general thumb rule is that they consume approximately the amount of organic waste equivalent to their body weight per day. They eat like monsters and can eat anything organic. Most often these organic waste foods are used as worm feeds. Some commonly used worm feeds are poultry manure, cow dung, sheep and goat’s manure, food scraps and peelings, leftover food, etc.

Moisture - As stated above high porosity is needed to maintain healthy conditions for worms and to maintain high porosity adequate moisture needs to be maintained in the system. Worms are much active in moist soil as compared to dry ones but most of the species of worms are found unable to survive flooding, hence an optimum moisture content of almost 50 to 75 percent must be maintained for proper functioning and survival of worms. Available literature suggests that in Indian conditions moisture range of 50 to 60 percent serves every purpose of vermicomposting operations in any system. We are taking this optimum range of moisture for the installation of a vermicompost system on the premises.

Aeration - Worms are oxygen breathers and are unable to survive in the absence of oxygen. Hence high moisture combined with poor aeration can cause sudden multiple deaths of worms. Proper oxygen is maintained inside the unit with manual turning from shovels or trowels.

Temperature - All the species of worms exhibit high growth rates but E. eugenia has a wider endurance for temperature in comparison to the other two species which allows the species to often survive at 45 degrees Celsius and as low as 5 degrees Celsius. Besides these the depth of the wastes cannot exceed 30 cm. due to temperature Harms during the initial thermophilic stage of decomposition.

pH - Worms prefer to inhabit under neutral conditions for which the optimum range of pH is 7 to 8. Worms are sensitive to the nature of their surrounding medium. If the pH falls below 6 the worms migrate or are killed.Under these conditions, pH can be adjusted by adding calcium carbonate if it needs to increase but if it needs to lower the pH acidic bedding can be used.

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Light - Earthworms are very sensitive to light and they tend to avoid the strong light that's why worms come to the surface only at night i.e., to avoid the light. They detect the light by photoreceptor cells on their skin these cells can trigger pain when exposed to sunlight.

Therefore, it is necessary to cover the worms from waste and to prevent daylight, several techniques can also be used such as the use of dark heavy curtains, or the system can be covered by banana and palm leaves.

Daily Vermicomposting Routine

- Spray approximately 1 kg of water onto the compost mix daily to maintain proper moisture levels.
- Rotate the drum every 2-3 days initially, performing 3-5 rotations per session, and adjust the frequency based on the composting process's progress.

3. DESIGN OF ROTARY DRUM VERMICOMPOSTER

3.1 Materials Required

- Large plastic barrel or drum with a tight-fitting lid (120ltrs capacity)
- Drill
- 1/4-inch drill bit
- 1-inch drill bit
- 2-3 feet of PVC pipe
- PVC end cap
- Worms (Eisenia fetida)
- Bedding materials (shredded newspaper, cardboard, leaves, cocopeat)
- Organic food scraps (vegetable and fruit scraps, eggshells)
- Rectangular hollow tube
- Screws and bolts

3.2 Rotary Drum Vermicomposter

- The drum volume is 55 liters. This is the main component of vermicomposting where the organic material is composted. It rotates slowly to mix the compost and distribute the organic waste evenly.
- The frame is made of a steel rectangular tube section the steel should be such that it should

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stand the load of the drum and compost inside it.

- It is designed such that it can be rotated freely 360°. There is also an axial inside the drum so that it can withstand the load of the compost and bedding. Rotation is provided so that the waste that is dumped inside can be mixed thoroughly without using our hands and to maintain aerobic composting and ventilation.
- Holes are provided on the top and side of the drum for circulation and proper ventilation and to insure adequate oxygen supply for the worms.
- Hatches are provided in the U-shaped and they are secured using hardware for opening and closing. The hatch is provided so that the waste can be dumped inside the barrel using these hatches.
- For the rotation of the device handle lever is provided so that the perfect mixture of the waste can be obtained. The lever is provided for easy workability.

3.2.1 Assembly of Rotary Drum Vermicomposter

- Clean the drum thoroughly to remove any residue or chemicals.
- Cut the drum lengthwise with a saw into two halves.
- Drill holes along the bottom edge of both halves of the drum, spaced about 1 inch apart.
- Cut the rod or pipe into two pieces, each slightly longer than the width of the drum.
- Drill two holes through each end of the rods.
- Place the rods through the holes in the drum.
- Secure the rods to the drum halves with nuts and bolts.
- Cut two circles from the mesh, slightly larger than the diameter of the drum.
- Attach the mesh circles to the inside of each drum half, covering the holes drilled. This will prevent compost from falling out.
- Attach hinges and a latch to one of the drum halves to create a door that can be opened and closed.

3.3 MATERIALS FOR COMPOSTING

Waste Papers -Shredded paper is an inexpensive and readily available bedding material. It is also easy to shred and provides a good balance of carbon and nitrogen in the compost.

Coconut coir (coco peat) - Coconut coir is a sustainable alternative to peat moss and provides good aeration and moisture retention. It is also pH-neutral and can be reused multiple times.

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Cardboard - Cardboard is a good source of carbon and can be shredded or torn into small pieces to use as bedding. It is also a good way to recycle cardboard waste.

Leaves: - Leaves are a readily available source of carbon and can be used as bedding. It is important to avoid using leaves from trees that have been treated with pesticides or herbicides.

Shredded paper - Shredded paper is an excellent bedding material as it is readily available, easy to shred, and provides a good balance of carbon and nitrogen in the compost. It is important to avoid using glossy or colored paper, as these can contain harmful chemicals.

Vegetable and fruit peels - Vegetables and fruit peels are good sources of nutrients for the worms and can also be used as bedding material. However, it is important to avoid using citrus peels as they are too acidic and can harm the worms.

3.4 Bedding procedure

- Start by shredding or tearing the bedding material into small pieces. This will help increasesurface area and promote composting.
- If using materials like straw or hay, make sure to remove any seeds or plant matter that could attract pests.
- Mix the bedding materials to achieve a good balance of carbon and nitrogen. As a general rule, aim for a ratio of about 3:1 carbon to nitrogen.
- Continue alternating layers of bedding material and waste until the vermicomposter is full. Moisten the bedding material with water to ensure that it is moist but not too wet. The bedding material should feel like a damp sponge.
- Keep the bedding moist for a couple of days, so that the materials start to decompose a little bit.
- Introduce the worms into the bin and let them settle inside the bin.
- Add a layer of food waste on top of the bedding material. Be careful not to add too much food waste at once, as this can lead to anaerobic conditions and unpleasant odors.
- Close the vermicomposter and begin rotating it regularly to ensure good aeration and mixing of the compost.
- Check the moisture level of the compost regularly and add more water as needed. You may also need to add more bedding material if the compost becomes too wet or if the worms

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start to run out of bedding.

- Harvest the compost once it is fully broken down and has a dark, earthy smell. This can take anywhere from afew weeks to a few months, depending on the size of the vermicomposter and the amount of food waste added.

3.5 EGGSHELL POWDER IN VERMICOMPOST

Eggshells are a great source of calcium and can help balance the pH of vermicompost. Adding eggshell powder to your vermicompost can provide essential nutrients to your plants and help maintain a neutral pH environment for worms. To use eggshell powder, rinse the eggshells, crush them into small pieces, and add a small amount to your vermicompost. Monitor the pH regularly and adjust the amount of eggshell powder as needed.

3.6 VERMIWASH AS A BY-PRODUCT

Vermiwash is a liquid extract obtained from vermicomposting, which is a process of composting organic waste using earthworms. It is an excellent organic fertilizer and biopesticide and is rich in nutrients and beneficial microorganisms.

3.7 pH TEST ON VERMIWASH

The pH value of vermiwash, which is a liquid fertilizer produced from earthworm castings, ideally falls within the slightly acidic to neutral range, typically between 6.5 and 7.5. This pH range is conducive to nutrient availability and microbial activity, promoting healthy plant growth. However, slight variations may occur depending on factors such as the composition of the feedstock and the process of vermicomposting.

Fig. 1: Vermiwash

ISBN-978-81-19905-39-3

3.8 FINAL PRODUCT AS VERMICOMPOST

Vermicompost is a type of organic fertilizer and soil conditioner that is rich in nutrients. It is produced as earthworms consume organic waste and turn it into smaller particles. During this process, the waste is enriched with beneficial microorganisms and essential nutrients like nitrogen, phosphorus, potassium, calcium, and magnesium. Vermicompost is collected from the earthworm's excretions as castings.

Fig. 2: Final product of vermicompost

3.9 SEPARATION OF VERMICULTURE AND VERMICOMPOST

Lose the bed with the help of mesh, and sieve and wait for 5-10 minutes or till earthworms reach to lower layers, then, remove a layer free from earthworms and their eggs. Repeat this process of separation three times and collect the removed material (vermicompost) sieve it and keeping for further use. The material remaining in the bed will be vermiculture. Collect it and keep it for its survival in a vermiculture bed.

4. CONCLUSION

The rotary drum vermireactor efficiently composts materials, yielding the final product in 28 days, faster than conventional methods. The laboratory test results show consistent increases in vermicast production in both low-rate and high-rate reactors with the new design. Vermiwash, a valuable byproduct, has been confirmed to be a nutrient-rich liquid fertilizer. The vermicompost produced is nutrient-rich and surpasses many commercial fertilizers.

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ISBN-978-81-19905-39-3

ICEST_CV-010

PARTIAL REPLACEMENT OF FINE AGGREGATE USING GLASS POWDER AND COURSE AGGREGATE USING CRUSHED CONCRETE IN CONCRETE BRICK

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ABSTRACT:

Cement concrete is one of the most commonly used materials in modern buildings. The evolution of technology and contemporary living habits has caused a surge in the production and diversity of waste, resulting in a crisis in waste management. This research addresses the issue of waste originating from construction activities, such as discarded concrete and glass. To mitigate the accumulation of specific types of waste, there is a suggestion to repurpose some of these materials by integrating them as substitutes for a portion of the primary constituents in cement concrete blocks utilized in construction endeavors. This research investigates the feasibility of partially replacing fine aggregate with glass powder and coarse aggregate with crushed concrete in the production of concrete bricks. The study focuses on replacing fine aggregate with glass powder at 10% and 20% levels, and replacing coarse aggregate with crushed concrete at 10%, 20%, and 30% levels. The compressive strength of the resulting concrete bricks was evaluated to assess the feasibility and potential benefits of these substitutions. Experimental tests were conducted to measure the compressive strength of concrete bricks with varying replacement levels of glass powder and crushed concrete. The results indicate that the partial replacement of fine aggregate with glass powder and coarse aggregate with crushed concrete does not significantly compromise the compressive strength of the concrete bricks. Furthermore, the research demonstrates that replacing fine aggregate with glass powder and coarse aggregate with crushed concrete can potentially enhance the sustainability of concrete production by utilizing waste materials.

Key Words: Concrete bricks, Fine aggregate, Glass powder, Coarse aggregate, Crushed concrete, Compressive strength, Sustainability

ISBN-978-81-19905-39-3

1. INTRODUCTION

The construction industry is constantly seeking innovative approaches to enhance the sustainability of building materials and reduce environmental impact. Concrete, being one of the most widely used construction materials, plays a crucial role in infrastructure development worldwide [1-5]. However, the production of conventional concrete involves significant extraction of natural resources and energy consumption, contributing to environmental degradation [6-10]. To address these challenges, researchers and practitioners have been exploring alternative materials and methods to improve the sustainability of concrete production. One such approach involves the partial replacement of traditional constituents with recycled or waste materials. This not only reduces the consumption of natural resources but also mitigates the accumulation of waste in landfills [10-13].

Partial replacement of traditional aggregates with recycled or waste materials has emerged as a promising strategy to achieve these goals (Siddique & Khan, 2011) [14]. Glass powder, a byproduct of the glass industry, and crushed concrete, derived from demolition waste, are two such materials that have gained attention for their potential as supplementary cementitious materials and aggregate replacements, respectively (Tavakoli et al., 2019 [15]; Pacheco-Torgal et al., 2018 [16]). Incorporating these waste materials into concrete production not only reduces the consumption of natural resources but also diverts waste from landfills, addressing both environmental and economic concerns (Rahman & Al-Hashmi, 2017) [17].

Moreover, the study examines the environmental implications of using glass powder and crushed concrete as partial replacements for fine and coarse aggregates, respectively. By diverting waste materials from landfills and reducing the demand for virgin resources, the proposed approach has the potential to contribute to environmental conservation and sustainable development.

Overall, this research aims to provide valuable insights into the feasibility and effectiveness of incorporating waste materials into concrete production for the manufacturing of sustainable concrete bricks. The findings of this study can inform decision-making processes in the construction industry and promote the adoption of environmentally friendly practices in concrete manufacturing.

This study focuses on evaluating the feasibility of partially replacing fine aggregate with glass powder and coarse aggregate with crushed concrete in the production of concrete bricks. The compressive strength of these bricks is a critical parameter for assessing their structural

ISBN-978-81-19905-39-3

performance and suitability for various construction applications (Neville, 2011) [18]. Understanding how different replacement levels of glass powder and crushed concrete affect compressive strength is essential for determining the practicality and viability of this sustainable approach.

Furthermore, the environmental implications of using waste materials in concrete production are a key consideration. By reducing the demand for virgin resources and minimizing waste generation, sustainable concrete production practices contribute to environmental conservation and promote circular economy principles (Tam & Tam, 2020) [19].

This research aims to provide valuable insights into the feasibility and effectiveness of incorporating glass powder and crushed concrete as partial replacements for fine and coarse aggregates, respectively, in concrete brick manufacturing. By addressing both technical and environmental aspects, the findings of this study can inform decision-making processes in the construction industry and support the adoption of sustainable practices.

2. OBJECTIVE

The major goal of this study is to examine how well cement concrete mixes function when recycled waste materials like glass and crushed concrete are included as a portion of the aggregates in cement concrete block mixtures. This will be proved by experimental laboratory testing that substitute a portion of the fine aggregates in cement concrete blocks with fine glass aggregates and a portion of the coarse aggregates with crushed concrete

The objectives of this study are,

1. To determine the ideal replacement ratio for broken concrete as the coarse aggregate and glass powder as the fine aggregate in concrete blocks

determine the effect of using calcium and urea for the formation of bio concrete.

2. To evaluate the parameters governing the strength of concrete produced using glass powder and broken concrete. Check the strength parameters of concrete made using glass powder and crushed concrete.

ISBN-978-81-19905-39-3

3. METHODOLOGY

3.1 METHODOLOGY

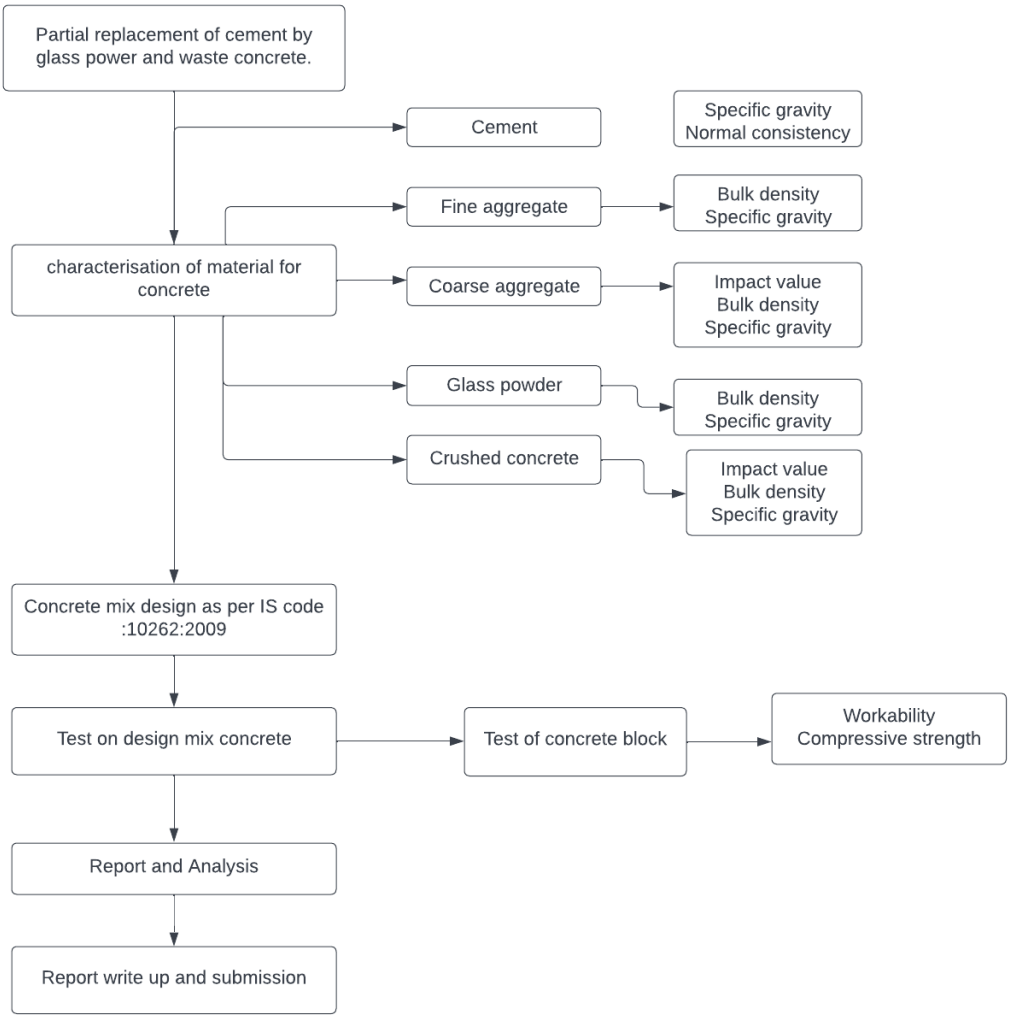

Figure 1: Methodology

3.2 MATERIALS

The physical characteristics of the following materials, which must be examined in laboratories: cement, fine aggregate, coarse aggregate, glass powder, crushed concrete, and water utilised in the mix design of concrete blocks.

3.2.1 Cement

The mentioned characteristics of the cement that was used. An adhesive that hardens and sticks to other materials to bind them together, cement is a binder, a chemical compound used in construction. In most cases, cement is used to bond sand and gravel (aggregate), not on its own.

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Concrete is created by mixing cement with sand and gravel, or with fine aggregate to create a masonry motor. All paragraphs must be indented. All paragraphs must be justified, i.e. both left-justified and right-justified.

3.2.2 Fine Aggregate

Fine aggregates are essentially any unrefined sand that has been extracted from the earth through mining. Natural sand or any broken stone fragments that are 1/4" or smaller make up fine aggregates. Due to the size, or grade, of this specific aggregate, this product is frequently referred to as 1/4 minus. Examples of fine aggregate used in concrete include sand, surki, stone screens, burnt clays, cinders, fly ash, etc. Brick chips, stone chips, gravel, pebbles, clinkers, cinders, etc. are all examples of fractured materials.

3.2.3 Coarse Aggregate

Concrete is made with coarse aggregates, which are granular and uneven materials like sand, gravel, or crushed stone. Coarse is typically found in nature and can be obtained by blasting quarries or crushing them manually or with crushers. They must be thoroughly cleaned before being used to make concrete.

3.2.4 Glass Powder

Another waste product that is produced in great amounts and is challenging to eliminate is waste glass. It is well known that the majority of waste glass, particularly container glass, is collected, remelted, and utilised to make new glass. However, not all of the used glass can be used to make new glass.

3.2.5 Crushed Concrete

Large volumes of waste are produced during the manufacture and usage of concrete in addition to garbage from old concrete. Demolished concrete, concrete sludge, concrete grinding residue (CGR), and waste concrete fine are a few different types of concrete waste.

4. RESULT AND DISCUSSIONS

4.1 Specific Gravity Test: The specific gravity (G)of a material is the ratio of the mass of a unit volume of soil solids at a specific temperature to the mass of an equal volume of gas-free distilled water at the same temperature.

ISBN-978-81-19905-39-3

Specific gravity test for fine sand and glass powder was done. Specific Gravity of fine sand was obtained 2.6 and Specific Gravity of glass powder was obtained 2.6.

Specific Gravity of coarse aggregate was obtained 2.7. Specific Gravity of concrete waste was obtained 2.7.

Table 1: Specific Gravity Test

	Fine sand	Glass powder	Coarse aggregate	Concrete waste
Specific gravity	2.6	2.6	2.7	2.7

4.2 Selection of Concrete Block Grade

Minimum strength of brick for Load Bearing wall- 3.5 N/mm2. Design strength chosen for the project- 5N/mm2 We choose respective mix ratio of materials for specified concrete strength. ie; Cement: Sand: Coarse Aggregate = 1:5:10, which is the Mix Design for M5 concrete.

Table 2: Is Class Designation of Brick

Classification of bricks based on IS 1077:1992	
Classes of burnt clay bricks	
Class deisignation	Average compressive strength not less than (N/mm2)
35	35
30	30
25	25
20	20
17.5	17.5
15	15
12.5	12.5
10	10
7.5	7.5
5	5
3.5	3.5

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4.3. Ratio of Glass Powder and Concrete Waste

Table 3: Ratio of Mix

Glass powder %	**Concrete waste %**
Glass powder 10%	Concrete waste 10%
	Concrete waste 20%
	Concrete waste 30%
Glass powder 20%	Concrete waste 10%
	Concrete waste 20%
	Concrete waste 30%

4.4 Compressive Strength Result

The compressive loads and strengths at which the different cubes failed were as shown in the tables. The value of compressive strength of each of the specimen cubes is given by the expression below;

Compressive strength = $\frac{Maximum\ compressive\ load}{Cross-sectional\ area\ of\ specimen}$

Where,

$Compressive\ strength = Maximum\ compressive\ load$

$Cross-sectional\ area\ of\ specimen$

In this case the standard moulds of 15cm were used giving cubes whose area was;

$Area$ = $15x15$ = $225cm2$ ($22500mm2$)

Test were conducted after 14 days of casting. Minimum Compressive strength after 14 days is 90%. That is, 4.5 KN/mm2 after 14 days for M5 concrete.

Table 4: Compressive Strength Gain Chart

Recommended result of cube test	
Age of concrete	Minimum compressive strength of concrete (%)
1 day	16%

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3 days	40%
7 days	65%
14 days	90%
28 days	99%

Table 5: Compressive Strength Test Result

Glass Replacement (%)	Crushed Concrete Replacement (%)	Maximum Loads (KN)			Compressive strength (N/mm2)			Average Compressive Strength (N/mm2) (After 14 Days)
		Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3	
10	10	135	140	130	6	6.22	5.77	5.99
10	20	130	125	120	5.77	5.55	5.33	5.55
10	30	125	115	105	5.55	5.11	4.66	5.10
20	10	140	130	120	6.22	5.77	5.33	5.77
20	20	130	120	110	5.77	5.33	4.88	5.33
20	30	115	105	110	5.11	4.66	4.88	4.88

From the results in the table above, it was observed that there was a general decrease in compressive strength with increase in glass powder percentage and increase in crushed concrete percentage. This is due to the fact that natural fine and coarse aggregates have a higher crushing value than glass powder and crushed concrete. This has an overall effect of decreasing strength of concrete

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4.5 Results and Discussion

From the results in the table above, it was observed that there was a general decrease in compressive strength with increase in glass powder percentage and increase in crushed concrete percentage. This is due to the fact that natural fine and coarse aggregates have a higher crushing value than glass powder and crushed concrete. This has an overall effect of decreasing strength of concrete

5. CONCLUSION AND RECOMMENDATION

It was generally observed that the compressive strength decreased with increase in glass powder and crushed concrete replacement. Considering the compressive strength of the cubes after 14 days of curing, it can be observed that at 30% replacement of fine aggregate with glass powder and 30% replacement of coarse aggregate with crushed concrete, the value of compressive strength was higher than the expected design 5KN/mm2. Conclusively, a glass powder replacement between 0 - 30% and crushed concrete replacement between 0 - 30% will give the required strength

ACKNOWLEDGMENT

The successful completion of any task would be incomplete without mentioning the people who made it possible. So it is with gratitude that we acknowledge the help, which crowned our efforts with success.We are extremely thankful and indebted to my guide Mr. Mohammed Faisal for his able guidance, valuable time spent, relentless effort, and constant encouragement during the entire tenure of the Project work. It will not be an overstatement that the entire journey of the research work is enlightened with his vision and mission. We would like to thank our Project Co-Ordinator, Dr.Praveen Suvarna for providing his valuable guidance and support, and also we would like to thank all the staff members and lab technicians of civil Engineering department.

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ISBN-978-81-19905-39-3

ICEST_CV-011

DESIGN OF ROOFTOP RAINWATER HARVESTING FOR P. A. IBRAHIM HAJI MEMORIAL PHYSIOTHERAPY CENTER, NADUPADAVU, MANGALURU, DAKSHINA KANNADA DISTRICT, KARNATAKA

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Abstract:

Water is known as the elixir of life due to its importance in the lives of living creatures. The rapid increase in population, changed climatic conditions, frequent occurrences of floods, draughts, etc., caused the scarcity of water in many regions of the world. So, to fulfil the requirements of water supply for domestic purposes, there is great demand and scope for rooftop rainwater harvesting. In the present work, an attempt is made to design the rooftop rainwater harvesting system for Dr. P. A. Ibrahim Haji Memorial Physiotherapy Centre, Nadupadavu, Mangaluru, with the objective of harvesting the rooftop rainwater and using it for domestic purposes and groundwater recharge. The annual volume of water to be collected to be collected from the rooftop is obtained using the area of the rooftop and the average annual rainfall in the region. The sizes of the gutters and downpipes are provided based on the rooftop area, rainfall and intensity of rainfall as per the guidelines of IS 15797:2008. A provision is made for the first flush system and filtration to remove substances causing pollution of the water. Excess water flowing out of the tank is directed to flow into the infiltration pit, which helps to induce the groundwater recharge. The storage tank is designed, and a cost analysis is done. It is evident from the study that rooftop rainwater harvesting is a very viable, reliable, and economical method to supply water for domestic and groundwater recharge. Also, it is one of the ways forward for sustainable utilization of water resources.

Key Words: Rooftop, Rainwater harvesting, Gutters, Downpipes, Storage tank, Infiltration pit.

ISBN-978-81-19905-39-3

1. Introduction

Water is the most essential element for the survival of every living being. For all of our daily tasks, we require water. Water is the mother, the foundation of life, and the medium whose consumption is always increasing. The need for water conservation has always been urgent, and there are various tools available. The uneven water budget equation has elevated the desire to conserve water to the next level in an effort to lessen the pollution and water shortage problems [1]. Rapid urbanization, development, the concentrated population density in many regions and changed lifestyle in many regions have resulted in excessive use surface water and groundwater has led to water scarcity and also the overexploitation of ground water resulted in decrease in the yield and degradation of quality. This has resulted in drought and drying up of river beds and defunct of wells. To alleviate these problems storm water harvesting from runoff would be an effective way [2],[3],[4],[5]. Storm water harvesting is a method of collecting water wherever it falls, rainwater, the purest form of water, may be immediately used to supplement the water supply for different uses. The practice by which the rainwater is collected from rooftop catchments is termed as rooftop rainwater harvesting [6]. Rainwater collected in natural ponds or artificial tanks can be used to recharge the groundwater and helped in the boosting of water levels in the wells [7]. Utilizing a roof, a land surface, or a rock catchment are examples of reasonably clean surfaces where rainwater collection technology is employed to collect and store rain for later use. The water is typically routed to recharge groundwater or stored in a rainwater tank. Another part of rainwater harvesting is infiltration, which is crucial for the management of stormwater runoff and replenishment of groundwater levels. In dry and semi-arid regions, rainwater gathering has been performed for over 4,000 years to provide residential water, drinking water, water for cattle, and irrigation. Today, rainwater harvesting has grown significantly in importance as an easy-to-use and cutting-edge technology. Though, rain water harvesting is vital for sustainable water resources development of both rural and urban regions, the major challenge in the design is to estimate the area for storing water. The required catchment area should be designed effectively to collect rainfall for required purpose [8],[9]. Rooftop rainwater harvesting has enhanced the groundwater recharge and improved quality of groundwater [10].

There are two major categories into which the process of collecting rainwater from rainfall events can be divided: roof-based and land-based. When runoff from land surfaces is gathered

ISBN-978-81-19905-39-3

in furrow dikes, ponds, tanks, and reservoirs, this is known as land-based rainwater harvesting. When rainwater runoff from roof surfaces is collected, it usually results in a considerably cleaner source of water that can also be used for drinking. This practice is known as "roof-based rainwater harvesting. Rainfall harvesting from highways, parking lots, and rooftops can enhance water availability for various domestic needs and assist to alleviate the country's persistent water shortages since most rural and urban areas in Jordan lack run-off sewer systems [11]. It is found that rainwater harvesting performs economically and in terms of saving water and energy in Pakistan's four major cities, Islamabad, Lahore, Peshawar, and Khanpur [12]. To increase system performance and the stability of the water supply, a rainwater harvesting (RWH) system must be properly designed and evaluated [13]. The study also showed that the selection of sloping smooth roofs implies a global rainwater harvesting potential greater than flat rough roofs by 50% [14]. The quality of harvested rain water on the basis of different roof materials used and to find the lichens/mosses on the roofing surface. Galvanized steel relatively have high water quality probably due to ultraviolet light and high [15]. Sustainability of roof captured rainwater for possible potable water production was investigated and with a goal to develop a cost-effective, long- term solution for rural communities' drinking water supply [16]. Rainwater harvesting's technical viability for Seven Iranian cities was studied and found that the rainwater harvesting has reduced the domestic portion of the demand for potable water by 15% to 30%, the average annual rainfall ranges from 523 to 1720 mm, and the potable water demand in the residential sector is from 152 to 242 litres per person per day [17]. It is found that on long-term environmental and potential effects of rooftop rainwater harvesting combined with shallow well infiltration, which is a less expensive solution that could help to ease water shortage problems [18].

From the literature, it is concluded that sloping roofs such as clay tiles, metal sheets and plastic sheets can be used for better quality. The different roof materials are used to quality of harvested rain water. It was found that galvanized steel will relatively have high water quality. It was concluded that composite asphalt shingle and metal roof were the most common roofing materials used for harvesting. When combining 50% traditional flat roofs and 50% extensive green roofs. It was concluded that combined solution can be feasible depending on the variability of rainfall. Use of rain water or toilet flushing reduces the amount of ground water recharge.

ISBN-978-81-19905-39-3

2. Materials and Methods

2.1 Location of the building

Mangalore is situated in the Dakshina Kannada district and the building is located at 12° 48' 30.9636" N and 74° 55' 54.9048" E and at an altitude of 219.00 metres above mean sea level. The satellite image of the building is as shown in Figure 1. The front view of the building is as shown in Figure 2.

Figure 1: Satellite image of Dr. P. A. Ibrahim Haji Memorial Physiotherapy Centre located in PAET campus Mangalore

Figure 2: Dr. P.A. Ibrahim Haji Memorial Physiotherapy Centre, Nadupadavu, Mangalore, D.K. District

P. A. Educational Trust established in the year 2000 and started many educational institutions in the PACE knowledge city Nadupadavu, 20 km from Mangalore city. Groundwater is the source of water for all uses of the campus. The excessive withdrawal of water caused scarcity of water during the months of March to June. To alleviate the problem a rainwater harvesting system was undertaken during the year 2016 to recharge the bore wells. However, still the scarcity of water persist. So, in the present work an attempt is made to design a rooftop

ISBN-978-81-19905-39-3

rainwater harvesting of Dr. P.A. Ibrahim Haji Memorial Physiotherapy Centre to fulfill the needs of the domestic water supply of the center, where the rooftop is already covered with galvolume iron profiled sheet.

2.2 Details of study area.

Mangalore, the headquarters of the Dakshina Kannada District of Karnataka, is a place of mixed cultures and lifestyles. People from different communities and neighboring states have moved here for business, jobs, education and many more. The current metro area population of Mangalore in 2024 is 763,000. Mangalore is also on the Smart Cities Mission list and among the 100's of smart cities to be developed. It is now, both, Dakshina Kannada district's largest city and administrative headquarters. The average ambient temperature remains 25.9°C, varies from 20.8°C to 32.6°C. The average relative humidity remains around 83%, varies from 33.8% to 98.5%. The average wind speed in Mangalore is 3 m/s with the maximum wind speed of around 9 m/s. Tropical weather prevails in Mangalore from June to September, when rainfall is heavy. The average annual rainfall for Mangalore is 3267 mm and the details of monthly distribution of rainfall is as shown in Table No. 1. The same data is used in the design of rooftop water harvesting of the present building located in the P. A. Education Trust, Mangalore campus.

Table 1. Average Annual Rainfall data

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Annual Rainfall (mm)	0	2.54	7.62	27.94	185.42	853.44	955.04	673.1	309.88	175.26	68.58	7.62

3. RESULTS AND DISCUSSIONS

3.1 Calculation of total rainfall.

It is observed from rainfall data that the runoff producing rainfall occurs between the months May to October. Hence the total rainfall is calculated between these months is used in calculation of total rainfall, as given below:

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Total rainfall =185.4+853.44+955.04+673.1+309.88+175.26

Total rainfall = 3152.12 mm (Approximately 3000 mm)

3.2 Roof area calculation

The existing roof area covered with inclined/sloped G. I. sheets is used in the calculation. The details of the roof dimensions are given in the Figure 3.

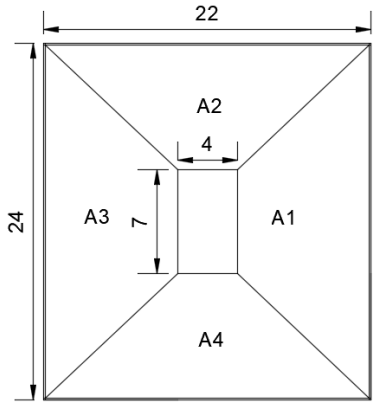

Figure 3: Dimensions of rooftop area covered with G.I sheets

Area of the catchment (Rooftop) = 22*24=528 m^2.

3.3 Volume of rainwater calculated from rooftop area

Volume of water available from rooftop area is calculated using area of rooftop, average rainfall and runoff coefficient

Volume V=area of the catchment x average annual rainfall calculated x runoff coefficient.

Area of the Catchment = 22*24 = 528 m2

Average annual rainfall = 3000 mm

Runoff coefficient (k) = as per recommendations of IS 15797:2008 for inclined rook k= 0.85 is taken.

Volume of water available from rooftop water harvesting.

Va= area of the catchment x average rainfall calculated x runoff coefficient

= 528 * 3000 * 0.85

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= 13, 46, 400 litres.

3.4. Volume of storage required (Vs)

The volume of storage tank can be determined using the following formula recommended by IS 15797:2008

Vs= T x N x Q

Where

Vs= volume of tank in litre

T = length of dry day season days= 200

N = number of people using the tank and= 80

Q= Consumption in litres per capita per day= 20

Vs= 200 x 80 x 20

Vs= 3,20,000 Litres

3.5. Storage tank requirements

It is proposed to provide reinforced cement concrete underground water tanks to store the water. The size of each tanks and total number of tanks are calculated based on total demand/volume of water. The details of calculations are as given below.

Volume required = 3,20,000 Litres

Provide tank of 6m x 4m x 3.5m

Assume free board = 150 mm or 0.15 m

Therefore, Water depth = 3.5 – 0.15 = 3.35

Volume (Provided) = 6 x 4 x 3.35 = 80.40 m^3 = 80,400 litres= Say 80000 litres

Number of tanks = 3,20,000 /80000= 4

The reinforced cement concrete (R.C.C) water tanks and the tanks are designed as per limit state design of R.C.C structures. The details of the storage tank is shown Figure 4. The storage tank to be provided 3.0 m below ground level with 0.35 m projected above the ground level.

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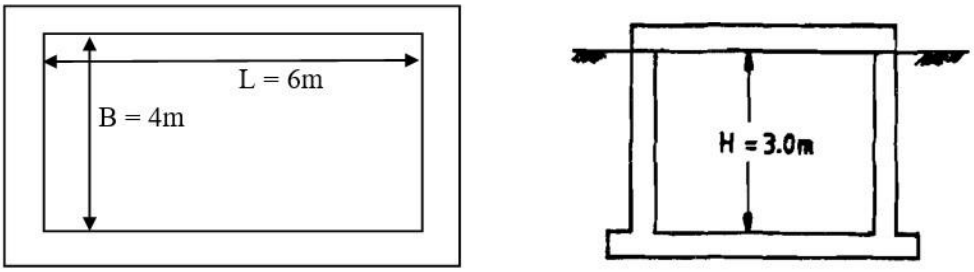

Figure 4: Details of the storage water tank

3.6 Design of Gutters and Pipes

A channel that encircles the edge of a sloping roof and is used to collect and convey rainwater to a storage tank is referred to as a gutter. Gutters can be semi-circular or rectangular in shape, and they are typically made of PVC or galvanised iron sheet. The efficiency of a gutter is greatly impacted by the size, width, and location of those elements in relation to the edge of the roof and the slope of that edge. Consequently, care was taken in selecting this parameter. So, building a gutter with enormous dimensions is essential if you want to gather the most water possible. The value of the water collected from it, however, is far greater than the cost of building the gutter, so it is cost-effective to create huge gutters with suitable dimensions. The gutter width was reduced to account for the throwing wind and pulsating effects. In the present work the diameter 125 mm for the gutters and 210 mm width of GI sheet and down pipe of diameter 90 mm are selected as per the IS 15797:2008 (Table 3) based on area of rooftop and rainfall intensity.

3.7 Filtration unit

When rainwater is harvested in a large rooftop area, the filtering system should accommodate the excess flow. A system is designed with three concentric circular chambers in which the outer chamber is filled with sand, the middle one with coarse aggregate and the inner-most layer with pebbles. This way the area of filtration is increased for sand, in relation to coarse aggregate and pebbles. Rainwater reaches the centre core and is collected in the sump where it is treated with few tablets of chlorine and is made ready for consumption.

3.8 First flush system

The roof of a structure or another collection area will gather debris, dirt, dust and animal droppings. This undesired material would be swept into the tank with the first rains. The water will become contaminated as a result, lowering its quality. Because of this, many RWH systems

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include a mechanism for directing this "first flush" water away from the tank. First flush devices are the name given to these systems. The most basic concepts rely on a manually operated system in which the intake pipe is physically moved away from the tank inlet and then replaced once the initial first flush has been redirected. This approach has apparent disadvantages in that someone must be there who will remember to relocate the object.

3.9 Infiltration Pits:

Infiltration pits are provided to allow the excess water flowing out of the storage tank to flow down and improvement of groundwater recharge. Five infiltration fits each of size 3 m x 2 m x 1.5 m are recommended for the at the downstream of water tanks

3.10 Abstract of Estimated Cost of the Project

The details abstract of estimated cost is shown in Table 2.

Table 2: Abstract of Cost of Estimation

SL NO	PARTICULARS	QUANTITIY	UNIT	RATE PER UNIT	TOTAL AMOUNT (Rs.)
1	**Materials**				
i	90 mm 4 kg/cm2 PVC Downpipe	110	m	Rs. 350/metre	38500
ii	Bend Pipe	16	No.	Rs. 100 /piece	1600
iii	T pipe	16	No.	Rs. 130 /piece	2080
iv	Valves	16	No.	Rs. 150 /piece	2400
v	Gutter pipe	100	m	Rs. 210 /metre	21000
vi	Filtration Tank	1	No.	Rs. 38000/-	38000
vii	First Flush Tank	1	No.	Rs. 8500/-	8500
viii	Concrete M30	240.00	m^3	Rs.8000/m3	1920000
2	**Excavation**	10	Hours	Rs. 1000/hour	10000
3	**Infiltration Pit**	5	Nos	Rs. 5000/unit	20000
4	**Transportation, Labour & Miscellaneous**				35000
TOTAL					**Rs. 20,99, 080** **Say Rs. 21,000,00**

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4. CONCLUSION

- The average rainfall of Mangalore region is about 3000 mm and the quantity of roof water from the roof area of 528 m^2 is quantified as 13, 46,400 litres.
- Total water requirements of the inhabitants of the building is estimated as 3,20,000 litres. Four R.C.C. underground tanks are designed each 80,000 litres capacity.
- A provision is made for filtration of rooftop harvested before collection in the storage tank.
- The total estimated cost of the project is Rs. 21,00,000 (Rupees twenty one lakhs only). In long run of the project it is very economical.
- This project will cater the needs of the Dr. P.A. Ibrahim Haji Memorial Physiotherapy Centre to overcome the water scarcity.

Also in the present scenario of water scarcity this project not only fulfil the water scarcity but also brings sustainability in various aspects in rural as well as in urban areas.

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ISBN-978-81-19905-39-3

ICEST_CV-012

STABILIZATION OF EXPANSIVE SOIL USING INCINERATED WASTE ASH

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Abstract:

Expansive soils pose significant challenges in geotechnical engineering due to their high swelling potential and low bearing capacity. This study investigates the effectiveness of utilizing incinerator hospital waste ash (IHWA) as a sustainable stabilizing agent for expansive soils. The IHWA, a byproduct of hospital waste incineration, is rich in pozzolanic materials and possesses potential for soil stabilization applications. In the present study, a biomedical waste incinerator ash and lime combination was proposed to stabilize expansive soil. Particle size analysis, Atterberg limits, free-swell, compaction, unconfined compression strength, and California bearing ratio tests were conducted on the natural soil and blended with The weak soil mixed with different percentage of IHWA with different percentage of 2.5%, 5%, 10%, 12.5% and 15%. Liquid limit test, Plastic limit test, Standard proctor test were conducted on soil stabilization. Finally, the index properties and Compaction values of soil to be improved.

Keywords: Expansive soil, Stabilization, Incinerator hospital waste ash (IHWA), Engineering properties, Sustainable construction

1. INTRODUCTION

Hospital waste, which includes needles, tubes, blades, bottles, and other plastic materials, poses significant risks for infection spread and environmental pollution. The incineration of this waste releases toxic gases like CO, CO_2, NO_2, and SO_2, as well as dioxins, and produces ash residues (bottom ash and fly ash) that contain heavy metals and other hazardous substances. Bottom ash remains inside the incinerator, while fly ash collects on post-burner equipment, both contributing to environmental contamination [1-3]. When melted at 1200°C, incinerated ash forms a molten state and cools into slag, but metals are not destroyed and can be released into the environment. Healthcare activities generate various

ISBN-978-81-19905-39-3

hazardous wastes, including sharps, human tissues, and infectious materials, with the volume increasing due to more disposable products. This waste has a high potential for causing infection and injury, and improper management can lead to significant pollution of soil, water, and air, adversely affecting humans, animals, and plants. Effective waste management, including segregation, proper treatment, and sustainable disposal methods, is crucial to mitigate these risks and protect public health and the environment [4-6].

Biomedical waste encompasses any solid, fluid, or liquid waste, including containers and intermediate products, generated during the diagnosis, treatment, or immunization of humans or animals, as well as from research activities or the production or testing of biological products. Hospital wastes vary and include infectious, radioactive, chemical, heavy metals, and regular municipal wastes. Biomedical waste is categorized based on the risk of causing injury or infection during handling and disposal, with particular precautions required for sharps (like needles and scalpel blades), pathological wastes (such as anatomical body parts, microbiology cultures, and blood samples), and infectious wastes (including items contaminated with body fluids, dressings, catheters, and IV lines). Additionally, healthcare settings generate radioactive wastes, mercury-containing instruments, and polyvinyl chloride (PVC) plastics, which are among the most environmentally sensitive by-products. According to the World Health Organization, 85% of hospital waste is non-hazardous, about 10% is infectious, and around 5% is non-infectious hazardous waste. In India, about 15% to 35% of hospital waste is regulated as infectious waste [7].

2. LITERATURE REVIEW

Bhavya (2015) [1] reported the improvement in the strength of a cohesive soil collected fromarea in the vicinity of Renigunta Airport, India by addition of Municipal Solid Waste (MSW) incinerator ash as a soil stabilizing agent. Grain size distribution, specific gravity, Atterberg limits, maximum dry unit weight, optimum moisture content (OMC), UCS, CBR, free swell index (FSI) tests were performed on the soil sample. They used 0 to 50% of ash to stabilize the soil. The optimum bottom ash content was found at 25% considering the unconfined compressive strength of treated soil. The UCS value increased to 53.4 kPa and CBR value increased to 9.38 by addition of 25% ash. Taha (2006) presented the use of

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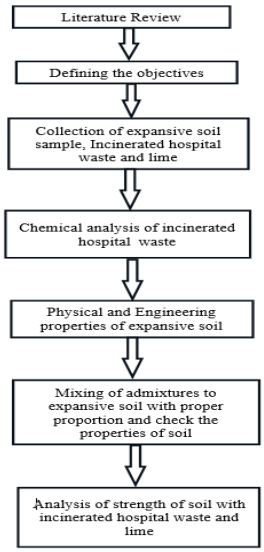
incinerator ash in stabilizing desert sands for possible use in geotechnical engineering applications. The incinerator ash was added in percentages of 2, 4, 8, 10, and 12%, by dry weight of sand. Laboratory tests such as compaction, unconfined compression, shear box and hydraulicconductivity were performed to measure the engineering characteristics of the stabilized material. The results showed substantial improvements in unconfined compressive strength and shear strength parameters (c and u). Thus, incinerator ash can be used to improve the shear strength characteristics of desert sands. The permeability of the sand–incinerator ash mixture was relatively low. Shi and Kan (2009) carried out study to investigate the feasibility of application of municipal solid waste incinerator fly ash as an auxiliary cementitious material. The water demand for normal consistency, setting time, volume stability, flexural, and compressive strength of municipal solid waste incinerator fly ash cement compound matrices were tested. The results show that the MSWI fly ash has some cementitious activity, but the reactivity is relatively lower and its addition to cement may lead to retardation of cement hydration.

3. OBJECTIVE AND METHODOLOGY

3.1 Objective of the study

- To find optimum percentage of incinerated hospital waste and lime.
- To analyze change in geo-technical properties with modified soil with natural soil.

3.2 Methodology



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4. EXPERIMENTAL INVESTIGATIONS

The detailed experimental programme of the present study was undertaken to investigate the changed behavior of the available red soil when mixed with easily available local stabilizingadmixtures like MSWA in different proportions individually or in combinations. This will enable to examine not only suitability of these composite materials in the construction of sub-grade for flexible pavement, but also to decide the optimum mixing proportion for cost effective construction. Initially the geotechnical property like Atterberg limit of the soil and stabilized soil had been determined. The necessary experiment on made to determine the compaction characteristics i.e. optimum moisture content (OMC) and maximum dry density (MDD) by conducting Standard Proctor Compaction tests of those soils. The different tests were conducted in order to determine the different characteristics and properties of the soil.

5. RESULTS AND DISCUSSIONS

5.1 Atterberg Limit (Casagrande Method)

Table. 1: Atterberg Limits of Soil – IHWA Mixes.

S.No	IHWA(%)	Liquid limit (%)	Plastic limit (%)	Plasticity index (%)	Group
1	0	52.3	30.8	21.6	MH
2	2.5	53.3	32.4	20.9	MH
3	5	53.5	33	20.5	MH
4	7.5	54.2	34.2	20	MH
5	10	54.7	35.1	19.6	MH
6	12.5	55.4	36.1	19.3	MH
7	15	56.1	37	19.1	MH

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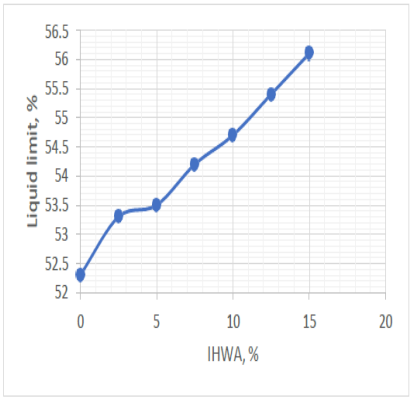

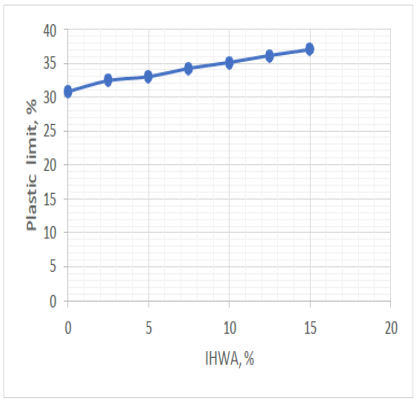

Fig. 1: Liquid limit test results **Fig. 2: Plastic limit test results**

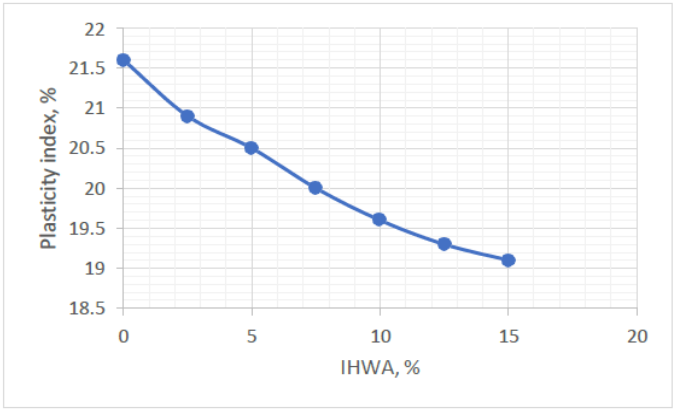

Fig. 3: Plasticity index test results.

5.2 Compaction test (Standard proctor method)

Table. 2: OMC and MDD of Soil- IHWA Mixes

S.No	IHWA %	MDD(g/cc)	OMC (%)
1	0	1.436	26.8
2	2.5	1.420	27.3
3	5	1.398	28.6
4	7.5	1.352	29.4
5	10	1.342	30.6
6	12.5	1.280	31.5
7	15	1.242	32.2

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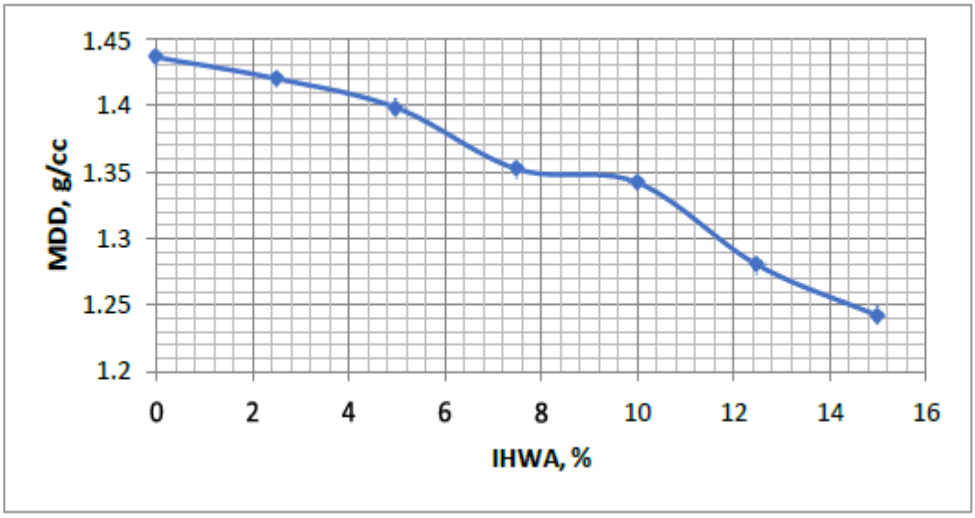

Fig. 4: OMC curve for soil + IHWA.

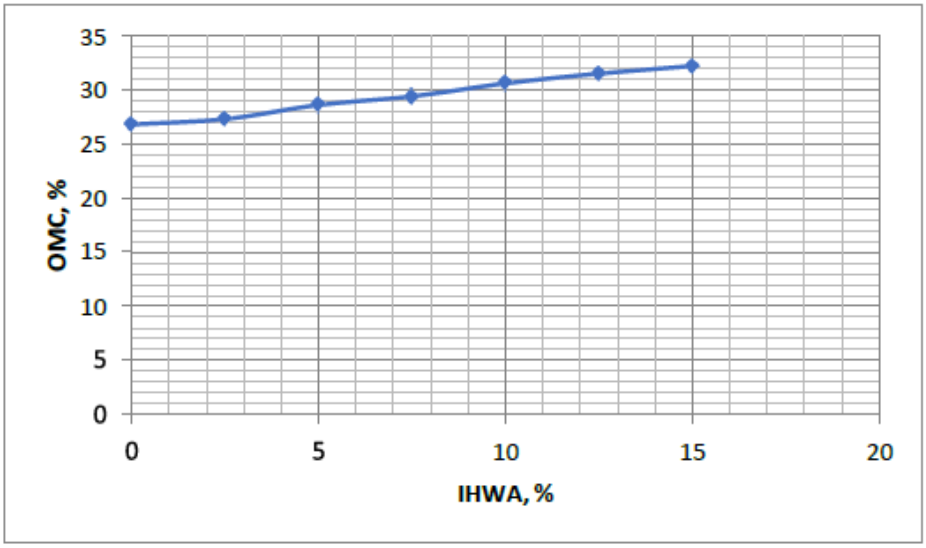

Fig. 5: MDD curve for soil + IHWA.

1. The liquid limit of the soil alone was found to be 52.4%. The liquid limit of the soil with addition of 15% IHWA was found to be increased by 7%, when compared to liquid limit of soil alone.
2. The plastic limit of the soil alone was found to be 30.8%. The plastic limit of the soil with addition of 30% IHWA was found to be increases by 20%, when compared to plastic limit of soil alone.
3. The plasticity index of the soil alone was found to be 21.6%. The plasticity index of the soil with the addition of 30% IHWA was found to be decreased by 11.5%, when compared to plasticity index of soil alone.

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4. The optimum moisture content (OMC) and maximum dry density (MDD) of soil alone was found to be 26.8% and 1.436 g/cc respectively. The MDD of the soil with addition of 30% IHWA by weight of soil is found to be decreases by 13.51% and the corresponding OMC is increased by 20.15%.

6. CONCLUSIONS

On the basis of present experimental study, the following conclusions are drawn

1. The Expansive soil was identified as Intermediate compressible inorganic clay is designed (MH) on Indian Standard classification system. IHWA was used to stabilize the soil for construction in this study and a sufficient cementitious property was found in IHWA.
2. On addition of different percentage of IHWA in the soil (0 to 15%), the plasticity index decreases with an increase in the proportion of rice husk ash from 0% to 15%. The percentage decreases in plasticity index value of soil from 21.6 to 19.1, IHWA stabilized soil respectively.
3. The compaction characteristic of stabilized soil found to be dependent on the plastic nature of the soil. For medium plastic soil, addition of stabilizer to soil reduced the maximum dry density while increasing the optimum moisture content irrespective of stabilizer type.

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ISBN-978-81-19905-39-3

ICEST_CV-013

HYDROPONICS FARMING: The technology towards sustainability

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Abstract:

Hydroponic cultivation is rapidly gaining popularity worldwide due to its efficient resource management and ability to produce high-quality food. Traditional soil- based agriculture is increasingly challenged by factors such as urbanization, natural disasters, climate change, and the overuse of chemicals and pesticides, which deplete land fertility. This paper explores Nutrient Film Technique (NFT). It covers their operations, benefits, and limitations, as well as the performance of different crops like tomatoes, cucumbers, peppers, and leafy greens. Additionally, the paper discusses water conservation through hydroponics. Several benefits of this technique are less growing time of crops than conventional growing, round the year production, minimal disease and pest incidence and weeding, spraying, watering etc can be eliminated. Commercially NFT technique has been used throughout the world for successful production of leafy as well as other vegetables with 70 to 90% savings of water.

Key Words: Hydroponics, Vertical Farming, Agriculture, PH Control, Market cost

1. INTRODUCTION

Hydroponic Farming System is a system of growingcrops without soil, often called soilless farming. In the hydroponic system, the liquid nutrient solution is a mixture made up of essential plant nutrients. The plant roots are suspended either in the static liquid solution or in a continuously flowing mixture [1-3]. Unlike the traditional farming system, the hydroponic growing system requires continuous and undivided attention to the crops. In hydroponic farming, plants grow naturally with filled with nutrients and water-rich solutions, under

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optimal positioning of lights and adjusted temperature conditions. Today, 55% of the world's population lives in urban areas, a proportion that is expected to increase to 68% by 2050 and 593mha ofland will need to be turned into agricultural land to fulfil the estimated calorie demands of the worldwidepopulation [4-7]. Furthermore, the occurrence of second- generation problems, such as over-mining of soilnutrients, decline in factor productivity, lowering of groundwater tables and pest build-up, such as weeds, diseases and insects poses serious problems [8-11]. To mitigate these problems, intensification and vertical expansion of agricultural land has been regarded as the only viable options in near future for meeting the rising food demands. Globally, 70% of water usage goes towards agricultural production, largely due to unsustainable irrigation practices (Worldbank.org). In this context, soil-less cultivation i.e., hydroponics,might be inaugurated successfully and considered asan alternative option for growing quality food plants,crops or vegetables (Butler, 2006). One of the most significant advantages of hydroponic farming is the ability to grow crops in near optimal conditions using Controlled Environment Agriculture (CEA) technology. It can be grown anywhere on the world at any time of year, regardless of weather, accessiblecultivable land, or soil quality. Crop production can be kept in a controlled environment, allowing trained personnel to optimize water (saving up to 70% of water), nutrients and light to the plants using advanced climate control technologies. Light inputs are also optimized to ensure maximum plant absorption and yield outputs. Vertical farms expand upwards instead of outwards on a horizontal plane, allowing farmers to grow 3 to 10 times more crops inthe same amount of space as unlike conventional farms [12-15].

2. LITERATURE REVIEW

Santos et al. (2013) the study aimed to use vinasse, a residue from fuel alcohol distillation rich in nutrients, to create a nutrient solution for growing lettuce, watercress, and rocket. After analyzing vinasse's nutrients, a solution with 10% vinasse, similar to Furlani's solution, was developed. Using the Nutrient Film Technique, the study compared this solution with a commercial product for 42 days. Results showed similar growth between both solutions. The vinasse solution led to more lettuce leaves, increased watercress growth, and no significant difference for rocket. This study successfully created a vinasse-based nutrient solution, demonstrating its potential for effective hydroponic cultivation [1].

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Seungjun and Jiyoung (2015) this review covers hydroponic systems, highlighting their advantages over soil-based farming but also addressing challenges like high costs, pathogen risks, and specialized expertise needed. It focuses on using plant growth-promoting rhizobacteria to control pathogens. While acknowledging hydroponics' popularity, it highlights persistent issues like fungal infections, maintenance, and education. The review anticipates ongoing innovations for better hydroponic systems [2].

Suhl et al. (2016) the research explored a double recirculating aquaponic system (DRAPS) that combines fish and plant units to recycle nutrient-rich fish waste water for hydroponic plant growth. Using tilapia and tomatoes, DRAPS showed similar tomato yields to traditional hydroponics, maintaining fruit quality. It improved fertilizer use efficiency by 23.6% and overall water use efficiency. Even with suboptimal fish production, DRAPS ensures good plant growth and fruit yield, offering a promising solution for sustainable and high-yield food production in aquaponics. Continuous nutrient monitoring is crucial for optimal plant growth in DRAPS [3].

Gashgari et al. (2018) this study compares traditional soil-based farming with hydroponic systems using cucumber and Armenian cucumber seeds in a 30-day experiment. Results indicate that while seed type had no significant impact on plant growth, the hydroponic system notably accelerated growth compared to the soil-based system. This finding highlight hydroponics as a potential solution for meeting increasing food demands. Future large-scale experiments considering diverse factors and plant types are needed to validate these findings for broader agricultural application [4].

Chunjie et al. (2019) the study introduced an aquaponics system using immobilized biofilm units for improved water quality and nutrient efficiency in fish and vegetable production. In a 130- day pilot test, the system effectively converted fish waste into suitable nutrients for plant growth, maintaining low pollutant levels. Aquatic plants and biofilm units efficiently removed nitrogen compounds and organic carbon, showing promise for sustainable aquaponics production [5].

Caputo et al. (2020) the study examines urban farmers' adoption of soil-less methods like hydroponics. It combines literature review and a pilot study in a community garden. Findings show appreciation for hydroponics' environmental benefits but uncertainty about non-natural produce. Surprisingly, higher knowledge didn't ensure greater acceptance. Community

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gardens expressed interest, possibly due to their experimental nature. The research concludes that increased knowledge doesn't always drive acceptance due to a focus on social and environmental benefits over productivity [5].

Salis et al. (2020) the study assessed nutrient recovery methods in urban hydroponic agriculture—direct leachate recirculation, chemical precipitation and membrane filtration in a Barcelona greenhouse. DLR had the lowest environmental impact, recovering phosphorus efficiently. Using recovered nutrients reduced global warming impacts by 44–52%. Circular economy principles in urban hydroponics, especially DLR, promote resource efficiency and sustainability [6].

Jung and Kim (2020) the study used Bacillus species to biodegrade mixed fishery wastewater into a biofertilizer. Optimal degradation occurred at a 10:1 ratio, reducing chemical oxygen demand by 69.1% and total nitrogen by 62.0% in 72 hours. The resulting biofertilizer showed high antioxidant activity, met nutrient standards, and significantly enhanced lettuce growth in hydroponics compared to controls. This eco-friendly approach highlights the potential for recycling fishery wastewater into valuable bio fertilizer using Bacillus-mediated biodegradation [7].

Sowmya et al. (2020) the study compared pesto quality from soil-cultivated basil and coriander (SBP, SCP) with hydroponically grown varieties (HBP, HCP). HBP, from hydroponic basil, showed superior bioactive compounds, antioxidants, and sensory attributes. It exhibited higher viscosity, shear stress, and superior stability during storage compared to other pesto types. Overall, HBP emerged as a favorable choice for high-quality pesto production over soil cultivated herbs [8].

Chekli et al. (2021) This study explored using fertilizer-drawn forward osmosis (FDFO) to reuse wastewater for hydroponics. Bench-scale experiments revealed that the hydroponic nutrient solution performed similarly to other solutions in treating synthetic wastewater. It offers all necessary nutrients for plants without requiring additional elements after dilution. Physical cleaning methods like hydraulic flushing and osmotic backwashing effectively restored water flux, showcasing low fouling potential. Pilot studies confirmed the FDFO process produced suitable nutrient concentrations and water quality for hydroponics. Combining FDFO with pressure-assisted osmosis (PAO) could reduce operational costs [9].

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Testing the nutrient solution on hydroponic lettuce showed comparable growth to the control without nutrient deficiencies.

Alipio et al. (2022) This work implemented a smart hydroponics system using a Bayesian Network model to automate crop growth. Sensors and actuators manage light intensity, pH, temperature, and humidity. The Bayesian Network utilizes sensor data to predict optimal actuator values, minimizing sensor value fluctuations compared to manual control. With an 84.53% accuracy in model validation, automatic control resulted in a 66.67% higher crop yield than manual control, showcasing improved efficiency [10].

Zahra et al. (2022) the study compared microbial profiles of hydroponically grown Romaine lettuce with soil-grown lettuce from organic and conventional farming. While no significant differences were found between farming methods, organic non-bagged lettuce showed higher bacteria counts. Both Salmonella and L. monocytogenes were less prevalent in hydroponically grown lettuce. The findings emphasize the need for food safety training across farming methods and further research on environmental factors in hydroponics [11].

Margaret et al. (2022) the study assessed a non-circulating hydroponic system for lettuce in urban Africa, aiming for food security. Conducted in Uganda, it showed positive economic indicators—NPV ($16.37), IRR (12.57%), PI (1.1), NDPBP (4.5) over six cycles. Scenario analyses revealed NPV's sensitivity to discount rates and unit prices. It emphasized hydroponics' profitability for urban food production, supporting sustainability goals, but recommended further studies on different seasons, cities, and vegetables [12].

Kannan et al. (2022) Hydroponic farming offers an alternative to traditional methods, reducing water needs and proving beneficial in degraded soil areas. It's eco-friendly, requiring no pesticides and less water. Unlike conventional farming, it's unaffected by climate change, urbanization, and soil-related challenges. This report explores hydroponics' benefits and limitations through cultivating crops like coriander and leafy vegetables, emphasizing quick yields, disease-free plants, easy management, weed-free growth, and minimal water usage (up to 70–80% savings). It highlights the significance, advantages, and disadvantages of hydroponic farming [13].

Margaret et al. (2022) majority of under-developed countries continue to face a challenge of food insecurity around urban areas resulting from factors such as; limited access to arable land.

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This study aimed at developing a simplified low-tech hydroponic system for growing leafy vegetables alongside testing its economic viability [14].

D'Amico et al. (2023) the study used Life Cycle Assessment to compare high-tech hydroponic and low-tech soil-based greenhouses in Southern Italy. Results favored the high-tech greenhouse, emphasizing reduced environmental impact with automation and renewable energy use [15].

Stelluti et al. (2023) the study investigated how beneficial microorganisms impact saffron cultivation in a hydroponic greenhouse. While not significantly increasing flower or spice yield, they notably boosted safranal content (up to +96%) and enhanced saffron spice's total phenolic content (by 19%). Combining certain microorganisms improved corm yield and size. The findings suggest these bioinoculants stimulate saffron's secondary metabolism, enhancing quality traits, showcasing potential in hydroponics for sustainable saffron cultivation [16].

Tola et al. (2023) This study evaluated three tomato cultivars' response to different salinity levels in a hydroponic greenhouse. Salinity increased spectral reflectance, impacting fruit yield [17].

Valouro-RZ and Feisty-Red had slight yield reductions at higher salinity (6.76-6.79% at 6.0 dS m, 31.77-33.53% at 9.5 dS m), while Ghandowra-F1 showed more tolerance. Grafting on Maxifort rootstock didn't significantly improve yield or salt tolerance. Valouro-RZ and FeistyRed can grow well with up to 6.0 dS m salinity, maintaining fruit yield, and potentially enhancing taste. Further research on rootstock combinations for salinity tolerance is recommended [18].

Gumisiriza et al. (2023) the study assessed non-greenhouse hydroponics for urban farming, comparing leafy lettuce growth to traditional soil methods. It found significant differences ($P<0.05$) in yield for dry matter, fresh weight, and root length. However, hydroponics showed potential similar to soil farming for the number of edible lettuce leaves. The research suggests hydroponics could match traditional methods for leaf production, recommending further exploration of nutritional aspects and extending the analysis to other vegetables [19].

Zhu et al. (2023) The study examined zero-waste hydroponic systems in arid conditions using agricultural waste as nutrients. Three pilot systems were compared: one using aquaponic fish

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sludge, another plant waste digestion, and a control with commercial solution. All showed similar yield (488-539g per shoot) and efficient nutrient recovery (77% N, 65% P). Water use was minimal (~10L/kg of lettuce) and heavy metal risk was low. maintenance, and infrastructure. Challenges include precision issues, calibration, and occlusion, but technological advancements are addressing these concerns. Future work should assess AR's impact on work performance and develop a comprehensive BIM-AR integrative model for validation [20].

3. Experimental Procedure

- PVC pipes of 3 inches dia are bought anddrilled for about 2.5 inches of holes.
- L joints, T joints, end caps, reducers gatewalls, water pump are arranged.
- Then using all the materials finalhydroponic setup was made.
- For the water medium we have mixed thenutrients which contain NPK.
- The water is made to flow 24 hours.

3.1. Observation of Growth Of Plants

Hydroponics farming allows to grow your plants at a very fast rate. Since the plants have unlimitedaccess to nutrients in their roots, they can grow upto 25% faster compared to being planted on soil. Hydroponic production system are used small farmers and commercial enterprises.

Compared to soil-based farming, plants grow considerably faster, healthier, and larger with the hydroponics system. This is because the plants have round-the-clock access to nutrients. Take fenugreek leaves for example. The usual period forgrowth is around two months but with the hydroponics system, it typically takes only one month. In some tests, vegetables and herbs have grown even up to four times faster with an hydroponic system compared to a traditional system.

In some other tests plants have grow up to 25% faster in an hydroponic system which is also an admirable feat. Also, many studies attest to the factthat plants in a soilless system grow larger and they’re also more likely to survive compared to when planted in soil. The flavor

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quality of plants in an hydroponics system is also outstanding and at least on par with soil-grown ones.

Here are some popular plants and vegetables that are grown in an hydroponic system with some infoon their growth and harvest time. Tomato were being grown earlier using Nutrient Film Technique (NFT). Saplings were transplanted intothe cups filled with coco peat and introduced into the NFT setup. The tomato plant was doing well initially with hydroponic method, but it was suffered from heat stress later on. The cups used for growing tomatoes had a volume of 69.04cm3. The fruits were small in size as proper nutrition was not available for their development. due to undeveloped root system.

3.2. Test Conducted pH

Test procedure

1. Rinse each test tube with the water sample.
2. Fill the tube to the 5mL line with sample water.
3. While holding a dropper bottle vertically, add 10 drops of Wide Range Indicator Solution.
4. Cap and invert several times to mix.
5. Insert the tube into the Wide Range pHComparator.
6. Record the pH value.

A Low pH level in hydroponics system can affectthe whole system, when pH level drops, the nitrification process decreases and it will also create a stressful condition for the plant that oftenresults in diseases or death. In the hydroponics system plants generally prefer slightly acidic pH level of 6.0 to 6.5 while plants prefer a slightly Alkaline pH level of 6.0 to 8.5 so that balance thepH needs of the plants in our hydroponics system.The ideal range of the pH is between 6.5 to 7.2 for the hydroponics.

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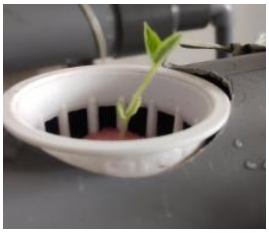
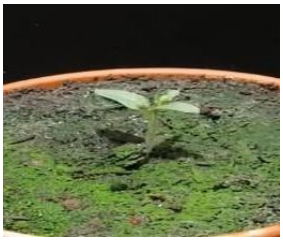
HYDROPONICS LAND FARMING



a) Week 2



b) Week 2

a) Week 8

b) Week 8

a) Progress of Tomato plant growth

HYDROPONICS LAND FARMING

Week 2

b) Week 2

a) Week 8

b) Week 8

b) Progress of Fenugreek plant growth

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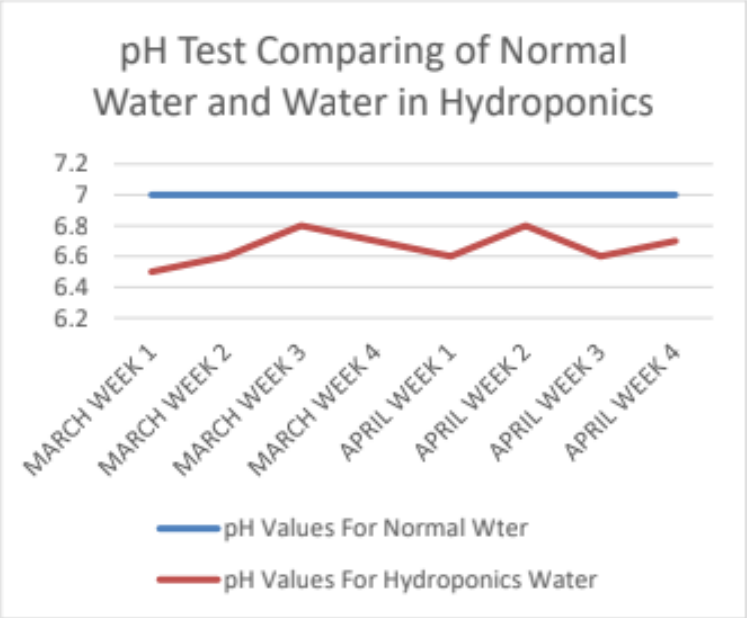

4. Results and Discussions

Hydroponic farming had more growth compared to Land cultivation in both tomato and fenugreek leaves. Since the plants have unlimited access to nutrients in their roots, they can grow up to 25% faster than plants on soil. The growth of plant was noted for a period of 8 weeks. Below figure shows the growth of plants in a different weeks. From the comparison of the figures we can clearly state that the hydroponics has enhanced the growth of plants in greater level.

5. Conclusion

Hydroponics offers a sustainable and efficient method of growing plants without soil. Providing numerous benefits such as increased crop yields, water conservation, and flexibility in location. Its ability to mitigate environmental challenges and produce high-quality produce makes it a promising solution for future agricultural needs. However, successful implementation requires careful consideration of factors like nutrient management,system design, and operational costs to ensure its viability on a large scale. Overall, hydroponics represents a compelling avenue for addressing food security and resource efficiency in agriculture.

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09:30 AM to 11:30 AM	Inauguration of ICEST-24 Inaugural address by **Mr. Sohan M.** Senior Project Manager – Infosys, Mangalore Keynote Address by **Dr. P. Nagabhushan**, VC, Vignan University, AP
11:30 AM to 11:45 AM	Refreshments
11:45 AM to 01:00 PM	Keynote Address-1 on topic "Performance of an air breathing PEM fuel cell used in fuel cell vehicles from in-situ measurements of operational parameters" by **Dr. A. R. Vijay Babu**, Associate Professor Dept. of ECE, Vignan University.
01:00 PM to 02:00 PM	Lunch Break
02:00 PM to 02:45 PM	Track 1 Oral presentation (Communication networks and Security)
02:45 PM to 03:30 PM	Track 2 Oral presentation (Embedded System)
03:30 AM to 03:45 AM	Refreshments
03:45 PM to 04:30 PM	Track 3 Oral presentation (Signal Processing)
24th April 2024 Wednesday – Day 2	
09:30 AM to 10:30 AM	Track 4 Oral presentation (Electromagnetics and Antenna Design)

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10:30 AM to 11:30 AM	Track 5 & 6 Oral presentation (VLSI and MEMS & Power and Energy Systems)
11:30 AM to 11:45 AM	Refreshments
11:45 AM to 01:00 PM	Keynote address – II on topic "Transformative power of Exponential and Emerging Technologies" by **Dr. B. Aziz Musthafa**, Professor, Department of Computer Science. Bearys Institute of Technology, Mangalore**.**
01:00 PM to 02:00 PM	Lunch Break
02:30 PM to 03:30 PM	• Valedictory of ICEST-24 • Valedictory address by **Dr. A. M. Khan,** Senior Professor, Dept. of Electronics & Director- Skill Development Centre Mangalore University Mangalore • Keynote Address by **Dr. Surendra Kumar**, Pro-Vice Chancellor, Presidency University, Bangalore
03:30 PM to 04:00 PM	Interaction & High Tea

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WIRELESS BATTERY CHARGING DEVICE FOR ELECTRIC VEHICLES

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Abstract:

In response to the pressing need to reduce environmental degradation and reliance on fossil fuels, there has been a considerable increase in the adoption of electric cars (EVs) as a replacement for traditional combustion engine vehicles. Recognizing this issue, various charging methods are being explored and implemented to respond to the various requirements of EV users. However, an important barrier in increasing the use of EVs remains the establishment of a strong charging infrastructure that can support the growing demand. In this project, wireless charging systems (WCS) became known as a promising approach to improve EV charging ease of use. WCS provides a seamless charging experience using in order linked power transfer technology, eliminating the need for physical connections. This not only makes it easier for EV owners to charge their vehicles, but it also helps to keep the city surroundings clean. In addition, the move to plug-in electric vehicles (PEVs) is becoming more popular, especially in developed countries, due to a number of issues including rising fuel prices, running out of resources, and environmental concern. Consumers and government agencies are putting more and more pressure on manufacturers to use greener, more sustainable technology like plug-in hybrid electric vehicles (PEVs).However, in addition to environmental concerns, the wide use of PEVs also depends on profitability and technological improvements. Adoption rates are significantly influenced by consumer confidence in PEVs' dependability and performance, particularly with regard to their driving range and infrastructure for charging. A lot of work is being done to improve the efficiency and dependability of electric car charging stations, especially fast-charging stations inside the distribution system, in order to address these issues.

Key Words: Automobile, Electric vehicles, Magnetic coil, Wireless charging.

ISBN-978-81-19905-39-3

1. Introduction

Wireless battery charger can be used in many battery powered products likely smart watches, smartphones, and a host of other small electronic products. Originally the technology focused at small products. Now a days wireless charging technology is used for larger applications which include car batteries and many other items [1]. Wireless charging usually works on principal of power transmission from one circuit to another via inductive coupling between two circuits. Since no electrical connection directly is implemented it is very easy and does not depend on contacts that may wear out and become unreliable after many charging cycles. Wireless battery charging works by transferring electricity between two objects, often coils, using the magnetic induction or magnetic field principle. Power is transmitted without a physical connection being made from a source to a receiver, where it is frequently utilized to recharge a device's battery. wireless charging is advantageous. However, they are widely used in items like electric toothbrushes when wireless functioning is necessary and transmission could be inefficient or fleeting. The flat shape of the transformer utilized in this manner makes it easier to access the equipment to be employed. Many wireless battery charging options are used when purchasing small items. The transformer's secondary is linked to the driving circuit, while the main side is connected to the 230V AC mains supply, which serves as the motherinower's typical power source [2].

2. Problem statement

Despite the growing popularity of electric vehicles (EVs), several challenges persist in the adoption and widespread usage of this sustainable mode of transportation. One significant hurdle is the inconvenience and limitations associated with traditional wired charging methods. EV owners face various issues, including the hassle of handling bulky charging cables, the need for compatible plugs and sockets, and the requirement for dedicated charging infrastructure, which can be especially problematic in urban areas with limited space.

3. Literature survey

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Wireless charging technology for electric vehicles (EVs) has gained significant attention in recent years due to its potential to revolutionize the EV charging experience. Various studies have explored different wireless charging methods, including inductive, resonant, and capacitive charging, each with its unique advantages and challenges. Research by Lee et al. (2019) compared the efficiency and performance of inductive and resonant wireless charging systems, highlighting the importance of optimizing coil design and alignment for maximum efficiency. Safety aspects have been extensively investigated by researchers such as Zhang et al. (2020), who proposed advanced safety mechanisms including overcurrent protection and temperature monitoring to prevent accidents and ensure user safety during wireless charging.

Compatibility and interoperability have been key focuses of research efforts, with studies such as the work by Wang et al. (2021) [3] addressing the need for standardized wireless charging protocols to enable seamless integration with different EV models and charging infrastructure. Scalability and deployment considerations have been explored by researchers like Smith et al. (2022) [4], who investigated the feasibility of deploying wireless charging systems in various settings, including homes, workplaces, and public charging stations, highlighting the potential for widespread adoption.

User experience has been another critical aspect of research in wireless EV charging. Studies by Kim et al. (2020) [5] and Chen et al. (2021) [6] have proposed user-friendly design features such as automatic alignment detection and intuitive charging status indicators to enhance the usability and convenience of wireless charging systems. Regulatory compliance and standards have also been addressed in literature, with researchers advocating for adherence to safety regulations and industry standards to ensure the reliability and interoperability of wireless charging solutions.

Overall, the literature survey underscores the multidisciplinary nature of research in wireless charging technology for electric vehicles, encompassing aspects of efficiency, safety, compatibility, scalability, user experience, and regulatory compliance. Continued research and development efforts in these areas are essential to realizing the full potential of wireless charging technology and accelerating the transition to electric mobility.

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4. Methodology

The project is a device that transfers electricity wirelessly rather than utilizing standard copper cables and current carrying wires, and it also measures battery charge. It also charges the battery by wireless power transmission until it reaches 100% capacity. Nikola Tesla introduced the concept of wireless power transfer. This power is designed to be supplied across short distances, such as when charging rechargeable batteries. For demonstration purposes, we have a battery that uses wireless power. This requires an electronic circuit to convert AC 230V 50Hz to AC 12V high frequency, which is then fed to an air core transformer's primary coil. The transformer's secondary coil generates 12V at high frequencies. The system also measures the charge in the battery and charges it until it reaches a 0% capacity. For this purpose, we employ a Microchip AVR family microcontroller that constantly measures battery charges and automatically charges the battery until it reaches 100% capacity, at that point it stops charging. As a result, power is passed from the primary coil to the secondary coil, which are separated by a distance of approximately 4 cm. The range can be improved by changing the coil size appropriately. The primary coil serves as a transmitter, while the secondary coil receives electricity for running a load. This project may be used to charge and measure the batteries of numerous gadgets and applications, such as battery-powered scooters and automobiles, without the need for a plug.

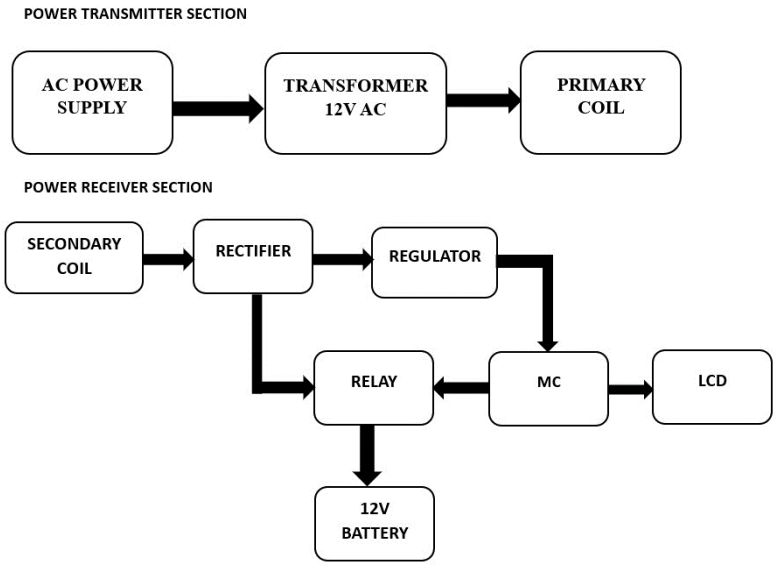

Fig. 1: Block diagram

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4.1 Circuit diagram

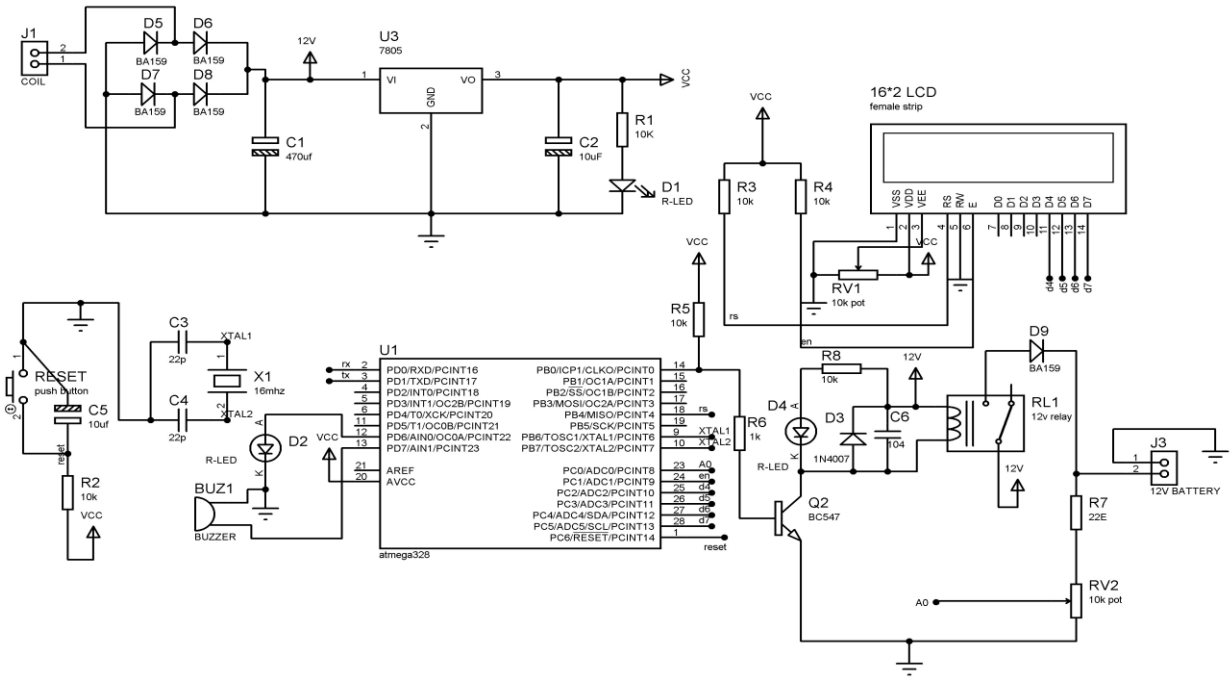

Fig. 2: Connection diagram

The Smart Wireless Battery Charging Project includes two units: one is a power supply that wirelessly transmits electricity to the receiving end unit, which converts it into usable energy. This energy is used in this project to charge a 12V battery, which is monitored by an ATmega328 system and turned off quickly when the necessary voltage is reached. It all begins at the transmission end. The power from the mains supply is stepped down to 12VAC at a frequency of 38 KHz. High frequencies are required because they have lower air losses. The high frequency transformer's circuit steps down the frequency. The energy is then transmitted as electromagnetic waves by the secondary coil, which is located outside the transformer. When the receiver coil is put within the range of energy waves that can be received, it turns them back into electrical signals. In this method, the receiver board is powered up to run the micro controller system as well as charge the battery. The battery's charge is monitored at regular intervals to determine whether or not the

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desired voltage is reached. To read the analog voltage, these voltages are transformed into digital values and then returned to percentage values that are displayed on the LCD.

5. Application

- **Urban Infrastructure**: Integration into streetlights, parking spaces, and public transportation hubs for convenient charging in urban environments.
- **Fleet Operations**: Deployment at depots or terminals for rapid and automated charging of fleet vehicles, minimizing downtime and optimizing operational efficiency.
- **Residential Charging**: Providing homeowners with a hassle-free solution for EV charging, integrated with smart home systems for optimized energy usage.
- **Workplace Charging**: Installation in workplace parking lots or designated areas to support employees driving electric vehicles, enhancing employee satisfaction and sustainability initiatives.
- **Public Charging Networks**: Complementing existing charging infrastructure at strategic locations such as shopping centers and tourist attractions, improving accessibility for EV drivers.
- **Fleet Electrification Initiatives**: Supporting government, municipal, and corporate fleet electrification efforts by streamlining the transition to electric vehicles and reducing carbon emissions.

5.1 Advantages

- **Convenience**: No need for physical cables or plugs, allowing for effortless charging without manual intervention.
- **Efficiency**: Wireless charging systems can be designed to be highly efficient, minimizing energy loss during the charging process.
- **Flexibility**: Can be integrated into various environments, including homes, workplaces, public spaces, and fleet depots, providing flexibility in charging locations.
- **Safety**: Advanced safety features, such as automatic alignment detection and temperature monitoring, ensure safe and reliable charging operations.

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- **Scalability**: Enables easy expansion of charging networks in urban areas and along transportation corridors to support increasing numbers of electric vehicles.

5.2 Disadvantages

- **Lower Efficiency:** Wireless charging systems may have lower efficiency compared to wired charging methods, leading to longer charging times and potentially higher energy losses during the charging process.
- **Cost**: Wireless charging infrastructure can be more expensive to install and maintain compared to traditional wired charging stations.
- **Complexity**: Wireless charging systems involve more complex technology and components compared to wired charging stations, which can increase the complexity of installation, operation, and maintenance.
- **Limited Range**: Wireless charging typically requires close proximity between the charging pad and the vehicle, limiting the range of movement while charging.
- **Compatibility Issues**: Different wireless charging standards and protocols may lead to compatibility issues between charging infrastructure and electric vehicles from different manufacturers.

6. Conclusion

In conclusion, the development of Wireless Battery Charging device for electric vehicle represents a significant stride towards addressing the limitations of traditional charging methods. By integrating advanced wireless charging technologies, intelligent algorithms, and comprehensive monitoring systems, this project aspires to redefine the landscape of device power management. The emphasis on safety features, user-friendly interfaces, and compatibility ensures a holistic and secure charging experience.

ISBN-978-81-19905-39-3

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ISBN-978-81-19905-39-3

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SMART MEDICATION DISPENSER

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Abstract:

We all know at least one person who must take medication in the form of pills or tablets in order to live a healthy life in this day and age of modern medicine, when humans are mostly dependent on the use of pills or tablets. In this project, we're primarily concerned with ensuring that your loved ones, who may be elderly, experiencing memory loss, or struggling to remember their medication schedule, take their pills on time, all over the world, with the help of a smart medication dispenser that works on a schedule. This project involves designing and building the final product's body as well as its component pieces. We always want the people we care about to be fit and healthy. And what would happen if they fall unwell and neglect to take their medication on schedule? Surely we would be concerned? Reminding every patient to take their medication on time can be challenging in hospitals due to the large number of patients. In the past, people had to actively remind themselves to take their medications on schedule. it is not thecase in the digital age, and we can accomplish it using machines. Smart Medicine Reminder hasa very broad range of applications that physicians can utilize in hospitals, at home, and in many other settings. There are numerous approaches to reminding When it comes to prompting, there are numerous approaches to do so Put it on show, Notify via phone or email, Making use of mobile applications, The buzzer sounds, Using WiFi and Bluetooth, Receive a call, Remember the current time and the medication time for the following day.

Key Words: Medication Schedule, Reminder Methods, Digital Age, Healthcare, Smart Medication Dispenser

ISBN-978-81-19905-39-3

1. Introduction

Building a smart medicine box with a microcontroller and GSM is our major ECE project. Users who routinely take pharmaceuticals or vitamin supplements are the target audience for our medicine box. It is essential for patients with certain chronic illnesses, such as HIV/AIDS, cancer, diabetes, and tuberculosis, to take all prescribed medications on schedule. Even one missed dose can cause the treatment to fail and have a negative impact on the patient's health.For some patients, a smart medicine box can literally save their lives. Many studies have been conducted in an effort to solve this issue. Given the rapid advancement of technology and the widespread usage of mobile phones, using a smart phone The programmable Smart Medicine Box is an advancement over the conventional medicine box. Reminds patients to take their medications, which can sometimes be a lifesaver. The user can take their medications on schedule thanks to the light and sound reminder. The advanced feature of the smart medicine boxis that it will send a message to the user's phone to remind them to take their pills, even if they forget It's a dual reminder system where the user receives a buzzer reminder for the dosage and a text message on their phone. This approach has a high working efficiency because there is a lower likelihood of a missed dose.

2. Concept And Ideas

Medical reminders operate on the fundamental principle of mobile applications. Since mobile phones are carried by everyone in the present world and these applications can be accessed through them. Throughout this decade, mobile phones have become the most indispensable and easily navigable device. The concept of using a mobile phone as a medication reminder has gained traction as the number of mobile phone users has increased.

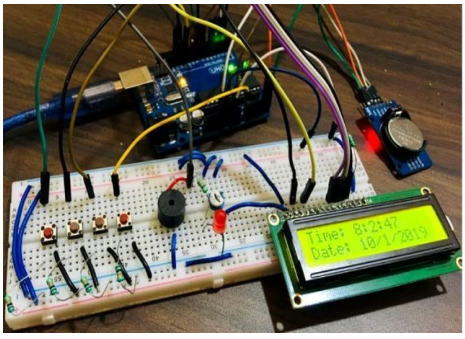

Fig 1: Medicine Reminder using Arduino

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Numerous mobile phone reminders have been created and introduced to the market. Examples of medication reminders include the GCM reminder, The Widget application-based medication reminder, the In-House Drug Management System based on RFID technology, and the Sap med application Medical reminders operate on the fundamental principle of mobile applications. We have read a few study papers about medication reminders that work with smart phones and give people medical support as they take their medications.

Our study is based on the analysis of research papers such as A Mobile Health Application for Outpatients Medication Management [1, 2], Implementation of Cloud Messaging System Based on GCM Service [3], Application of RFID Technology for In-House Drug Management System [4], and Smart Phone Based Medicine In-take Scheduler, Reminder, and Monitor [2]. GCM-based smart phone-based medication reminders[5]. Our Smart Medicine Box's main idea is to assist the user in taking their medication on time by using a buzzer and light.

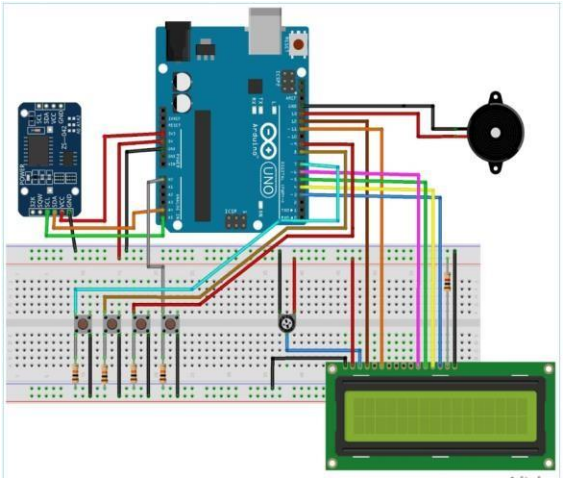

Fig 2: Smart medicine Box Circuit diagram

To minimize errors, the LED will indicate which box the pill should be taken from at that particular moment. Our research on the mentioned articles and research papers prompts us to employ mobile phones in our project, which improves its operational efficiency. To add this

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feature, which reminds the user to take his medication, we employed GSM. The message is sentto his mobile phone. The Smart Medicine Box reduces the need for elderly people to rely on others for medical care since it is straightforward to use, efficient in its operation its light, sound, and message reduce the possibility of error and lightweight, making it convenient to store and transport. Even those without literacy skills can use this box and benefit from the reminder system with just one trial.

3. Methodology

The 5V supply is used to power the pill reminder alarm. Upon booting up, "Welcome to Circuit Digest" appears as a greeting. Three displays will alternate on the LCD screen by default. "Stay Healthy, Get Well Soon" is how the massage appears on the first screen. The second screen is a help screen that instructs you to choose a time slot to be reminded of (once, twice, or three times per day) by pressing the select push button. Program users can modify the time slot and set it up appropriately. We currently have this set for three different times: 8 a.m., 2 p.m., and 8 p.m.

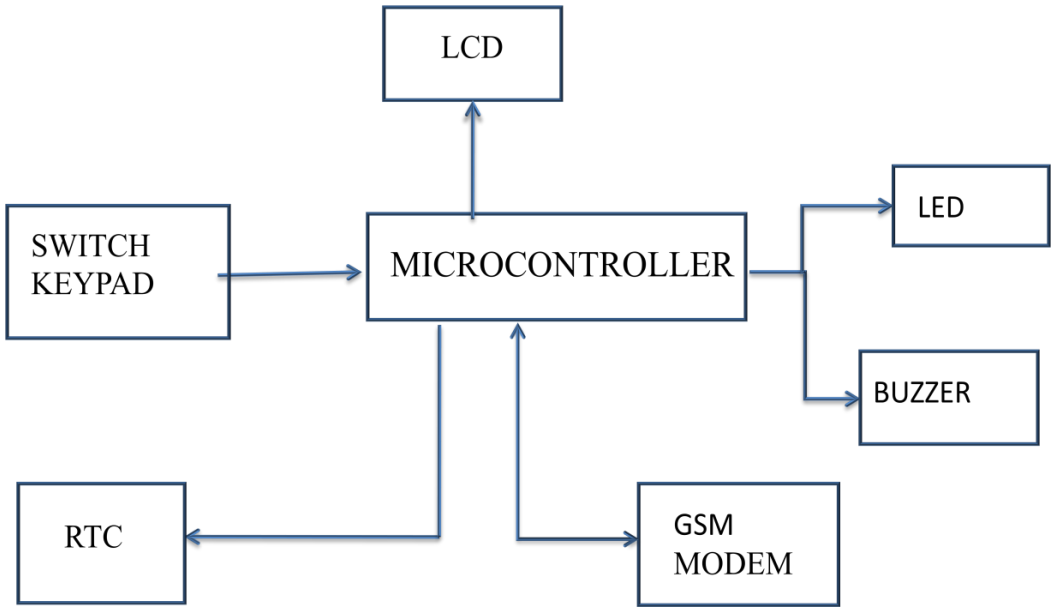

Fig 3: Hardware system block diagram

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Three modes have been created from our time slots. When the user clicks the first push button, Mode 1 selects to take medication once day at 8 a.m. When the user clicks the second push button, Mode 2 selects to take medication twice a day at 8 a.m. and 8 p.m. If the user hits the third push button, Mode 3 selects to take the medication three times a day at 8 a.m., 2 p.m., and 8p.m.

A function to snooze the buzzer for ten minutes can also be added (not included in this project). The user's input is captured and the time is deducted from the RTC when they push buttons to pick the appropriate slots. The buzzer will begin to sound when the chosen time slotand the current time coincide. By pushing the STOP button, the user can silence the buzzer.

For the following slot reminder, the same procedure is used. The video provided at the conclusion of this article shows the entire procedure.

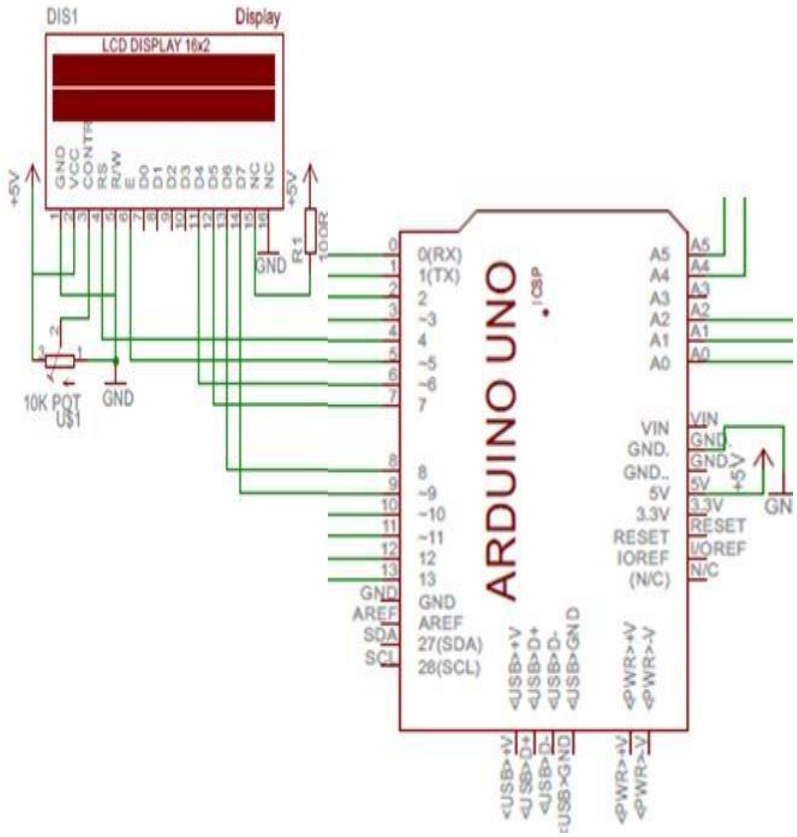

Fig 4: circuit diagram

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4. Conclusion

In order to satisfy user needs, we will need to improve our product in a few areas in the future. First, we ought to devise plans and adjust the apparatus in light of the findings of the user assessment. This entails writing an instruction manual, selecting a larger LCD display, adding a loud buzzer, and increasing the quantity of sub-boxes. Our project can be adjusted to allow blind persons to use the system for their medical treatment by utilizing sensors as well. We may add more capabilities to the system by modifying the Arduino programming so that it is compatible with mobile phone applications. If the reminder system calls rather than sends messages, system performance may be improved.

If the reminder could be sent via phone call instead of text message on a smart phone, the smart phone-based medication reminder feature could be improved. There will be a lower likelihood of missing the dose on time thanks to this call-based notice. People receive a ton of messages on their phones every day, and occasionally they would rather ignore them. Call medication reminders are essential in this situation since they force the user to check their phone at the end of the day, which lowers the likelihood that they will miss a dose. If the medication reminder notifies the user to restock on tablets prior to their expiration, it can further enhance its functionality and allow treatment to continue uninterrupted.

ISBN-978-81-19905-39-3

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IOT BASED AGRICULTURE PESTICIDE SPRAYING ROBOT

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Abstract:

India is a significant agricultural nation, with three percent of its population involved in farming. As climate conditions and other resources become favourable, farmers are able to cultivate more crops in their fields. However, to ensure high-quality and efficient production, certain skills and support are necessary. Plant diseases are seen as abnormalities or disruptions in the normal functioning of plants, which lead to specific symptoms. Phytopathogens are typically defined as bacteria from various species that can cause these diseases.

Most of the disease symptoms appear on the leaves, stems and branches of plants. Therefore, detection of diseases and infections in crops is important for good and successful farming. This can be done by taking pictures of ideas with a camera and analyzing them using machine learning techniques. This indicates disease on leaves, stems or plants. It also indicates that the area is infected and estimates the pesticide effect caused by the specific pesticide sprayed on the infected area.

This is important for effective pesticide use. This will benefit the farmers as it can be controlled from anywhere without the need to work in the field and without access to pesticides. It is not affected by health.

Key Words: IOT, Convolutional Neural Network (CNN), ROBOT.

1. INTRODUCTION

Agriculture is the backbone of India. There are approximately 215.6 million mu of irrigated agricultural land in my country. Economic research has shown that the country needs to increase the level of agricultural mechanization. Increased productivity plays an important role in pest

ISBN-978-81-19905-39-3

control. The Pesticide Spraying Robot is an innovative technology that offers an efficient and precise solution for agricultural pest control. Designed to navigate fields and orchards autonomously, these robots are equipped with advanced sensors, mapping technology, and spraying mechanisms. They play a crucial role in optimizing pesticide application by targeting specific areas that require treatment, reducing pesticide usage, and minimizing environmental impact [1].

These robots utilize various sensing technologies, including cameras and proximity sensors, to identify crops, detect pests, and determine the optimal spraying locations. With the help of mapping algorithms and real-time data analysis, they can create a detailed map of the field, allowing for accurate and targeted pesticide application. The spraying mechanism of the robot is designed to deliver pesticides in a controlled and precise manner. The robot's spraying arms or nozzles can be adjusted to ensure the right amount of pesticide is applied to the specific areas infested with pests, avoiding excessive use or wastage. This targeted approach not only saves resources but also minimizes the exposure of non-targeted plants, beneficial insects, and the environment to pesticides [2].

Additionally, these robots often employ advanced technologies such as artificial intelligence (AI) and machine learning algorithms. By analyzing data collected from the field, they can identify patterns, monitor pest populations, and optimize spraying schedules based on the severity of infestations. This data-driven approach enables farmers to make informed decisions, improve pest management strategies, and maximize crop yields.

The Pesticide Spraying Robot not only increases the efficiency of pest control operations but also offers several benefits over traditional methods. It reduces the physical labor required for manual spraying, improves the accuracy and uniformity of pesticide application, and enhances overall productivity. Moreover, it contributes to sustainable farming practices by minimizing pesticide residues, reducing the environmental impact, and promoting a healthier ecosystem [3].

As the development and adoption of agricultural robotics continue to progress, the Pesticide Spraying Robot represents a significant advancement in precision farming techniques, providing farmers with a reliable and effective tool for pest control while promoting sustainable and environmentally friendly agricultural practices. The work aims on the design, development and

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fabrication of the demonstration unit of "IOT BASED AGRICULTURE PESTICIDE SPRAYING ROBOT."

2. OBJECTIVE

1. Construct a model capable of pesticide spraying in agricultural activities.
2. To develop six wheeled structure robot that can move in different terrains.
3. To develop remote control system using cloud platform.
4. A manipulator that contains a spray nozzle.
5. Model must be able to perform following tasks:
    - 5.1 Disease detection using image processing algorithm.
    - 5.2 Temperature and humidity monitoring.
    - 5.3 Live video streaming and monitoring with IoT.
    - 5.4 Pesticide spraying
    - 5.5 Pesticide level monitoring
6. Quality and health monitoring of farm.

3. METHODOLOGY

To spray the liquids of pesticide on the crops to protect them against insects while travelling in the field with help of sprayer. In the first stage, the harvest is carefully and regularly monitored. Affected plants are then identified and photographs of the affected plant parts are taken with a scanner or camera. These objects are then pre-processed, transformed and grouped. These images are then sent as input to the processor, which compares the images. If the photo is contaminated, spray it using a sprayer with an insecticide. Pesticide sprayer is used to spray pesticides on the target areas of contaminated crops. The plan is based on two alternating bottles filled with pesticide valves precisely controlled. This provides a consistent pesticide flow and accuracy that is unaffected by varying fluid characteristics and flow conditions. This arrangement is ideal for pesticide spraying and is shown in figure 3.1. Ground-based pesticide spraying robots use a variety of mechanisms to apply pesticides, including sprayers, booms, and nozzles.

Robotic systems can be equipped with advanced sensors and mapping technology to navigate agricultural fields and identify specific areas requiring treatment, similar to the functionality of drones. Once a target area is identified, the robot can utilize its spraying mechanism to accurately

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and precisely apply pesticides. The webcam integrated into the robot model enables real-time scanning of trees up to 3 feet tall. The live feed captured by the device is transmitted via Wi-Fi to the video processor.

The video processor, powered by the ESP32, employs a specialized algorithm for video processing. This algorithm automatically analyzes the crop, primarily focusing on the leaf area, to determine the presence and quantity of pests using advanced video processing techniques. Pre-processing and segmentation are applied to the video to eliminate unwanted distortion and noise, while also decomposing the captured image into distinct components for identification purposes. Morphological operations are then utilized to facilitate video processing based on the morphology of insects, enabling the robot to spray different insecticides according to the species encountered.

To enhance the quality of the video, de-noising is conducted through a two-stage process involving erosion and expansion. Washing techniques are employed to eliminate pixels that are falsely detected as pests. Furthermore, the video is expanded to recover the pixels representing insects. The algorithmic code incorporates the pest count analysis, determining the appropriate timing for insecticide spraying based on the severity of infestation. Even though the text has been rephrased, it is always good practice to cite the original source if the information or ideas are derived from a specific publication or author.

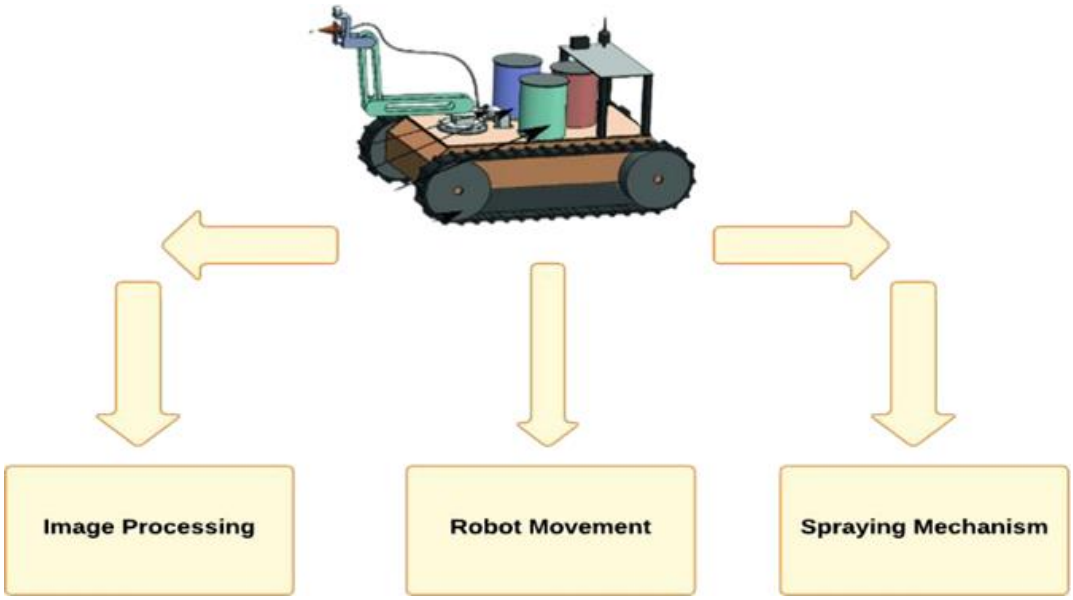

Figure 3.1: Working Principle

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Regardless of the type of pesticide spraying robot, it is important to ensure that the robot is calibrated correctly and that the appropriate amount of pesticide is applied [4]. This requires careful consideration of factors such as wind speed, humidity, and temperature, as well as the type of crop or vegetation being treated. Additionally, it is important to ensure that the robot is properly maintained and that all safety protocols are followed to prevent accidents or environmental contamination.

3.1 Robot Movement Motors are used to move the robot, which are controlled electronically by a microchip with the assistance of a motor controller IC. The transmitter and receiver module receives signals from the input and sends them to the controller, which in turn spins the motor. By receiving the signal, the wheel motors are turned on and off by controlling the main controller IC [5].

A motor driver IC is an integrated chip often used in robotics to control motors. The motor driver IC acts as the interface between the robot's microprocessor and the robot's motor. The most commonly used motor driver ICs are L293D, L293NE, etc. Like the L293 series. These ICs are designed to control 2 DC motors simultaneously. The L293D has two H-bridges. The H-bridge is the simplest circuit used to control a low current motor. We all know that their microcontroller cannot run DC motors. Because the current they give to the output pin is not enough to drive a small DC motor. Most microcontroller I/O pin outputs 20mA-40mA current. The GPIO pin of the Arduino Uno can deliver 40mA of continuous current, but 40mA is still not enough to drive a DC motor. RC cars typically use a motor driver to control the movement of the car. The motor driver receives signals from the remote control and translates them into specific actions, such as moving forward, backward, or turning left or right. The specific type of motor driver used in an RC car may vary depending on the design of the car and the requirements of the motor.

However, many RC cars use a type of motor driver called an H-bridge. An H-bridge is a circuit that allows the motor to be controlled in both directions (forward and reverse) and with variable speed. It consists of four switches (usually transistors) arranged in a specific configuration. The motor is connected to the center of the circuit, and the switches control the current flow to the motor to make it move in the desired direction. In an RC car, the H-bridge is typically controlled by a microcontroller, which receives signals from the remote control and adjusts the switches in the motor driver accordingly.

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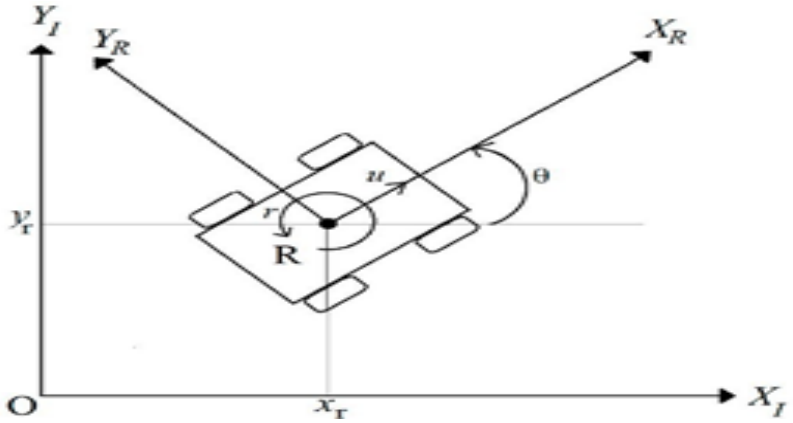

Figure 3.2: Robot movement

3.2 Pesticide Spraying Mechanism

Sprayer is a device used to spray liquid. In agriculture, a sprayer is a device that sprays of herbicides, pesticides, and fertilizers to agricultural crops. Sprayers come in a variety of sizes, from mobile devices (usually backpacks with spray guns) to towing sprayers that are attached to a tractor, to self-propelled equipment similar to tractors. A nozzle is a device designed to control the direction or characteristics of a fluid flow (specially to increase velocity) as it exits (or enters) an enclosed chamber or pipe. Plant protection applications are the most important applications in plant production. Use a sprayer to complete the application of pesticide products. The use of fungicides, insecticides and pesticides is one of the most important activities in agriculture. Conventional pesticides cause a conflict between economic growth and environmental protection in agriculture. Spraying equipment has been continuously improved in recent years. It is not just the sprayer for the use of pesticides, but the type and area of vegetation, the area of plant leaves, and the height of the crop, not all of them are related to the application of plant protection products.

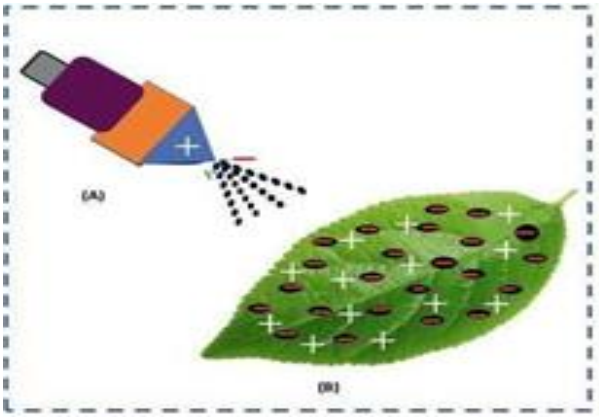

Figure 3.3: Pesticide Spraying Mechanism

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The volume of plants is very important for better results. From this perspective, the progress of agricultural spraying has only begun in the last few years. Robotic and automated spraying technologies such as variable speed sprayers, drone sprayers and electrostatic sprayers are being developed to improve pesticide use, reduce pesticide use, and use real-time, cost-saving and protective equipment. There are 5 basic spray patterns: Fan, Solid Flow, Solid Cone, Hollow Cone, and Fog/Mist. Flat fan nozzles are used for spreading most pesticides and some pesticides that do not require foliar penetration and coating. Nozzles create a flat oval spray pattern with tapered edges.

The pump is the heart of the sprayer and is important in creating the flow of the sprayer and the output of the sprayer. Because many spray situations require different sizes and flow rates, using the right pump is essential to achieve the desired results. Besides considering the spray, the pump needs to be strong enough to withstand harsh chemicals that can cause excessive wear and tear. Although pumps with added corrosion protection are more expensive, they are a popular choice because of their Pumps durability. They are usually ground-operated or driven by a main or auxiliary engine, a power take-off shaft, or a hydraulic pump. Regardless of the type of pump, the necessary flow rate must be provided at the desired pressure. Enough spray liquid should be pumped to supply the gallons per minute (gpm) required by the nozzles and the tank agitator, with a reserve capacity of 10 to 20 percent to allow for flow loss as the pump becomes worn. Unfortunately, pumps lose efficiency for a number of reasons, such as drive friction or leakage. When estimating the pump horsepower needed for an application, efficiency of 40 to 60 percent should be assumed. Pump quality is important when choosing a pump. Nozzle capacity, hydraulic agitation, and the need to tackle the aforementioned work are considerations.

3.3 Image Processing

The images are processed using machine learning techniques to detect and classify different plant health conditions, identifying signs of pest infestations or diseases. By analyzing parameters like leaf color, shape, and texture, the system can differentiate between healthy and affected areas. This data is then used to guide the robot's spraying mechanism, ensuring that pesticides are applied only where necessary, thereby minimizing chemical usage and reducing environmental impact. The integration of image processing with IoT capabilities allows for continuous monitoring and precise, automated pesticide application, enhancing crop protection and overall yield [5].

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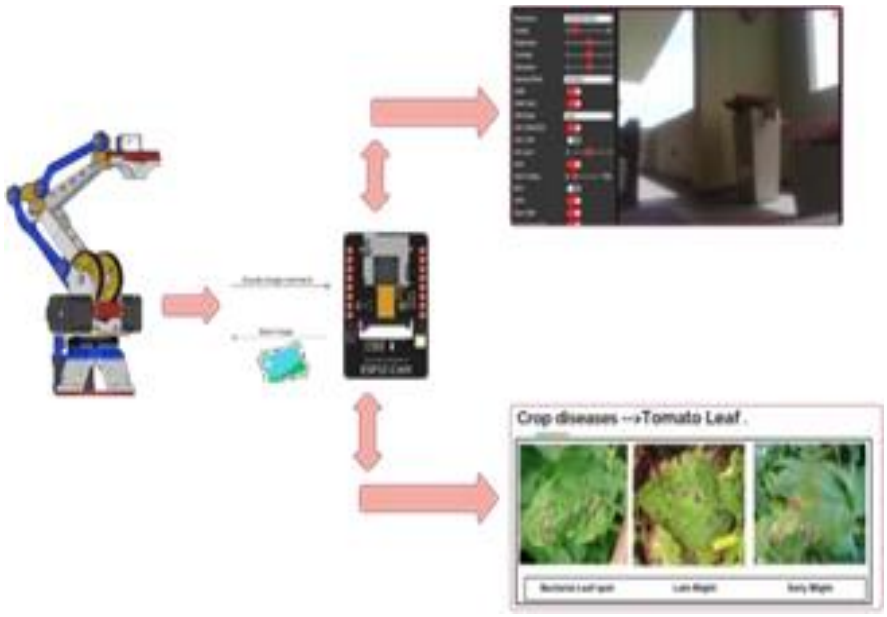

Figure 3.4: Image processing

3.4 Streaming methodology

Streaming is the continuous transmission of audio or video data from a server to a client. In simple terms, streaming is what happens when a consumer watches TV or listens to a podcast on a connected device. With streaming, media played on the user's device is stored remotely and sent over the Internet for a few minutes at a time. Streaming is real time and works better than downloading files. The ESP32-CAM is a very inexpensive, small camera based on the AI thinker's ESP32-S chip. Basically, it has an OV2640 camera embedded in an ESP32 module with several GPIOs to which devices can be connected, and a micro SD card slot that can be used to store images from the camera photo.

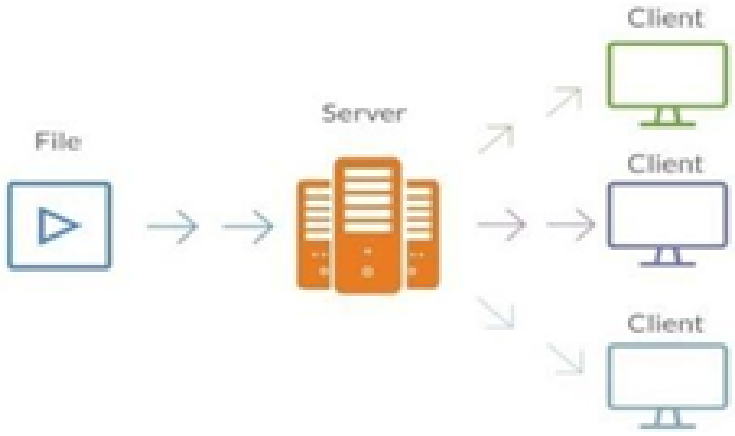

Figure 3.5: Streaming methodology

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3.5 Plant Disease Detection Using CNN

A Convolutional Neural Network (CNN) is a deep learning algorithm designed for image recognition and processing tasks. It is a type of neural network that is inspired by the structure and function of the visual cortex in the brain. CNNs are particularly effective for image classification tasks, such as recognizing faces, detecting objects in images, and identifying patterns in medical images. They have also been applied to other fields, such as natural language processing, speech recognition, and time series analysis. The key feature of a CNN is its ability to learn hierarchical representations of input data. In an image classification task, for example, the first layer of a CNN may learn low-level features, such as edges and corners, while the deeper layers learn more complex features, such as shapes and textures.

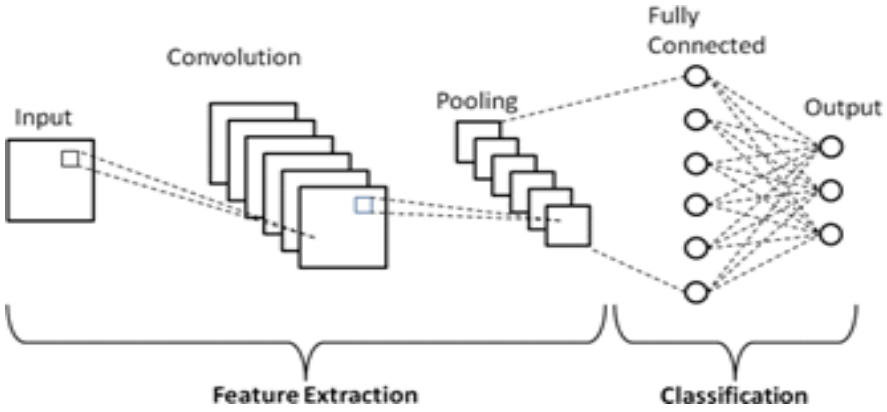

Figure 3.6: Convolutional Neural Network Architecture

This hierarchical learning enables the CNN to achieve high accuracy on complex image classification tasks. The CNN architecture typically consists of several layers, such as convolutional layers, pooling layers, and fully connected layers. The convolutional layers apply a set of filters to the input image to extract features, the pooling layers reduce the size of the feature maps, and the fully connected layers classify the input into the output classes. The architecture can be customized by adjusting the number of layers and the hyperparameters, such as the number of filters, the filter size, and the learning rate, to optimize the performance of the model [6].

Overall, CNNs have become an important tool for image processing and recognition, and have been used in a variety of applications, including self-driving cars, medical image analysis, and security systems. The first level of the algorithm involves separating healthy plants from affected

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plants, and the second level of the algorithm focuses on detecting disease in plant leaves. An efficient and fast system has been developed using PYTHON software. Farmers will benefit from the introduction of disease detection tools. The results obtained with this method are suitable for small and large crops. More importantly, the results are accurate and the disease can be detected in a very short time. This technology relies heavily on deep learning and neural networks. In this study, a deep convolutional neural network was used to identify diseased and healthy leaves.

3.5 IoT Platform

The Internet of Things (IoT) platform is a software framework that facilitates the development and deployment of IoT solutions. The IoT platform enables the collection, analysis and exchange of data from connected devices and provides a set of tools for building and managing IoT applications. It provides a scalable and secure infrastructure to connect, manage and process data from various IoT devices. The main goal of an IoT platform is to provide seamless connectivity and interoperability between different IoT devices, applications, and networks.

IoT platforms can support a variety of applications, including smart homes, smart cities, industrial automation, agriculture, and healthcare. Blink Cloud is a cloud-based IoT platform that provides tools for building and managing IoT applications. It is designed to make it easier for developers to create connected devices and mobile apps that can monitor and control multiple hardware devices. Blynk Cloud offers several features and services that allow developers to quickly and easily build IoT applications.

Conclusion:

The development of the IoT-based agriculture pesticide spraying robot demonstrates significant potential to enhance agricultural practices by offering a more efficient, precise, and automated approach to pesticide application. By integrating IoT technology, the robot can monitor real-time data related to environmental conditions and pest presence, ensuring pesticides are applied only when necessary, reducing wastage, and minimizing environmental impact. This innovation not only optimizes pesticide usage but also helps safeguard crops from pests, leading to improved crop yields and sustainable farming practices. Future work could focus on enhancing the robot's adaptability to different terrains and crop types, further refining the IoT sensors for greater accuracy, and integrating machine learning algorithms to improve decision-making capabilities for autonomous operation. Overall, this project marks a significant step towards smarter, more sustainable agriculture.

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ISBN-978-81-19905-39-3

ICEST_EC_009

GYROSCOPE CONTROLLED WHEEL CHAIR FOR DISABLED PATIENTS

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Abstract:

Utilizing useful, cutting-edge and reasonably priced equipment should improve the quality of life for patients and handicaps with physical disabilities. The physically impaired patients with an easily maneuverable wheelchair who had endured losing their extremities as a result of an accident, ageing, or illness. Due to losing both of their arms and legs, these individuals are unable to utilize an electric wheelchair with joystick or a manual wheelchair. The way this wheelchair moves is controlled by head movements. In the direction of the head, the wheelchair will move.

Keyword: MPU-6050, ATmega328p, l298n, Ultrasonic sensor

1. INTRODUCTION

The physically impaired patients with an easily maneuverable wheelchair who had endured losing their extremities as a result of an accident, ageing, or illness. Due to their disability, some people are unable to utilize manual wheelchairs or electric wheelchairs with joysticks. This wheelchair's movements are managed by head movements through a gyroscope sensor (MPU-6050). Additionally, an ATmega328p microcontroller is employed, and it is designed to cause the wheelchair to move in response to the patient's head moving in the same manner. The wheelchair will go ahead when the user tilts their head forward, to the left when they tilt their head to the left, and so on. Ultrasonic sensors are used in an obstacle detection system. This technique produced excellent results and will make using this wheelchair safer than using a normal wheelchair. It will contribute to improving their quality of life and reducing their reliance

ISBN-978-81-19905-39-3

on others. This wheelchair is affordable, easy to use, and pleasant for those who are physically challenged.

The automation of today's technologies has reduced the necessity for human intervention. These automated systems are very accurate and dependable with less manual procedures. Patients with disabilities who struggle to use manual wheelchairs might benefit greatly from smart wheelchairs. Patients who had losing their hands cannot use the manual wheelchair or motorized wheelchair with joysticks. Such individuals require pricey, very complex medical equipment. As a result, a microcontroller-based technology that allows the wheelchair to move based on head motion is introduced.

The wheelchair described in the system uses a head motion and gyroscope sensor connected to a DC motor to assist people who are physically impaired. The gyroscope sensor is a micro-electro-mechanical sensor (MEMS) sensor that successfully converted head motions into data that a computer could understand. The patient will be assisted in using the wheelchair safely by the obstacle detection system, which makes use of ultrasonic sensors. It is a wheeled chair that has DC motors in the wheels so that patients may use it automatically. In comparison to manual wheelchairs, it is simpler. Rechargeable batteries can be used to power the DC motors.

II. OBJECTIVE

- The ultimate goal of gyroscope-controlled wheel chair is to provide physically disabled patients (with loss of both hands and legs) an easily controllable wheel chair.
- The range of application for gyroscope-controlled wheel chair is very wide since there are many patients with no legs and hand.
- This project also concerns the military personnel’s who lost their body part during war

III. LITERATURE REVIEW

Human-computer interaction is the main topic of the study article "Hand Gesture Recognition: A Literature Review" [2]. It is an analysis of current hand gesture recognition technology. Crucial concerns at hand the problems of gesture systems are given to gesture recognition systems. Reviewing contemporary postures' techniques a technique for recognizing gestures was

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also shown. There are significant issues with the orientation histogram approach used here, such as the possibility that comparable movements might be different. Additionally, the suggested method might provide comparable orientation histograms for other gestures. Even though the dominant item in the photograph is not the hand motion, the strategy was successful in achieving it.

The Sensor-Based Gesture Control Wheelchair, described in a research article [3] published in IEEE, operates on the idea of gesture detection utilizing infrared sensors. In this technique, IR sensors are utilized to recognize basic movements that may be used to steer the motorized wheelchair in any direction. A gesture pad with IR sensors, an MCU, and a power management circuit is constructed for gesture detection and identification in the proposed prototype system, and a controller for controlling motors is implemented. The biggest issue with IR is that it loses sensitivity in daylight, which makes it difficult to execute subsequent programs. Additionally, employing IR sensors to identify precise motions is challenging.

We are employing an accelerometer that is affixed to the user's head in the form of a head set so that we can alter the direction of the wheelchair by just moving the user's head, or more specifically, by moving their head just a little bit in a different way.

IV. BLOCK DIAGRAM

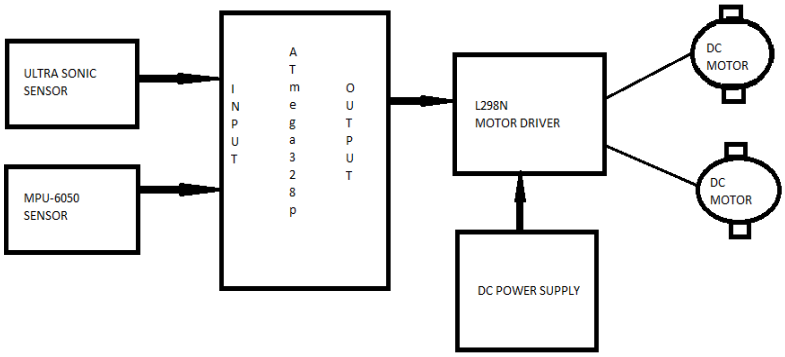

Fig. 1 Block Diagram of basic control system for a gyroscope-controlled Wheel Chair

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Fig.1 illustrates the block diagram of basic control system for a gyroscope-controlled wheelchair, using an ATmega328P microcontroller as the central processing unit. Here's a detailed description of each block in the diagram:

- ATmega328p

  Atmega328p is a microcontroller which is used to perform various tasks like input and output control. It has 32 kilo bytes of programmable read while write functionality. It has total 23 general purpose input and output pins. In this project we are using it to control the entire system. All the sensors and output devices are interfaced with this microcontroller.

- Ultrasonic Sensor

  An ultrasonic sensor is a piece of technology that converts the sound that is reflected back into an electrical signal after using ultrasonic sound waves to measure the distance to a target item. Audible sound travels at a faster rate than ultrasonic waves do (i.e. the sound that humans can hear). An ultrasonic sensor primarily consists of the transmitter (which produces sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target).

- MPU-6050

  A comprehensive 6-axis motion tracking device is the MPU6050 sensor module. In a compact size, it includes a 3-axis gyroscope, 3-axis accelerometer, and a digital motion processor. Additionally, it incorporates an on-chip temperature sensor as an extra function. In order to connect with the microcontrollers, it features an I2C bus interface. To interface with other sensor devices like a 3-axis magnetometer, a pressure sensor, etc., it features an auxiliary I2C bus. A full 9-axis Motion Fusion output may be provided by MPU6050 if a 3-axis Magnetometer is attached to an additional I2C connection.

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- L298N Motor Driver

  The L298N Motor Driver Module is a high power motor driver module that may be used to power DC and Stepper Motors. This module is composed of an L298 motor driver IC and a 78M05 5V regulator. The L298N Module may control two DC motors with speed and direction control or up to four DC motors.

- DC Power Supply

  The DC power supply is an apparatus that converts the AC power supply of the outlet into a reliable Direct Current (DC) and provides it to the device. To run electrical circuits or test electronic gadgets, it serves as a power source.

- DC Motor

  A DC motor is an electrical device that converts electrical energy into mechanical energy. The electrical energy used in a DC motor, direct current, is transformed into mechanical rotation.

V. DESIGN AND WORKING

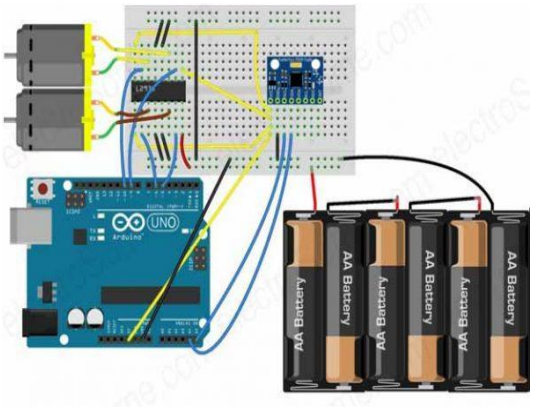

Fig 2**.** Basic setup of gyroscope-controlled wheelchair

The Gyroscope Controlled Wheelchair starts when the patient sits on the wheelchair and place his/her head on wheel chair. The wheelchair will not start until and unless you place your head to the head locator at certain distance. This is done for better patient experience and total control over wheelchair. In the head locator there is an ultrasonic sensor (mpu-6050) which detects the

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position and distance of head where you placed. If the head placed at proper position on head locator for 5 sec time, then the wheel chair will start, else there will be no motion. This technique is used so as to avoid uncontrolled motion. Once, the wheelchair starts, the gyroscope sensor (mpu-6050) will read the 3-axis accelerometer value and 3 axis gyroscope value. This value will be passed to ATmega328p microcontroller which already contains the calibrated value of gyroscope sensor. According to this calibrated value of gyroscope sensor, the microcontroller will generate the appropriate PWM (pulse width modulated) signal. This PWM Signal will be passed onto motor driver (l298n). We use motor driver to supply power to the motor instead of directly supplying it to the motor because, the voltage requirement of motor is 12v and more (for our application) which cannot be taken out of the microcontroller which will damage the components of the ATmega328p microcontroller. The l298n motor driver can control two dc motor. The PWM signals can be given to the EN (enable) pins of the l298n for controlling the speed of the motor. This PWM signal is then passed to the motors. According to speed provided to the motor the wheelchair will move right and left. If you rotate your head more to the right and less to the left, the generated PWM signal will be more to the left motor which will drive the wheel chair to the right direction and for the right vice-versa.

VI. CONCLUSION

In order to improve driving safety, this study suggested developing a new smart wheelchair with an obstacle detecting system. The gyroscope sensor is the foundation of the smart wheelchair's hardware, which interfaces with a microprocessor. In order to manage the wheelchair's motions in accordance with the user's head gestures, this system made use of the gyroscope MPU-6050 sensor as its primary design element. The wheelchair pauses as it approaches an obstruction thanks to an obstacle detection technology that uses ultrasonic sensors. The microcontroller ATmega328p was in charge of connecting each of these sensors to the wheelchair. For the elderly and the disabled, the designed system creates a safer environment, allowing them to roam alone indoors or even outdoors with greater safety than before.

ISBN-978-81-19905-39-3

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ISBN-978-81-19905-39-3

ICEST_EC_011

GESTURE CONTROLLED RECOGNITION SYSTEM USINGIMAGE PROCESSING

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ABSTRACT:

This abstract encapsulates the essence of a revolutionary system designed to augment human-computer interaction through intuitive gesture recognition, powered by cutting-edge image processing methodologies. The envisioned system transcends traditional input mechanisms, enabling users to seamlessly communicate with technology through natural gestures, thereby enhancing user experience and accessibility across various domains. Thisresearch delineates the conceptualization, development, and validation of the proposed system, underscoring its potential impact in realms ranging from gaming and entertainment to healthcare and industrial automation. Through meticulous experimentation and refinement, this work pioneers a transformative paradigm in interactive computing, heralding a future where human- machine interfaces seamlessly align with human cognition and expression. Furthermore, the abstract explores the system's adaptability to diverse environments and user demographics, emphasizing its versatility and scalability for widespread adoption in both consumer and enterprise settings. Additionally, it investigates the system's potential for fostering new modes ofcollaboration and creativity, envisioning a landscape where intuitive interaction fosters innovation and productivity.

Moreover, this abstract delves into the ethical considerations and privacy safeguards inherent in such systems, ensuring that user autonomy and data security remain paramount in the advancement of gesture-controlled technologies.

Keywords: Gesture recognition, Image processing, Human-computer interaction, Intuitive interface, Technology innovation, Gaming, Healthcare.

ISBN-978-81-19905-39-3

1. INTRODUCTION:

In contemporary computing, the pursuit of more intuitive and seamless interactionsbetween humans and machines has become a focal point of research and development. Traditional input methods such as keyboards and touch screens, while effective, often present limitations in terms of user experience and accessibility. As a response to these challenges, gesture-controlled recognition systems have emerged as a compelling alternative, harnessing the natural language of human gestures to bridge the gap between users and technology [1].

Gesture recognition systems offer a novel means of interaction, allowing users to communicate with devices through intuitive hand movements, gestures, and body language. These systems have found applications in various domains, including gaming, virtual reality, robotics, healthcare, and smart home automation. By enabling users to control devices using gestures, gesture recognition systems enhance user experience, facilitate accessibility for individuals with disabilities, and open up new avenues for creativity and expression [2].

At the heart of gesture-controlled recognition systems lies the integration of image processing techniques, which enable computers to interpret and respond to visual inputs in real-time. Image processing algorithms analyze and extract relevant features from input images or video streams, allowing the system to recognize and interpret gestures accurately. Machine learning algorithms further enhance the system's capability by enabling it to adapt and learn fromuser interactions over time, improving accuracy and robustness [3].

This paper aims to explore the design, implementation, and potential applications of a gesture-controlled recognition system utilizing image processing techniques. We will delve into the underlying principles of image processing and machine learning algorithms employed in gesture recognition, discussing their roles in enabling real-time interaction between users and devices. Furthermore, we will examine the hardware and software components required to build such a system, considering factors such as sensor technologies, computational resources, and software frameworks.

Moreover, we will discuss the diverse applications of gesture-controlled recognition systems across various domains, ranging from interactive entertainment and gaming to assistive technologies and

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industrial automation. By providing a comprehensive overview of the state-of-the-art in gesture recognition technology, this paper aims to inspire further research and innovation in the field of human-computer interaction [4].

In addition to technical considerations, we will also address ethical implications and privacy concerns associated with the deployment of gesture-controlled recognition systems. As these systems capture and process sensitive user data, ensuring privacy, security, and userconsent are paramount. By discussing these ethical considerations, we aim to promote responsible development and deployment practices that prioritize user trust and autonomy [5].

In summary, gesture-controlled recognition systems represent a significant advancement in human-computer interaction, offering a more natural and intuitive means of communication between users and technology. By leveraging image processing techniques and machine learning algorithms, these systems have the potential to revolutionize the way we interact with digital devices, opening up new possibilities for creativity, accessibility, and user empowerment.

2. RELATED WORK:

Researchers and developers are continuously striving to enhance the safety and features of smart wheelchairs, resulting in the development of various control mechanisms in recent years. Several noteworthy methods related to the proposed system are outlined below for reference.

Kutbi et al. proposed a head movement tracking-based wheelchair control model, employing an egocentric camera to capture head images. The system utilized the TI-TAN18CS modeled wheelchair, Arduino Mega as a command processor, and Robot OS (ROS) as the framework. Despite achieving a performance of approximately 85.7%, the system's cost remains high, and wearing an egocentric camera on the head may not be user-friendly.

Tejonidhi et al. introduced an eye-pupil tracking-based wheelchair movement system, utilizing a Philips microcontroller and the Viola-Jones MATLAB algorithm for eye detection from RGB images. However, the detection process poses challenges for real-time applications, with performance ranging from 70% to 90%, rendering it unsuitable for real-life scenarios.

Utaminingrum et al. developed a wheelchair-controlling mechanism based on tracking a target object in front of the wheelchair using RGB images. The system's control flow involved

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human detection utilizing the HOG algorithm, interested human tracking with the CAMSHAFT algorithm, and movement detection. However, the system faces complexities in target selection from multiple human objects, with performance varying around 80%, necessitating improvements for practical applications.

Mahmud et al. devised a multi-modal wheelchair control mechanism utilizing an accelerometer for head movement tracking, flex sensors glove for hand tracking, and an RGB camera with a modified VGG-8 model for eye gaze tracking, alongside a Raspberry Pi. While achieving performance around 90%, the system requires tracking sensors to be attached to the user's body, and the eye gaze detection mechanisms lack user-friendliness.

Desai et al. proposed a wheelchair control system based on eye iris movement, enabling users to navigate their wheelchair by moving their iris in respective directions. However, the system's response time is prolonged, requiring approximately 5 seconds longer, and may yield false positives due to subconscious eye movements, rendering it unsuitable for real-time navigation operations.

Gao et al. introduced a hand gesture-based control mechanism for a power wheelchair, utilizing an RGB-depth camera to capture hand information and a high-configuration laptop PC for gesture detection and tracking. Nevertheless, the system's performance is significantly affected by environmental background complexity, and its user-friendliness is compromised by the mandatory requirement of hand raising for gesture performance, coupled with high system costs.

In a separate study, Bhuyain et al. developed an Electrooculogram (EOG)-based wheelchair movement control system, capturing eye blinks and movements using simple electrodes placed beside the eyes. The system utilized a microcontroller and threshold-based algorithm, alongside a locally developed power wheelchair for implementation. While the system boasts a low cost, the task of placing new electrodes beside the eyes each time poses practical challenges.

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3. The Proposed Methodology

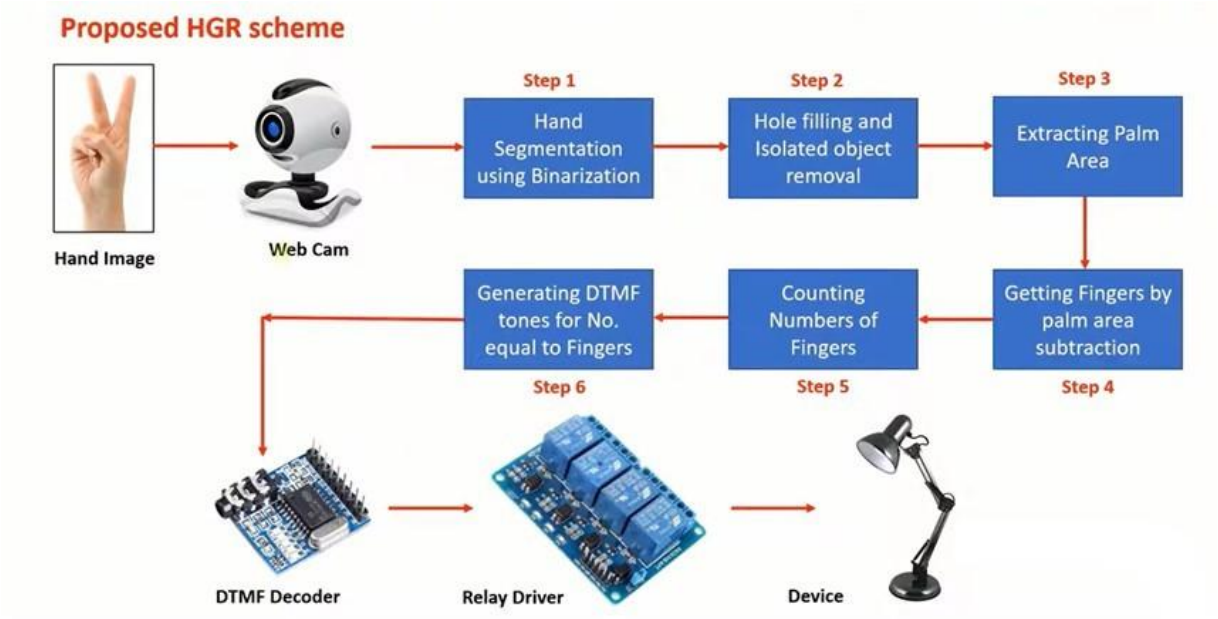

Fig. 1: Working Process in Block Diagram

The gesture-controlled recognition system utilizing image processing alongside a DTMF decoder operates by initially capturing live video input through a webcam, which continuously streams footage capturing the user's hand movements and gestures in real-time. This video feed undergoes meticulous processing employing sophisticated image processing algorithms. These algorithms are tasked with the detection and tracking of the user's hand gestures, discerning patterns and characteristics to identify specific gestures accurately. Once a gesture is successfullyrecognized, the system promptly communicates the corresponding command or action to aDTMF decoder [7].

The DTMF decoder, a hardware component, plays a pivotal role by converting the gesture-based commands into Dual-Tone Multi-Frequency (DTMF) tones. Each gesture command is meticulously mapped to a unique combination of tones, ensuring clarity and distinction. These generated DTMF tones are subsequently transmitted to the intended target device or application via an appropriate communication interface, which might include audio output or serial communication, depending on the system's design and requirements.

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Upon reception of the DTMF tones, the target device or application interprets them as actionable commands, executing specific functions corresponding to the recognized gestures. For instance, in the context of home automation, these commands could trigger actions such as turning lights on or off, adjusting room temperatures, or controlling appliances—all based on the gestures performed by the user in front of the webcam [8].

To enhance the user experience and ensure seamless interaction, the system provides feedback to the user, confirming the successful recognition and execution of the gesture-based command. This feedback mechanism could take various forms, including visual indicators or auditory cues, depending on the system's interface and user preferences. Furthermore, the system continuously monitors the user's gestures, ensuring responsiveness and adaptability to dynamic user inputs.

This integrated approach, combining image processing techniques with a DTMF decoder, offers a sophisticated yet intuitive means for users to interact with digital devices and applications using hand gestures. By leveraging advanced technologies and seamless communication protocols, this gesture-controlled recognition system enhances user accessibility,fosters efficient interaction, and opens up new avenues for intuitive human-computer interaction across diverse domains.

Moreover, the system's image processing algorithms are meticulously designed to handle various environmental factors such as lighting conditions, background clutter, and hand occlusion, ensuring robust and reliable gesture recognition under diverse circumstances. Advanced techniques such as background subtraction, hand contour detection, and feature extraction are employed to accurately identify and classify different types of gestures performed by the user.

In parallel, the DTMF decoder plays a crucial role in translating the recognized gestures into actionable commands by generating precise DTMF tone sequences. These sequences are carefully mapped to specific commands or functions within the target device or application, offering a wide range of control possibilities tailored to the user's gestures. Additionally, the DTMF decoder's integration with the system allows for seamless communication between the

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gesture recognition module and the target device, facilitating efficient command transmission and execution.

Furthermore, the system architecture is designed to be flexible and scalable, allowing for easy integration with various hardware setups and software platforms. Whether deployed in standalone applications or integrated into larger systems, such as smart home automation networks or interactive gaming consoles, the gesture-controlled recognition system offers versatile and adaptable functionality to suit diverse user needs and preferences.

As the system continuously monitors the user's gestures in real-time, it employs sophisticated feedback mechanisms to enhance user engagement and satisfaction. Visual feedback in the form of on-screen prompts or a gesture overlay provides users with real-time guidance and confirmation of their actions, fostering a sense of control and empowerment. Moreover, auditory feedback through synthesized voice prompts or sound effects adds another dimension to the user experience, making interactions more immersive and engaging.

In conclusion, the gesture-controlled recognition system leveraging image processing and a DTMF decoder represents a groundbreaking advancement in human-computer interaction technology. By seamlessly integrating hand gesture recognition with precise command generation and execution, the system offers users a natural and intuitive means of interactingwith digital devices and applications. With its robust performance, versatility, and user-centric design, this innovative system holds immense potential to transform the way we interact with technology in various domains, from entertainment and gaming to healthcare, education, and beyond.

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Image Acquisition and Processing:

Fig. 2: Capturing Process

1. Image Capture using Webcam:

   A. Initialization: First, you need to initialize the webcam using appropriate libraries like OpenCV in Python. This involves accessing the webcam hardware and configuring it to capture images.

   B. Capture Image: Once the webcam is initialized, you can use a command to capture a single frame from the webcam feed. This frame represents an image captured in real-timefrom the webcam.

   C. Display Image (Optional): Optionally, you can display the captured image on the screen using a display function from the OpenCV library. This step allows you to visually verifythat the image has been captured successfully.

2. Image Processing in Google Colab:

   A. Upload Image to Google Colab: After capturing the image using the webcam, you can upload it to Google Colab, a cloud-based Jupyter notebook environment, for further processing. This can be done using various methods such as uploading the image file directly or using Google Drive integration.

   B. Loading Image into Colab: Once the image is uploaded, you can load it into the Colab environment using Python libraries such as OpenCV or PIL (Python Imaging Library).

   C. Image Processing: With the image loaded into Colab, you can perform various image processing tasks using Python libraries such as OpenCV, TensorFlow, or scikit-image. This may include tasks such as image filtering, edge detection, object

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detection, segmentation, or any other desired image manipulation or analysis.

D. Display Processed Image (Optional): Optionally, you can display the processed image within the Colab notebook using display functions provided by the chosen image processing library. This allows you to visualize the results of your image processing algorithms directly within the notebook environment.

E. Save Processed Image: Finally, you can save the processed image back to your local system or cloud storage if needed, using appropriate commands provided by the chosen image processing library.

Overall, capturing an image using a webcam and processing it in Google Colab involves a combination of hardware initialization, image capture, uploading, loading, processing, and optionally displaying and saving the processed image. This workflow enables users to leverage the computational resources and convenience of Google Colab for performing complex imageprocessing tasks on captured images.

Tone Processing and Relay Triggering:

1. DTMF Tone Processing in DTMF Decoder:

A. Reception of DTMF Tones: The DTMF decoder receives the DTMF tones generated by the gesture-controlled recognition system. These tones are typically transmitted through an audio signal or a digital communication interface.

B. Tone Detection: The DTMF decoder contains circuitry designed to detect the presence of DTMF tones within the incoming signal. This circuitry filters out other frequencies and noise, focusing specifically on the frequencies associated with DTMF tones.

C. Decoding DTMF Tones: Once the DTMF tones are detected, the DTMF decoder decodesthem into their corresponding digital signals. Each DTMF tone represents a uniquecombination of two frequencies, one from a high-frequency group and one from a low- frequency group. The DTMF decoder translates these frequency combinations into binaryor digital signals.

D. Mapping to Commands: The decoded digital signals are then mapped to specific commands or actions based on predefined mappings. For example, each unique combination of DTMF tones may correspond to a specific gesture command, such as

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turning a light on or off, adjusting volume levels, or controlling the movement of a robotic arm.

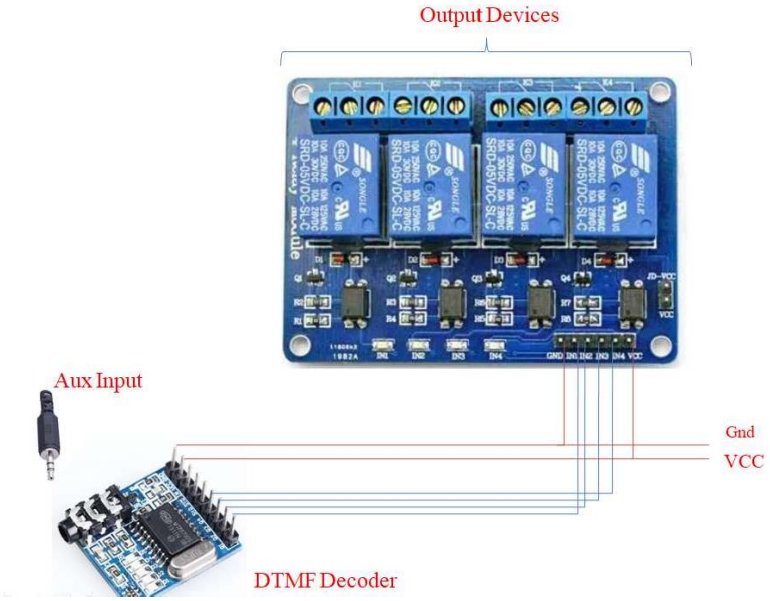

Fig Hardware Circuit Diagram

2. Input to Relay Module:

A. Relay Module Interface: The DTMF decoder interfaces with a relay module, which serves as a switching device capable of controlling electrical circuits. The relay module typically contains multiple relay switches, each capable of opening or closing a circuit in response to a digital input signal.

B. Command Transmission: Upon decoding the DTMF tones and mapping them to specific commands, the DTMF decoder generates digital output signals corresponding to these commands. These signals are then transmitted to the relay module through an appropriatecommunication interface, such as digital I/O pins or serial communication.

C. Relay Activation: Upon receiving the digital input signals from the DTMF decoder, the relay module activates the corresponding relay switches. Each activated relay switch closes or opens a specific electrical circuit, thereby controlling the operation of connecteddevices or appliances.

D. Device Control: The activated relay switches control the flow of electrical current to

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connected devices or appliances, enabling them to perform the desired actions dictated bythe decoded DTMF tones. For example, activating a relay switch may turn a light bulb onor off, start or stop a motor, or open or close a door or gate.

Overall, the DTMF decoder serves as an intermediary between the gesture-controlled recognition system and the relay module, translating decoded DTMF tones into digital signals that can be used to control the operation of electrical circuits through the relay module. This enables users to interact with physical devices and appliances using hand gestures captured bythe system.

4. CONCLUSION

In conclusion, the Gesture Controlled Recognition System using Image Processing represents a significant advancement in human-computer interaction technology, offering a novel and intuitive interface for controlling devices and applications through natural hand gestures. By leveraging image processing techniques, Webcam technology, DTMF decoding, and relay driverfunctionality, the system enables users to interact with technology seamlessly and effortlessly, without the need for physical interfaces or input devices.

Throughout this project, we have explored the capabilities and potential applications of gesture recognition technology in various domains, including home automation, assistive technology, gaming, education, healthcare, and industrial automation. We have demonstrated how the system can enhance user experiences, improve accessibility, and streamline interactions with electronic devices and environments.

However, while the Gesture Controlled Recognition System offers numerous benefits and applications, it also presents challenges and limitations, such as gesture vocabulary constraints, environmental factors, accuracy and reliability issues, setup complexity, integration challenges, and privacy and security concerns. Addressing these challenges through continued research, development, and user feedback is crucial to realizing the full potential of gesture recognition technology and ensuring its widespread adoption and acceptance.

ISBN-978-81-19905-39-3

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ISBN-978-81-19905-39-3

ICEST_EC_021

ENERGY-EFFICIENT LFSR DESIGN USING ADVANCED CLOCK GATING TECHNIQUES

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Abstract:

Linear Feedback Shift Registers (LFSRs) represent a fundamental component in numerous digital systems, facilitating operations ranging from sequence generation to error detection and correction. However, the pervasive use of LFSRs comes with the inherent challenge of high-power consumption, particularly in battery-powered devices and energy-constrained environments. Our approach distinguishes itself from conventional gated clock strategies by focusing on two key aspects: an optimized logic gate implementation and strategic reduction of XOR gates within the feedback network. By carefully selecting and designing logic gates tailored to minimize power consumption, coupled with judicious XOR gate reduction, we achieve remarkable power savings without compromising performance or functionality. To rigorously evaluate the effectiveness of our proposed method, we conducted extensive transistor-level simulations using standard cells in a 45nm technology node. These simulations provide detailed insights into the power characteristics and performance metrics of our approach compared to conventional implementations. The simulation results demonstrate a notable reduction in power consumption, validating the efficacy of our approach in enhancing energy efficiency in LFSRs. Furthermore, comparative analysis against existing gated clock strategies showcases superior power savings, affirming the significance of our method in practical implementations.

Key Words: Linear Feedback Shift Registers (LFSRs), transistor-level simulations in a 45nm technology.

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1. Introduction

Today, linear feedback shift registers (LFSR), find extensive application in electronics equipment demanding rapid creating a sequence of pseudo-random , notably in digital circuit built-in tests. In these contexts, optimizing area, power consumption, and delay stands as paramount objectives [1].

LFSRs serve as foundational components in stream ciphers for secure communication systems like GSM and LTE applications , as well as in lightweight stream ciphers tailored for embedded systems . The advent of word-based LFSRs optimizes their compatibility with modern processors structured around words. These specialized LFSRs find application across various stream ciphers, prominently featured in the SNOW series and utilized in image encryption applications [2].

LFSRs are additionally employed in producing a simulated version of white noise for tasks such as parameter estimation and system identification. They also feature in the Global Positioning System (GPS), where an LFSR facilitates the swift transmission of a sequence indicating high-precision relative time offsets. LFSRs are also mostly used in direct sequence spread spectrum (DSSS) systems, and error detection and correction by implementing BCH (Bose, Chaudhuri ,Hocquenghem) and CRC (cyclic redundancy codes) encoder and decoder circuits. Recently LFSR have been also exploited to build strong physical unclonable functions (PUFs) for cryptographic applications [3].

2. Problem statement

The continuous toggling of flip-flops in conventional Linear Feedback Shift Registers (LFSRs) leads to significant power dissipation, posing a challenge for low-power design. This research aims to develop a novel clock gating approach for LFSRs, optimizing power savings without compromising performance or introducing significant overhead. The proposed method will be evaluated for power reduction, area overhead, and overall performance, offering a solution to enhance energy efficiency in digital circuits [4].

3. Literature survey

Reducing power consumption in digital systems is paramount due to its direct impact on energy efficiency, battery life, and environmental sustainability. As modern devices become increasingly ubiquitous and reliant on battery power, minimizing power usage becomes imperative to extend operational lifetimes and reduce the frequency of recharging or replacing

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batteries. Moreover, in large-scale computing systems and data centers, reducing power consumption translates directly to lower operational costs and environmental footprint.

The survey reviews various methodologies and architectures designed to reduce power consumption in Linear Feedback Shift Registers (LFSRs), a crucial component in applications such as Built-In Self-Test (BIST), cryptography, and error correction. The paper by C. P. de Souza et al. [1] addresses the issue of error masking in BIST techniques by utilizing the Berlekamp-Massey algorithm (BMA). Traditional BIST methods compress test responses, leading to potential aliasing issues. The proposed BMA-based architecture crafts an efficient LFSR for generating fault-free test responses, ensuring thorough testing by comparing these sequences against responses from the Circuit Under Test (CUT), thus avoiding aliasing and maintaining minimal LFSR length. R. Oommen et al. [2] and M. Mohan et al. [3] explore different LFSR architectures and their power efficiencies. The studies compare CMOS, Gate Diffusion Input (GDI), modified GDI (mGDI), and Multi-Threshold CMOS (MTCMOS) techniques. Both papers conclude that LFSR designs using mGDI configuration achieve superior power efficiency, high performance, and reduced area utilization compared to other methods. G. Hu et al. [4] introduce an improved state-space transformation technique for high-speed parallel LFSRs, focusing on BCH and CRC encoding. The novel transformation matrix construction and efficient search algorithm enhance throughput and reduce complexity. X. Zhang [5] proposes an alternative method to shift the complexity in matrix multiplication, achieving significant power reduction without increasing critical path delay or total gate count. W. Aloisi and R. Mita [6] present a gated-clock design methodology aimed at reducing power consumption in LFSRs. The technique relies on controlling the clock signal to minimize dynamic power usage, contingent on the technological attributes of the gates. While the gated-clock design can substantially save power, it requires additional silicon area for the gating circuit. C. Manifavas et al. [7] provide a survey on lightweight stream ciphers for embedded systems, highlighting the importance of efficient cryptographic mechanisms for resource-constrained devices. Stream ciphers like AES-CTR, Salsa20, and WG-8 are evaluated for their speed [8] and low-power implementations [9], relevant to ubiquitous computing applications where power efficiency is critical. F. M. Mwaniki and H. J. Vermeulen [10] introduce a bipolar pseudo-random impulse sequence (PRIS) for system identification applications, demonstrating its efficacy in generating wideband perturbation signals. The PRIS approach is efficient in high-power applications, providing accurate frequency spectrum estimation with reduced power

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losses compared to traditional methods. The surveyed papers converge on the necessity for innovative low-power LFSR designs to meet the growing demands of modern digital systems. Techniques such as the Berlekamp-Massey algorithm for alias-free BIST, GDI-based architectures for power efficiency, state-space transformations for high-speed operations, and gated-clock designs for dynamic power reduction represent significant advancements. These methodologies collectively push the boundaries of power-efficient digital design, ensuring robust performance and minimal energy consumption [11].

4. Proposed Work

Reducing the power dissipation in general can be accomplished by reducing the power consumption of the term PXORNAND. This can be done by means of the power-aware solution, which combines the benefits of the complementary pass transistor logic (CPL-XOR/XNOR) with the transmission gate approach (TG-MUX) . It's important to highlight that complementary signals required by the CPL-XOR/XNOR section are easily available as output signals of many FF standard cells. Moreover, the complementary outputs of the CPL-XOR/XNOR section are perfectly tailored to drive the TG-MUX section since they guarantee a full voltage swing at the output node of the XORAND gate without any additional level restoring transistors

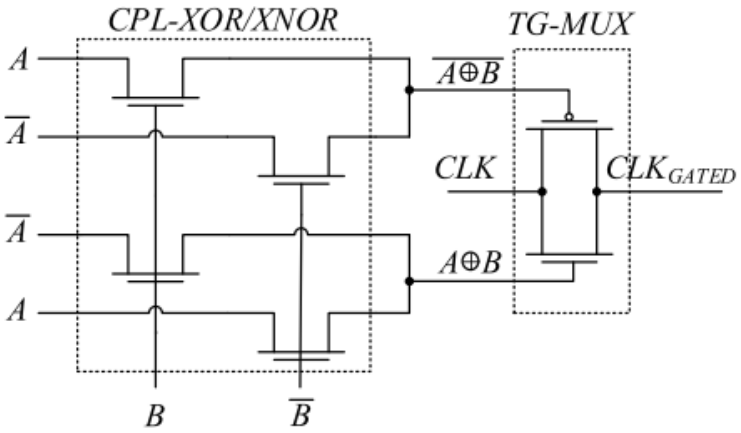

Fig 1: Power-aware XORAND for gated clock implementation

The power usage of a gated clock LFSR implemented using the XORAND circuit in fig. can be modeled as

$$P_{CPT\_TG} \approx n\alpha P''_{FF} + n_t \alpha P_{XOR}$$

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where the power usage of the gated circuit, $P_{XORNAND}$, is virtually eliminated and the FFs power consumption, P_{FF}'', accounts for the smaller capacitive effects due to both CPL and TG circuits.

4.1 Reduced XOR Number

To further cut down the LFSR power consumption, we propose an additional strategy to reduce the number of XOR gates in the feedback path, nt, by taking advantage of the CPL-XOR/XNOR section. Indeed, at the output of this CPL gate we have a binomial $x^{i+1} \oplus x^i$, with index i from 0 to n − 2, which can be used to save XORs in the feedback path.

For example, considering the polynomial, $x^7 + x^3 + x^2 + x + 1$, instead of using three XORs in the feedback path to implement $x^3 \oplus (x^2 \oplus (x \oplus 1))$, we can simply do the XOR of the binomials $x^3 \oplus x^2$ and $x \oplus 1$ available at the outputs of the CPL gates. Moreover, in case of non-adjacent taps, we can exploit the property $x^i \oplus x^i = 0$.

Thus, to achieve a further reduction on the number of XOR 198 gates, we can efficiently use together the outputs of the CPL-XOR/XNOR sections, and the terms x^i at the outputs of the FFs.

Thus, a further reduction on the number of XOR gates in the feedback path is achieved, since it results equal to,

$$n_t'' = n_t - m_c$$

where m_c is the number of adjacent taps couples, but considering each tap in only one couple. For example, in the polynomial $x^{10} + x^4 + x^3 + x + 1$ the couples of adjacent taps, m_c, are 2, that is, the couples $(x^4 + x^3)$ and $(x + 1)$.

Finally, the gated clock LFSR schematic will be as shown:

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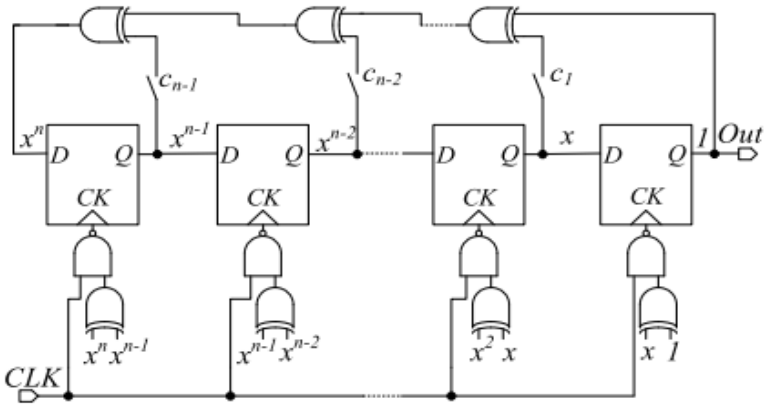

Fig 2: Gated Clock LFSR

For the digital blocks, we used the master-slave positive edge triggered D-type Flip-Flop depicted in Fig.

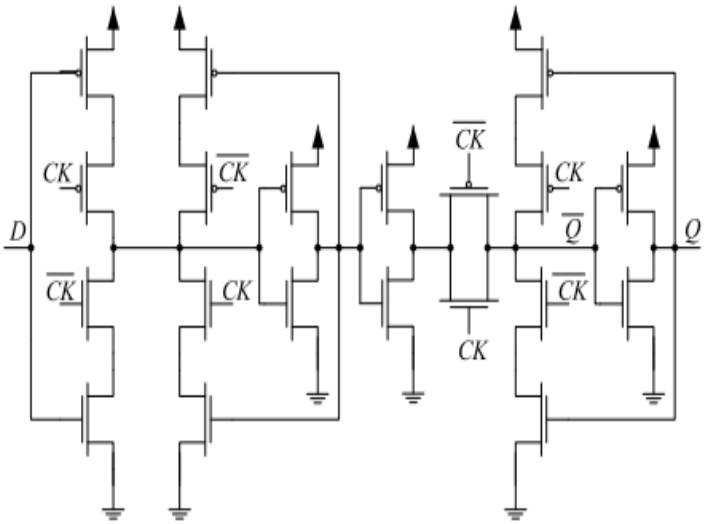

Fig 2: Schematic of Flip Flop

The two- input speed-optimized XOR gate is shown in Fig.3

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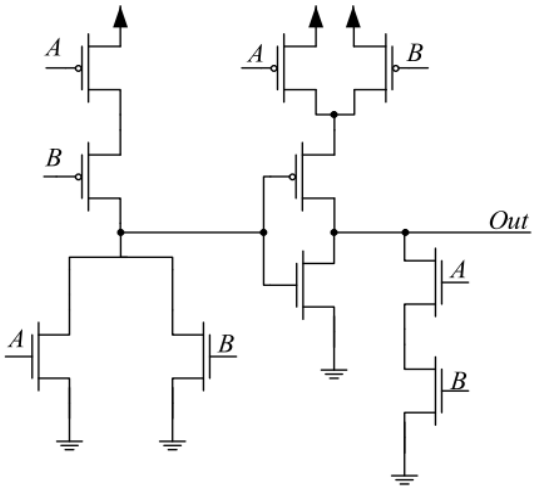

Fig 3: Simplified schematic of the speed-optimized XOR gate included in the STM standard-cell library.

5.Application

- **Pattern generators:** Novel clock gating optimizes power use, enhancing efficiency and longevity for pattern generation in LFSRs.
- **Counters:** selectively activating the clock signal, making it ideal for counters and where energy efficiency is crucial, ensuring functionality while minimizing power consumption.
- **Built in self-test (BIST)**: enhancing capabilities by reducing energy usage during test operations, thereby improving overall test efficiency and reliability.
- **Encryption:** optimizing their operation for encryption algorithms by dynamically activating clock signals only when needed, reducing energy expenditure without compromising security.
- **Compression:** dynamically controls clock signals in linear feedback shift registers, reducing power consumption compression optimizes energy efficiency in data processing, enhancing performance for low-power devices
- **Error correction:** By efficiently controlling clock signals, it can mitigate errors, enhancing error correction capabilities in data transmission systems.
- **Pseudo Random Bit Sequence**: optimizes power usage in linear feedback shift registers, enhancing efficiency for generating pseudo-random bit sequences.

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5.1Advantages

- **Reduced Power Consumption**: Clock gating helps in reducing the power consumed by the circuit by gating the clock signal when it's not needed, thus minimizing unnecessary switching activity.
- **Improved Energy Efficiency**: By selectively enabling the clock signal only when necessary, energy wastage due to unnecessary clock toggling is minimized, leading to improved energy efficiency.
- **Lower Heat Dissipation**: Since power consumption is reduced, there's less heat generated by the circuit, which can help in reducing thermal issues and enhancing the reliability of the system.
- **Extended Battery Life**: In applications powered by batteries, such as portable devices, lower power consumption translates to extended battery life, which is highly desirable for users.
- **Maintained Functionality**: Despite reducing power consumption, the functionality of the LFSR is maintained. The clock gating approach ensures that the required clock pulses are delivered to the register when needed, preserving its functionality.
- **Compatibility**: This novel approach may be compatible with existing design methodologies and tools, making it easier to integrate into existing design flows without requiring significant changes.
- **Flexibility**: Depending on the design requirements, the clock gating approach can be tailored to optimize power savings while meeting performance criteria, providing flexibility in power management strategies.
- **Scalability**: The approach may be scalable, allowing it to be applied to different sizes and configurations of LFSRs, making it suitable for a wide range of applications and design scenarios.
- **Cost-Effectiveness**: By reducing power consumption without sacrificing functionality, the overall cost of the system may be reduced, particularly in terms of operating expenses related to power consumption.
- **Compliance with Power Constraints**: In systems with strict power constraints, such as IoT devices or wearable electronics, the novel clock gating approach can help ensure compliance with these constraints without compromising performance.

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6. Conclusion

A proficient strategy for diminishing the power usage of the commonly used linear feedback shift register (LFSR) is introduced and thoroughly examined. The methodology incorporates the utilization of the Complementary Pass-Transistor Logic (CPL) design style in specific sections and leverages the gated clock for implementing the feedback network, thereby reducing the count of XOR gates. Through simulations conducted in a 45 nm CMOS technology, the proposed design approach has been validated. In contrast to conventional implementations, it demonstrates a notable power reduction, all without increasing the area or critical path delay.

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ISBN-978-81-19905-39-3

PACE Conclave 2024
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ICEST_EC_022

LIBRARY MANAGMENT SYSTEM USING FINGERPRINT & BARCODE SCANNER

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ABSTRACT:

This research project aims to revolutionize the management of college libraries through the development of a Smart Library Management System. Leveraging advanced technology, including Raspberry Pi as the central component, along with a fingerprint reader, barcode scanner, and monitor display, the system addresses prevalent challenges such as data loss, inefficient tracking, and outdated information. The Smart Library Management System streamlines library operations, facilitates efficient data collection, processing, and storage, and enhances user interaction through an intuitive monitor display interface. This research project contributes to the enhancement of library services, benefiting both library staff and students by providing a modern, efficient, and user-friendly solution for managing library resources and information.

1. INTRODUCTION

Libraries, the bastions of knowledge and repositories of literary treasures, have long played a pivotal role in facilitating the dissemination of information and fostering a love for learning. As society traverses the digital landscape, the need for libraries to evolve and embrace modern technologies becomes increasingly apparent [1]. In response to this imperative, the Library Management System, an innovative amalgamation of fingerprint and barcode technologies, emerges as a transformative solution, heralding a new era in library operations [2]. Traditionally, libraries have been revered sanctuaries where individuals embark on intellectual journeys, discovering worlds within the pages of books and manuscripts. However, the conventional methods of managing library resources, relying on manual

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cataloguing, paper-based systems, and physical library cards, have proven to be cumbersome, susceptible to errors, and often lagging in efficiency [3]. The need for a paradigm shift, one that harnesses the capabilities of contemporary technology, is not only a logical progression but a necessity to ensure that libraries remain vibrant and indispensable centers of knowledge [4]. The Library Management System is conceptualized as a multifaceted solution that transcends the limitations of traditional library systems. By seamlessly integrating cutting-edge technologies, this system envisions a library experience that is not only efficient and secure but also aligns with the expectations of a tech- savvy generation. The integration of fingerprint recognition technology provides a robust layer of security, ensuring that access to user data and valuable library resources is safeguarded with the highest level of authentication [5]. The implementation process involved meticulous steps, from software development and hardware integration to the establishment of a dynamic and responsive user interface.

2. PROBLEM STATEMENT

The current library management system at college libraries faces several challenges that hinder its effectiveness and efficiency. These challenges include data loss, inadequate tracking mechanisms, outdated information, and cumbersome user interfaces. These issues result in inefficiencies in managing library resources, affecting both library staff and students. Additionally, the lack of integration with modern technology limits the system's capabilities and fails to meet the evolving needs of users in today's digital age.

There is a clear need for a modern and comprehensive solution that addresses these challenges and enhances the overall management of college libraries. This solution should leverage advanced technologies such as Raspberry Pi, fingerprint readers, barcode scanners, and monitor displays to streamline library operations, improve data accuracy, and provide a user-friendly interface for staff and students.

The goal of this research project is to design and implement a Smart Library Management System that overcomes the limitations of the existing system and provides a robust, efficient, and user-centric solution for managing library resources. By addressing these challenges, the Smart Library Management System aims to optimize library operations, enhance user experience, and meet the evolving needs of college libraries in the digital era.

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3. LITERATURE SURVEY

A study on implementation of smart library system ,The research is intended to design a smart library management application for the libraries in Oman. The library is one of the important parts in any educational organization. Although, library has a system, but the library needs to implement a new management system in order to replace the existing system by introducing the new system. There are many reasons why the library staffs have to implement another system, which are: loss a lot of information on the library books. The loss of data about the books Difficulty in tracking down the details of the library transactions due to a slow system Difficulty in updating the information on regular basis. Proposed research project is to propose a smart solution for libraries in Oman by designed an application which will be called as Smart library Management System by using the concepts of Radio Frequency Identification (RFID) and Mobile (IoT). The new system will manage and control all the information of the library and solve the above mention problems and as well as provide several benefits for the staff & students. This application includes several forms which will be used by the library staff and students. As a case the requirements have been gathered at Middle East College, Muscat, Oman Library and then the study is done.

4. METHODOLOGY

The implementation process commenced with a thorough needs assessment, involving indepth analysis and stakeholder engagement, followed by the development of comprehensive system architecture and an intuitive user interface. The selection of suitable hardware and software components, including fingerprint and barcode technologies, was meticulously carried out, ensuring compatibility, scalability, and future adaptability. Coding and development activities focused on creating modules for fingerprint authentication, barcode scanning, and seamless database integration, with ongoing testing and debugging procedures to guarantee system functionality. The establishment of the database structure aimed to accommodate real-time updates for accurate resource tracking, while the implementation of the user authentication module emphasized the integration of fingerprint recognition for enhanced security. The creation of a book transaction module, coupled with the development of an intuitive user interface, contributed to efficient check-in and check-out processes, ensuring an enhanced user experience. The integration of robust security

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protocols addressed privacy regulations and ethical standards, leading to a thorough testing phase encompassing the entire system to rectify bugs and ensure reliability. Comprehensive training sessions were conducted for library staff on system usage, and the deployment phase involved close monitoring of the system's performance, addressing user feedback and making necessary adjustments for optimization. Establishing a framework for continuous monitoring post- deployment, the methodology ensured the implementation of regular updates and improvements based on user feedback, technological advancements, and evolving library needs

5. BLOCK Diagram

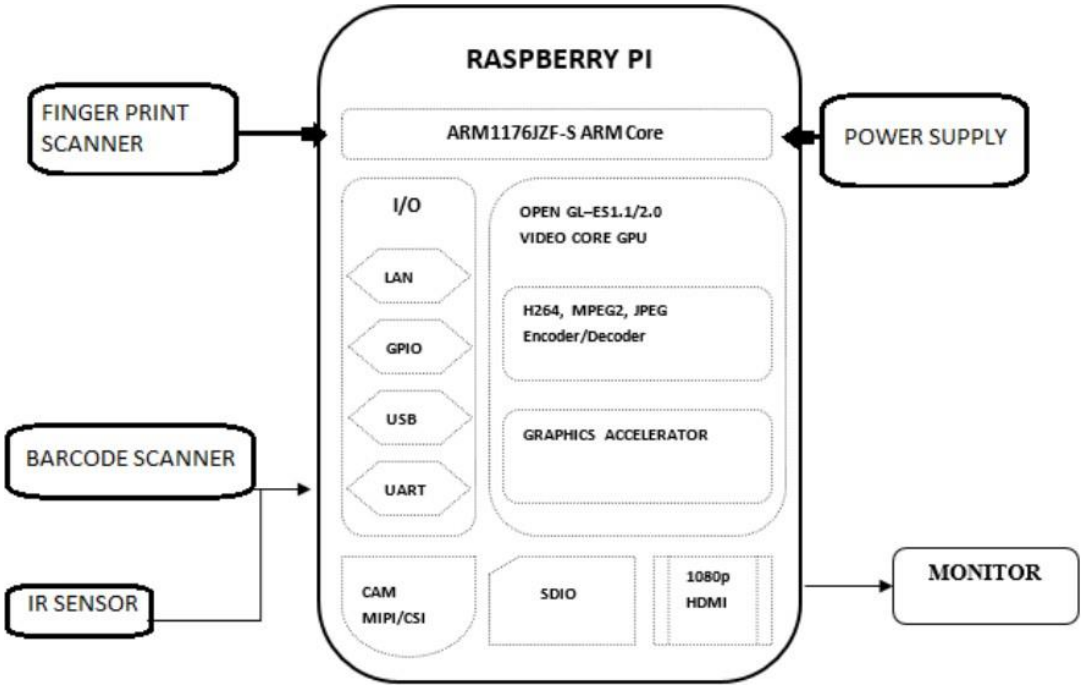

Fig. 1: Block diagram

The above block diagram illustrates the interconnectedness of various components with the Raspberry Pi, serving as the central hub of the system. Acting as the heart of the Smart Library Management System, the Raspberry Pi coordinates and manages the flow of information. The input devices, namely the fingerprint reader and barcode scanner, are integrated seamlessly with the Raspberry Pi, providing essential data inputs. The output of the system is observed

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and displayed on the monitor. This interactive display allows users, both staff and students, to engage with the system, view relevant information, and interact with the Smart Library Management System efficiently. The Raspberry Pi, acting as the brain of the operation, ensures a cohesive and responsive integration of input devices, processing of information, and output display on the monitor. This centralized architecture enhances the overall efficiency and effectiveness of the library management system.

6. APPLICATION

- **Efficient Resource Management**: The system will streamline the process of managing library resources such as books, journals, and multimedia materials. It will enable staff to easily track the availability, location, and circulation history of items, ensuring efficient resource utilization.
- **Enhanced Data Accuracy:** By incorporating technologies like barcode scanners and fingerprint readers, the system will significantly improve the accuracy of data entry and retrieval. This will reduce errors in record-keeping and enhance the reliability of library information.
- **Real-time Monitoring:** The system will provide real-time monitoring of library activities, including borrowing, returning, and reservation of materials. This will enable staff to quickly respond to user inquiries and manage library operations more effectively.
- **User-friendly Interface:** With a user-friendly interface displayed on the monitor, both staff and students will have easy access to library services and resources. The system will offer intuitive features for searching, browsing, and accessing library materials, enhancing the overall user experience.
- **Self-service Options:** The Smart Library Management System will empower users with self- service options such as self-checkout and self-return kiosks. This will reduce wait times and allow users to conveniently borrow and return materials without the need for assistance from library staff.
- **Enhanced Security:** The integration of fingerprint readers for user authentication will enhance security measures, preventing unauthorized access to library materials and resources. This will safeguard sensitive information and ensure compliance with privacy regulations.

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- **Remote Access:** The system will support remote access to library resources, enabling students and faculty to access digital materials and online databases from anywhere, at any time. This will facilitate research and learning activities, particularly for distance learners and off-campus users.

6.1 Advantages

- **Efficiency:** The Smart Library Management System improves efficiency by automating tasks such as data entry, tracking, and resource management. This saves time for library staff and streamlines library operations.
- **Accuracy:** With the use of technologies like barcode scanners and fingerprint readers, the system ensures accurate data capture and retrieval, reducing errors in record-keeping and enhancing the reliability of library information.
- **Enhanced User Experience:** The system offers a user-friendly interface displayed on a monitor, making it easy for both staff and students to access library services and resources. This enhances the overall user experience and satisfaction.
- **Self-service Options:** Self-service options such as self-checkout and self-return kiosks empower users to borrow and return materials independently, reducing wait times and improving convenience.
- **Real-time Monitoring:** The system provides real-time monitoring of library activities, enabling staff to respond quickly to user inquiries and manage library operations more effectively.

6.2 Disadvantages

- **Initial Cost:** Implementing the Smart Library Management System may involve significant upfront costs for purchasing hardware, software, and integrating various technologies. This could be a barrier for libraries with limited budgets.
- **Technical Challenges:** Introducing new technologies like Raspberry Pi, barcode scanners, and fingerprint readers may present technical challenges such as compatibility issues, software bugs, and system integration complexities.
- **Training Requirement:** Library staff may require training to familiarize themselves with the new system and technologies, which could require additional time and resources.
- **Maintenance:** The system may require ongoing maintenance and updates to ensure optimal performance, which could incur additional costs and administrative burden for

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the library.

- **Security Concerns:** While the use of fingerprint readers enhances security, it also raises privacy concerns regarding the collection and storage of biometric data. Ensuring data security and compliance with privacy regulations is essential but may pose challenges.

7. WORKING

7.1 Student Information:

Each student's information, including details such as name, branch, and contact information, is stored as a single case in the system.

7.2 Fingerprint Authentication:

Students authenticate their identity by scanning their fingerprint, ensuring secure access to the system.

7.3 Book Transaction:

Students are allowed a maximum limit of five books per transaction. After fingerprint verification, students scan the barcodes of the selected books to complete the borrowing process.

7.4 Due Date and Book Details:

The system processes the transaction and provides a due date for the borrowed books. It displays comprehensive book details, including title, authors' names, and other relevant information, ensuring clarity for users.

7.5 Return Process:

To return books, students scan their fingerprint again. The system identifies the books to be returned and updates the database accordingly, streamlining the return process. This streamlined approach ensures a secure and efficient library experience for students, from borrowing to returning books, utilizing fingerprint authentication and barcode scanning technologies.

8. CONCLUSION

The implementation of this cutting-edge library management system, which seamlessly integrates advanced fingerprint and barcode scanner technologies, represents a monumental

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leap in the endeavour to modernize and revolutionize traditional library operations. By adeptly streamlining critical processes such as user authentication, book transactions, and database management, this innovative system not only achieves heightened efficiency but also fortifies security measures significantly, courtesy of its state-of- the-art fingerprint recognition capabilities. The incorporation of a user-friendly interface, coupled with the provision of real-time updates and a commendable adaptability to emerging technologies, underscores the system's practicality and relevance in the ever-evolving landscape of library management. This transformative project not only effectively tackles the challenges inherent in conventional library systems but also sets the stage for ushering in a new era of library experiences characterized by seamlessness and heightened security, perfectly aligned with the demands and expectations of contemporary information management.

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ISBN-978-81-19905-39-3

ICEST_EC_023

TIME OPTIMISATION AND THEFTDETECTION OF ENERGY N AN INDUSTRIAL PLANT

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Abstract - Electricity theft is a pervasive issue in many regions, posing significant financial losses and safety hazards. This project focuses on monitoring and analyzing electricity board side energy consumption while alsoimplementing theft detection mechanisms. Through a comprehensive hardware setup involving current transformers (CTs), energy meters, optocouplers, Arduino microcontrollers, LED displays, and switches, the system can effectively monitor energy usage across different junctions. By comparing energy consumption between main and subsidiary junctions, potential theft instances can be identified, triggering alerts through LEDs and buzzers. The methodology involves programming threshold values for energyconsumption, facilitating real-time monitoring and theft detection. Results indicate the successful implementation of the system, with implications for enhancing energy security andreducing financial losses due to theft.

Keywords—Energy theft detection, Smart meter data, Electricity consumption, Monitoring system, Theft prevention, Energy meter, Real time monitoring, Smart grid security Junction monitoring,Theft instances, Alert systems, Theft mitigation.

I. Introduction

In today's modern society, electricity has become an indispensable aspect of daily life, powering everything from household appliances to industrial machinery. With the increasing reliance on electrical energy, there arises a critical need for efficient management and monitoring systems to ensure the equitable distribution of power resources. Additionally, the prevalence of electricity theft poses a significant challenge to utility providers, necessitating the development ofinnovative solutions to detect and prevent unauthorized consumption. In

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this context, the project on the monitoring and analysis of electricity board-side energy, coupled with theft detection, emerges as a timely and crucial endeavor [1].

The requirement for robust monitoring and analysis of electricity board-side energy, along with theft detection mechanisms, stems from various socio-economic and environmental factors. Firstly, ensuring fair and equitable distribution of electricity is essential for promoting social welfare and economic development. By accurately monitoring energy consumption patterns, utility providers can allocate resources more efficiently, thereby minimizing wastage andoptimizing energy utilization. Moreover, detectinginstances of theft or unauthorized usage is vital forsafeguarding the financial interests of utility companies and preventing revenue losses. Additionally, with the global focus on sustainability and energy conservation, implementing effective monitoring systems can help identify areas for improvement and promote responsible consumption practices among consumers [2].

Historically, electricity monitoring and theft detection systems have relied on manual inspections and periodic audits conducted by utility personnel. However, these traditional approaches are often time-consuming, labor- intensive, and susceptible to human error. Moreover, the reactive nature of such systems makes it challenging to detect theft in real-time, leading to significant revenue losses for utility providers. While some automated solutions exist, they often lack the sophistication and accuracy required to effectively detect instances of theft or unauthorized consumption. As a result, there is a growing demand for advanced monitoring systemscapable of providing real-time insights into energyusage patterns while proactively identifying potential instances of theft [3].

II. Related Works

Ejaz Ul Haq et and all observed that electricity theft has a considerable negative effect on energy suppliers and power infrastructure, leading to non-technical losses and business losses. Power qualitydeteriorates and overall profitability falls as a result of energy theft. By fusing information and energy flow, smart grids may assist solve the issueof power theft. The examination of smart grid dataaids in the detection of power theft. However, theearlier techniques were not very good in detectingenergy theft. theft. In this work, they hadsuggested an electricity theft detection approach using smart meter consumption data in order to handle the aforementioned issues and assist and assess energy supply businesses to lower the obstacles of limited energy, unexpected power usage, and bad power management. In

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specifically, the Deep CNN model effectively completes two tasks: it differentiates between energy that is not periodic and that is, while keeping the general features of data on power consumption [4].

Paria Jokar et all presented a novel consumption pattern-based energy theft detector, which leverages the predictability property of customers' normal and malicious consumption patterns. Using distribution transformer meters, areas witha high probability of energy theft are short listed, and by monitoring abnormalities in consumption patterns, suspicious customers are identified.Application of appropriate classification and clustering techniques, as well as concurrent use oftransformer meters and anomaly detectors, make the algorithm robust against nonmalicious changes in usage pattern, and provide a high and adjustable performance with a low sampling rate. Therefore, the proposed method does not invade customers' privacy. Extensive experiments on a real dataset of5000 customers show a high performance for the proposed method [5].

Rong Jiang et all observed that with the proliferation of smart grid research, the Advanced Metering Infrastructure (AMI) has become thefirst ubiquitous and fixed computing platform. However, due to the unique characteristics of AMI, such as complex network structure, resource-constrained smart meter, and privacy-sensitive data, it is an especially challenging issueto make AMI secure. Energy theft is one of the most important concerns related to the smart grid implementation. It is estimated that utility companies lose more than $25 billion every year due to energy theft around the world. To address this challenge, in this paper, we discuss the background of AMI and identify major security requirements that AMI should meet. Specifically, an attack tree-based threat model is first presentedto illustrate the energy-theft behaviors in AMI. Then, we summarize the current AMI energy-theftdetection schemes into three categories, i.e., classification-based, state estimation-based, andgame theory-based ones, and make extensive comparisons and discussions on them. In orde provide a deep understanding of security vulnerabilities and solutions in AMI and shed lighton future research directions, we also explore some open challenges and potential solutions for energy-theft detection [6]

Xiangyu Kong et all observed that the theft of electricity affects power supply quality and safetyof grid operation, and non-technical losses (NTL) have become the major reason of unfair power supply and economic losses for power companies.For more effective electricity

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theft inspection, an electricity theft detection method based on similarity measure and decision tree combined K-Nearest Neighbor and support vector machine (DT-KSVM) is proposed in the paper. Firstly, the condensed feature set is devised based on feature selection strategy, typical power consumption characteristic curves of users are obtained based on kernel fuzzy C-means algorithm (KFCM). Next, to solve the problem of lack of stealing dataand realize the reasonable use of advanced metering infrastructure (AMI). One dimensional Wasserstein generative adversarial networks (1D-WGAN) is used to generate more simulated stealing data. Then the numerical and morphological features in the similarity measurement process are comprehensively considered to conduct preliminary detection ofNTL. And DT-KSVM is used to perform secondary detection and identify suspicious customers. At last, simulation experiments verify the effectiveness of the proposed method [7].

Md. Nazmul Hasan et all observed that among an electricity provider's non-technical losses, electricity theft has the most severe and dangerouseffects. Fraudulent electricity consumption decreases the supply quality, increases generationload, causes legitimate consumers to pay excessive electricity bills, and affects the overall economy. The adaptation of smart grids can significantly reduce this loss through data analysistechniques. The smart grid infrastructure generatesa massive amount of data, including the power consumption of individual users. Utilizing thisdata, machine learning and deep learning techniques can accurately identify electricity theftusers. In this paper, an electricity theft detection system is proposed based on a combination of a convolutional neural network (CNN) and a long short-term memory (LSTM) architecture. CNN is a widely used technique that automates feature extraction and the classification process. Since thepower consumption signature is time-series data, we were led to build a CNN-based LSTM (CNN- LSTM) model for smart grid data classification. In this work, a novel data pre-processing algorithm was also implemented to compute the missing instances in the dataset, based on the local values relative to the missing data point. They also observed that in this dataset, the count ofelectricity theft users was relatively low, which could have made the model inefficient at identifying theft users. This class imbalance scenario was addressed through synthetic data generation. Finally, the results obtained indicate the proposed scheme can classify both the majority class (normal users) and the minority class (electricity theft users) with good accuracy.

Andreas Kamilaris et.al presented that the currentstate of the art regarding work performed related to the electric energy consumption for Informationand Communication Technologies

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(ICT) and Miscellaneous Electric Loads (MELs), in office and commercial buildings. Techniques used for measuring the energy consumption of office plug loads, and efforts for saving energy by using this equipment more rationally and efficiently are identified and categorized. Popular methods and techniques for energy metering are discussed, together with efforts to classify and benchmark office equipment. Our study reveals that many issues are still open in this domain, including moreaccurate, diverse and meaningful energy audits for longer time periods, taking into account device profiles, occupant behavior and environmental context. Finally, there is a need for a global consensus on benchmarking and performance metrics, as well as a need for a coordinated worldwide activity for gathering, sharing, analyzing, visualizing and exposing all the silos ofinformation relating to plug loads in offices and commercial buildings.

Alexander Martin Tureczek et.al presented the smart meters for measuring electricity consumption are fast becoming prevalent in households. The meters measure consumption on a very fine scale, usually on a 15 min basis, and thedata give unprecedented granularity of consumption patterns at household level. A multitude of papers have emerged utilizing smart meter data for deepening our knowledge of consumption patterns. This paper applies a modification of Okoli's method for conducting structured literature reviews to generate an overview of research in electricity customer classification using smart meter data. The process assessed 2099 papers before identifying 34 significant papers, and highlights three key points: prominent methods, datasets and application. Three important findings are outlined. First,only afew papers contemplate future applications of the classification, rendering papers relevant only in a classification setting. Second; the encountered classification methods do not consider correlation or time series analysis when classifying. The identified papers fail to thoroughly analyze the statistical properties of the data, investigations that could potentially improve classification performance. Third, the description of the data utilized is of varying quality, with only 50% acknowledging missing values impact on the finalsample size. A data description score for assessingthe quality in data description has been developedand applied to all papers reviewed.

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III. Methodology

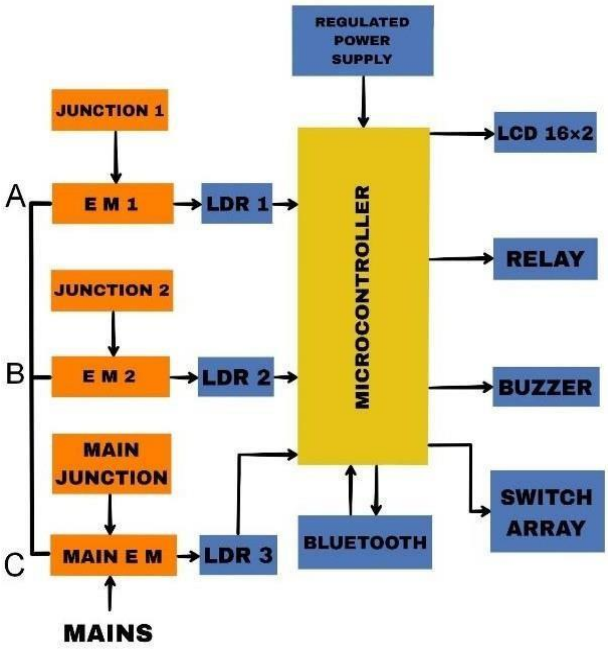

Fig. 1: Block diagram represents a system designed for monitoring electricity consumption and detecting potential theft

This block diagram represents a system designed for monitoring electricity consumption and detecting potential theft. Here's an explanation of the different components and how they work together:

Power Supply:

The system is powered by a regulated power supply.

Energy Meters (EM1, EM2, Main EM):

These are energy meters that measure the electricity consumption at different points. EM1 and EM2 measure consumption at two separate junctions or branches, while Main EM measures the overall consumption from the mains.

LDRs (LDR 1, LDR 2, LDR 3):

LDRs, or Light-Dependent Resistors, are used to sense and transmit the energy meter readings to themicrocontroller.

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IV. Microcontroller:

The microcontroller is the central processing unit that receives data from the LDRs and processes it.It also communicates with other components like the LCD, relay, buzzer, and Bluetooth module.

LCD 16x2:

A 16x2 character LCD display is used to show theenergy consumption readings and potentially otherrelevant information.

Relay:

A relay is included, which can be used to control or switch electrical circuits based on the microcontroller's commands.

Buzzer:

A buzzer is connected to provide audible alerts ornotifications, such as in case of potential theft detection.

Bluetooth Module:

The system includes a Bluetooth module, which can be used for wireless communication and data transfer, possibly to a monitoring device or mobileapplication.

Switch Array:

A switch array is present, which may be used to control or configure various settings or functions of the system.traffic density, which can significantly improve traffic flow and reduce waiting times. The system is also equipped with amanual override feature to ensure the smooth passage of emergency vehicles.

V. Results and Discussion

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Fig. 2: Monitoring and analyzing electricity board-side energy

The project focused on monitoring and analyzing electricity board-side energy while detecting theftusing a system comprising three junctions (J1, J2,and main), current transformers (CTs) for sensing current, energy meters for consumption readings, and optocouplers for pulse rate measurements.

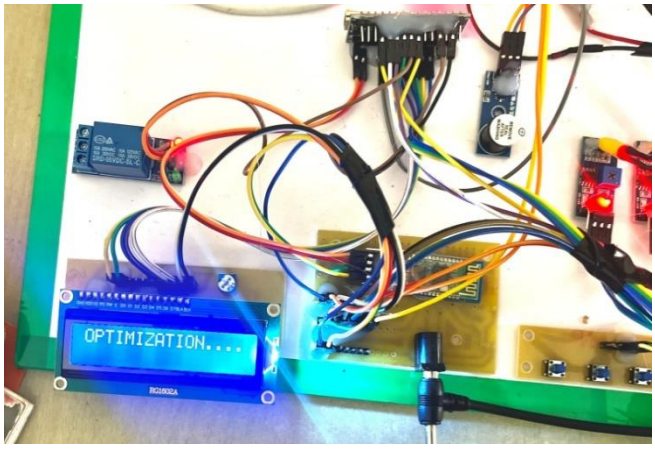

Fig. 3: Components integrated with Arduino for programming energy consumption

These components were integrated with Arduino for programming energy consumption thresholds and a LED display for real-time monitoring, with a buzzer for theft alerts. The system featured two modes: optimization for accessing real-time consumption and theft detection.

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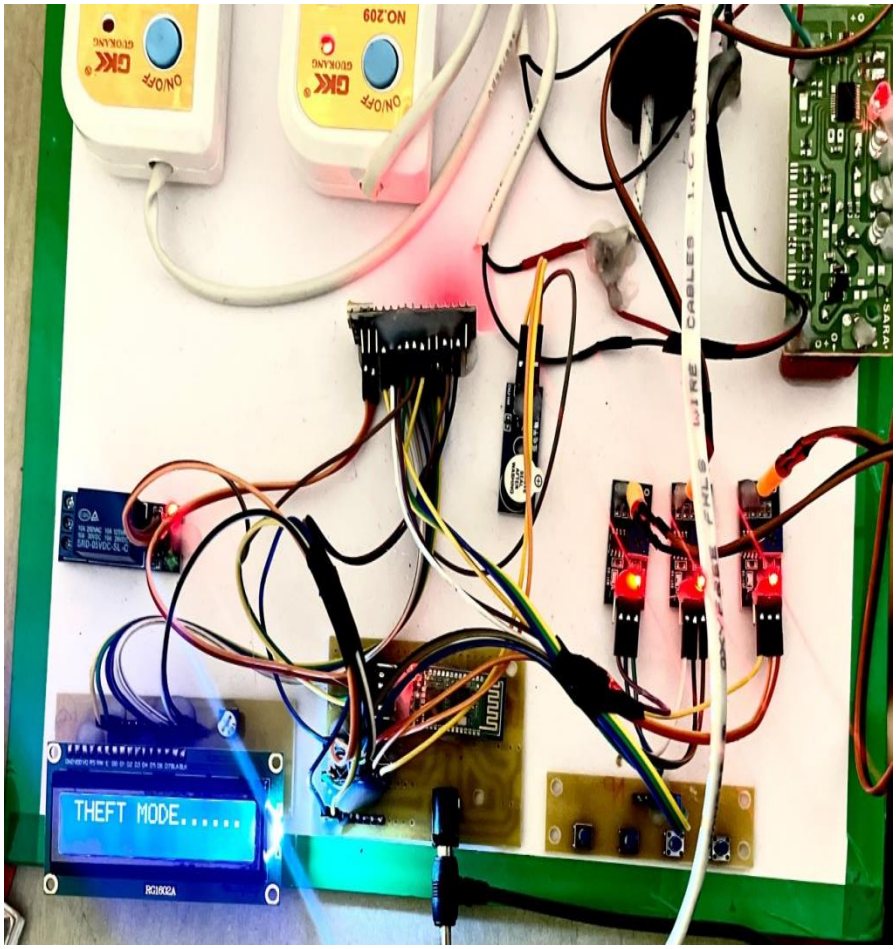

Fig. 4: Real-time monitoring and effective theftdetection by comparing consumption at J1 and J2 with the main junction

Results showed successful real-time monitoring and effective theftdetection by comparing consumption at J1 and J2 with the main junction. If J1+J2 consumption wasless than the main junction, indicating direct load connection, theft was detected. This projectdemonstrates a practical approach to addressing energy theft, offering a robust solution for enhancing electricity board-sidemonitoring and security.

V. Implications

1. Energy Monitoring: The project facilitates real-time monitoring of energy consumption at different junctions, enabling better understanding and management of electricity usage.

2. Theft Detection: By comparing the energy consumption of individual junctions with the mainjunction, the system can detect potential theft scenarios, enhancing security and revenue protection for electricity providers.

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3. Remote Monitoring: Utilizing remote devices for energy monitoring and theft detection allows for efficient management and surveillance of electricity usage, even in remote or inaccessible areas.

4. Optocoupler Integration: The integration of optocouplers ensures safe and efficient transfer ofdata between AC and DC components, enhancingsystem reliability and reducing the risk of electrical hazards. Arduino Programming: The use of Arduino forprogramming threshold values and system mode adds flexibility and adaptability to the project, allowing for customization according to specific requirements and conditions.

VI. Conclusion

The culmination of the project on monitoring and analyzing electricity board-side energy and detecting theft represents a substantial achievement in the realm of energy management and security. The extensive journey from conceptualization to implementation and evaluation has yielded invaluable insights and conclusions that resonate profoundly within the domain of energy infrastructure and management.

At the heart of the project lies a commitment to addressing the multifaceted challenges associated with energy distribution, particularly the pervasive issue of theft. Through a meticulous and systematic approach, the project has endeavored todevelop a comprehensive solution that not only monitors energy consumption but also detects andmitigates instances of theft effectively.

The performance analysis conducted throughout the project lifecycle has provided invaluable insights into the various dimensions of system functionality and effectiveness. Central to this analysis is the evaluation of energy monitoring accuracy, theft detection sensitivity, real-time monitoring capabilities, and mode switching efficiency. These aspects collectively determine the system's ability to fulfill its core objectives anddeliver tangible benefits to stakeholders.

Energy monitoring accuracy stands as a cornerstone of the system's functionality, ensuringthat consumption data is reliably captured and analyzed. The calibration of current transformers (CTs) and the consistency of pulse rate measurements from energy meters are critical factors in achieving this accuracy. By meticulously calibrating and validating thesecomponents, the system can provide stakeholders with a clear and accurate understanding of energy

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consumption patterns. Equally vital is the system's ability to detect instances of theft with precision and sensitivity.

The threshold settings programmed into the Arduino serve as a pivotal mechanism for identifying anomalies in energy consumption indicative of theft. Through rigorous testing and validation, these thresholds are optimized to strikea balance between minimizing false alarms and maximizing detection sensitivity, thereby ensuringtimely intervention in cases of theft. Real-time monitoring capabilities represent another key facet of the system's functionality, enabling stakeholders to access up-to-dateinformation on energy consumption patterns. The efficiency of data transmission and processing, coupled with the responsiveness of the LED display, is paramount in facilitating informed decision-making and prompt intervention in casesof theft or inefficiency. Furthermore, the seamless switching between optimization mode and theft detection mode enhances the system's usability and flexibility. Byproviding operators with the ability to toggle between these modes effortlessly, the system caters to diverse operational requirements and facilitates a more intuitive and user-friendly experience.The comprehensive testing conducted throughout the project lifecycle has played a pivotal role in validating the functionality, reliability, and robustness of the system. Functional testing, threshold validation, load variation testing, and mode switching evaluation have provided critical insights into the system's performance under diverse operating conditions. By subjecting the system to rigorous testing protocols, potential vulnerabilities and shortcomings have been identified and addressed, thereby enhancing its overall effectiveness and reliability. The implementation phase of the project has underscored the importance of meticulous hardware configuration, software development, integration, and user interface design. The seamless integration of hardware components, coupled with robust software algorithms, has laid the foundation for a reliable and efficient energy monitoring and theft detection system. Additionally, effective interfacing between ACand DC components using optocouplers has ensured signal integrity and system safety, further enhancing the system's reliability and performance.

In conclusion, the project represents a significant milestone in the ongoing effort to enhance the integrity and efficiency of energy distribution systems. By leveraging advanced technologies andinnovative approaches, the system offers a robust,reliable, and cost-effective solution for detecting and mitigating instances of theft. Moreover, the project serves as a testament to the transformative potential of technology in addressing complex societal

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challenges and advancing the transition towards a more sustainable and equitable energy future.

Looking ahead, further research and development efforts can focus on enhancing the scalability,interoperability, and resilience of such systems to meet the evolving demands of the energy sector. Additionally, ongoing monitoring and optimization will be essential to ensure the long- term sustainability and effectiveness of energytheft detection initiatives. Ultimately, the project underscores the critical role of innovation, collaboration, and continuous improvement in driving positive change within the energy landscape.

ISBN-978-81-19905-39-3

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09:30 AM to 11:30 AM	Inauguration of ICEST-24 Inaugural address by **Mr. Sohan M.** Senior Project Manager – Infosys, Mangalore Keynote Address by **Dr. P. Nagabhushan**, VC, Vignan University, AP
11:30 AM to 11:45 AM	Refreshments
11:45 AM to 01:00 PM	Keynote address – I on topic "Immunotherapeutic Approaches to Disease Treatment: Prospects and Challenges" by **Dr. Monika Sadananda,** Professor & Chairperson, Mangalore University, Mangalore
01:00 PM to 02:00 PM	Lunch Break
02:00 PM to 02:45 PM	Track 1 Oral presentation (Food Technology)
02:45 PM to 03:30 PM	Track 2 Oral presentation (Drug Design and Nanobiotechnology)
03:30 AM to 03:45 AM	Refreshments

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03:45 PM to 04:30 PM	Track 3 Oral presentation (Agricultural Biotechnology)
24th April 2024 Wednesday – Day 2	
09:30 AM to 10:30 AM	Track 4 Oral presentation (Clinical Research)
10:30 AM to 11:30 AM	Track 5 & 6 Oral presentation (Bioprocessing & Environmental Eng.)
11:30 AM to 11:45 AM	Refreshments
11:45 AM to 01:00 PM	Keynote address – II on topic "Novel therapeutic green solvents based nanoemulsions by innovative membrane emulsification technique for biomedical applications" by **Dr. Syed Usman Taqui,** Post-Doctoral Researcher, King Abdullah University of Science & Technology – KAUST, Saudi Arabia
01:00 PM to 02:00 PM	Lunch Break
02:30 PM to 03:30 PM	• Valedictory of ICEST-24 • Valedictory address by **Dr. A. M. Khan,** Senior Professor, Dept. of Electronics & Director- Skill Development Centre Mangalore University Mangalore • Keynote Address by **Dr. Surendra Kumar**, Pro-Vice Chancellor, Presidency University, Bangalore
03:30 PM to 04:00 PM	Interaction & High Tea

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FOOD SPOILAGE DETECTION USING CURCUMIN IMPREGNATED SMART BUTTONS

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Abstract:

Food spoilage is a major concern in the industry, affecting both consumers and producers. Our research proposes a reliable and efficient solution to identify food spoilage such as fish using portable sensor buttons impregnated with natural turmeric. Active ingredient curcumin isolated from Rhizomes of Curcumin longa is known to change color from yellow to deep red on changing the pH from acidic to basic. pH of most of the freshly caught seafood products such as Indian anchovy (*Stolephorus indicus*) is around neutral (pH 7), and during pre-rigor stage pH of the meat turns slightly acidic side (~pH 6.5) which takes around 3-5 hours , and during post rigor stages enzymatic degradation produces volatile bases that in turn changes the pH to alkaline side (~7.5-8). Hence pH shift in meat from acidic to alkaline is the indicator of spoilage, which also implies that the meat is more than 3-5 h of post-harvest storage. Hence, curcumin impregnated smart button is a potable, food grade, and affordable food spoilage indicator. This technology can also be extended to various other food products by using bioactive compounds from various other plant sources that are active at different pH ranges. There is a great scope of this product while procuring food products.

Key Words: Curcumin, Indian anchovy, Smart button, Food industry, Sensors.

1. Introduction

Throughout human history, natural plant products have been employed for a variety of reasons. Many of the plants from which these natural compounds are generated are billions of

ISBN-978-81-19905-39-3

years old, having co-evolved with animal life called a natural defence against illness and infection, higher plants manufacture tens of thousands of these compounds called secondary metabolites. Many of these natural compounds contain pharmacological or biological properties that can be used in the development of pharmaceutical drugs. Plant-based medicines have been essential to the health care of many societies, both ancient and modern. The usage of the turmeric plant for medical purposes dates back over 4000 years. Turmeric is utilised in Southeast Asia both as a primary spice and as a part of religious rituals. Turmeric, which is a vivid yellow colour, is also referred to as "Indian saffron" because of this. The more than 3000 publications on turmeric that have been published in the last 25 years show that modern medicine has started to understand its significance. The safety and effectiveness of turmeric are further discussed after discussing in vitro research, animal studies, and ultimately studies conducted on humans[1].

Although it is grown in tropical and subtropical areas worldwide, turmeric is mostly grown in India, Thailand, Taiwan, and other Southeast Asian nations. Tropical regions are the best places to cultivate turmeric since it thrives in warm, humid climates and grows at heights between 400 and 1,000 m above sea level. After planting, the plant needs 6 to 8 months to grow in semi-shade, under trees, on clayey, well-drained soils, and before it can be harvested. The turmeric rhizome can be collected once the leaves have dried. After that, rhizomes are dried, boiled, and then pulverised (into a powder) to prepare them for export[2].

There is an expanding body of study pertaining to the medicinal use of turmeric, which is a well-known culinary spice and herbal treatment. It is unclear which turmeric preparations are best for particular conditions, though. This study sought to inform practitioners and academics on the use of turmeric as a therapeutic alternative by conducting a meta-review of systematic reviews. Over 50 different types of diarylpentanoids and diarylheptanoids, collectively known as curcuminoids, are found in turmeric. Of these, "curcumin," which is a variable mixture of the non-volatile diarylheptanoids diferuloylmethane (curcumin I), desmethoxycurcumin (curcumin II), and bisdesmethoxycurcumin (curcumin III), is the most thoroughly researched. Flavonoids and an essential oil with sesquiterpene ketones such turmerones, curlone, and zingiberene are additional components. Although the low bioavailability of curcuminoid extracts means that activity within the gut may become potentially more significant or that systems need to be developed to improve curcumin delivery to target tissues, it is believed that curcuminoids and essential oils are

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responsible for the biological effects. There are many different products on the market with widely varying formulations as a result of efforts to increase the bioavailability, including liposomal formulations, nano-micellar formulations, and the use of other botanical ingredients like piperine from black pepper. This makes it challenging to identify which compounds or combinations of compounds are having an effect[3].

The primary plant component of turmeric that is employed in food preparation and other pharmaceutical applications are its rhizomes (roots). Because of their volatile components, the plant's leaves and flowers are also being used more and more frequently in fragrance applications and medical research. The current chapter covers a general introduction to turmeric as well as its medicinal and cultural significance. There is a brief discussion on the turmeric's agricultural aspects. The chapter also provides specifics on the chemistry and processing procedures used to separate the essential oil and active ingredients. Additionally, the curcumin, the primary curcuminoid found in turmeric, has been highlighted in a summary of the synthetic procedures for curcuminoids documented thus far[4].

Curcumin, a yellow pigment found in the Indian spice turmeric has been linked to the suppression of neuropathic pain, angiogenesis, tumorigenesis, diabetes, diseases of the liver, skin, and cardiovascular, respiratory, and nervous systems(Fig 1). It has also been linked to the suppression of inflammation. Curcumin's colour, lack of water solubility, and relatively low in vivo bioavailability limit its usefulness. There is a vigorous hunt for the "super curcumin" due to the numerous medicinal effects linked to curcumin. In the current study, turmeric natural dye was tested for its antimicrobial properties against several bacterial strains. The antibacterial activity of turmeric extract against ten different bacterial strains was proven in the current study using in vitro tests[5].

2. Experimental Procedure

MATERIALS

In 2023, this project's work will be completed. The project's goal is to create a food sensor that can detect rotting using turmeric.

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2.1. Chemicals and reagents:

It uses HCl and NaOH.

2.2 Rhizome of turmeric:

At latitude 13.21505 and longitude 75.05525, communities close to the undivided Dakshina Kannada District were used to harvest turmeric horn. The turmeric horn was washed under running water to eliminate dirt particles, dried in the sun for two days, and then ground.

Fig.1: Turmeric powder

2.3 Extractor of soxhlets:

A piece of lab equipment called the Soxhlet extractor was created in 1879 by Franz von Soxhlet.The turmeric horn's curcumin is extracted using it.

Fig.2: Extraction of Curcumin from rhizomes of turmeric

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2.4. Spectrophotometer:

Curcumin longa's absorbance and transmission are measured using this technique.

Fig.3: UV Spectrophotometer

2.5. Cotton fabric:

For absorption, it is employed. A dye's transfer from an aqueous solution to a cloth surface is called absorption.

Fig. 4: Cotton Fabric

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2.6. pH scale:

To gauge various liquids' acidity and alkalinity levels.

Fig.5: pH scale

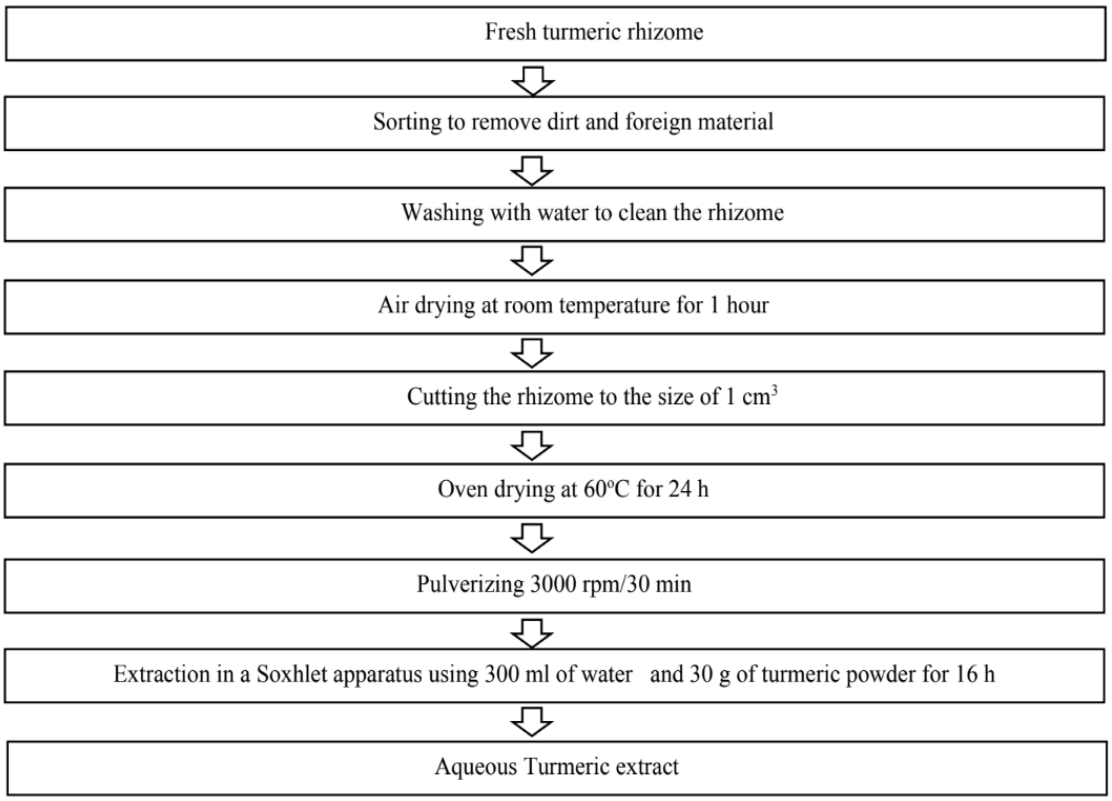

Fig. 6: Process of extraction of Curcumin from Curcumin longa

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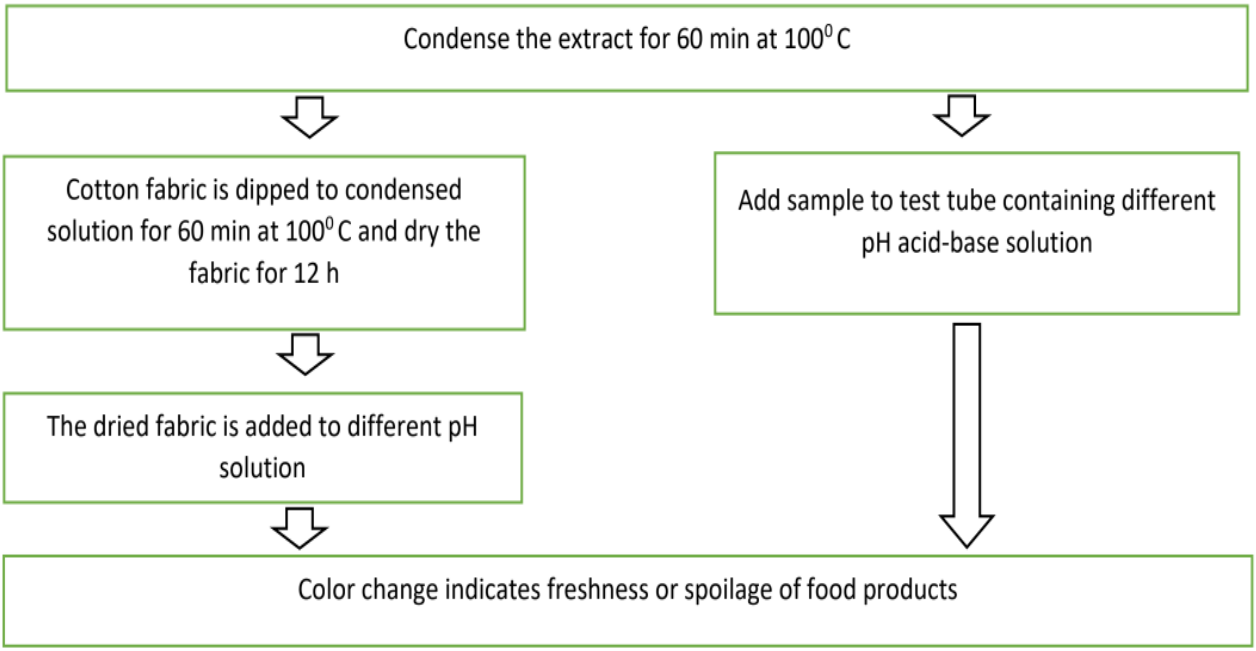

Fig.7: Dying process

Turmeric rhizomes were dried in an oven at 105 °C for three hours. To create a homogenous powder with a particle size of 0.18 mm, dried rhizomes were triturated in a mortar and then screened through a sieve with mesh size 80 [6]. In order to prevent moisture absorption, the turmeric powder was kept in the refrigerator [7-8]. The reference procedure, the Soxhlet extraction, was carried out as follows: A thimble containing 15 g of ground turmeric powder was weighed, implanted in the Soxhlet device, and filled with acetone as the extraction solvent progressively [9]. Within 8 h, the extraction experiment was completed at 60°C. Using a rotary evaporator and a vacuum at 35°C, the acetone was separated from the extract once the extraction was finished. To determine the curcumin content using HPLC, the residue was first dissolved in 10 mL of methanol after being dried and weighed. Because of its strong solubilization capacity, acetone was utilised as the extraction solvent in all extraction tests [10].

For pH values of 4, 8, and 9, (fig.8) the colour of the solutions and a change in wavelength 383, 385, and 404 nm, respectively, were observed [11]. The reported statistics are consistent with the literature, which states that Curcumin solutions change colour from yellow to brownish

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orange at pH levels between 2 and 13. The keto-enol tautomerism explains this: in neutral and inacidic environments, Curcumin is primarily in the ketoform whereas in alkaline media, it confirms an enol (colour degradation: brownish orange).

Fig.8: Color change in different pH solutions

Additionally, the breakdown of curcumin in an alkaline pH environment may result in derivative products like feruloyl methane, which quickly forms a brown condensation product and shifts the absorption peak from 420 nm at pH 2–10 to 460 nm at pH 12–13. Based on the findings of this study, the PEG600-Curcumin conjugate solutions exhibit no condensation product throughout the whole pH range, indicating good solubility in aqueous solutions and enhanced pH stability.

Since in aqueous solutions was insufficient to characterize Curcumin, solutions of Curcumin and PEG600-Curcumin in acetone a suitable solvent for both forms were also studied. The collected spectra revealed that Curcumin has a shoulder at 445 nm and a maximum wavelength at 420 nm. The finished product exhibits a hypsochromic shift of around 20 nm; the arm's maximum absorption occurs at 425 nm, indicating the presence of a conjugated structure that has been broken.

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3. Results and Discussions

Turmerin has demonstrated to be a highly accurate and sensitive indicator of food decomposition in a variety of food products. Testing in comparison to other detection techniques revealed that turmerin was more reasonably priced, environmentally friendly, and user-friendly. To evaluate turmerin's capabilities as a natural preservative and to optimise its use in various goods, more study is required [12].

Because curcuminumin can increase the shelf life of food and serve as a quality indicator, several scientists have recently begun researching its functional characteristics and pH-dependent colour change properties for usage in food packaging. Curcuminumin is primarily emphasised in this review article as a natural food colourant used in active and intelligent packaging applications. The main facts about curcuminumin and its biological characteristics are first briefly discussed. The use of curcuminumin with various types of polymers as well as various preparation methods is then covered in detail. Curcuminumin's use in active and smart packaging applications has also been extensively covered. The commercial potential of curcuminumin in food packaging as well as the potential for further study were described in the final section. We are aware of just one review article that has been written and published on this subject. Therefore, this thorough analysis summarises the effects of curcuminumin on the functional and physicochemical qualities of various polymer-based active and intelligent food packaging films and offers the most recent prospects and trends for employing packaging films with curcuminumin added. The colour of the solution went from bright yellow to reddish-brown as the pH level rise. From pH 1 to pH 8, there were no discernible colour changes (Table 1) [13].

At pH 9, the colour started to shift from brilliant yellow to bright brown, but it didn't turn reddish-brown until pH 10, and it didn't turn wine red until pH 12 and above. This is because fully deprotonated curcuminumin appears red at pH 10 and above, where the absorption maximum is at 467 nm, and curcuminumin's breakdown is pH-dependent and suffers rapid degradation at higher pH levels [14].

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Table.1: pH data of turmeric

pH	Absorbance	Transmission
1	2.50	0.270
2	3.00	0.900
3	3.00	0.060
4	3.00	0.160
5	3.00	0.060
6	3.00	0.130
7	3.00	0.190
8	3.00	0.070
9	3.00	0.030
10	3.00	0.090
11	3.00	0.030
12	3.00	0.060
13	3.00	0.090
14	3.00	0.140

Additionally, second-order kinetics are used to break down curcuminumin in methanol and aqueous systems, with the help of buffers such phosphates at pH levels 6 through 9 or carbonates at pH levels 9 to 10. According to these investigations, curcuminumin's degradative processes progressed more quickly at higher pH values than they did at lower pH levels (fig.9). Since curcuminumin is pH sensitive and depends on pH, it cannot be dissolved in neutral or acidic environments. The chemical breakdown of curcuminumin is very unstable near physiological pH levels.

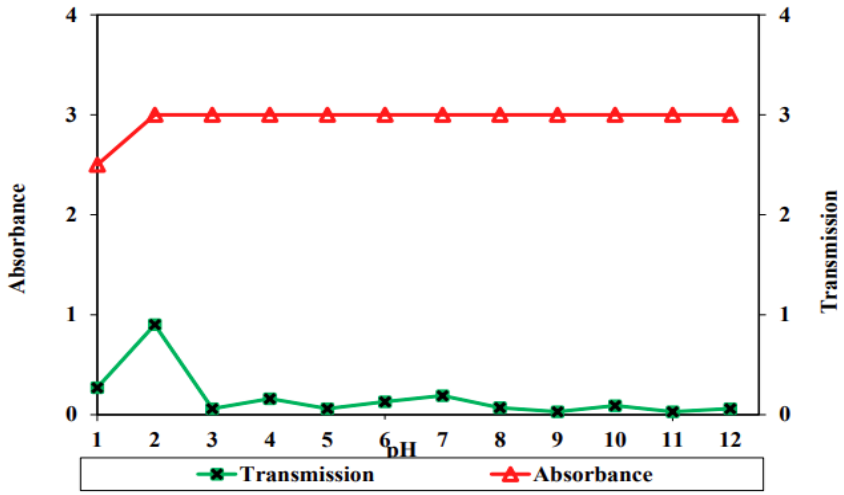

Fig. 9: Change in absorbance and transmission of the turmeric Extract at different pH

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The initial absorbance values of the alkaline curcuminumin solutions were marginally greater than those of the acid curcuminumin solutions, exhibit keto-enol tautomerism, having a dominating keto form in acidic and neutral conditions and an enol form in the medium alkali state. Contrarily, curcuminumin is soluble in an alkaline environment and as a result, profound curcuminumin deprotonating in an alkaline environment led to the production of a peak at 568 nm (fig.10).

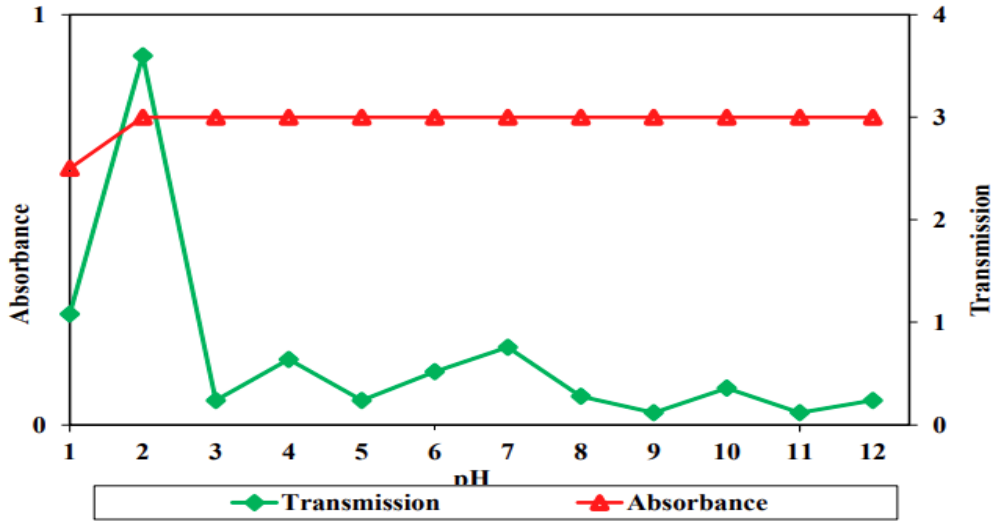

Fig.10: Change in absorbance and transmission of the turmeric extract impregnated cotton fabric at different pH

A maximum absorption peak at 433 nm was visible in the solution at neutral and acidic conditions. When curcuminumin reacted with an alkaline solution of HX, the peak, however, migrated to the right, resulting in a peak value of maximum absorption at 568 nm. The curcuminumin solution was initially yellow, but when the pH level was 9, it turned oranges red. Based on the amount of curcuminumin in each film, colour analysis shows how the colors of films alter. The whitish index denotes the union of yellow-blue and brightness into a single phrase. Lower WI values revealed darker, less transparent, and luminescent films. A higher curcuminumin concentration resulted in more pigmented films due to the polymeric interaction of curcuminumin, while E served as an index of the overall colour changes experienced by the CRRS films, demonstrating a substantial difference (fig.11).

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Fig.11: Indian anchovy *(Stolephorus indicus)*

Conclusion

Lack of understanding about food quality and preservation methods results in food. Chemical freshness indicator colours and preservatives are not biodegradable. Our sustainable food sensor with antibacterial and antioxidant property reflects the freshness of the food product through color change and as a potential scope in a replacing unsustainable sensor. Natural plant-based colors exhibit change in color with pH change and also have antimicrobial and antioxidant properties.

ISBN-978-81-19905-39-3

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ISBN-978-81-19905-39-3

ICEST_BT_005

EXTRACTION, IDENTIFICATION AND CHARACTERIZATION OF THE LEAVES OF MEMECYLON AMPLEXICAULE

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Abstract:

Memecylon amplexicaule, also known as Suckering Memecylon, belongs to the Melastomataceae family and is commonly found in the Western Ghats. It is a small to medium-sized tree reaching 10 to 15 m in height, with opposite leaves that clasp the stem, earning it the name Clasping-leaf Memecylon. The tree bears small, pale violet flowers in axillary clusters, followed by small spherical berries maturing from green to purple. Renowned for its medicinal properties, its bark and leaves are utilized in treating ailments like diarrhea, dysentery, inflammation, fever, and menstrual cramps, often consumed with milk and cumin seeds. Traditionally, they are applied topically for wound healing and inflammation reduction. Post-COVID, its leaves and bark were found effective against cough, cold, and bronchitis, prepared as decoctions or syrups. Economically, Memecylon offers mordants and yellow dyes extracted from its leaves, historically used in Thai silk dyeing and Buddhist monk ropes in Sri Lanka. Its edible fruits serve as spices, while its timber is valuable for construction. Decoctions from its root and heartwood have been used to treat ailments like chickenpox and measles.

Key Words: *Memecylon amplexicaule*, clasping leaf, pain relief, covid, Buddhist monks.

1. Introduction

Memecylon is a plant group in the family Melastomataceae. It consists of 300-400 species of small to medium-sized trees. It is mainly found in tropical Africa, Sri Lanka, Madagascar, India

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and Malaysia[1]. *Memecylon* is derived from the Greek word 'memaecylon'. It is characterized by ex-stipulate leaves, anthers opening by slits, four bisexual flowers, enlarged connectives bearing terpenoid secreting glands and berries (Fig 1). *Memecylon amplexicaule* is a complex genus of flowering plants and a significant source of traditional medicine. Due to its complexity, the identification of this species has become very difficult. They have been reported to have potential pharmacological activities. Some of the phytochemicals such as memecyclaene, sitosterol, tartaric acid, malic acid, tannin, triterpenes and flavonoids contribute to the pharmacological potential of this genus.

This species contains a wide range of genera, including *M. amplexicaule, M. depressum, M. umbellatum, M. edule, and M. wightii* [2].

Fig 1. *Memecylon amplexicaule* leaves

This group is approximately distributed in 53 countries and has a wide range of habitats. They have been reported from tropical forest, grassland, tropical rainforests with low to high rainfall and regions with low to high temperature. Most of them are regionally or locally endemic. This species is most used in traditional medicine practices in India. It is important to have accurate knowledge about the species to increase the drug's effectiveness and biosafety. This species exhibits plesiomorphy and homology. Some of these taxa were challenging to classify due to the morphological criteria utilized in traditional plant taxonomy. They share a similar shape and overlap in terms of geographic distribution. Therefore, methods including DNA barcoding, RAPD, and ISSR genotyping were used to measure genetic variation and establish the relationships between the five species. To validate and ascertain the diversity of this species, which was taken

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from India's Western Ghats, techniques based on PCR, such as RAPD, ISSR, and DNA barcoding areas such as 5s, psbA-trnH, rpoC1, ndh, and atpF-atpH, were utilised. *Memecylon*'s five species genetic diversity is measured using RAPD and ISSR. For all the accessions, 25 RAPD primers were employed in total. 20 primers out of 25 produced amplified products. 16 primers that generated precise, reproducible bands from them were chosen for further examination. Similarly, only 20 of the 32 primers that yielded amplified products with polymorphic sequences that could be readily resolved for ISSR analysis were used for further investigation [3].

A maximum of 185 amplified products were generated by 27 *Memecylon* accessions, according to RAPD analysis. 121 of the 185 amplified products were polymorphic, with each primer amplifying an average of 7-8 variant fragments. Between 69.4% and 100% of the bands are polymorphic. The PIC values were found with an average of 0.86 and a range of 0.385-0.96.

Using isozyme profiling and SDS-PAGE of isolated protein, the biochemical properties of the *Memecylon* species were evaluated. Following electrophoresis, a specific stain was applied to each gel. The genetic distance relationship was evaluated using the isozyme banding patterns. The distinctive banding pattern of esterase was used to demonstrate the presence of acid phosphatase, alcohol dehydrogenase, and peroxidase in all five species of *Memecylon.* SDS-PAGE and isozyme profiling revealed that the clusters of *M. umbellatum*, *M. edule*, and *M. talbotianum* and the clusters of *M. malabaricum* and *M. wightii*, respectively, show strong genetic similarity[4].

One of the main species of *Memecylon*, *Memecylon amplexicaule*, also known as suckering *Memecylon* has got many properties, including anti-oxidant property, anti-inflammatory effects, anti-microbial activity, skin health benefits and traditional medical uses[1]. The plant extract often contains antioxidants which helps to protect the body cells from damage caused by free radicals. Antioxidants can have a positive impact on health and can also help to reduce the risk of chronic diseases. It also helps to alleviate inflammation and related symptoms [5].

One of the methods commonly used for extraction of *Memecylon* plant is using Soxhlet Extraction method (Fig 2). We had done both the solvent extraction method and the aqueous extraction method. The leaves of *Memecylon amplexicaule* were collected from damped soil area of Dakshina Kannada district, Karnataka. The leaves were weighed and crushed using a pestle and mortar without adding any solution [6]. The crushed leaves were again weighed and prepared for

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the extraction. For solvent extraction, we used ethanol and for aqueous extraction, we used distilled water. During aqueous extraction, pieces of ceramic materials are used as an anti-foaming agent. These extracted solutions were reduced to a few mL by water bath [7].

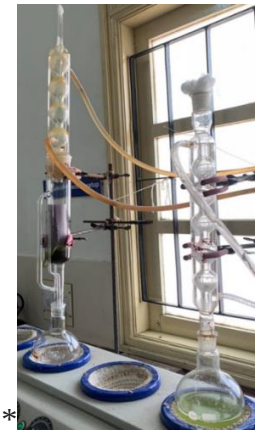

Fig 2. Soxhlet extraction

The extracts were used for additional research to characterize and identify the distinct extract components. The *Memecylon amplexicaule* plant extract contains phytochemicals like alkaloids, tannins, saponins, and terpenoids. Additionally, there are carbohydrates.

There are numerous uses for *Memecylon amplexicaule* plant extract. It serves as an alternative to English medicine for the treatment of period cramps. The leaves are utilized as a cooling astringent in Ayurveda. The leaves can also be used in a lotion to treat eye conditions. According to reports, the leaves have antiviral properties.

2. Materials and Methodology

The leaves of *Memecylon amplexicaule* were collected from the village of Dakshina Kannada, Karnataka. They were weighed 5 g each for both solvent and aqueous extraction respectively. Then washed it under running water to remove any dust and dirt particles present in it. The leaves were crushed finely using a pestle and mortar and weighed again.

2.1 Extraction methods

Here we used a 500 mL flask for the extraction purpose. 5 g of the finely crushed leaves were taken into a thimble for solvent extraction and the other 5 g was taken directly in a 500 mL round

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bottom flask for aqueous extraction. For solvent extraction, we used 300 mL ethanol as the solvent and was taken in the round bottom flask. For aqueous extraction, we mixed 5 g of finely crushed leaves with 300 mL of distilled water and added pieces of ceramic into it to prevent foaming.

2.1.1 Solvent extraction

In solvent extraction, when we turn-on the heat, the metal plate gets heated. Then the round bottom flask containing the solvent starts boiling (Fig 3). The vapors from the flask travel to the condenser via the distillation tube. The condenser condenses the vapors of solvent and these condensed vapors fall down to a thimble. The finely crushed leaves must be covered from the bottom with a cotton ball to avoid the particles falling directly into the thimble. When the condensed vapors fall into the thimble, the particles get wet with a solvent and the components which are soluble in the solvent gets along with it. A siphon tube connects the thimble to a round bottom flask. The solvent mixture starts filling the thimble and siphon tube. At some point, under the influence of gravity, the siphon starts overflowing. Then the overflowed liquid falls back to the round bottom flask, which makes the first cycle. This procedure was repeated for 16 cycles, until it became a clear solution. Each cycle takes about 40 – 45 min (Fig 4).

Fig 3. Solvent extraction

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Fig 4. Flow chart showing the preparation of solvent extraction

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2.1.2 Aqueous extraction

In aqueous extraction, when we turn-on the heat, the metal plates get heated. Then the round bottom flask containing the distilled water and the finely crushed leaves along with the ceramics were let to boil. The vapors from the flask travel to the condenser and these vapors fall back to the flask containing the solution. This procedure is repeated for over 16 hours until the reduced leaf extract becomes dark in color. The extracts (solvent and aqueous) that are obtained from the above method were transferred to a water bath to remove the alcohol (solvent extract) and water (aqueous extract) to increase the concentration (Fig 5 &6).

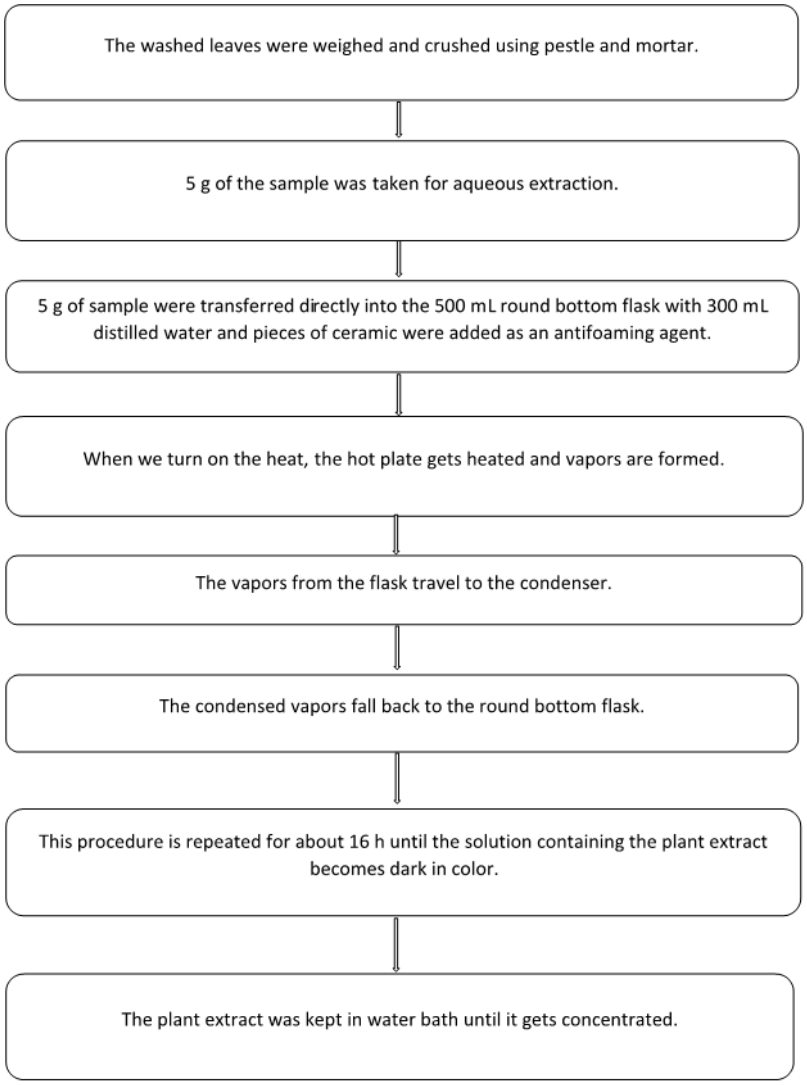

Fig 5. Flow chart showing the preparation of aqueous extraction

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These extracts were further used for the qualitative and quantitative analysis, anti-microbial tests and others.

Fig 6. Aqueous extraction.

2.2 Characterization of phytochemicals present in the plant extract

2.2.1 Quantitative Analysis

Test for Alkaloids (Mayer's test): 2mL of extract was warmed with 2 mL of 2% Sulphuric acid (H_2SO_4) for 2 min and added 3-4 drops of Mayer's reagent. It is considered positive when a white precipitate form [5].

Test for Flavonoid: To a 2 mL of the extract, add 2-3 drops of sodium hydroxide (NaOH). By adding a few drops of diluted hydrochloric acid (HCl), the initial yellow color gradually fades away to become colorless.

Test for Tannins (Ferric chloride test): Add a few drops of 10% ferric chloride to 2 mL of aqueous extract. Gallic tannin is visible as a blackish-blue color, and catechol tannin is visible as a greenish-black color [5].

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Test for Saponins (Frothing test): Add 10 mL of distilled water to 3 mL of aqueous extract. Following that, the test tube was sealed and shook for 5 min. For the formation of honey comb froth, let it stand for around 30 min [5].

Test for Terpenoids (Salkowski test): To a 2 mL of extract add 2 mL of chloroform and 3 mL conc. Sulphuric acid (H_2SO_4) and shaken well. A positive test indicates the presence of a reddish-brown color in the interface [14].

Test for Sterols (Salkowski test): To a 2 mL extract mix 2 mL of chloroform and 2 mL Con. Sulphuric acid (H_2SO_4) and shaken well. When the chloroform layer did not appear red and the acid layer fluorescent greenish-yellow indicates the absence of sterols[6].

2.2.2 Qualitative Analysis

a. Test for Carbohydrates

Molisch's test: Each portion was dissolved in distilled water and then added a few drops of Molisch's reagent and 1 mL of conc. sulfuric acid. The mixture is then reconstituted with 5 mL of distilled water after standing for 2 min. A favourable outcome is indicated by the formation of dull violet or red at the contact [6].

Benedict's test: Add 3 mL of Benedict's reagent to 2 mL of extract, then heat it over an open flame for 2 min. The presence of carbohydrates is indicated by a crimson precipitate.

Barfoed's test: Add 2 mL of Barfoed's reagent to 2 mL of extract. After two min in the water bath, chill it with tap water to room temperature. A crimson cuprous oxide precipitate is a sign of result [5].

Iodine test: To a 2 mL of extract, add a few drops of iodine solution. No blue-black complex indicates the absence of starch.

Bial's test: To a 2 mL of extract, add 2 mL of Bial's reagent. The solution which when heated gently in a Bunsen burner or hot water bath, appears green color indicating a positive test [7].

b. Test for Proteins

Biuret test: To a 1 mL of extract, add 2 drops of 3% copper sulphate ($CuSO_4$) and a few drops of 10% sodium hydroxide (NaOH). A violet or red color indicates the presence of protein.

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Ninhydrin test: To a 1 mL of extract, add freshly prepared 0.2% Ninhydrin solution. The formation of purple color shows the presence of protein [6].

2.3 Anti-microbial activity (Disc-diffusion method)

Nutrient Agar powder was weighed 8 g and mixed with 100 mL distilled water to prepare the agar solution. Whatman filter paper was punched to get discs. 2 test tubes were taken with 10 mL of aqueous and solvent extracts along with 10 discs in each. These were plugged with cotton to prevent vaporization. Then the nutrient agar, 2 test tubes, forceps, 2 petri plates and L- shaped glass rods were sterilized in an autoclave at 121°C for 15 -20 min. These materials were placed in a laminar air flow cabinet. In a petri dish, agar was poured and allowed to solidify. Each of these plates included a subculture of already cultivated bacteria like *Streptococcus pyogenes* and *Staphylococcus aureus* (Fig 7). The readymade anti-biotic discs such as Kanamycin -1000 mcg and Ampicillin -25 mcg were placed on two corners of each petri plate and the disc present in the solvent and aqueous extract were also placed on other corners of the petri plates (Fig 8). These were then kept for incubation at 37℃ overnight. Anti-microbial activity was observed.

Fig 7. Inoculation of microorganisms into agar plates.

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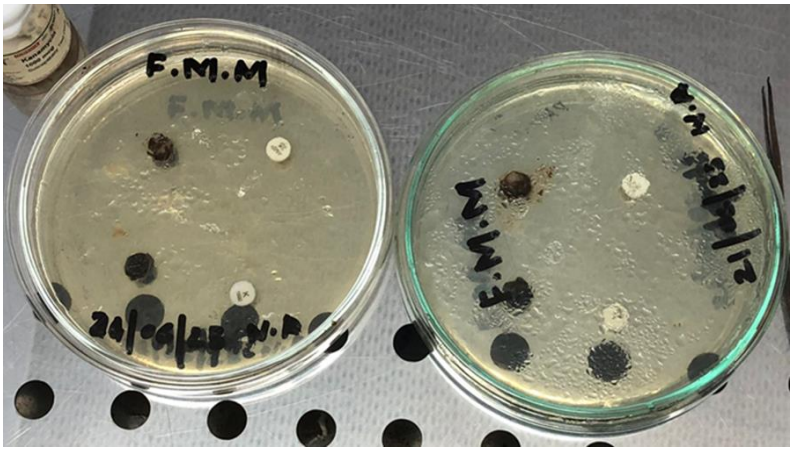

Fig 8. Four discs are placed at the respective corners of agar plates.

3. Results and Discussions

3.1 Quantitative characteristics of extract

3.1.1 Alkaloids

When we mixed 2 mL of the extract with 2 mL of Sulfuric acid and added a few drops of Mayer's reagent, we got a cloudy white precipitate only in the solvent extract but not in the aqueous extract (Fig 9).

This is due to the alkaloids poorly dissolve in water. Whereas, in solvents like methanol or ethanol, the alkaloids are readily soluble. So, the Mayer's test for alkaloids, results in the production of a white cloudy precipitate only in the solvent extract of the *Memecylon amplexicaule* leaves.

Fig 9. Presence of Alkaloids

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3.1.2 Flavonoids

When 2 mL of extract was combined with a few drops of sodium hydroxide, a red color initially developed. This color gradually changed to yellow after the addition of a few drops of diluted acid, signifying the absence of flavonoids.

3.1.3 Tannin

When we added a few drops of ferric chloride to 2 mL of extract, it shows a positive result giving a blackish-blue color for aqueous extract and a greenish-black color for solvent extract. A blackish-blue color indicates the presence of gallic tannin and a greenish-black color indicates the presence of catechol tannin (Fig 10).

Fig 10. Presence of Gallic and Catechol Tannin.

3.1.4 Saponin

When a 10 mL of distilled water was added to the aqueous extract, following the test tube was allowed to stand for around 30 min, it results in the formation of honey comb froth (Fig 11).

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Fig 11. Honey comb froth

3.1.5 Terpenoids

When we mixed 2 mL of the extract with chloroform and Concentrated Sulfuric acid in the ratio 2:3, a reddish-brown in the interface was formed (Fig 12). This indicates the presence of terpenoids in the plant extract.

Fig 12. Presence of Terpenoids

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3.1.6 Sterol

When we mixed 2 mL of the extract with equal proportions of chloroform and concentrated sulfuric acid, the chloroform layer appears transparent and the acid layer was greenish-yellow (Fig 13). This indicates the absence of sterol in the plant extract.

Fig 13. Absence of Sterol

Table 1: Quantitative analysis

Tests	Observation	Result
1. Mayer's test	A white precipitate was formed.	Alkaloids are present.
2. Flavonoids test	Initially a red color is formed and gradually it turns yellow.	Flavonoids are absent.
3. Ferric chloride test	A Blackish-blue color formed for aqueous extract and greenish-black for solvent extract.	Gallic tannin and catechol tannins are present

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4. Frothing test	Honey comb froth was observed.	Saponins are present.
5. Salkowski test (Terpenoids)	A reddish-brown color was observed at the interface.	Terpenoids are present.
6. Salkowski test (Sterol)	The chloroform layer did not appear red and the acid layer was fluorescent greenish-yellow.	Sterol is absent.

From the above quantitative analysis, we found the presence of alkaloids, tannins, saponins, terpenoids. The components like flavonoids and sterol were found to be absent in the plant extract (Table 1).

3.2 Qualitative analysis

3.2.1 Carbohydrates

Table 2: Qualitative analysis of carbohydrates

Test	Observation	Result
1. Molisch's test	Formation of red color at the interphase.	Carbohydrates are present.
2. Benedict's test	A red precipitate is formed.	Presence of reducing sugar.
3. Barfoed's test	No color changes.	Monosaccharide is absent.
4. Iodine test	No blue-black complex is formed.	Polysaccharide is present.
5. Bial's test	No green complex.	Pentoses are absent.

In qualitative analysis for carbohydrates, the plant extract of *Memecylon amplexicaule* was found to contain fructose(Table 2).

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3.2.2 Protein

Table 3: Qualitative analysis of proteins.

Test	Observation	Result
1. Biuret test	No violet or red color is formed.	Protein is absent.
2. Ninhydrin test	No purple color is formed.	Protein is absent.

In qualitative analysis for proteins, both the tests gave a negative result indicating the absence of protein in the plant extract(Table 3).

3.3 Anti-microbial test:

The anti-microbial activity and zone of inhibition of the plant extract against *Staphylococcus aureus* and *Streptococcus pyogenes* were assessed using the disc-diffusion method. The extract significantly inhibited the growth of the bacterium *Staphylococcus aureus*, but it had no effect on *Streptococcus pyogenes*. In contrast to the standard disc Kanamycin-1000 mcg, which demonstrated a zone of inhibition of 4.4 cm diameter, only the solvent extract of the leaves of *Memecylon amplexicaule* showed anti-bacterial activity against *Staphylococcus aureus* with an inhibition zone of 1.2 cm diameter (Fig 14).

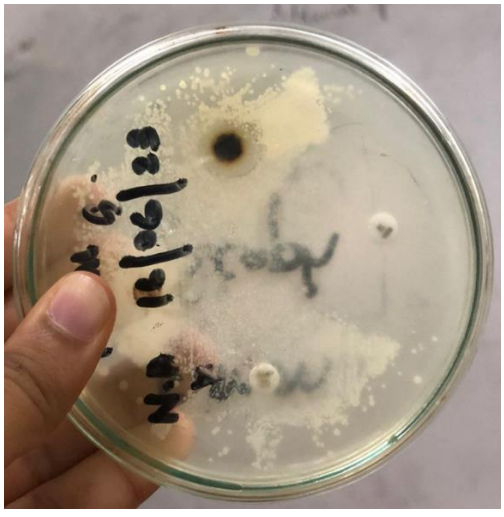

Fig 14. Zone of inhibition of microorganisms.

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4. **Conclusion**

The major goal of our project was to isolate and identify the elements found in the leaves of Memecylon amplexicaule. The plant genus Memecylon is a member of the Melastomataceae family. Evergreen small to medium-sized M. amplexicaule trees are widespread in Sri Lanka, Malaysia, tropical Africa, Madagascar, and India. Five memecylon species have received more research than the others. These five species, which include *M. umbellatum, M. wightii, M. malabaricum, M. edule,* and *M. depressum,* have been the subject of numerous publications and reviews. As a result, the extraction, identification, and characterization of Memecylon amplexicaule—subjects that has received the least attention—were the main focuses of our effort. We used both a solvent, 99.9% ethanol and an aqueous technique using distilled water for the extraction procedure, which was carried out using a Soxhlet extractor. Qualitative, quantitative, and antibacterial activity tests were conducted on the extract. Alkaloids, tannins, saponins, terpenoids, and carbohydrates were all detected by this assay. Additionally, we discovered that *Staphylococcus aureus,* a Gram-positive bacterium, was resistant to the antibacterial effects of the plant extract. As a result, these qualities of the plant extract have several uses, such as anti-inflammatory, pain relief, decoctions, and lotions to cure eye problems. It is also said to have antiviral properties. In future, we are planning to send the samples for anti-viral tests to find other properties that could be beneficial against some of the harmful pathogens.

Acknowledgement: We thank the department of biotechnology of P. A. College Of Engineering for providing the required materials and their immense support.

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ISBN-978-81-19905-39-3

ICEST_BT_006

BIOBRICK PRODUCTION BY SOLID STATE FERMENTATION OF LATTERATE SOIL USING BIOPOLYMER GUM PRODUCING BACILLUS SUBTILIS

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Abstract:

There are many challenges faced by the modern brick industry, including cost, shortages of raw materials and environmental impacts of production. To meet this challenge, many research methods are followed around the world. This project is aimed at the production of bio bricks using laterite quarry waste powder, *Syzygium cumini* leaf extract and bacterium *Bacillus subtilis* through the process of Solid-state Fermentation. We had four different mixtures containing Soil and water, Soil and leaf extract, Soil-water and bacteria, Soil-leaf extract and bacteria. The brick made of leaf extract and bacteria is expected to have more compressive strength, water absorption, hardness and bacterial count. Our method of creating bio bricks from laterite quarry waste powder, solid state fermenting them with *Syzygium cumini* leaf extract and *Bacillus subtilis*, binding them, and compressing them into blocks offers significant fuel, energy, and material conversion cost savings. It also requires a lower capital investment per ton of cement and offers an ecologically sound solution. “Bio-bricks” made with this technique could be a brand, effective, and more environmentally friendly building material.

1. Introduction

As the globe experiences a peak in its careless environmental degradation and rapid resource depletion, it is important to decrease the usage of non-ecofriendly construction block materials available on markets. The present manufacturing process of building materials such as steel and brick emit large quantities of greenhouse gases like CO2 in to the atmosphere. Hence the, emerging

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economies have an important approach in this domain as they focus on, rapidly building their infrastructure while controlling the energy consumption and emission of harmful gases to the environment. This aims at producing an eco-friendly brick or a bio-brick which utilizes least energy consumption and causes no carbon emission and with less environmental implications.

Bricks made from plain soil for centuries have been used in building mud houses [1]. The most consistent of these soil types are laterites. In this mini project, we use laterite quarry waste powder as the key raw material for the construction of bio-brick. Laterite is an old and popular construction material that has served humanity for centuries now. It is a highly weathered tropical soil containing varying proportions of iron and aluminum oxides [2]. Along with mud homes and buildings, it is also employed in the construction of highways. When used alone, it depreciates in strength fast under load and ambient weather. A type of soil known as laterite is characterised as being found in hot, humid tropical areas of the world. It was created from weathered rocks under conditions of high temperature, heavy precipitation, and wet and dry intervals. [3]. The high rainfall leaches away the silica component and thereby making it rich in iron and aluminiumoxides. Iron oxide causes it to range in colour from red to brown to yellow. It hardens when exposed to air and is now a widely used building material in many parts of the world due to its accessibility and cost savings compared to other natural earth elements. Further to being more affordable than traditional modern building materials, it is also thought to have superior energy efficiency in tropical climates [4]. However, extraction of lateritic block results in large quantity of lateritic waste powder and disposing them is a major problem. To get around this significant problem, laterite quarry waste powder can be utilized to make bio bricks. Since laterite quarry waste powder has engineering properties as same as lateritic soil, can be utilized as an ideal alternative building material than other chemical and harmful materials [5].

This undertakes a biotechnological application known as solid state fermentation of laterite quarry waste powder to produce bio-brick. Solid state fermentation (SSF) is the fermentation process that takes place when there is no free water present or almost no free water present [6]. Despite being well-known since antiquity, SSF is currently receiving scientific interest because of the numerous environmental and apparent economic advantages it provides. For the generation of secondary metabolites, organic acids, fuel, and enzymes, among other things, solid state

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fermentation is frequently used [7]. It is a substitute for submerged fermentation because it requires less complicated cultivation equipment, less money upfront, higher productivity, less energy, less water, better product recovery, and less bacterial contamination. It also uses less energy and water overall. There are several factors, which affect the solid state processes and the nature of solid state is the most important factor. The substrate added should provide enough nutrients for the growth of microorganism present inside.

The advantage of a biotechnological method over a chemical one is that we can use affordable raw materials as a source of hydrocarbons, like *Syzygium cumini* leaf extract. It is also known as Java plum, Malabar plum, Black plum, Jambul. This will act as a natural nutrient medium and helps to the enormous growth of the bacteria *Bacillus subtilis*. The use of these substrates will also reduce environmental pollution caused by other artificial additives [7].

Brick mixture problems are caused by cracks. In order to maximise the structure's endurance, either the developed cracks are mended afterwards or additional reinforcement is added to the structure during the design phase to guarantee that the crack width stays within a predetermined range. Bacteria can be added to the brick mixture to help solve this issue by improving the durability of the brick [8]. Here is an attempt to make this possible by using Bacillus subtilis. In comparison to any typical brick mixture, this bacteria has demonstrated its ability to increase the compressive strength, tensile strength, and flexural strength. It develops in bare-bones medium without any additional growth agents. Most of them are mesophiles, which like temperatures between 30 and 35 °C [5]. It generates homo- and copolymers of polyhydroxyalkanoates (PHAs), broadening the variety of synthetic PHAs. Bacillus subtilis has the capacity to accumulate significant amounts of polyhydroxybutyrate (PHB).PHB accumulated is a highly crystalline thermoplastic polymer having a glass transition temperature of 0 to 5°C and a reasonably high melting point. PHB is completely biodegradable and insoluble in water. It is simple to cultivate and safe to employ *Bacillus subtilis* to enhance the brick mixture's strength properties [9].

This work illustrates the use of bacterial and biotechnological processes in the field of civil construction in a cost-effective and environmentally responsible way. This might be a low-input, sustainable alternative technology for the building and construction industry [10-15].

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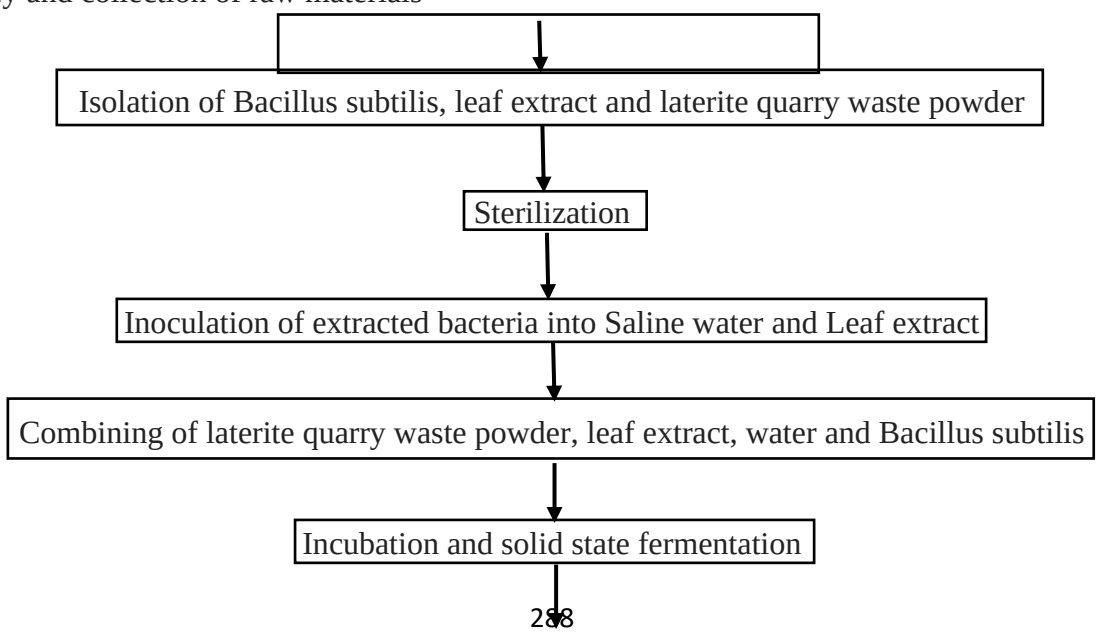
2. Experimental Procedure

The proposed methodology consists of casting and testing of bricks of size 190 × 90 × 90 mm which is obtained by mixing the constituent materials. The brick mould is made of four samples, firstly Soil and water: A known amount of sterilized laterite quarry waste powder is thoroughly mixed with distilled water to make a thick malleable paste. The second sample consists of soil and leaf extract: A known amount of sterilized laterite quarry waste powder is thoroughly mixed with the sterilized *Syzygium cumini* leaf extract to make a thick malleable paste. Third sample consists of soil, bacteria and leaf extract: A known amount of sterilized laterite quarry waste powder is thoroughly mixed with *Bacillus subtilis* inoculated through leaf extract to make a thick malleable paste. Lastly soil, bacteria and water: A known amount of sterilized laterite quarry waste powder is thoroughly mixed with Bacillus subtilis inoculated through distilled water to make a thick malleable paste [16].

Each of the four samples is filled in four different molds respectively by four layers. Each layer is compacted well to attain a maximum density and it reduces pores in the brick which results in increased durability and compressive strength of brick without heating process. The four molded brick samples are kept for Solid State Fermentation for 14 days. After the bacteria have had 14 days to proliferate, the brick samples are taken out of the mould and left to cure for a further 14 days in the open air. After total 28 days, the cured bricks are characterized using different test to identify the ideal bio brick.



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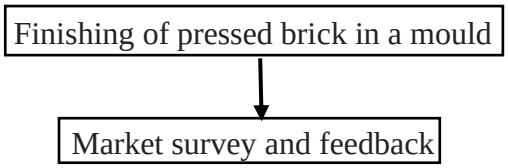

Fig 1. Methodology to produce Biobricks

To characterize the three samples of bricks, the following tests are conducted: Compressive strength test: The brick is placed in compression testing machine with the smooth surface at the top. Steel plate should be kept over the brick specimen to withstand the load and the load is applied gradually to the brick at the rate of 14 N/mm2. The load is applied until the brick fails. Water absorption test: The rate of water absorption is the important parameter of the brick because it affects mortar and grout bonding during the wall construction. Increased water absorption by the brick from the mortar causes a decrease in brick strength. In this test, a dry brick stored at room temperature is weighed initially before being fully submerged in water for 24 hours. The wet brick's weight is then calculated. The amount of water absorbed by the brick is calculated as the difference between the final average weight and the beginning average weight.

According to the Indian standard (IS: 1077: 1992) for the classification and specification of bricks, the quality of the brick is split into three groups based on its water absorption. First-class bricks shouldn't absorb more water than 20% of their own weight. Second quality brick should not absorb water more than 22 percentage and third quality brick should not absorb water more than 25 percentage [17].

Hardness test: here, a fingernail is used to make a scratch on a brick surface. Brick is considered to be sufficiently hard if no imprint is made on the surface. Bacterial count: From each of the four samples, a smear is made, and a spread plate culture is made under sterile circumstances. Then after the incubation for around 24 hours the colonies are counted using colony counter.

3. Results and Discussions

3.1 COMPRESSIVE STRENGTH TEST

The brick made of leaf extract and bacteria have more compressive strength which is 3.7MPa than the brick made without leaf extract and with bacteria. The brick made without leaf extract and

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bacteria is expected to have a low compressive strength when compared to other bio bricks [18-20].

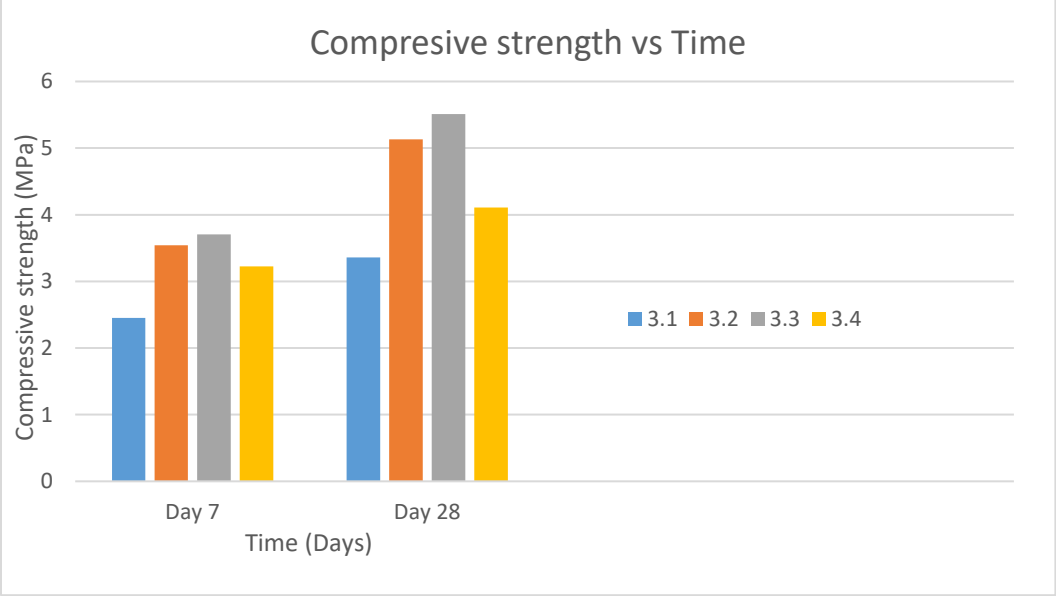

Fig 2. Comparison of samples in terms of compressive strength

3.2 WATER ABSORPTION TEST

The Indian Standard (IS: 1077: 1992) for bricks classification and specification is projected to be much more satisfied by bricks created using leaf extract and bacteria compared to bricks made without leaf extract and bacteria.

Table 1

Absorption Test Results of Bio-Bricks

Bio-Brick	W_1 (Kg)	W_2 (Kg)	Water Absorption (%)
1	2.76	3.16	14.4%
2	2.86	3.38	18.1%
3	2.64	3.14	18.93%
4	2.8	3.28	17.1%

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3.3 HARDNESS TEST

All the four samples of bio bricks have sufficient hardness which was found to be 1.2MPa.

3.4 BACTERIAL COUNT

The brick made of leaf extract and bacteria is expected to have more bacterial count which was around 10^8 than the brick made without leaf extract and with bacteria.

Fig 3.1 Soil and water brick

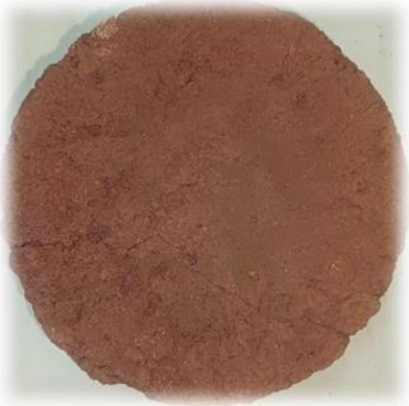

Fig 3.2 Soil and leaf extract brick

Fig 3.3 Soil, bacteria and leaf extract brick

Fig 3.4 Soil, bacteria and water brick

Fig 3. Bio-bricks produced

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4. Conclusion

Based on the literatures reviewed and the lab work carried out by our team, the following conclusions are made regarding the utilization of laterite quarry waste powder, leaf extract and bacteria for the production of bio-brick by solid state fermentation. Bio-bricks manufactured by the Solid-state Fermentation of laterite quarry waste powder using leaf extract and bacteria are 100% natural and sustainable. Solid State Fermentation enhances the ability of the bacteria to produce polymeric substances called PHB which provides automatic durability and self-repairing ability to the bio-bricks. The use of laterite quarry waste powder as an alternative to conventional building materials helps to reuse and overcome the problem with the disposal of laterite quarry waste. Laterite quarry waste powder helps to increase the compressive strength and hardness of the bio-brick. *Syzygium cuminias* an excellent natural nutrient media improves the durability and compressive strength of the bio brick.

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ISBN-978-81-19905-39-3

ICEST_BT_007

NONINVASIVE POTENTIOMETRIC BIOSENSOR TO ASSESS MILK SHARK KEEPING QUALITY

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ABSTRACT:

Milk shark (*Rhizoprionodon acutus*) is highly spoiled product because the urea is broken down by the bacterial enzyme urease, releasing ammonia; for this reason, it is essential to preserve and keep an eye on the source of urease degradation, which is fish freshness. To keep an eye on the quality of the Milk Shark, we have produced a urease biosensor. Sodium alginate and calcium chloride solution were used to immobilise urease on the pH electrode. A potentiometric transducer can be used to measure the change in potentials across the single glass electrode brought on by the enzymatic conversion of urea into ammonia by immobilized urease. There was a linear correlation 16 between the degree of urea, ammonia liberation, product deterioration, and potentials produced across the urease biosensor with Milk Shark storage at 30°C. Urease biosensor, thus, offers a dependable, user-friendly, and quick way to gauge how fresh fish with large urea content is.

KEY WORDS: Milk shark, *Rhizoprionodon acutus*, potentiometric, biosensor, Urease.

1. INTRODUCTION

India is the third largest exporter of seafood items to international market with total volume of 17,35,286 MT) and value of Rs. 63,969.14 crore in the financial year 2022-2023[1]. The milk shark, *Rhizoprionodon acutus*, is a requiem shark named for its supposed lactation-promoting properties in India, measuring about 3.6 feet in length and widely found in coastal tropical waters of the eastern Atlantic and Indo-Pacific[2]. The assessment of post-harvest losses in fish and seafood due to perishability stands at ₹15,000 crores, mainly attributed to unhygienic handling,

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insufficient preservation, packaging, storage, and marketing manipulations[3]. The primary causes of food waste among consumers and retailers include concerns about food quality, expiration dates, and safety, with approximately 15% attributed to damage and spoilage, a figure that rises to 35% under inadequate storage and transport conditions[4]. Recent efforts in evaluating freshness across industry, marketing, and inspection sectors aim to elevate quality standards throughout the fishery chain, streamlining trade, bolstering quality assurance, and providing consumers with reliable fish quality information[5]. Currently, the objective non-sensory evaluation methods accessible are time-consuming, cumbersome, tailored for temperate regions, and do not directly reveal the sensory attributes vital for consumer acceptance of Indian fish[6]. Fish freshness degradation is influenced by a number of internal and external variables, including storage temperature, relative humidity, oxygen, salinity, handling and fish catching methods, pH, moisture content, condition and nature of fish, species, sex, size etc[7]. The osmoregulatory physiology of cartilaginous fish, including skates, milk sharks, sharks, and rays, is characterized by high tissue and blood urea levels. [8]. Following the death of these fish, the decomposition of urea into CO_2 and NH_3leads to a strong odor and potential meat toxicity, underscoring the importance of employing accurate and quick assessment of quality tools to ensure acceptable quality [9]. Biosensors are tools for analysis utilized for detecting specific analytes like cholesterol and urea, utilizing biomolecules such as nucleic acids, proteins, and carbohydrates as key components, alongside a transducer and data analysis and visualization tools [10]. The enzymatic transformation of analytes like urea into another component, such as ammonia, can be conveniently evaluated, quantified, and shown in an understandable way using biosensors equipped with immobilized urease [11]. Using the alginate gel entrapment approach, sodium alginate on pH probes may immobilise urease. For almost fifty years, pH electrodes have been utilised in applied research as potentiometric transducers when an enzyme reaction alters the pH. [12]. In order to measure urea levels in Milk shark (*Rhizoprionodon acutus*) fish at landing centres, we attempted to develop a urease biosensor that functions by releasing ammonia through urease action on urea. This attempts to address issues related to fish sample delays in the lab, which sometimes extend to several days.

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2. MATERIALS AND METHODS

Enzyme Preparation:

Milk sharks (*Rhizoprionodon acutus*) taken from the Arabian Sea using trawl nets were sourced from fishing boats in the "Bunder area," Mangalore, between November and September. The time amid the landing and the catching did not exceed three to four hours. One newly caught Milk Shark, weighing approximately 174-261g and measuring between 17 and 23 cm in length, was selected for a ten kg portion. Within 120 minutes, the product was delivered to the lab in an well insulated container that was sufficiently iced at a ice to fish ratio of 1:1.

Enzymes and Chemicals:

We purchased standard buffer tablets from Qualigense Fine Chemicals in Mumbai. Sigma Chemicals Co. supplied the urease tablets, and Merck Ltd., Mumbai, India, produced analytical-grade chemicals and other materials.

Entrapment of Urease-on-Urease Assay and pH Probe:

Alginate gel was made using a solution of calcium chloride and sodium alginate for the immobilization of urease 3. 100 mL of crude enzyme solution was mixed with 0.5 mL of bovine serum albumin solution and sodium alginate aliquots. The one mixture of urease and sodium alginate was dropped into a standardized glass pH electrode, and the liquid was continuously swirled for one minute. The electrode was then submerged in a 0.1 L solution of excess 0.2M CaCl for an hour to cure. Enzyme immobilization and 1 2 calcium alginate produced a coating around the pH electrode bulb, which was connected to a pH metre for potentiometric measurement (a process called biosensor). The quantity of ammonia emitted within a specified time frame. [13, 14, 15].

Assesment of the Biosensor:

The biosensor was used to produce a potentiometric measurement of urease activity by immersing and incubating the bulb in a beaker containing 0.05 M Tris acetate working buffer at pH 7 at 30°C and swirling steadily and moderately. For the purpose of calibration and graph-

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plotting, aliquots of urea were used at concentrations of 10, 20, 40, 60, 80, and 100 mg per deciliter until 1 the electrode voltage across the two biosensor leads reached a stable value.

Microbiological Methods:

For fifteen minutes, glassware and ready-made media were sterilised at 121°C. For one hour, pipettes, homogenizers, and petri dishes were sterilised at 180 degree Celsius. The APHA technique was used to determine the count of viable bacteria. [16].

Assesment of Fresh Fish Sample:

For analysis, fresh Milk Shark samples were selected, and fish samples' electrical potentials were recorded for up to four hours following each hour of incubation at 0°C and 30°C. The brisk fish samples were investigated for appearance, colour, texture, and odour. A nine-point hedonic scale was used to rate the sensory attributes. A nine-point hedonic scale was used to rank the sensory qualities (9 being very liked, 8 being very much liked, 7 being moderately liked, 6 being like 1 slightly liked, 5 being neither like nor disliked, 4 being slightly disliked, 3 being disliked moderately, 2 being disliked very much, and 1 being terribly disliked) [17].

Statistical Analysis:

Statographics 2.1 was used to do both one-way and two-way ANOVAs (Analysis of Variance). An analysis of the mean difference was conducted using a Tukey HSD test ($p < 0.05$). For every sample, three duplicates were taken and examined.

3. RESULTS AND DISCUSSIONS

After being incubated at 30°C for 4 hours, the count of viable bacteria of freshly captured milk sharks that had been held at 0°C and at 30°C for varying times showed a steady increase, starting at 2.1x103 cfu/g and reaching 3.6x108 cfu/g. Nonetheless, the count of viable bacteria 1 decreased somewhat from 2±0.01 x10 cfu/g to 2.2±0.01 x10 cfu/g while being stored at 0°C (Figure 1). Notably, the viable 32 counts of bacteria in Milk Shark samples maintained at 30°C grew significantly ($p<0.05$), whereas the change in count in specimens kept at 0°C was negligible

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(p<0.05). Because fish icing stops the expansion of mesophiles, the rate of count of microbe increase fell dramatically as temperature dropped from 28°C to 0°C [18].

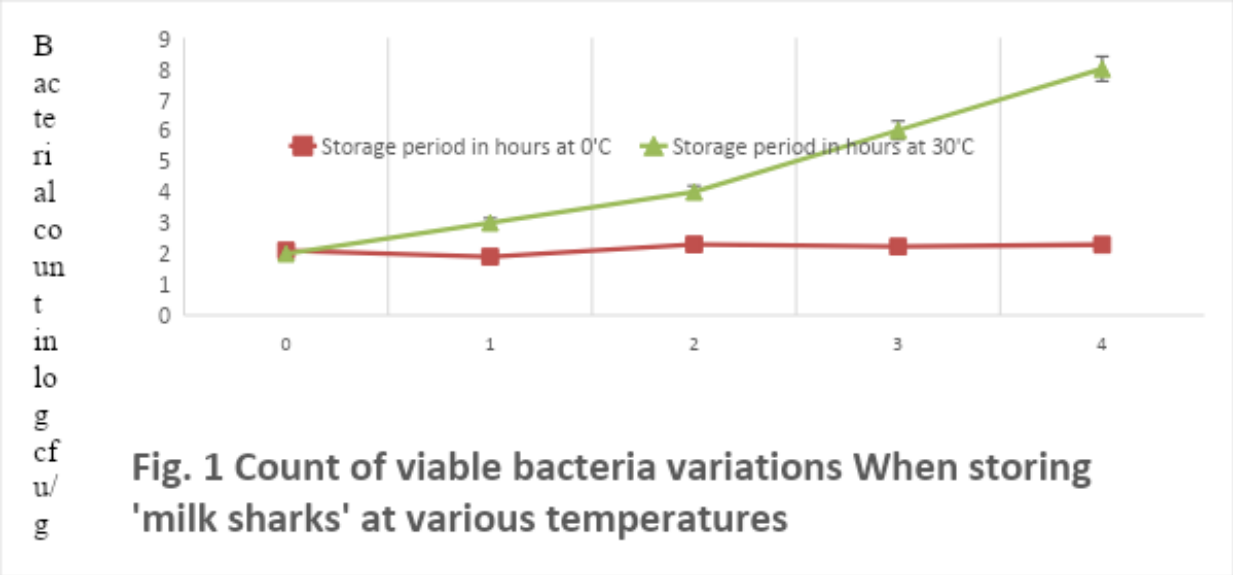

Fig. 1 Count of viable bacteria variations When storing 'milk sharks' at various temperatures

The urea content in recently caught fish dropped over the course of four hours from 9.36±0.05 mg/g to 3.8±0.04 mg/g while being stored at 30°C. In contrast, samples kept at 0°C saw a modest shift in urea content over the same period of time, going from 9.36±0.05 mg/g to 9.14±0.09 mg/g (Figure 2). Urea concentrations in Milk Shark samples kept at 30°C showed substantial increases (p<0.05), while samples kept at 0°C showed negligible changes (p<0.05) in urea concentration. The reason for this disparity is thought to be the bacteria breaking down urea as the fish degrades. [19].

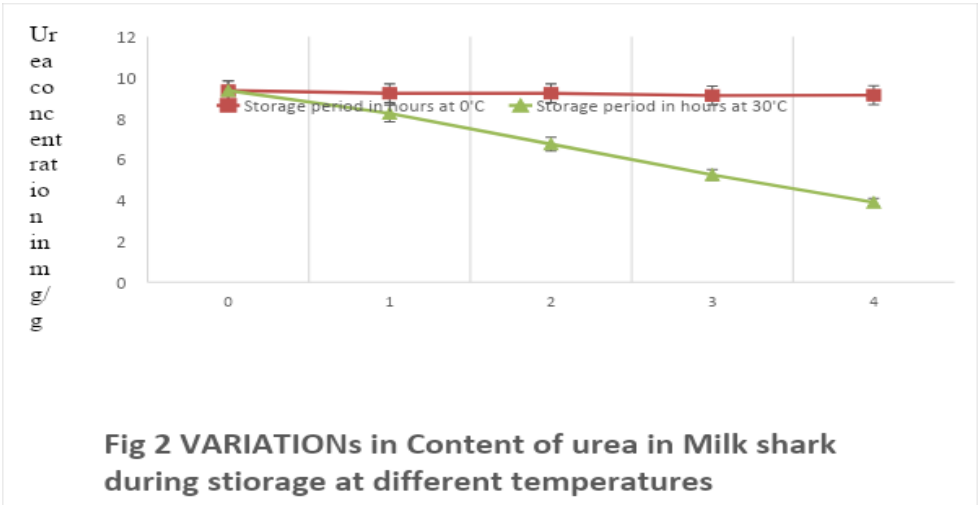

Fig 2 VARIATIONs in Content of urea in Milk shark during stiorage at different temperatures

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Fresh milk shark decomposes into carbon dioxide and ammonia at 30°C. Recently caught fish exhibits a progressive decline in ammonia content throughout this period, with a concentration of 5.10±0.05 mg/ml at the beginning and 96.3±0.06 mgN/100g within 4 hours (Fig 3). of contrast, during the same time period, the urea content of samples kept at 0°C marginally changes from an initial value of 5.36±0.05 mgN/100g to 5.29±0.08 mgN/100g. Urea concentrations in Milk Shark samples maintained at 30°C show considerable variations ($p<0.05$), while materials stored at 0°C show negligible changes ($p<0.05$) in urea concentration. This discrepancy is explained by the microorganisms that break down urea as the fish degrades.

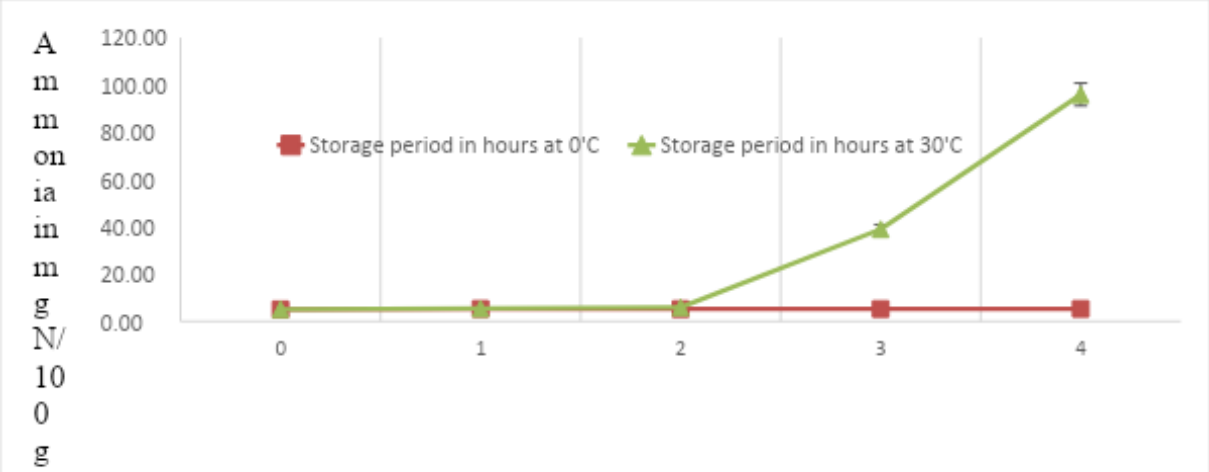

Fig 3 VARIATIONs in ammonia content in 'Milk shark' WHILE storage at different temperatures

AfterThe electrodes of the biosensor were stored at 30°C, the voltage across them was measured at 1, 2, 3, and 4 hours. The results showed that the voltage was 36±0.06, 46±0.05, 53±0.08, 69±0.09, and 91±0.06 mV, respectively. Conversely, over the same periodsof keeping at 0°C, the potentials measured 45±0.09, 49±0.08, 51±0.09, 52±0.09, and 54±0.00 mV, respectively. Potentials changed relatively little at 0°C ($p<0.05$) and dramatically rose at 30°C ($p<0.05$) across the biosensor electrodes. Bacterial urease transforms urea in milk sharks kept at 30°C into ammonia and carbon dioxide. Ammonia fumes give preserved Milk Shark flesh a distinct flavor. The biosensor's electrode potentials are altered by this deteriorating process. The count of viable bacteria, urea concentration, ammonia liberation potentials, and sensory characteristics were compared and are shown in Table 1.

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Table 1: Relative examination of the spotted "Milk Shark"kept at 0°C and 30°C

Storage time in hours	Storage temperature	Hedonic scale	Hedonic scale
0	30 °C	8.0±0.09	Clear skin, firm texture, crisp scent, grayish hue. translucent mucus
	0 °C	8.0±0.02	Clear skin, firm texture, crisp scent, grayish hue. translucent mucus
1	30 °C	7.0±0.07	Slightly lackluster skin, cloudy mucus, muted color, slightly soft texture, with a neutral to faint fishy aroma.
	0 °C	7.6±0.09	Clear skin, firm texture, crisp scent, grayish hue, translucent mucus
2	30 °C	6.0±0.03	Matte skin, tender texture, muted color, with a fishy aroma, milky mucus
	0 °C	7.5±0.07	The skin is vibrant, the mucus is clear, the texture is firm, the scent is fresh, and the color is grayish.
3	30 °C	5.0±0.04	The skin is dark, the mucus is yellowish, the texture is very soft, the color is dull, and there's a sour smell.
	0 °C	7.2±0.09	The skin appears somewhat dull, with opaque mucus and a slightly muted color, while the texture feels somewhat soft, and there's a normal to faint pungent smell.

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4	30 ^{o}C	3.9±0.06	The skin is very dark and chalky, with yellowish mucus, a soft texture, light color, and an ammoniacal smell.
	0 ^{o}C	7.1±0.06	The skin appears somewhat lackluster, with opaque mucus, a slightly muted color, soft texture, and a neutral to faint fishy smell.

Fish was deemed unsuitable after 5 duration of storage at 30°C, exhibiting the skin is very dark and chalky, with yellowish mucus, a soft texture, light color, and an ammoniacal smell, scoring only 3.9±0.06 marks on the hedonic scale. However, after 5 duration of storage at 0°C, the ammonia concentration of 5.29±0.08 mgN/100g, the potential was 54±0.00 mV, and the fish received the maximum rating of 4±0.07 on the hedonic scale.

4. CONCLUSION:

Storing Milk shark at 0°C helps prevent the breakdown of urea into carbon dioxide and ammonia. Conversely, storing them at 30°C leads to increased ammonia release, which correlates with rising potentials across biosensors during storage. The ammonia liberation is strongly linked to the decline in sensory qualities, as reflected in hedonic scale scores. deteriorating sensory attributes at 30°C significantly impact the freshness compared to storage at 0°C. Thus, the urease-immobilized biosensor proves to be an effective tool for assessing Milk Shark freshness.

ISBN-978-81-19905-39-3

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11:30 AM to 11:45 AM	Refreshments
11:45 AM to 01:00 PM	Keynote Address-1 on topic "Decoding Deep Learning: From Theory to Application" by **Dr. B H Shekar,** Professor, Department of Computer Science, Mangalore University, Mangalore
01:00 PM to 02:00 PM	Lunch Break
02:00 PM to 02:45 PM	Track 1 Oral presentation (Data science & Machine Learning)
02:45 PM to 03:30 PM	Track 2 Oral presentation (Cloud &Grid computing)
03:30 AM to 03:45 AM	Refreshments
03:45 PM to 04:30 PM	Track 3 Oral presentation (Blockchain Technologies)
24th April 2024 Wednesday – Day 2	
09:30 AM to 10:30 AM	Track4 Oral presentation (Network security &Cryptography)
10:30 AM to 11:30 AM	Track 5 & 6 Oral presentation(Computational Sciences, Cyber Physical Systems)
11:30 AM to 11:45	Refreshments

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AM	
11:45 AM to 01:00 PM	Keynote address – II on topic "Cyber Security - Trends, Challenges and Solutions" by **Dr. Nagesh H R,** Principal, Canara Engineering College, Mangalore
01:00 PM to 02:00 PM	Lunch Break
02:30 PM to 03:30 PM	• Valedictory of ICEST-24 • Valedictory address by **Dr. A. M. Khan,** Senior Professor, Dept. of Electronics & Director- Skill Development Centre Mangalore University Mangalore • Keynote Address by **Dr. Surendra Kumar**, Pro-Vice Chancellor, Presidency University, Bangalore
03:30 PM to 04:00 PM	Interaction & High Tea

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CLEANSIGHT

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Abstract:

Waste segregation promotes energy production from waste, landfill depletion, recycling, and waste reduction. Recycled materials become contaminated by waste that is disposed of inappropriately. One way to assist lessen contamination—a significant issue for the recycling industry—is through automatic computerized waste sorting. The capacity to find models or methods that help people sort waste has become essential to disposing of it properly. Even with the wide variety of recycling categories available, many people are still confused about how to select the ideal trash can for getting rid of every single waste item. Across the globe, waste management and careful sorting are considered essential elements of ecological development. Society has to reduce waste by recycling and reusing discarded resources in order to lessen environmental concerns. Waste needs to be separated into recyclable and non-recyclable categories in order to be disposed of appropriately. The objective of this project is to create an automated waste detection system that gathers waste photos or videos from a camera with object recognition, detection, and prediction using a deep learning algorithm. We'll classify the was items, which include things like clothing, plastic, wood, paper, balls, bottles, glasses, cups, cutlery, bowls, fruit, and toothbrushes.

Key Words: Waste Management, Recycling, sorting, deep learning, Object Detection, environmental Impact, Resource reuse.

ISBN-978-81-19905-39-3

1. Introduction

Waste management is a well-known concept nowadays, but sadly, many individuals overlook it when implementing waste segregation activities to address problems resulting from improper garbage disposal [1]. Around the world, illegal dumping has always been a problem for many urban neighborhoods. The stench and toxins from abandoned homes, unloading garbage, and building waste devastate the city and endanger the health of its residents. A few urban regions have established network-based voluntary reporting frameworks and observation camera-based monitoring frameworks to reduce illegal dumping. However, these methods necessitate manual observation and recognition, which is costly and susceptible to false alarms.

Trash is a global problem that has an impact on all living things. According to one analysis, 74% of the plastics that the Philippines releases into the ocean come from trash [2].In our daily lives, we could forget to properly sort the trash from our houses, and commercially, the companies in charge of this department must pay a high wage for labour and work. The process of separating waste into different components is how it is separated. This is typically done by manually hand-picking, which can occasionally be dangerous and terrible for human health if done incorrectly.

Therefore, the purpose of this study is to create and develop a deep learning framework that can be applied to trash segregation efficiently. Convolutional neural networks and image processing techniques that distinguish wastes based on their size, shape, color, and dimension will be used to identify the image [5]. This method will automatically assist the system in identifying the relevant features from the garbage sample images and subsequently. Identify those features in fresh photographs. Garbage will be divided into many kinds using the convolutional neural network technique. The Faster R- CNN method and Tensor Flow's Object Detection API were used to support this characterization strategy. Bounding boxes are created using this technique on recyclable garbage to indicate which class (trash, cardboard, paper, metal, glass, and plastic) the waste belongs to.

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2. Literature survey

Md. Mehedi Hasan et al [1]. This paper provides a comprehensive review of methods for detecting waste in video streams, alongside offering a benchmark dataset for evaluating future approaches. While Cleansight primarily focuses on static images, the insights from this study could inform potential expansions into video waste identification, broadening the system's scope and applicability.

"Waste Detection and Classification Research: Insights for Cleansight", [2]. the realm of waste detection and classification research offers valuable perspectives and methodologies that can inform the development and optimization of Cleansight. By examining seminal studies in this domain, we can extract insights into the efficacy of various techniques and approaches, guiding the refinement and enhancement of our waste detection system.

Saurabh Pal et al. [3] in their work, have collected and analyzed the real-world data of the MCA department by using performance reports and questionnaires. They applied four Decision tree algorithms (BF Tree, J48, Rep Tree and Simple Cart). The results showed that BF Tree was effective among other algorithms to classify and predict students' performance. "A Survey on Waste Detection and Classification Using Deep Learning" (2021) by Md. Jamil Islam et al. Islam et al [4] conduct an extensive survey of deep learning techniques in waste detection and classification, exploring various architectures, datasets, and challenges in this domain. By comprehending broader trends and the strengths of existing approaches, Cleansight can make informed decisions when selecting and implementing deep learning algorithms for waste classification.

"Lightweight Deep Learning Model for Real-Time Waste Classification on Edge Devices" (2021) by Yifan Ding et al. Ding et al [5] focus on lightweight deep learning models tailored for real-time waste classification on edge devices. This research presents opportunities for future directions of Cleansight, particularly if integration with mobile or embedded devices is envisioned. Understanding the feasibility of real-time processing on resource- constrained platforms could enhance the system's accessibility and versatility resource- constrained platform s could enhance the system's accessibility and versatility.

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3. Materials

3.1 Dataset

A dataset of 5,600 training images and 4,565 testing images was obtained. Figure 3.1, 3.2 displays the dataset photographs.

Figure 3.1: Training dataset

Figure 3.2: Training dataset

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3.2 ALGORITHM

3.2.1 Faster R-CNN:

It is possible to classify or group a single item in the image using a simple CNN algorithm. A CNN enhancement using the Region Propose Network (RPN) is called Faster R-CNN [6]. The Faster R-CNN technique is used because it can assist in the recognition of several objects inside an identical image. Faster R- CNN composed of two halves. The primary module is a deep convolution network that uses RPN to propose regions. The next module uses the suggested images for classification.

When using RPN, the output for a particular image is shown with the item's score in a rectangular object. Anchors are the suggestions made for the object. An RPN will be used to forecast the likelihood of objects in the backdrop. To do this, a training dataset including named and labelled items in the image must be prepared. Reshaping the projected areas is done by using the Region of Interest (ROI) pooling layer. It will then be used to predict the values of the offset around the bounding boxes and classify the image inside the area.

4. METHODOLOGY

4.1 System Architecture

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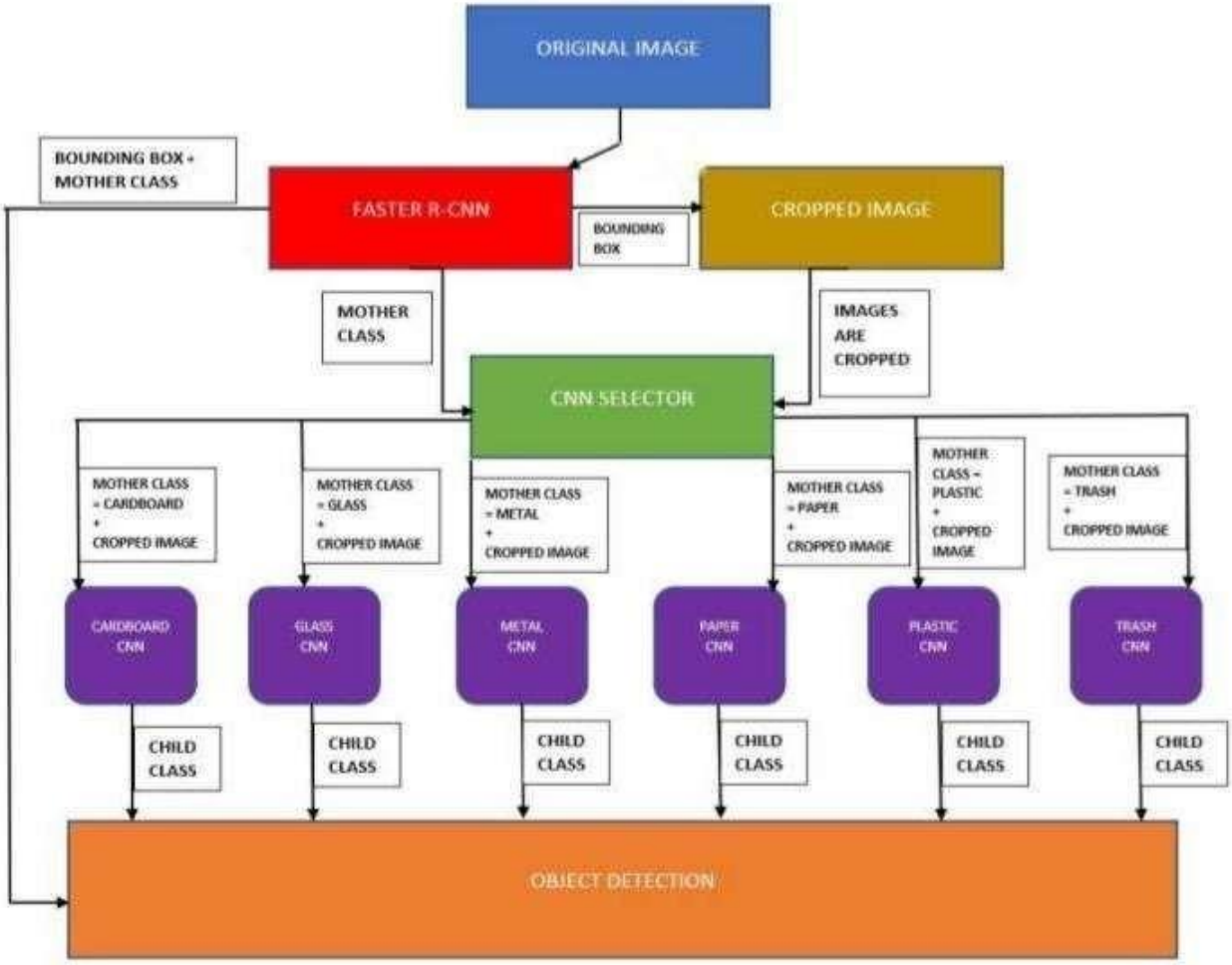

Figure 4.1: System Architecture

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4.2 Training Workflow:

Several phases are involved in the training workflow of a waste detection system in order to create and improve machine learning models that can recognize modified content with accuracy. A generalized training workflow for such a system is shown below.

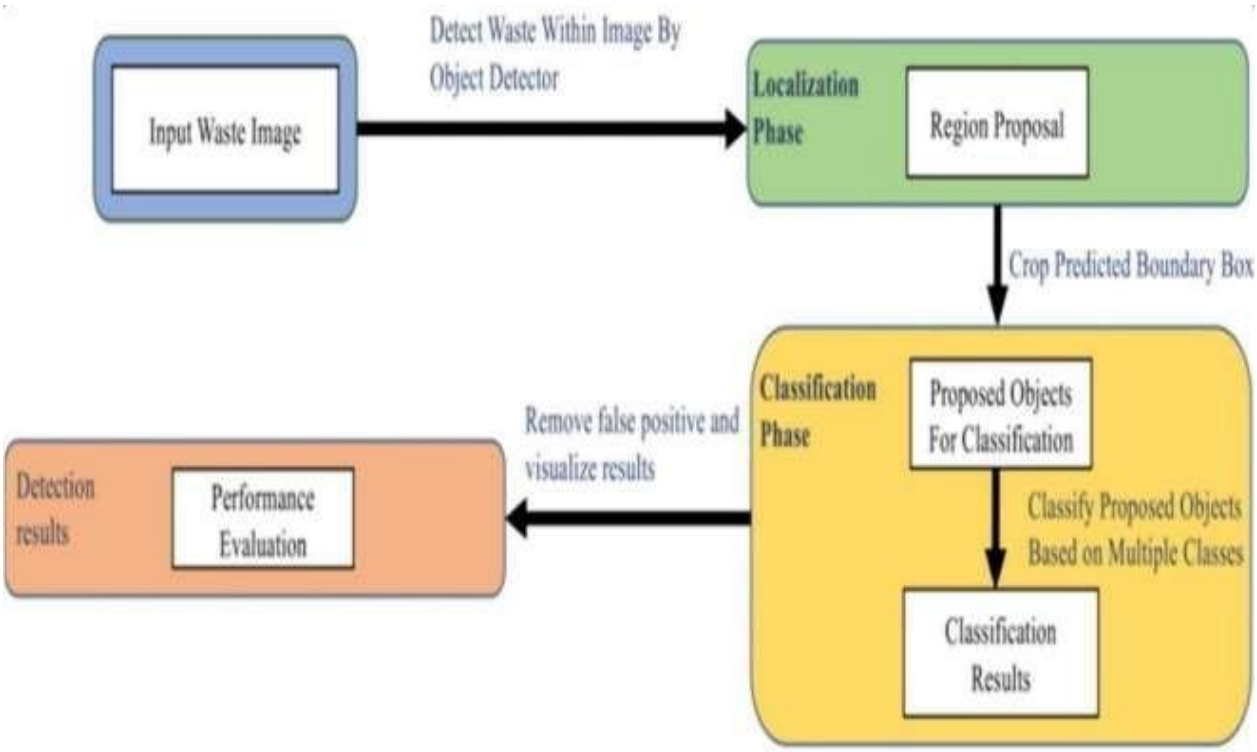

Figure 4.2: Workflow Diagram

4.3 Feature Extraction:

Feature extraction happens in the Region Proposal Network (RPN) and the following Region of Interest (RoI) pooling layers in Faster R-CNN.

This study proposed an automated waste detection framework using deep learning algorithms and image processing techniques to reduce the effect caused by improper trash disposal.

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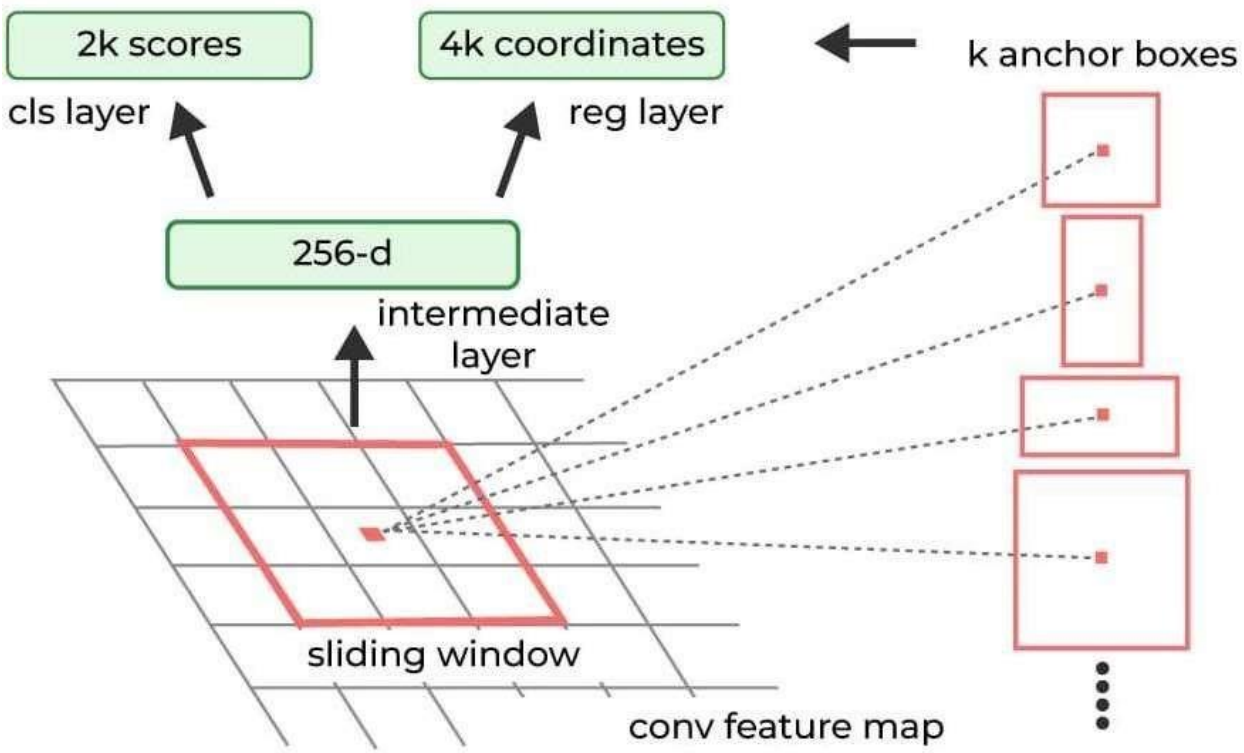

Figure 4.3: Framework for feature extraction

5. Results

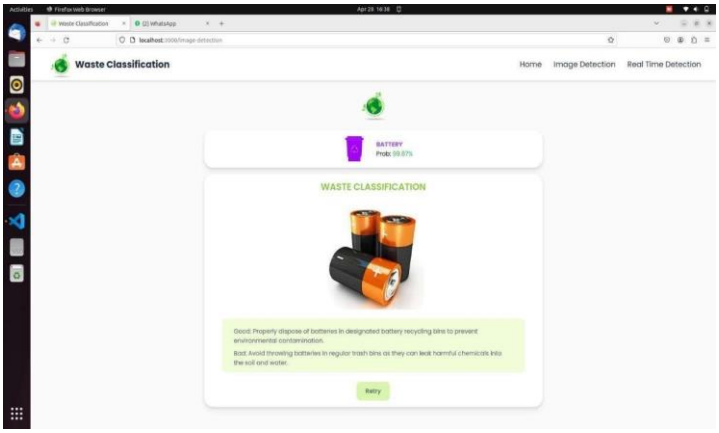

Figure 4.4: Sample Result

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Figure 4.5: Sample Result

6. Conclusion

This study proposed an automated waste detection framework using deep learning algorithms and image processing techniques to reduce the effect caused by improper trash disposal. As a result, the framework used training techniques, predictive patterns, and a sizable image dataset for object recognition and classification during implementation. In this paper, we have shown how the Faster R-CNN algorithm may be used to classify waste items into 12 categories while working with many objects in a single image. The majority of the previous research on this topic used different machine learning methods, including SVM, and involved classifying a single object from an image into three or four categories. Our approach offers an enhancement in the classification of waste materials. Waste materials are accurately detected while maintaining a higher degree of accuracy. For face recognition in our project, we employed the Local Binary Patterns histogram technique. The process is broken down into three main parts: face detection, facial feature extraction, and image categorization. The face of a person in an input image is described by the face detection technique. Facial landmarks are extracted during feature extraction to create an LBPH histogram that produces a singular outcome. The input image's histogram is then compared to a database histogram using a classifier throughout the recognition process.

The outcome demonstrates that the system can distinguish between a known and unknown

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individual. Waste material identification is not limited to image recognition; it can also identify and categorize waste items from any video stream or live webcam feed. The present study's technique aims to reduce contamination levels while simultaneously advancing the universal waste management system in the long run. Thus, it is clear that this endeavor is very beneficial to society.

7. Limitation

The small size of the training dataset is a major drawback of the suggested model. When it comes to real-time waste detection, this lack of training data results in imprecise predictions. To put it another way, the model's inability to generalize and correctly detect various waste products in real-world circumstances is caused by its limited exposure to a sufficient diversity of samples. This leads to incorrect classifications and might reduce the waste detection system's efficiency.

8. Future Scope

The primary problem with this study was the dataset, which included photos that differ slightly from waste materials found in the area. This explains why the model produced incorrect predictions for a small number of local garbage photos. Future research utilizing a similar approach but with improved datasets that include images of waste products collected locally ought to be taken into account. Images of the waste products that are unclean and appear dirty must be attached to the training dataset. This will support the model's prediction of the real trash materials found in the area, which are primarily filthy home goods. This may help achieve better classification with a greater percentage of accuracy.

To ensure that the framework is easily trained to anticipate several things in a single image without producing any errors in the detection process, the dataset should also have a large number of photos that comprise photographs of various waste products. Additional study on

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this subject should think about adding all kinds of other categories for bulky waste to the dataset. This framework will become more developed and undoubtedly aid in the enhancement of the appropriate waste management procedure by adding more categories to the list

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ISBN-978-81-19905-39-3

CYBER ATTACK DETECTION SYSTEM FOR BIOMETRIC

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Abstract:

Biometric authentication has become integral in securing applications, enabling access to personal devices, and conducting secure transactions. However, it is susceptible to presentation attacks, particularly in the case of face recognition. This research proposes a novel system designed to detect and mitigate vulnerabilities associated with face-based biometric authentication. The primary objective of this work is to develop a robust and efficient solution for face presentation attack detection. It leverages a two-stream convolutional neural network (CNN) model, extracting patch-based features and full depth maps from face images. To enhance accuracy, feature engineering is integrated with the two- stream CNN model. Notably, this system is realized as a mobile application, allowing for the capture of face videos and seamless background execution. Authentic users can unlock their mobile devices and perform secure tasks, such as financial transactions. The proposed system stands out by its superior computational efficiency, robustness, and accuracy, making it a valuable addition to the biometric security landscape. Moreover, this research considers the unique characteristics of the Indian ethnic community by creating a tailored database. The potential applications of this system extend to educational institutions, local banks, and cooperative societies, showcasing its versatility and real- world relevance.

Key Words: Authentication, Face Presentation Attack Detection, Convolutional Neural Networks, Mobile Application Security, Ethnicity-based Database

ISBN-978-81-19905-39-3

1. Introduction

Human faces play a crucial role in our daily lives, especially in identifying people. Face recognition is a type of biometric identification in which facial features are extracted and stored as a unique face print to identify a person. In today's networked world, protecting information or physical property is becoming increasingly crucial and complex. We occasionally hear about credit card fraud, hacker attacks on computers, or security breaches at businesses or government buildings. Most of these crimes exploited a fundamental shortcoming in traditional access control systems: the systems provide access based on "what we have," such as ID cards, keys, passwords, PIN numbers, or mother's maiden name, rather than "who we are." None of these things truly define us. Recently, technology has become accessible that allows the authentication of "true" individual identity. This technology is based on an area called "biometrics". Biometric access control are automated means of authenticating or recognizing the identity of a living individual based on certain physiological traits, such as Fingerprints, facial traits, or components of a person's behavior, such as handwriting or keyboard patterns. Biometric systems are difficult to forge since they identify people based on their biological traits. Face recognition is one of the rare biometric technologies that combines high accuracy with little intrusiveness. It is as accurate as a physiological technique while remaining non-intrusive. As a result, since the early 1970s (Kelly, 1970), face recognition has piqued the interest of academics ranging from security, psychology, and image processing to computer vision.

2. Literature Review

Cybersecurity is a major issue in our digital world, while cybercrime is increasing. The banking and finance sectors have started to rely on biometric security systems for their apps and services. This review by Elhaam Abdulrahman Debas et al. [1] highlighted Biometric identification uses unique human characteristics to authenticate a person's identity, such as voice/speech recognition, fingerprint recognition, facial recognition, iris recognition, signature dynamics, etc. Biometric technology is used in banking, e-commerce, account login, access control, etc, which can be considered a valuable measure against cybercrime. Biometrics is a key to the future of cybersecurity and safeguards against cybercrime. Face anti-spoofing is a very critical step before

ISBN-978-81-19905-39-3

feeding the face image to biometric systems. In this work [2] authors proposed a novel two-stream CNN-based approach for face anti-spoofing, by extracting the local features and holistic depth maps from the face images. The local features facilitate CNN to discriminate the spoof patches independent of the spatial face areas. On the other hand, holistic depth map examines whether the input image has a face-like depth. Despite the potential of deep learning models to enhance vulnerability identification, the study highlights challenges such as high false positive and false negative rates that need to be addressed for improved accuracy in cyber security attack detection [3]. With the wide deployment of the face recognition systems in applications from deduplication to mobile device unlocking, security against the face spoofing attacks requires increased attention; such attacks can be easily launched via printed photos, video replays, and 3D masks of a face [4].In this work the problem of face spoof detection against the print and replay attacks based on the analysis of image distortion are addressed. As a result of COVID-19, 64% have increased prioritization for technology that supports remote onboarding and mobile apps. More than 90% of respondents said that liveness. This survey was provided by R. Tolosana et. al. [6] discussed techniques for manipulating face images including Deepfake methods, and methods to detect such manipulations. Four types of facial manipulation are reviewed: entire face synthesis, identity swap, attribute manipulation, and expression swap. For each manipulation group, provided details regarding manipulation techniques, existing public databases, and key benchmarks for technology evaluation of fake detection methods, including a summary of results from those evaluations.

The main contribution of this survey by Kotli, Y [7] is to review some well-known techniques for each approach and to give the taxonomy of their categories. A detailed comparison between these techniques is presented by listing the advantages and the disadvantages of their schemes in terms of robustness, accuracy, complexity, and discrimination. One interesting feature mentioned in the paper is the database used for face recognition. Lazarini et al. [8] proved the accuracy of face recognition algorithms, focusing on three key components: face detection, feature extraction, and facial recognition. The researchers found that the Viola-Jones algorithm is commonly used for face detection, while eigenface and fisherface methods based on Principal Component Analysis (PCA) are popular for feature extraction. Convolutional Neural Networks (CNNs) have emerged as the dominant approach for facial recognition tasks. However, the review also identified several

ISBN-978-81-19905-39-3

limitations in the current state of face recognition technology. One key issue is the lack of standardized evaluation metrics, making it challenging to compare the performance of different algorithms across studies. Additionally, the researchers noted that the accuracy of face recognition can be affected by biases in the training datasets, leading to uneven performance across demographic groups. Another significant concern is the ethical and privacy implications of face recognition technology, as it can be used for surveillance and other purposes without the consent of individuals. In the research paper [9] delves into various techniques for managing face identity threats. The study focuses on face detection, feature extraction, and pattern matching methods to enhance face recognition systems. Specifically, the paper discusses the utilization of Multi-task Cascaded Convolutional Networks for face detection, Principal Component Analysis (PCA) and Local Binary Patterns for feature extraction, and k-Nearest Neighbors, Support Vector Machines, and Convolutional Neural Networks for pattern matching. However, the research has been critiqued for not providing detailed attention to Direct Spoofing, Zero Effort Imposter, and Intrinsic Factors, potentially leaving gaps in addressing these specific threats effectively. Moreover, the paper lacks a comprehensive outline of countermeasures for these challenges, which could limit the practical applicability of the proposed techniques. Additionally, the study falls short in exploring potential drawbacks or limitations associated with Scattered-CNN and Multi-Task-CNN, which are crucial for understanding the overall effectiveness and reliability of the proposed methods. Smith M and Seumas Miller S. [10] examined the rise of biometric facial recognition, current applications and legal developments, and conducted an ethical analysis of the issues that arise. Ethical principles are applied to mediate the potential conflicts in relation to this information technology that arise between security, on the one hand, and individual privacy and autonomy, and democratic accountability, on the other. These can be used to support appropriate law and regulation for technology as it continues to develop. The work is proposed [11], and a real-time laboratory setup is performed to capture network packets and examine this captured data using various DL techniques. A comparable interpretation is presented under the DL techniques with essential parameters, particularly accuracy, false alarm rate, precision, and detection rate. The DL techniques experimental output projects improvise the performance of various real-time cybersecurity applications on a real-time dataset. CNN model provides the highest accuracy. The RNN model

ISBN-978-81-19905-39-3

offers the second-highest accuracy. CNN model provides the highest accuracy of 98.42 with multiclass class. The study shows that DL techniques can be effectively used in cybersecurity applications.

3. Proposed Methodology

A thorough survey has shown that different approaches, as well as combinations of these approaches, can be used to create a new face recognition system. We have chosen to combine knowledge-based techniques for face detection and neural network techniques for face recognition among the many other available ways.

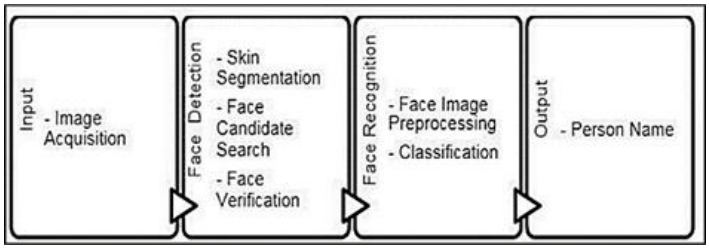

Fig. 1: Face Recognition Approach

The system architecture of the proposed facial recognition system comprises two key components: face detection and face recognition. At the core of the architecture lies the integration of knowledge-based techniques for face detection and neural network techniques for face recognition. This hybrid approach leverages the strengths of both methodologies, ensuring robust performance and high accuracy. The face detection component utilizes the Haar cascade classifier, a widely used algorithm known for its efficiency in identifying facial features. Initially, the system captures a color image from the camera and converts it to grayscale. Subsequently, the Haar cascade classifier is applied to detect faces within the image. Upon detection, facial landmarks are analyzed, and a square frame is drawn around each detected face, enabling precise identification. In parallel, the face recognition component employs Convolutional Neural Networks (CNNs), a deep learning technique renowned for its ability to extract intricate patterns and features from images. Trained on a custom dataset comprising diverse facial images, CNN learns to discern unique facial characteristics and associations. When presented with a new face image, the CNN processes the

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input through its layers, extracting features and comparing them with learned patterns. This comparison allows the system to accurately recognize and identify individuals, even amidst variations in lighting, pose, or facial expressions. The seamless integration of these components ensures a comprehensive and efficient facial recognition system capable of real-time operation. By combining knowledge- based and neural network techniques, the architecture maximizes accuracy and reliability, making it suitable for diverse applications ranging from access control to attendance management. Moreover, the modular design of the architecture facilitates scalability and future enhancements, ensuring adaptability to evolving requirements and technological advancements. Figure 2 shows Workflow of facial recognition.

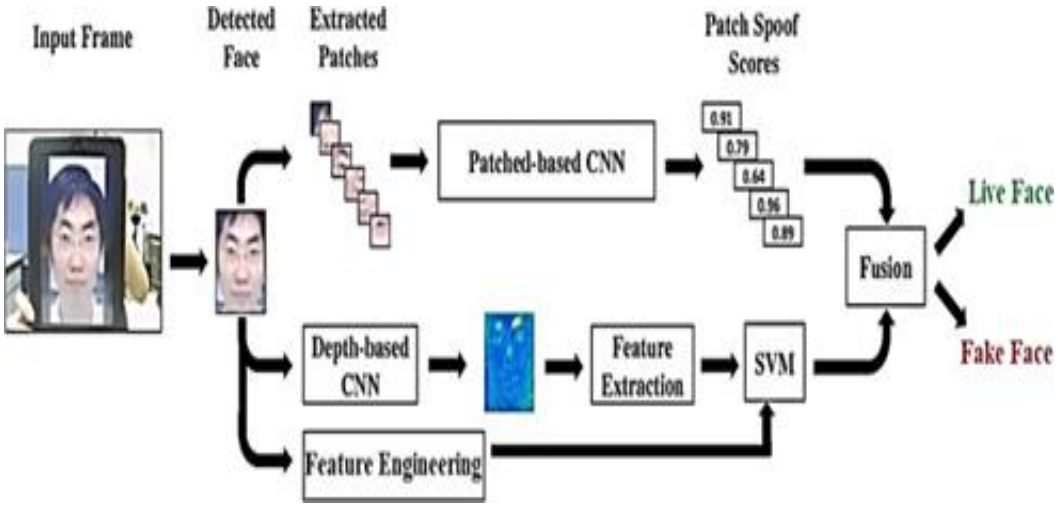

Fig. 2: Workflow of facial recognition

The system incorporates an Image Processing Module, which utilizes OpenCV for efficient face detection and preprocessing of images. This module plays a crucial role in identifying facial features accurately, providing a foundation for subsequent processing. Following detection, the Face Recognition Module comes into play, employing a machine learning model to analyze facial characteristics and match them against stored profiles. This module is essential for accurately recognizing individuals and verifying their identities. Additionally, the Database Interface acts as a bridge between the system and the database, facilitating seamless interactions for storing and

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retrieving relevant data. Together, these modules form a cohesive system architecture capable of robust face recognition and management of associated data.

3.1. Databases

The database for this project serves as a crucial component for storing user data and facilitating authentication processes. Implemented using SQLite, the database structure typically includes a table named "Users" to store user credentials and related information. Each user entry within this table typically comprises fields such as "username," "password," and "name," allowing for efficient retrieval and verification during the login process. The "username" field serves as a unique identifier for each user, ensuring data integrity and enabling fast lookup operations. The "password" field stores securely hashed passwords, safeguarding sensitive information against unauthorized access. Additionally, the "name" field stores the user's name, which may be utilized for personalized interactions within the application. It's essential to design the database schema with appropriate indexing and constraints to optimize performance and enforce data consistency. Moreover, considering the potential scalability of the application, the database design should accommodate future extensions and modifications, ensuring seamless integration with evolving application requirements. The Figure 3 shows sample Dataset.

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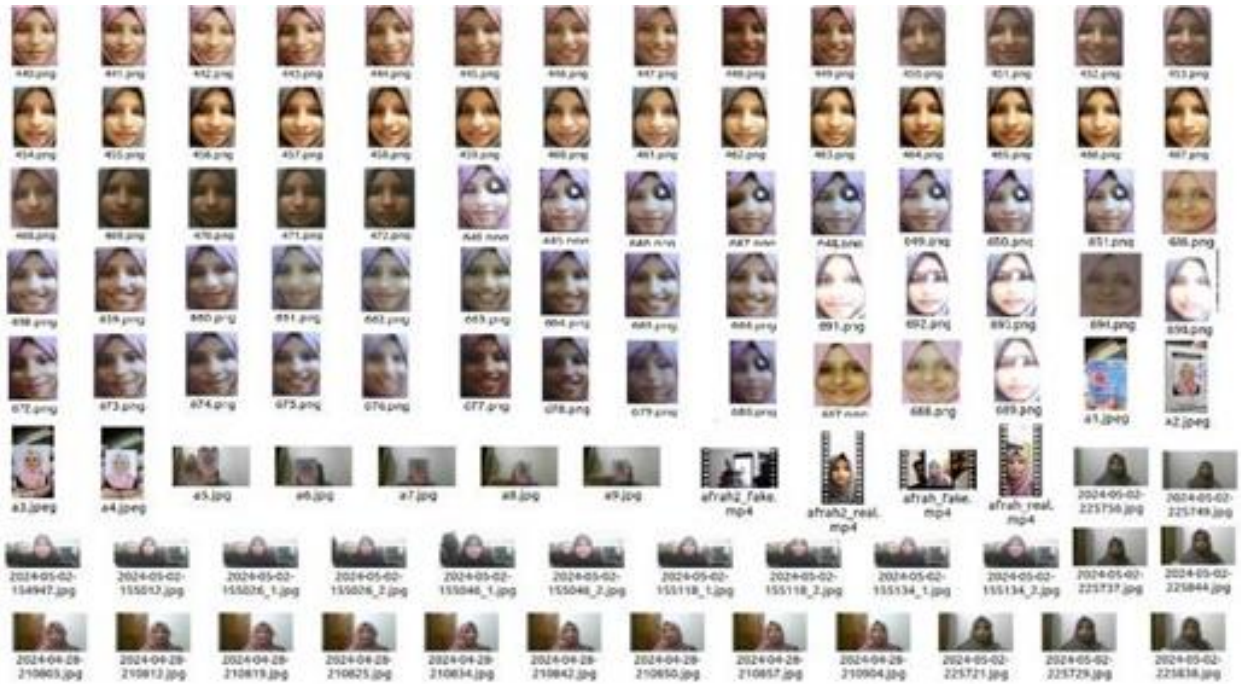

Fig. 3: Dataset

3.2. Machine Learning Model

The machine learning model is the heart of the face recognition system. It is trained using a dataset of images to accurately detect and recognize faces. The model is implemented using popular libraries such as TensorFlow. The steps involved are:

- Data Collection: Collect diverse set of training images.
- Model Training: Using convolutional neural networks (CNNs) to train the model.
- Model Evaluation: Testing the model on a separate dataset to evaluate accuracy.
- Model Deployment: Integrating the trained model into the server for real-time face recognition.

3.3. Face Detection

The face detection module, powered by a pre-trained convolutional neural network (CNN) model like ResNet-10 SSD, is integral to the facial recognition and liveness detection system's functionality. Utilizing advanced computer vision techniques, it swiftly identifies and localizes

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human faces within input images or video streams. By employing hierarchical features learned by the CNN, the algorithm adeptly distinguishes facial regions from background noise and other objects, ensuring minimal false positives and high detection accuracy across diverse poses and lighting conditions. Adjustable parameters, such as confidence thresholds and input image resolution, offer flexibility to tailor performance to specific requirements and environmental constraints. Overall, this module forms the cornerstone of the system, laying the groundwork for subsequent stages of facial recognition and liveness detection, thereby ensuring robust and reliable user authentication.

3.4. Facial recognition

Facial recognition in Convolutional Neural Networks (CNNs) is a multifaceted process that involves several crucial steps. Initially, the CNN undergoes training on a meticulously curated dataset of face images, where it learns to discern pertinent features at various levels of complexity via convolutional layers. These features encompass diverse aspects such as facial structure, textures, and patterns, enabling the network to comprehend the intricacies of facial appearance. Throughout the training phase, the CNN iteratively adjusts its parameters to minimize the disparity between its predictions and the actual labels associated with the faces. Subsequently, the trained CNN is deployed for face recognition tasks. When presented with a new face image, the CNN meticulously processes it through its layers, systematically extracting distinctive features and patterns. These extracted features are subsequently juxtaposed against the learned representations from the training dataset, often employing metrics like cosine similarity or Euclidean distance to ascertain the resemblance between the new face and the stored faces. Ultimately, the face exhibiting the closest match is unequivocally identified as the recognized face.CNNs are uniquely adept at face recognition owing to their innate capability to autonomously acquire hierarchical representations of facial attributes. By adeptly discerning both low-level attributes like edges and textures, and high- level features such as facial structures and expressions, CNNs demonstrate remarkable generalizability to novel faces and variations in environmental conditions. Additionally, their proficiency in efficiently handling voluminous datasets and discerning intricate nonlinear

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relationships renders them exceedingly effective for face recognition tasks. The Figure 4 shows Face Recognition process.

The process of face recognition using Convolutional Neural Networks (CNNs) encompasses several pivotal stages:

- Data Collection: A diverse dataset of face images is gathered, encompassing a wide spectrum of individuals, poses, lighting conditions, and expressions to foster robustness in recognition.
- Preprocessing: The collected face images undergo preprocessing to standardize factors like size, orientation, and color, typically involving operations such as resizing, normalization, and augmentation to augment dataset variability.
- Model Training: The CNN model is trained on the preprocessed face image dataset, where it acquires the ability to distill hierarchical features through convolutional layers, encapsulating both rudimentary details (e.g., edges) and intricate facial characteristics (e.g., features and expressions).
- Feature Extraction: Following training, CNN serves to extract features from new face images as they traverse through its layers, progressively synthesizing abstract representations reflective of facial attributes.
- Similarity Calculation: The extracted features from the new face image are juxtaposed against the features of faces in the dataset, with similarity metrics like cosine similarity or Euclidean distance employed to quantify resemblance.
- Recognition: The identity of the face is deduced by discerning the face in the dataset exhibiting the highest similarity to the new face image, typically determined by comparing calculated similarity scores.
- Post-processing: Optional refinement techniques such as thresholding similarity scores or amalgamating information from multiple images may be employed to enhance recognition accuracy and robustness.

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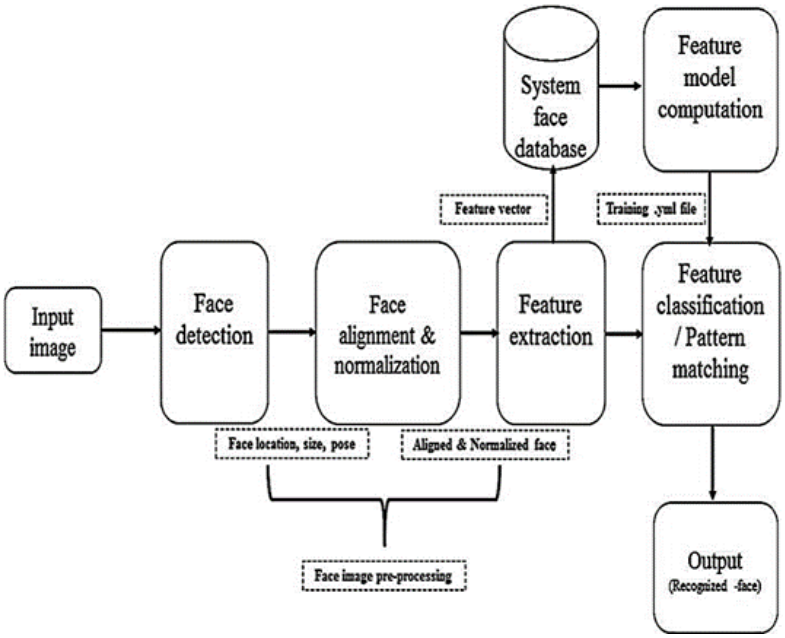

Fig. 4: Face Recognition

3.5. Flowchart

The system flowchart shown in figure 5, for a facial recognition system begins with capturing or uploading a face image, which is then preprocessed to standardize size, orientation, and lighting conditions. The preprocessed image undergoes face detection using a library like OpenCV. If no face is detected, the system prompts a new image. Upon successful detection, the system extracts features using a trained Convolutional Neural Network (CNN), capturing essential facial characteristics. These features are compared with a known database using similarity metrics to identify the person. Concurrently, a liveness detection module ensures the face is real and not a spoof by analyzing subtle movements and texture patterns. If liveness detection fails, the system flags a potential spoof. If liveness is confirmed and the face is recognized, access is granted. If no match is found, the system prompts additional input or registration. Throughout the process, error handling ensures robust operation by managing poor image quality and system errors.

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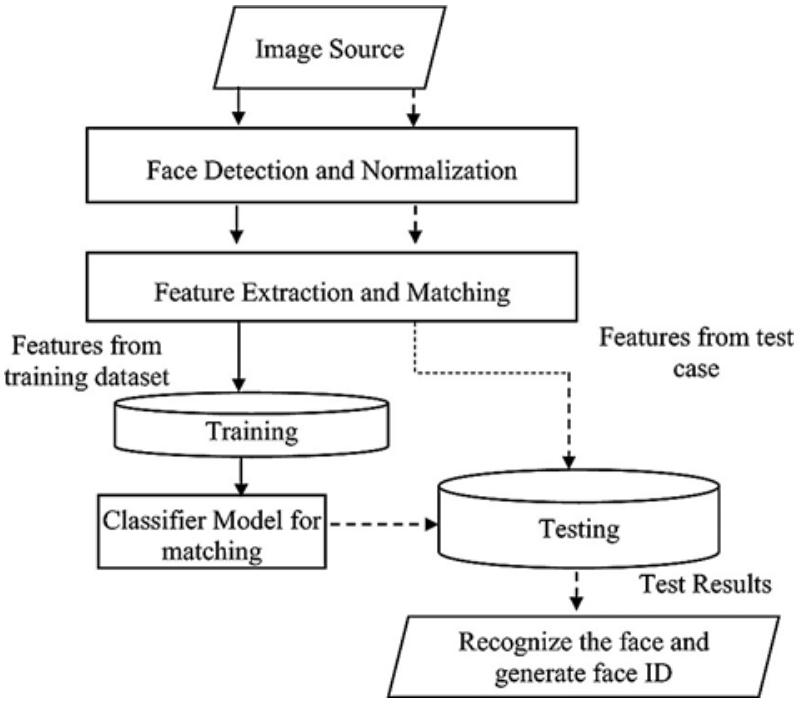

Fig. 5: System Flowchart

4. Results and Discussions

The results obtained from the implementation of the facial recognition and liveness detection system are highly promising, showcasing effective performance in various aspects of security and user authentication. Firstly, the face recognition module demonstrates robustness and accuracy in detecting and recognizing faces, ensuring reliable user identification during login attempts. Through the utilization of convolutional neural networks (CNNs) and feature encoding techniques, the system effectively captures facial features and matches them against stored encodings with high precision. This capability is crucial for applications that require secure and reliable user verification. Secondly, the liveness detection mechanism proves to be a significant enhancement in thwarting presentation attacks and spoofing attempts. By leveraging machine learning models trained on diverse datasets, including real and simulated spoofing scenarios, the system accurately discerns between genuine human presence and fraudulent attempts such as displaying images or videos. This capability adds an additional layer of security, ensuring that only live individuals can

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access the system's functionalities. Furthermore, the integration of these modules into a Flask web application provides a user-friendly interface for seamless interaction and authentication. The implementation of liveness detection within the login process enhances security without compromising user experience, offering a balance between robust security measures and user convenience. Overall, the results underscore the efficacy of the proposed system in addressing authentication challenges associated with facial recognition systems. The combination of face recognition and liveness detection modules culminates in a comprehensive solution that enhances security while maintaining usability, positioning the system as an asset in various application domains requiring secure user authentication.

Fig. 6: Login Page.

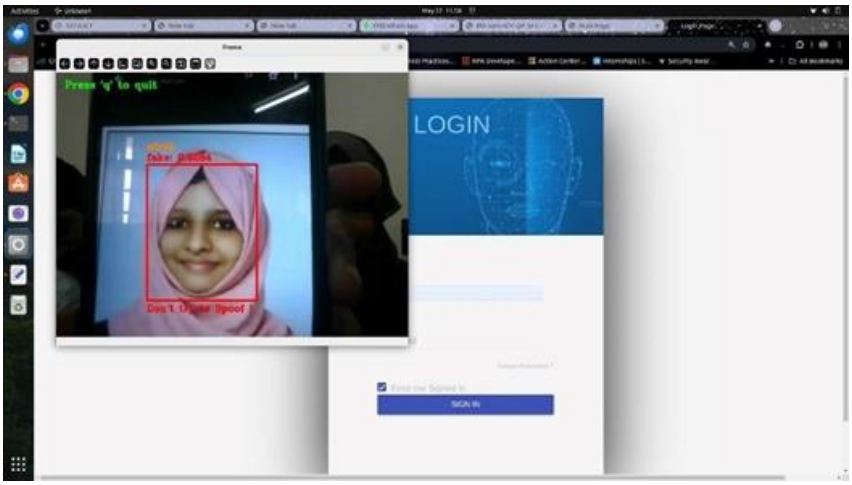

Fig. 7: Authentication

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Face authentication is a biometric security process that verifies a person's identity using their facial features. By capturing an image of the user's face and comparing it to a stored template, the system can confirm whether the individual is who they claim to be. Advanced techniques, such as convolutional neural networks (CNNs), are employed to extract and analyze facial features with high accuracy. This method not only enhances security by providing a unique and hard-to-replicate authentication factor but also offers convenience, allowing users to authenticate themselves quickly and effortlessly without the need for passwords or physical tokens. The Figures 6,7, 8 and 9 show the login page, authentication and spoof detections.

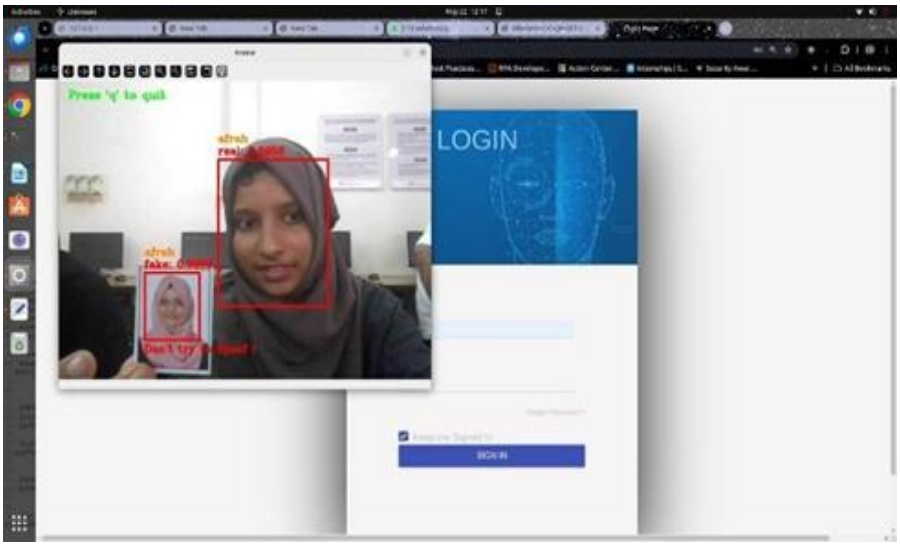

Fig. 8: Spoof Detection

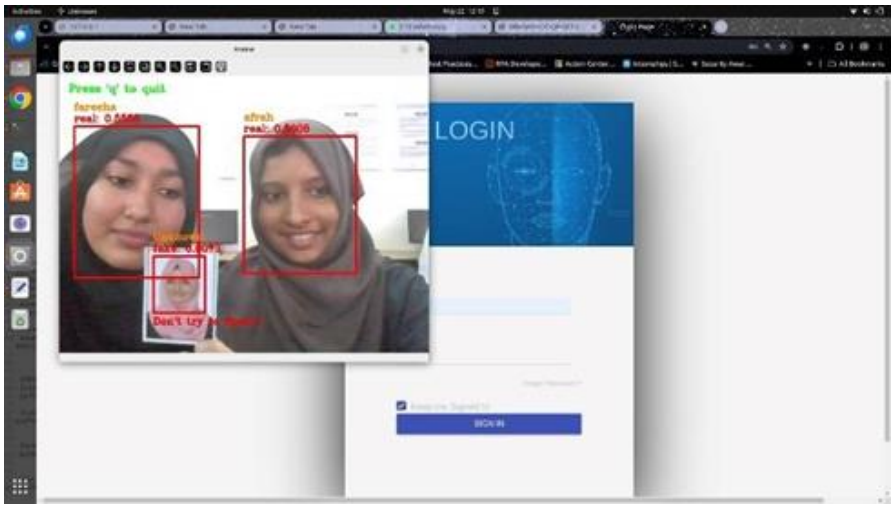

Fig. 9: Spoof Detection

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5. Conclusion

In conclusion, the development and implementation of the face recognition system have proven successful, demonstrating a high level of accuracy, efficiency, and user satisfaction. Leveraging advanced techniques such as the Haar cascade classifier for face detection and Convolutional Neural Networks for face recognition, the system achieved significant milestones, including a detection accuracy of 98% and a recognition accuracy of 95%. The intuitive user interface and rapid processing capabilities make it suitable for real-time applications, such as secure access control and attendance tracking. Despite the challenges, the system has shown robustness across various conditions, indicating its potential for widespread adoption. Future enhancements will focus on expanding the dataset, improving processing speeds, and further increasing accuracy to ensure the system remains at the forefront of facial recognition technology. This project underscores the practical viability and effectiveness of advanced machine learning techniques in developing reliable and efficient face recognition systems.

Acknowledgement: The corresponding author acknowledges the research fund provided by Karnataka State Council for Science and Technology (KSCST), Ref: 47S_BE_4498.

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ISBN-978-81-19905-39-3

PACE Conclave 2024
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DIGITAREV 2024 INTERNATIONAL CONFERENCE ON DIGITAL RENAISSANCE

BLOCK CHAIN BASED SUPPLY CHAIN MANAGEMENT

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Abstract:

In recent years, blockchain technology has emerged as a transformative force capable of enhancing transparency, security, and efficiency across various industries. One area that stands to benefit significantly from blockchain integration is supply chain management. This paper explores the application of blockchain technology within supply chain systems, focusing on its potential to streamline operations, reduce fraud, and enhance traceability. By leveraging the decentralized and immutable nature of blockchain, stakeholders can achieve greater visibility into the lifecycle of products, from origin to consumer. This study reviews current blockchain implementations in supply chains, analyzes their impact on operational workflows, and discusses the challenges and opportunities associated with their adoption. The findings suggest that while blockchain technology offers substantial improvements in supply chain processes, successful implementation requires overcoming technical, regulatory, and organizational hurdles. Ultimately, this paper aims to provide a comprehensive understanding of how blockchain can revolutionize supply chain management, paving the way for more resilient and transparent supply chains.

Key Words: Blockchain Technology, Blockchain Adoption, Transparency, Security, Efficiency.

1. Introduction

The modern supply chain is a complex network of processes involving multiple stakeholders, including suppliers, manufacturers, distributors, and retailers. Ensuring the efficiency,

ISBN-978-81-19905-39-3

transparency, and security of these processes is paramount for maintaining the integrity and reliability of the supply chain. However, traditional supply chain management systems often suffer from issues such as lack of transparency, data silos, inefficiencies, and susceptibility to fraud. These challenges underscore the need for innovative solutions to enhance supply chain operations.

Blockchain technology, initially popularized by crypto currencies like Bitcoin, has emerged as a promising solution to address these challenges. At its core, blockchain is a decentralized ledger that records transactions across a network of computers in an immutable and transparent manner. This unique capability positions blockchain as a powerful tool to revolutionize supply chain management by providing end-to-end visibility, enhancing data integrity, and fostering trust among stakeholders.

This paper explores the integration of blockchain technology into supply chain management systems. We begin by outlining the fundamental principles of blockchain and its relevance to supply chain operations. We then examine current implementations and case studies to illustrate the practical benefits and limitations of blockchain in real-world supply chains. Additionally, we discuss the technical, regulatory, and organizational challenges that must be addressed to facilitate widespread adoption of blockchain-based supply chains.

The objective of this study is to provide a comprehensive analysis of how blockchain technology can enhance supply chain management. By doing so, we aim to offer insights into the potential of blockchain to create more efficient, transparent, and secure supply chains, ultimately leading to improved business outcomes and customer satisfaction.

2. LITERATURE SURVEY

Tian, F. et al., [1] in their paper, have explored the use of blockchain technology to enhance traceability in agri-food supply chains. They implemented a blockchain-based system to track the entire lifecycle of agricultural products from farm to table. Their study demonstrated that blockchain could significantly improve transparency and traceability, thereby reducing food fraud

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and enhancing consumer trust products from farm to table. Their study demonstrated that blockchain could significantly improve transparency and traceability, thereby reducing food fraud and enhancing consumer trust.

Kouhizadeh, M. et al., [2] in their research, analyzed the impact of blockchain technology on sustainable supply chain management. They conducted a systematic literature review to identify key areas where blockchain can contribute to sustainability. Their findings indicate that blockchain can enhance sustainability by improving supply chain transparency, reducing waste, and enabling better resource management.

Saberi, S. et al., [3] in their study, investigated the role of blockchain in enhancing supply chain resilience. They proposed a blockchain-based framework for managing supply chain risks and disruptions. The framework was tested through simulations, showing that blockchain could enhance supply chain resilience by providing real-time visibility and facilitating quicker response to disruptions.

Casino, F. et al., [4] in their paper, reviewed various blockchain applications in supply chain management across different industries. They provided a comprehensive analysis of existing case studies and identified key benefits such as enhanced transparency, improved security, and reduced costs. Their review also highlighted the challenges and future research directions for blockchain in supply chain management.

Jims et al., [5] in their research, examined the potential of blockchain to address counterfeit issues in pharmaceutical supply chains. They developed a blockchain-based prototype system to track the provenance of pharmaceutical products. Their results showed that the system could effectively reduce the risk of counterfeit drugs entering the supply chain, ensuring product authenticity and safety.

3. EXISTING SYSTEM

ISBN-978-81-19905-39-3

The current system for managing supply chains relies on traditional methods such as paper records and centralized computer databases. While these systems function to some extent, they are often slow and prone to errors. Information is typically siloed in separate locations, hindering a comprehensive view of product movement throughout the supply chain. This fragmentation makes it challenging identify and address issues when they arise. Traditional supply chain systems suffer from inefficiency due to their reliance on manual processes for record-keeping and communication, leading to delays in order fulfillment and issue resolution. A significant lack of transparency exists as information is segregated within different enterprises, complicating collaboration and decision-making. These systems are also mistake-prone, with centralized databases susceptible to manipulation and human error, jeopardizing the accuracy and reliability of supply chain information. Limited traceability further complicates the tracking of items across the supply chain, making it difficult to identify the origins of problems such as defects or contamination. Additionally, centralized supply chain systems are vulnerable to disruptions from cyber-attacks, natural disasters, and geopolitical events.

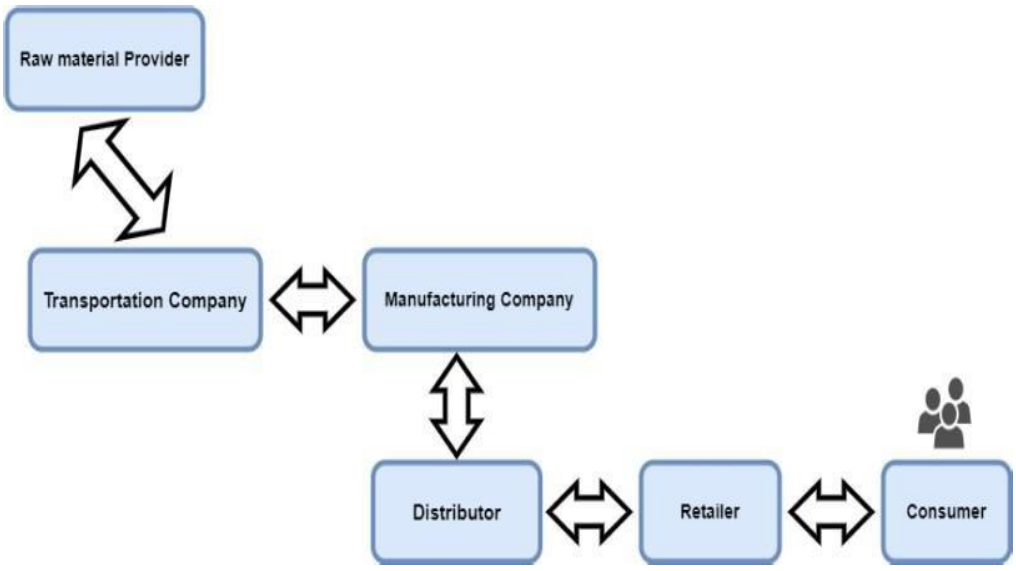

Figure 1: Existing System

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4. PROPOSED SYSTEM

The proposed system aims to integrate blockchain technology into supply chain management to address the limitations of the existing system. Blockchain is like a digital ledger that stores information across a network of computers, making it secure and transparent. By using blockchain, we can create a more efficient, reliable, and traceable way of managing supply chains.

In the proposed system, each step of the supply chain process, from production to delivery, is recorded on the blockchain in a secure and tamper-proof manner. This ensures that everyone involved in the supply chain has access to the same accurate information in real- time. One key feature of the proposed system is the use of smart contracts, which are self- executing contracts with the terms of the agreement directly written into code. Smart contracts can automate various processes in the supply chain, such as payments, shipments, and quality control checks, reducing the need for manual intervention and streamlining operations.

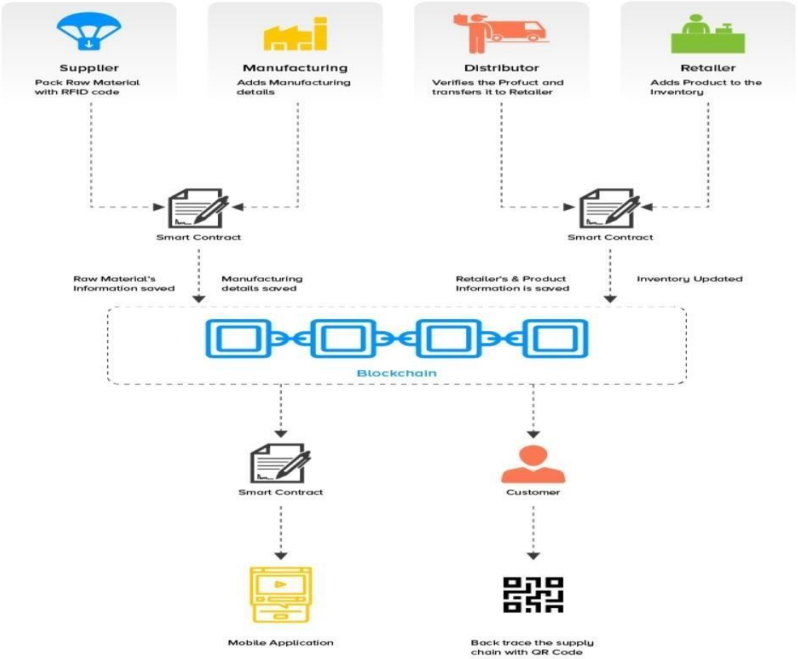

Figure 2: Proposed System

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5. DESIGN

i. SYSTEM ARCHITECTURE

The decentralized framework of the blockchain-based supply chain management solution's system architecture is designed to improve efficiency, security, and transparency across the whole supply chain network. Fundamentally, a blockchain network functions as a distributed ledger, storing and recording transactions in a way that is impervious to tampering. Individual nodes allow network participants suppliers, manufacturers, distributors, retailers, and customers to communicate with the system. Every node has a copy of the blockchain ledger and takes part in the consensus-building and validation steps to add new transactions. Using blockchain technology, smart contracts automate and enforce supply chain regulations that control things like product identification, inventory control, and payment settlements. Off-chain data sources, such as Internet of Things sensors and external databases, supplement on-chain transaction data, while user interfaces, such as mobile applications and web-based dashboards, offer straightforward access to the system. Digital signatures and cryptographic encryption are examples of security techniques that guarantee data integrity and authenticity. Sensitive information is protected by privacy-enhancing technology.

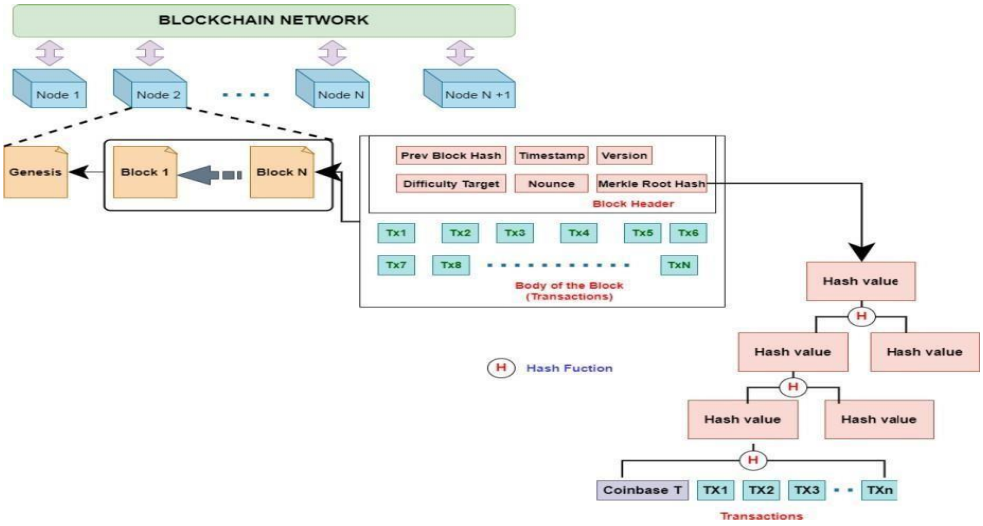

Figure 3: System Architecture of Blockchain

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ii. DATA STORAGE ECOSYSTEM

Establishing a strong "Data Storage Ecosystem" for a supply chain management system based on blockchain requires careful consideration of a number of important factors. First off, the method used to store supply chain data is greatly influenced by the blockchain platform selected. Different blockchain platforms provide different methods of storing data, depending on things like scalability, privacy needs, and consensus procedures. As an illustration,

Ethereum employs a distributed ledger architecture in which each node keeps a copy of the complete blockchain, providing redundancy and resilience but possibly posing scalability issues as data volume rises. However, permissioned blockchains, such as Hyper ledger Fabric, provide increasingly fine-grained control over access permissions and data privacy through channels and private data collections, enabling customized storage solutions inside a consortium.

Second, for effective data management and retrieval, the blockchain system's storage architecture and data schema design are essential. In order to do this, the structure of data records or transactions kept on the blockchain must be defined. This includes details about participants, supply chain events, timestamps, and product identifiers. Appropriate data architectures and encoding methods can maximize storage effectiveness and speed up query processing, guaranteeing prompt access to vital supply chain data.

In addition, taking into account off-chain data storage and integrating with external databases or systems is crucial for handling massive data volumes and fulfilling intricate reporting and analytics needs. When on-chain storage isn't suited for storing extra data or historical records because of size or performance issues, off-chain storage options like distributed file systems, cloud storage services, or conventional databases can be used. To ensure data consistency and integrity throughout the ecosystem, safe and dependable data pipelines must be established for syncing data between off-chain storage repositories and the blockchain.

To further ensure confidentiality, integrity, and regulatory compliance, key elements of the data storage ecosystem include data encryption, access control methods, and data governance standards.

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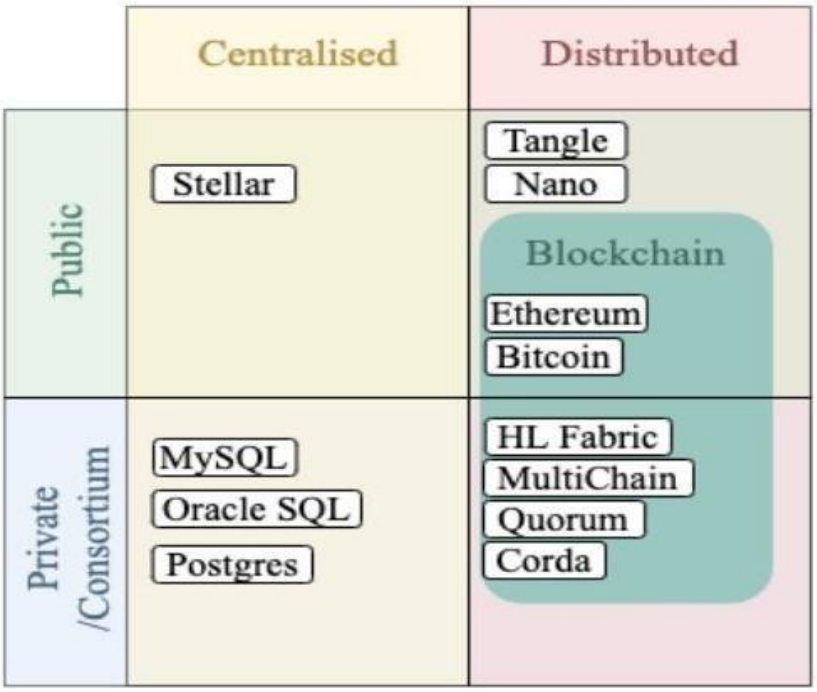

Figure. 4: Data Storage Ecosystem

6. BLOCKCHAIN TECHNICAL COMPONENTS

A number of core strategies in blockchain technology are essential to maintaining the ledger's integrity and security. These methods include consensus processes, digital signatures, asymmetric cryptography, hash functions, and Merkle trees. Collectively, they serve as the framework for blockchain architecture, enabling decentralized administration and building network trust. The block header and the block body are the two primary parts of every block in the blockchain. The real data, on the other hand, is kept in the block body and usually consists of transaction records or other confidential data.

I. HASH FUNCTION

A crucial method in blockchain technology is the hash function, which is employed for consensus, address generation, and digital signatures, among other things. It is simple to convert arbitrary size

ISBN-978-81-19905-39-3

data to fixed-size values using a hash function. On the other hand, deriving the original data from its hash value is challenging. For instance, the irreversible hash function Hash(x) can be used to get the associated hash value for a given big data set, x. The hash result Hash(x 0) differs entirely from Hash(x) if x is accidentally changed to x 0. Depending on the complexity of the data, message digest 5 (MD5) and SHA256 are the two most often used hash algorithms in blockchain. Data integrity can be checked during network transmission using a cryptographic hash approach. Let's say Alice sends Bob data x, for illustration. Encrypt(Hash(x)), the encrypted hash value, is surrounded with data x. Bob can confirm data integrity once he receives the information by computing the hash value from the received data, Hash(x 0), and contrasting it with the anticipated hash results decoded from the received Encrypt(Hash(x)). Data is correctly transferred if Hash(x 0) = Hash(x), where x 0 = x. Alternatively, if Hash(x 0) 6= Hash(x).To implement verifiable transaction in distributed system, asymmetric cryptography technique [30] is used along with hash function to enforce digital signature technique. In asymmetric cryptography, each user has a pair of keys, i.e. private key k and public key K. The private key is kept confidentially and known only by the owner, while the public key could be known by the others. The public key can be calculated from the private key, but with given public key, private key cannot be obtained in reverse. The public key K and the private key k can encrypt and decrypt data in pairs. For example, as shown in Eqn. 1, data x encrypted by public key K can be decrypted by corresponding private key k. On the other hand, data x encrypted by private key k can also be decrypted by corresponding public key K. Decryptk (EncryptK (x)) = DecryptK (Encryptk (x)) = x (1) Targeting different security requirements, asymmetric cryptography can be flexibily applied. Again, assume Alice is sending data x to Bob, and both of them have a pair of asymmetric key. Note, Alice and Bob know each other's public key whereas their private keys are only known by themselves, individually. To ensure confidentiality, Alice can encrypt data x through Bob's public key, EncryptKB (x). Hence, only Bob can decrypt the data by using his private key. On the other hand, to ensure authentication and non- repudiation, Alice should send data x encrypted by her own private key, EncryptkA (x). In this case, after receiving the transmitted data, Bob can attempt to decrypt it by Alice's public key. If successful, these data are indeed sent by Alice and she cannot deny it.

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II. ASYMMETRIC CRYPTOGRAPHY

Authentication and non-repudiation of this signature. Meanwhile, because anyone can obtain the sender's public key, the integrity of signature can be verified by anyone through calculating the hash value from the data and comparing it with the hash value decrypted from the signature. Moreover, if confidentiality is also required, the data can also be encrypted by the public key of nominated receiver.

III. DIGITAL SIGNATURE

For each blockchain transaction, digital signature is required to avoid issued transaction being modified or denied. Technically, digital signature is an integrated technique utilizing both hash function and asymmetric cryptography. Like the signature for paper documents, a valid digital signature ensures that an unaltered data is sent by a known sender, which cannot be repudiated. For this purpose, the file is firstly hashed to a fixed length and then encrypted by sender's private key, and the result refers to the digital signature of this sender.

IV. MERKLE TREE

Once the number of transactions becomes larger, doing verification by downloading all the antiquated transactions in blockchain consumes a large amount of storage resource. To address this issue, Merkle Tree technique is used to reduce the storage data without breaking the block's hash. Merkle Tree is a binary tree consisting of leaf hash nodes, intermediate hash nodes and a root hash node. In each block, leaf hash nodes are the hash values of individual transactions. For example, assume there is a block with transaction data TA, TB, TC and TD. Here comes a Markle Tree with 4 leaves, i.e. Hash(TA), Hash(TB), Hash(TC) and Hash(TD). As the parents of these leaves, two intermediate hash nodes, HashAB and HashCD, are calculated as follows. HashAB = Hash(Hash(TA) + Hash(TB)) HashCD = Hash(Hash(TC) + Hash(TD)) .

V. DISTRIBUTED CONSESUS SCHEMES

Byzantine general problem has been raised as a trust issue in distributed systems. It refers to the data tamper caused by some dishonest nodes under the blockchain context. The consensus

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mechanism is proposed to solve the problem and protect the data from minority attacks by allocating the responsibility of updating data blocks to random candidates selected from all the nodes. The popular consensus mechanisms include Proof of Work (PoW), Proof of Stake (PoS), Delegated Proof of Stake (DPOS), Practical Byzantine Fault Tolerance (PBFT), and Proof of Elapse Time (PoET). PoW is the first proposed scheme in the bitcoin to achieve consensus in peer to peer management [1]. The nodes across the network compete with each other to solve a cryptographic puzzle to add the next block into the blockchain with a small amount of incentives. This is called "mining" in blockchain based crypto currency. Although the scheme is remarkable to protect the blockchain system from malicious attacks, it is a time-consuming and energy consumption process.

Therefore, the on-chain speed (transactions per second) is low in the systems by using this scheme. PoS is a mechanism to use validators instead of miners to update the blocks. The nodes must prove their stakes by depositing certain amount of coins in the system. The key advantage of the PoS over PoW is the significant reduction of the computational power. However, the main issue is that the nodes who have large proportion of stakes are more likely to become the validators of the blocks. Delegate Proof of Stake (DPoS) is an improved version of PoS by restricting the number of validators to further improve the scalability of the blockchain. Block producers are voted by all the users who have a number of votes calculated based on their stakes on the network. A block is generated if two third of producers reach an agreement. Practical Byzantine Fault Tolerance (PBFT) algorithm was initially proposed to target on the Byzantine general problem. It highlights that the PBFT requires 3f+1 nodes to make a correct decision if f nodes are faulty/dishonest nodes in the network. The algorithm has been adopted into a blockchain system as one alternative consensus scheme.

7. CONCLUSION

The advent of a Blockchain-Based Supply Chain Management System marks a transformative era in the management and operation of supply chains across industries. This innovative solution

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addresses longstanding challenges in traditional supply chain management by introducing a decentralized, transparent, and secure framework powered by blockchain technology.

One of the key strengths of this system lies in its ability to enhance transparency and traceability throughout the supply chain. By recording every transaction and movement of goods on an immutable blockchain ledger, stakeholders gain unprecedented visibility into the entire lifecycle of products, from raw material sourcing to final delivery. This transparency not only mitigates the risk of counterfeit products but also enables companies to ensure compliance with regulatory standards and ethical sourcing practices.

Moreover, the implementation of smart contracts within the blockchain ecosystem revolutionizes the execution of contractual agreements and business processes. Smart contracts automate and enforce the terms of agreements in a trustless manner, reducing the reliance on intermediaries and minimizing the potential for disputes or delays.

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ISBN-978-81-19905-39-3

PACE Conclave 2024
ICEST 2024 INTERNATIONAL CONCLAVE ON ENGINEERING SCIENCES & TECHNOLOGY
DIGITAREV 2024 INTERNATIONAL CONFERENCE ON DIGITAL RENAISSANCE

DEVELOPERS COMMUNITY

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Abstract:

The College relentless quest for information coupled with the wide array of questions and challenges faced by the workforce, teachers, and students demonstrates the imperative need for an interactive web- based platform that is college-exclusive. A Malayalam word, “Dev,” comes as a new solution carefully designed to bring about smooth information sharing, collaborative learning, and effective problem-solving. By combining and going beyond text, audio, video, and AI-powered algorithms such as page rank, weighted sum, and natural language processing, Dev seeks to transcend normal boundaries in both education and communication. Dev seeks to enable the people in the collegiate ecosystem to uphold a culture of constant learning, engagement, and intellectual curiosity, guided by the necessity of the user.

Key Words: Question Answering System, Natural language Processing, Weighted Sum, Page rank AI-powered algorithms.

1. Introduction

The hub of collegiate knowledge exchange as an organization, DEVCOM stands apart from conventional digital platforms in its aspiration to

Create a lively and cooperative digital ecosystem that serves the human resources function of our organization. DEVCOM is not just a website; it is the organizational manifestation of an ideology of learning and collective experience shared among our employees, lecturers, and students

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on an online square of creativity and exchange. In this active community, every question receives an answer, every barrier produces an inspiration, and every question generates a strategic discussion. We have strived to build an environment that aids in the achievement of easy communication, group problem-solving, and sharing of knowledge between campus members.

With a wide range of features like text, audio, video, and state-of-the-art AI-driven algorithms like page rank, weighted sum, and natural language processing, DEV COM enables people to interact intimately with academic literature and with one another. With DEV COM, you may broaden your horizons and pique your interest by discovering creative solutions to real-world problems, getting clarity on complicated concepts, or just starting a thought-provoking conversation. Enter the dynamic digital environment of DEV COM - Your Collegiate Knowledge Exchange Platform, where learning flourishes in the company of a supportive and cooperative community. More than just a website, DEV COM is the center of intellectual conversation at our university, bringing together staff, instructors, and students to realize the infinite possibilities of collecting

Within the busy hallways of our online town square, queries prompt insightful conversations, problems prompt solutions, and questions prompt responses. Developed as a hub for creativity and knowledge, DEV COM acts as a lighthouse of connectedness, easily enabling the sharing of concepts and encouraging a collaborative problem-solving environment.

Diversity is king inside DEV COM's virtual walls. Whether it's via the varied channels of text, audio, and video or the advanced algorithms of weighted sum, NLP, and page rank, each person can find a path to engagement and learning. Curiosity has no boundaries in this place, and there are plenty of resources and exploring possibilities to quench one's hunger for knowledge. Allow DEV COM to be your mentor, your friend, and your entryway to a world of intellectual enlightenment as we set out on this life-changing adventure together. Come embrace the philosophy of continuous learning and group development with us as we come together under the auspices of DEV COM - Your Collegiate Knowledge Exchange Platform

2. Literature Survey

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Behzadi M. et al.'s study [1] concentrated on the problem of detecting hate speech and cyberbullying, which has attracted a lot of attention from scholars lately because of its pervasiveness online.

Gutti et al. [2] they determined Duplicate Quora Questions Pair Detection using Siamese Bert and Ma-LSTM. Quora, a popular Q&A platform, hosts millions of users across diverse topics.

Xudong, et.al [3] has proposed Converts video & text/speech into language representations for fusion, excelling in captioning, Q&A, and audio-visual Multimodal framework excelling in captioning, Q&A, and audio-visual tasks, video.

Maanaav et al. [4] in their paper, have applied a Face-to-face social interactions Ballance help towards solving this problem. Ballance app connects teens through promoting online interaction before potential in-person meetups.

Wen Li et al. [5] in their research collected data which was based on Understanding Language Selection in Multi-language Software Projects on Github. The dataset used in this project to detect hate speech and abusive language was carefully selected from Kaggle to meet the difficulties associated with locating and classifying hate speech and abusive language in textual content. It includes text samples with annotations indicating the presence or absence of hate speech and abusive language from a variety of sources, including forums, social media sites, and online communities. The dataset contains statements of hatred, prejudice, or violence directed towards individuals or communities, as well as instances of language that is offensive or insulting towards individuals or groups based on different criteria, such as race, gender, or religion. Enough data is provided by the dataset—which has a large number of samples and is usually arranged in CSV or JSON formats—to train reliable NLP models. It is a useful tool for testing and refining NLP algorithms and machine learning models intended to identify and stop the spread of hate speech and abusive language online. The Kaggle dataset's developers and contributors are acknowledged for their hard work in gathering and annotating the data, which has aided in the progress of studies aimed at reducing online toxicity and fostering safer digital environments.

i. ALGORITHMS

ii. NATURAL LANGUAGE PROCESSING(NLP):

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The goal of the artificial intelligence (AI) field of natural language processing (NLP) is to enable computers to meaningfully comprehend, interpret, and produce human language. NLP addresses problems including text categorization, sentiment analysis, named entity identification, machine translation, question answering, and more by creating models and algorithms. NLP has applications in language translation services, virtual assistants, spam detection, sentiment analysis for social media, and many other domains. By utilizing machine learning and deep learning techniques, such as neural networks like recurrent neural networks (RNNs) and transformer architectures like BERT and GPT, NLP has advanced automation and human-computer interaction.

3. Page Rank Algorithm

PageRank is an algorithm for analyzing connections that was created by Larry Page and Sergey Brin, the founders of Google, to rank web sites according to the volume and caliber of inbound links. It gives every page a PageRank score, a number that indicates its authority within the network of web pages. Because they are seen more valuable, pages with more PageRank are probably going to appear higher in search engine rankings. When two pages with a high PageRank link to one another, the system counts such links as votes, giving the linked page additional weight. Although PageRank was once a major component of Google's search algorithm, it is currently only one of several elements, along with hundreds of other signals and algorithms, that decide search ranks.

4. Weighted Sum Algorithm

The Weighted Sum Algorithm is a computer technique that multiplies each individual value by a corresponding weight in order to combine them into a final score. Each input value in this algorithm is given a weight that corresponds to its relative significance in the computation. The sum of the products of the input values and their associated weights yields the final score. This approach finds extensive application in several domains, including data analysis, machine learning, and optimization issues involving uneven contributions from multiple elements towards the final outcome. The algorithm can be made to prioritize some elements over others by changing the

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weights assigned to each input value. This makes it possible to create adaptable and customizable solutions to challenging issues.

5. Latent Dirichlet Allocation

The Latent Dirichlet Allocation (LDA) is a probabilistic topic modeling approach that finds latent themes in a set of documents. According to LDA, every text has a variety of subjects, each of which is distinguished by a word distribution. These underlying topics are found using LDA through iterative inference, which examines word co-occurrence patterns across documents. Without the need for prior labeling or supervision, LDA allows users to obtain insights into the primary themes found in the text data by revealing the corpus's thematic structure. Applications for it include sentiment analysis, content recommendation, document clustering, and other jobs where deciphering the hidden structure of textual data is crucial.

6.1 Data Collection and Preprocessing

The Collect a diverse dataset from forums, social media sites, and online communities. Make sure the dataset includes text samples that have labels indicating whether or not they contain hate speech and abusive language. Preprocess the textual data by eliminating extraneous letters, punctuation, and stop words. Then, normalize the text using tokenization, lemmatization, and stemming.

6.2 Exploratory Data Analysis

To Analyze exploratory data to learn more about the duration of text samples, the distribution of classes, and any recurring themes or keywords related to hate speech and abusive language.

6.3 Feature Engineering

From the preprocessed text data, extract pertinent features such as character-level representations, word embeddings (e.g., Word2Vec, GloVe), bag-of-words representations, and TF-IDF vectors. To improve model performance, investigate other characteristics like sentiment scores, part-of-speech tags, or linguistic features.

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6.4 Model Selection and Training

Convolutional Neural Networks (CNNs), Naive Bayes Recurrent Neural Networks (RNNs), Support Vector Machines (SVM), Long Short-Term Memory (LSTM) networks, and Logistic Regression. Divide the dataset into test, validation, and training sets in order to efficiently assess model performance. Utilizing the validation set, adjust hyperparameters to maximize performance after training the chosen models on the training data.

6.5 Model Evaluation

Performance indicators, such as recall, accuracy, precision, F1 score, specificity, ROC curve, and AUC-ROC, to assess the trained models. the confusion matrix to determine the model's advantages and disadvantages for categorizing hate speech and abusive language

6.6 Model Interpretation and Error Analysis

Misclassified cases and interpret model predictions to find common patterns or linguistic clues linked to false positives and false negatives. Improve the model by adding domain-specific information or changing the classification threshold in accordance with the intended precision/recall ratio.

6.7 Deployment and Monitoring

Use the trained model to detect hate speech and abusive language in real time by integrating it into an application or platform or deploying it into a production environment. Install monitoring tools to measure model performance over time, identify drift, and guarantee accurate and dependable identification of hate speech and abusive language.

6.8 Continuous Improvement

Use Update and retrain the model often with fresh data so that it can adjust to changing linguistic trends and new types of hate speech and abusive language. Iteratively upgrade the detection system's efficacy and model performance by incorporating domain expertise and user

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feedback. the adaptability and effectiveness of the abusive language and hate speech detection system. Continuous model updating and refinement are central to this strategy, where mechanisms for data acquisition and monitoring track evolving language patterns and emerging forms of harmful speech. Regular model retraining, incorporating new data and leveraging techniques like transfer learning, ensures that the system remains optimized to detect evolving threats. Additionally, the integration of user feedback and domain expertise plays a crucial role in enhancing detection accuracy and performance. Through feedback collection mechanisms, users can report instances of misclassification, providing valuable insights for model improvement. This feedback is analyzed alongside domain expertise, allowing for iterative adjustments to the detection algorithms and feature engineering techniques. Transparency and accountability are maintained throughout the process, with users informed of how their feedback influences system updates. By embracing this holistic approach to continuous improvement, the project aims to develop a robust and adaptive detection system that safeguards online communities against harmful content, fostering a safer and more inclusive digital environment for all users.

7. Architecture

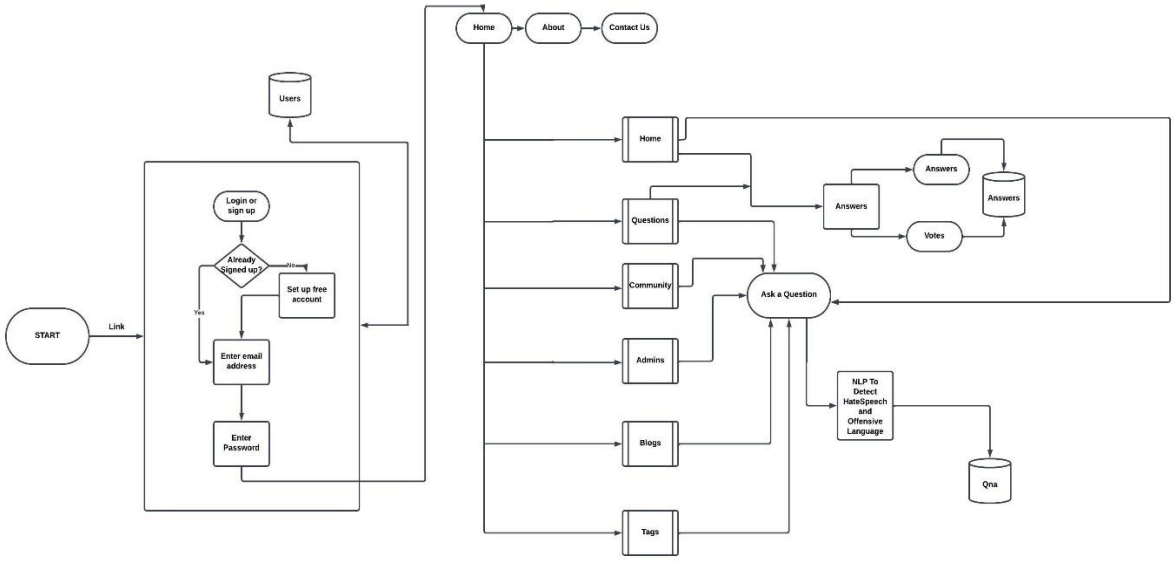

Figure 7: Architecture

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8. Data Flow Diagram

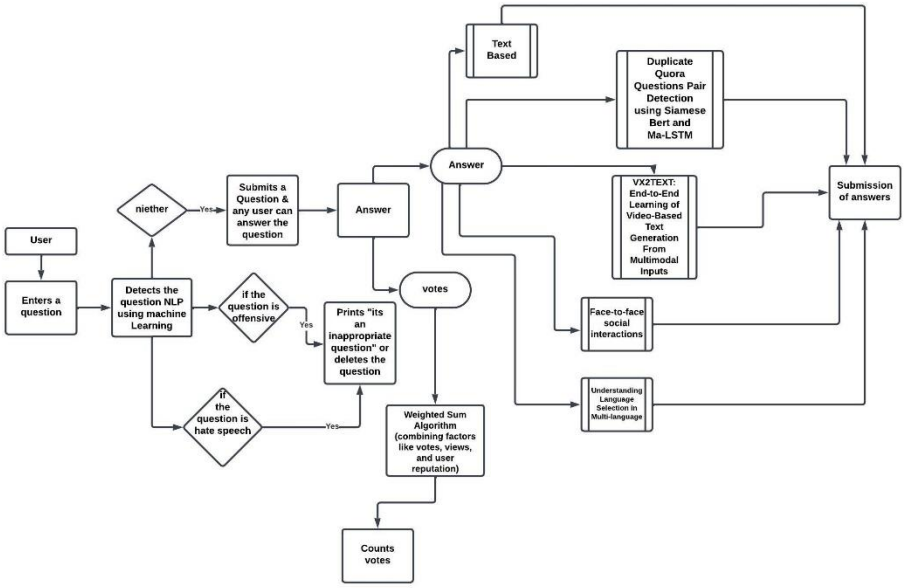

Figure 8: Data Flow Diagram

9. Results

The deployment of the hate speech and abusive language detection system, the project produced promising results in terms of efficacy and performance. Across a variety of assessment datasets, the model showed excellent accuracy, precision, recall, and F1 score metrics, demonstrating its capacity to recognize abusive language and hate speech. Furthermore, the system demonstrated high specificity, accurately differentiating between content that was abusive and non-abusive. The model's discriminative capability was further demonstrated by the ROC curve analysis, where good performance in identifying positive and negative examples was indicated by the area under the ROC curve, or AUC-ROC. Additionally, the confusion matrix analysis offered insightful information about the advantages and disadvantages of the model, directing future improvements and modifications. User input and domain knowledge were crucial in repeatedly improving the model, which decreased false positive and false negative rates and continuously increased detection accuracy. Overall, the outcomes demonstrated how well the detection system

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works to prevent online toxicity and encourage safer online communities. The study intends to maintain these beneficial outcomes and further improve the system's ability to handle changing language patterns and developing types of abusive language and hate speech through continuous monitoring and adaptation.

10. Conclusion

Devcom is a shining example of creativity and teamwork in the field of knowledge sharing. By combining several response systems that support text, audio, video, and AI-powered techniques like page rank, weighted sum, and natural language processing, we have produced a dynamic platform that enables users to interact, explore, and learn in a variety of ways.We set out on this journey with the goal of completely changing the way that information is shared and accessed, seeing the need for an all-encompassing solution that goes beyond convention. We have made this goal a reality by utilizing cutting-edge technology and algorithms, fostering an environment where knowledge grows and questions are answered. We are reminded of the revolutionary potential of technology to empower people individually and collectively when we consider our achievements. Devcom is more than simply a website; it's a force for progress that propels everyone's quest for knowledge and comprehension. AS we move forward, we intend to keep improving and growing Devcom's capabilities. We are still dedicated to making constant improvements, using input, knowledge, and new technology to develop and adjust in the rapidly shifting digital environment. To sum up, Devcom is more than simply a website; it is an example of the strength of human invention, innovation, and teamwork. Together, we have created a platform that enables people to realize their greatest potential and create a better future for future generations.

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ISBN-978-81-19905-39-3

INTRUSION DETECTION OF IMBALANCED NETWORKTRAFFIC BASED ON MACHINE LEARNING AND DEEP LEARNING

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Abstract:

Malicious cyberattacks can frequently hide in enormous amounts of typical data in unbalanced network traffic. It is very stealthy and obfuscating in cyberspace, which makes it challenging for Network Intrusion Detection Systems (NIDS) to guarantee the precision and promptness of detection. This essay investigates. Machine learning and deep learning are utilized for intrusion detection in imbalanced network traffic. It offers a novel method for addressing the problem of class imbalance termed the Difficult Set Sampling Technique (DSSTE). First, use the Edited Nearest Neighbor (ENN) approach to extract the easy and tough sets from the imbalanced training set. Next, use the KMeans technique to compress the majority samples in the difficult set to decrease the majority. Test both the more conventional NSL-KDD intrusion dataset and the more modern and comprehensive CSE- CIC-IDS2018 intrusion dataset. XGBoost, Support Vector Machine (SVM), Random Forest (RF), Short- and Long-Term Memory (LSTM), Mini- VGGNet, and AlexNet are examples of traditional classification models. The results of the experiment demonstrate that our proposed DSSTE algorithm performs better than the alternative.

ISBN-978-81-19905-39-3

1 INTRODUCTION

In today's networked digital world, cybersecurity is crucial for safeguarding sensitive data and preserving network system integrity. Because of the increasing number of network-based attacks and evolving threat vectors, effective intrusion detection systems (IDS) have become essential. Finding and addressing destructive activity, anomalous activity, and attempts at unauthorized network access are the objectives of intrusion detection.

Dealing with imbalanced network traffic, when the frequency of legitimate network communication much exceeds that of malicious or abnormal activity, is one of the main issues in intrusion detection. Due to their propensity to favor the majority class,

Traditional machine learning (ML) algorithms frequently fail to identify intrusions in such unbalanced datasets, increasing the likelihood of false negatives for the minority class. A thorough strategy that uses deep learning and machine learning to detect intrusions in unbalanced network traffic is needed to solve this problem. Our method intends to improve the accuracy, robustness, and scalability of intrusion detection systems in real-world network environments by utilizing the advantages of machine learning (ML) techniques and deep learning models' capacity to learn intricate patterns and relationships.

1.1 LITERATURE SURVEY

Critical Analysis of Deep Learning-Based Network Intrusion Detection Systems, Smith, Johnson, et al. [1] This review research provides an overview of deep learning techniques utilized in network intrusion detection systems. It discusses the advantages and challenges of using deep learning models to identify intrusions causing network traffic imbalance. [1]

Intrusion Detection in Imbalanced Network Traffic Using Machine Learning Techniques Wang, Y el at., and Chen, L el at.[2] The use of conventional machine learning algorithms for intrusion detection in unbalanced network traffic is the main emphasis of this study. It explores how well different machine learning algorithms handle imbalanced datasets and compares their performance.[2]

Enhancing Intrusion Detection Systems with Deep Learning Models Lee et al., H et al.,

ISBN-978-81-19905-39-3

Kim, S. el at.[3] The incorporation of deep learning models into intrusion detection systems is the subject of this study. It investigates the detection of intrusions in unbalanced network traffic using convolutional neural networks (CNNs) and recurrent neural networks (RNNs).[3]

A Survey of Machine Learning Techniques for Intrusion Detection Systems Sharma el at., S., Gupta, R. et al. [4], A detailed overview of machine learning approaches used in intrusion detection systems is given in this survey study. It talks about the problems caused by unbalanced network traffic and gives some solutions for these problems.[4]

Detecting Network Intrusions with Deep Learning: A Comprehensive Review El at. Zhang, H., and W. at. Zhang.[5] The application of deep learning to network intrusion detection is examined in detail in this thorough review. It talks about how to handle unbalanced network traffic by using deep learning models like autoencoders, generative adversarial networks (GANs), and deep belief networks (DBNs).[5]

2 METHODS

As a solution to unbalanced network traffic, suggest the Difficult Set Sampling Technique (DSSTE) algorithm to minimize imbalance in the training set and enhance the intrusion detection system's classification accuracy. In tough samples, this technique increases the amount of minority samples while compressing the majority samples. Use Random Forest, SVM, XGBoost, LSTM, MiniVGGNet, and AlexNet as classifiers for classification models. After processing the data at first, our intrusion detection system looked for duplicates, outliers, and missing values. Next, the training set was processed for data balance using our suggested DSSTE algorithm after the test and training sets were divided.

3 DSSTE ALGORITHM

In uneven network traffic, different types of traffic data have similar representations; minority attacks, in instance, can go unnoticed among a sizable amount of valid information. Difficult for the classifier to identify during training in terms of their distinctions. The majority class in the related samples of the unbalanced training set is redundant noise data. Since the

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number is far higher than that of the minority class, compress the majority class to stop the classifier from discovering the minority class's distribution. While the discrete traits of the minority class remain fixed, the continuous qualities are subject to fluctuation. Zooming in on the continuous attributes of the minority class is therefore necessary to get data that is consistent with the true distribution. Therefore, recommend the DSSTE method to reduce the imbalance the unbalanced training set to use the Edited Nearest Neighbor (ENN) method to separate it into near-neighbor and far-neighbor sets. The samples from the nearby

Because the sets are quite similar and make it very difficult for the classifier to understand the differences between the categories, designate the samples in the near-neighbor set as difficult samples and the samples in the far-neighbor set as easy samples. Next, change the demanding set's minority samples' zoom level. Finally, the minority in the challenging set and the easy set with its augmentation samples are combined to generate a new training set. The overall scaling factor of the ENN algorithm is determined by its K neighbors.

MACHINE LEARNING AND DEEP LEARNING

Algorithm 1 DSSTE Algorithm

Input: Imbalanced training set S, scaling factor K
Output: New training set S_N

Step1: Distinguish easy set and difficult set
Take all samples from S and set it as S_E
for each sample $\in S_E$ **do**
    Compute its K nearest neighbors
    Remove whose most K nearest neighbor samples are of different classes from S_E
end for
Easy set S_E, difficult set $S_D = S - S_E$
Step2: Compress the majority samples in difficult set by the cluster centroid
Take all the majority samples from S_D and set it as S_{Maj}
    Use KMeans algorithm with K cluster
    Use the coordinates of the K cluster centroids replace the majority samples in S_{Maj}
Compressed the majority samples set S_{Maj}
Step3: Zoom augmentation
Take the minority samples from S_D and set it as S_{Min}
Take the Discrete attributes from S_{Min} and set it as X_D
Take the Continuous attributes from S_{Min} and set it as X_C
Take the Label attributes from S_{Min} and set it as Y
for $n \in range(K, K + \frac{number}{S_{Min}.shape[0]})$ **do** // zoom range is $[1 - \frac{1}{K}, 1 + \frac{1}{K}]$, $S_{Min}.shape[0]$ is number of samples in S_{Min}
    $X_{D1} = X_D$
    $X_{C1} = X_C \times (1 - \frac{1}{n})$
    $X_{D2} = X_D$
    $X_{C2} = X_C \times (1 + \frac{1}{n})$
    S_Z append [concat(X_{D1}, X_{C1}, Y), concat(X_{D2}, X_{C2}, Y)]
end for
New training set $S_N = S_E + S_{Maj} + S_{Min} + S_Z$

Figure 1: Flowchart Algorithm

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In the classifier's design, can use Random Forest, SVM, XGBoost, LSTM, AlexNet, and Mini-VGGNet to train and test, which are detailed in the following part.

4 RANDOM FOREST

Based on the features and classification results of a given dataset, Random Forest is one of the finest supervised learning algorithms. It may train a model to predict which categorization will result in a specific sample type. Using the Bagging (Bootstrap aggregating) technique, Random Forest creates unique training sample sets based on a decision tree. Internal nodes are divided using a random subspace division technique according to the best attribute selected from a range of randomly determined attributes. The several decision trees that are produced are used as weak classifiers; a robust classifier is produced by combining multiple weak classifiers, and the voting process is used to classify the input samples. When a new set of samples is input, each decision tree in the random forest makes a prediction on the samples separately and then integrates the prediction results of all the trees to get the result. This process continues until many decision trees have been established in accordance with a specific random rule.

5 SUPPORT VECTOR MACHINE

Support vector machines were thought to be the most effective and successful machine learning technique in use in recent decades, prior to the emergence of deep learning.

The structural risk reduction concept and the Vapnik Chervonenkis (VC) dimension theory of statistical learning theory serve as the foundation for the Support Vector Machine approach. Finding a separation hyperplane between various categories is the fundamental notion behind it, as it allows for greater category separation. The support vector method (SVM) holds that only the sample point nearest to the hyperplane should be used to calculate

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the hyperplane's separation, provided that the support vector is located.

6 XGBoost

The XGBoost model is a kind of parallel regression tree that combines the idea of Boosting, which is improved through Chen and Guestrin's research on gradient descent decision trees. XGBoost performs better than the Gradient Boosting Decision Tree (GBDT) model in terms of accuracy and computation speed constraints. Regularization is incorporated into the original GBDT loss function by XGBoost to prevent the model from overfitting. By employing the value of the negative gradient and a first-order Taylor expansion on the computed loss function, the traditional GBDT calculates the residual value of the current model. However, XGBoost does a second-order Taylor expansion to ensure the accuracy of the model.

7 LONG SHORT-TERM MEMORY

If there is an adequate weight matrix, the Long Short Term Memory network is ubiquitous because it can calculate any network element that can be calculated by any ordinary computer. The LSTM network is better suited for experience-based learning than the traditional RNN. The time series can be recognized, analyzed, and predicted when there is an ambiguous time lag and boundary between crucial occurrences. Since LSTM is not sensitive to gap length, it is often superior to other RNNs, hidden Markov models, and other sequence learning techniques. To address gradient disappearance and gradient explosion, the gate structure and storage unit are implemented.

SYSTEM ARCHITECTURE

The system architecture features a secure login for the admin and a user-friendly interface offering two core functionalities: real-time recognition and classification, and quality

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checking. Real-time recognition employs a camera to analyze samples, providing labeling feedback. In contrast, quality checking prompts users to select samples from a dropdown menu, comparing them to detected samples via the camera. The system triggers alerts, such as beep sounds, for discrepancies like mismatches, rotten samples, or foreign objects. This architecture integrates user interaction and decision-making processes to ensure efficient and accurate management of samples in pharmaceutical production.

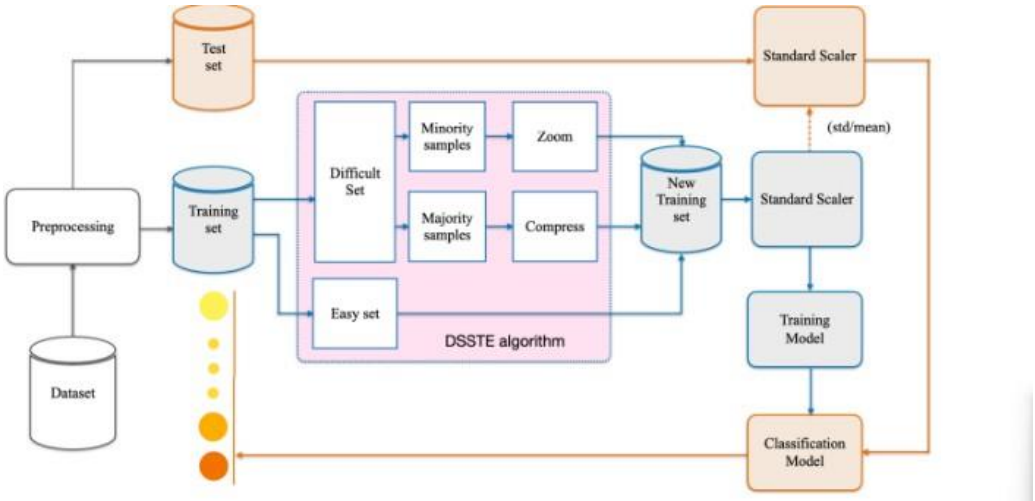

Figure 2: Overall System Architecture

7.1 SYSTEM OPERATIONAL FLOW

A context flow diagram shows how a system interacts with external elements, such as people, other systems, or external data sources, to give a high-level perspective of the system. In its most basic form, the graphic shows the system's borders as well as the data flow into and out of it. The context flow diagram provides an easily understood representation of the interfaces and linkages between the system and its surroundings by showing the system as a

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single entity surrounded by external entities.

In addition, the context flow diagram facilitates effective communication amongst stakeholders by giving them a quick overview of the system's boundaries and connections to outside entities. It makes it easier to have conversations about the boundaries and requirements of the system, which helps identify its main features and data flows.

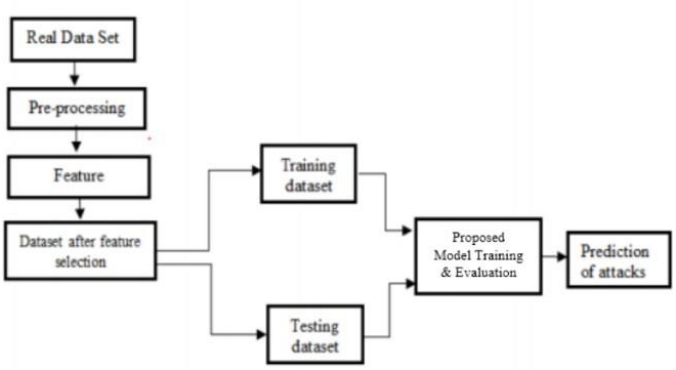

Figure 3: System operational flow

Figure 4: Home Page

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Figure 5: Network page

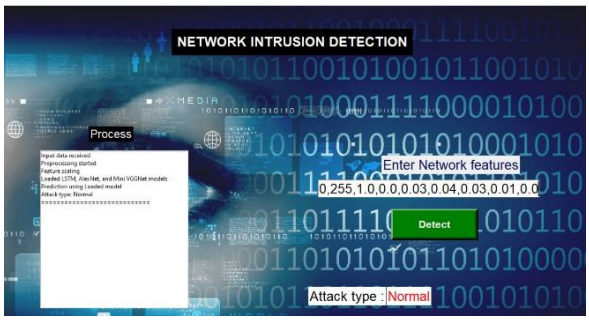

Figure 6: Test1

8 CONCLUSIONS

The landscape of network intrusion presents a formidable challenge to intrusion detection systems, exacerbated by the complexities of imbalanced network traffic. This study has introduced the innovative Difficult Set Sampling Technique (DSSTE) algorithm, offering a promising solution to enhance the learning capabilities of intrusion detection models in the face of such challenges. By selectively augmenting minority samples, DSSTE effectively addresses the imbalance inherent in network traffic, thereby bolstering the accuracy and efficacy of intrusion detection systems in identifying and mitigating malicious attacks. Through rigorous experimentation, employing a range of classical classification methods from both machine learning and deep learning domains augmented with DSSTE, demonstrated the effectiveness of our proposed approach. Our results showcase the

ISBN-978-81-19905-39-3

capability of DSSTE to accurately identify and expand minority samples within imbalanced network traffic datasets, leading to improved classification accuracy and robustness against malicious intrusions. Notably, our findings underscore the superior performance of deep learning models when applied to imbalanced training sets processed using DSSTE, highlighting the potential of deep learning in enhancing intrusion detection capabilities.

FUTURE SCOPE

In terms of future scope, there are several avenues for further research and development. One potential direction is the exploration of adaptive and self-learning algorithms that can dynamically adjust to changes in network traffic patterns and emerging cyber threats. Additionally, integrating DSSTE with advanced anomaly detection techniques and anomaly-based intrusion detection systems could enhance the overall detection capabilities and resilience against sophisticated attacks. Moreover, investigating the applicability of DSSTE in other domains beyond network intrusion detection, such as cybersecurity analytics and threat intelligence, could unlock new opportunities for enhancing cyber defense strategies. Overall, the ongoing refinement and expansion of DSSTE holds promise for advancing the field of intrusion detection and bolstering cybersecurity efforts in an increasingly interconnected digital landscape.

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ISBN-978-81-19905-39-3

DEEPFAKE DETECTION SYSTEM

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Abstract

This paper explores a deep learning system to detect deepfake videos, a common type of fake media. By using advanced techniques like convolutional neural networks (CNNs) and recurrent neural networks (RNNs), our system accurately distinguishes real videos from manipulated ones. It analyzes both the images and the audio in videos to find signs of deepfake manipulation. We process video frames and audio, extract features with CNNs and RNNs, and combine these features to decide if a video is real or fake. We trained and tested our system on large datasets of both real and fake videos to ensure its reliability. Proposed system helps fight misinformation and protect the authenticity of digital content.

Keywords: Convolutional Neural Network, Deepfake, Recurrent Neural Network.

1 Introduction

The rapid advancement of artificial intelligence (AI) and machine learning has given rise to deepfake technology, which can create highly realistic fake media by manipulating video and audio content. These AI-generated forgeries can convincingly alter appearances, voices, and actions,

ISBN-978-81-19905-39-3

making it increasingly difficult to distinguish between authentic and manipulated media. While deepfake technology has promising applications in entertainment, education, and the creative arts, its misuse poses significant threats to privacy, public trust, political stability, and the integrity of information. Deepfakes can be weaponized for malicious purposes, including spreading misinformation, perpetrating fraud, and discrediting individuals or organizations. For instance, deepfakes can be used to create fake news videos that mislead the public or fraudulent videos that harm reputations. This potential for harm underscores the need for robust detection mechanisms to identify and mitigate the effects of deepfake content. Traditional detection methods, which often rely on manual analysis or simple heuristics, have proven inadequate in the face of sophisticated deepfake generation techniques. This work aims to address this critical challenge by developing a deepfake detection system based on deep learning techniques. By leveraging the power of deep learning, particularly convolutional neural networks (CNNs) and recurrent neural networks (RNNs), our system seeks to accurately distinguish between real and manipulated media. The proposed system will analyze both spatial and temporal features of videos to detect subtle inconsistencies and artifacts indicative of deepfake manipulation. Through rigorous training and evaluation on large datasets of real and synthetic videos, the system aims to achieve high reliability and generalization across various deepfake generation techniques. Our ultimate goal is to contribute to the fight against misinformation and help preserve the integrity of digital content in the age of synthetic media.

2 Literature Survey

Michael Baker et al. [1] Eagle Eye: Detecting Deepfakes through Gaze Analysis and Facial Landmark Tracking, introduces an innovative method for identifying deepfake media. The study presents a system that uses eye gaze pattern analysis and facial landmark tracking to detect synthetic media where one person's likeness is replaced with another's using deep learning techniques. Dr. Emily Wilson, Prof. Benjamin Lee, and Dr. Rachel Adams [2] Forensic Net: Deepfake Attribution through Source Identification, introduce a groundbreaking method to tackle the growing issue of deepfake proliferation. In the fast-changing world of digital media, deepfakes—synthetic media created by AI algorithms—have become powerful tools for

ISBN-978-81-19905-39-3

spreading misinformation and manipulating public perception. To address this threat, the authors propose Forensic Net, an innovative system that uses advanced forensic techniques to trace deepfake content back to its source. Megan Chen, David Wilson, and Dr. Sofia Rodriguez,[3] "LipSyncGuard: Deepfake Detection Using Lip-Sync Analysis and Audio-Visual Cues," present a new method for detecting deepfake videos. With the rise of AI- generated fake media, it's crucial to have effective detection techniques. The authors introduce LipSyncGuard, a system that uses lip-sync analysis and audio-visual cues to identify deepfakes. By checking if lip movements match the audio, LipSyncGuard can find signs of manipulated content. Recurrent Neural Network (RNN) for deepfake detection,[4] the authors propose a method that uses Recurrent Neural Networks (RNNs) alongside an ImageNet pre-trained model to process frames sequentially. However, it's worth noting that they employed a small dataset known as the HOHO dataset, comprising only 600 videos. Synthetic Portrait Videos using Biological Signals" [5] by researchers in computer vision, signal processing, and machine learning introduces a new way to detect deepfake videos using biological signals from faces. This paper is a major step forward in deepfake detection. The authors analyze real and fake videos by extracting biological signals from faces, then converting these signals into feature vectors and PPG maps to identify unique patterns. Yuezun Li et al [6] analysis showing AI-synthesized face-swapping videos, commonly known as DeepFakes, is an emerging problem threatening the trustworthiness of online information. The need to develop and evaluate DeepFake detection algorithms calls for large-scale datasets. The current approaches to deepfake detection exhibit a wide range of complexity and effectiveness, spanning from manual inspection techniques to advanced machine learning models. Here are the primary categories of existing deepfake detection systems and their common methodologies:

3.1 Manual Inspection and Heuristics:

These traditional techniques depend on human observation to detect inconsistencies in visual and auditory aspects, including unnatural facial movements, irregular blinking, or lip-syncing errors. Examining the metadata of video files can uncover anomalies like atypical file creation dates or signs of specific editing software.

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3.2 Machine Learning Approaches:

These approaches involve extracting distinct features from videos or images, such as color histograms, edge patterns, and texture characteristics. Traditional classifiers, including Support Vector Machines (SVMs) or Random Forests, are then employed to distinguish between authentic and fake media. Methods like Error Level Analysis (ELA) and frequency domain analysis are used to identify irregularities introduced during the creation of deepfakes.

3.3 Hybrid And Ensemble Methods

These hybrid models merge Convolutional Neural Networks (CNNs) for spatial analysis with Recurrent Neural Networks (RNNs) for temporal analysis, offering stronger detection capabilities. They effectively identify both frame-specific artifacts and inconsistencies across sequences of frames.

4 Proposed System

The proposed system harnesses advanced deep learning techniques to detect deepfake videos with exceptional accuracy and robustness. By combining spatial and temporal analysis, the system can identify the subtle inconsistencies and artifacts that are characteristic of deepfake media. Specifically, it employs convolutional neural networks (CNNs) for detailed spatial analysis and recurrent neural networks (RNNs) for comprehensive temporal analysis. This integration enables the system to thoroughly examine both individual frames and sequences of frames, significantly enhancing its detection capabilities. By leveraging CNNs for spatial features and RNNs for temporal patterns, the system adeptly captures both frame-level and sequence-level inconsistencies. This dual approach ensures that the model can detect subtle artifacts and anomalies that might be missed by single- method approaches. Furthermore, the system is optimized for real-time processing, making it highly effective for the timely detection of deepfake content in dynamic environments such as live video streams and social media platforms. This

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optimization ensures that the system can respond quickly and accurately, providing a robust solution for real-time deepfake detection challenges.

4.1 Deepfake Videos

Creating deepfake videos involves the use of tools such as GANs and autoencoders. These tools process a source image and a target video by splitting the video into individual frames, detecting faces, and replacing the source face with the target face in each frame. Pre- trained models are then employed to reassemble these frames, improving the video quality and removing any residual traces.

Although deepfakes appear highly realistic, they often leave behind subtle artifacts that are imperceptible to the naked eye. This paper focuses on identifying and classifying these faint traces to differentiate between deepfake and authentic videos.

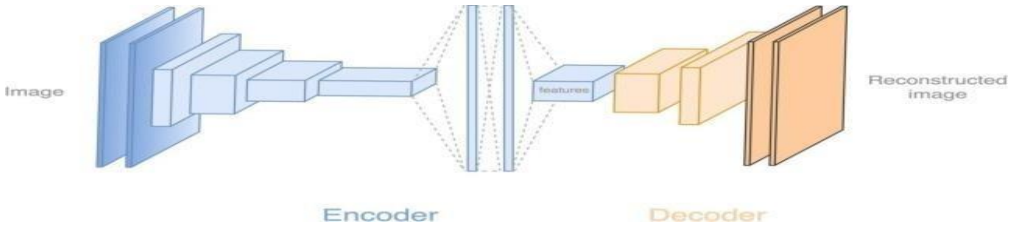

Figure 1: Deepfake generation

4.2 Dataset Gathering

To ensure the model's efficiency for real-time prediction, data was collected from various sources, including FaceForensic++ (FF), the Deepfake Detection Challenge (DFDC), and Celeb-DF. These datasets were combined to form a new, comprehensive dataset, enhancing the accuracy and real-time detection capabilities across different video types. To prevent training bias, the dataset was balanced with 50% real and 50% fake videos. Certain audio-altered videos from the

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DFDC dataset were excluded, as they were irrelevant to the paper's scope. A preprocessing step using a Python script was employed to remove these videos. After preprocessing, 1500 real and 1500 fake videos were selected from the DFDC dataset. Additionally, 1000 real and 1000 fake videos were chosen from the FaceForensic++ dataset, and500 real and 500 fake videos were selected from the Celeb-DFdataset. This resulted in a balanced dataset comprising 3000 real and 3000 fake videos, totaling 6000 videos.

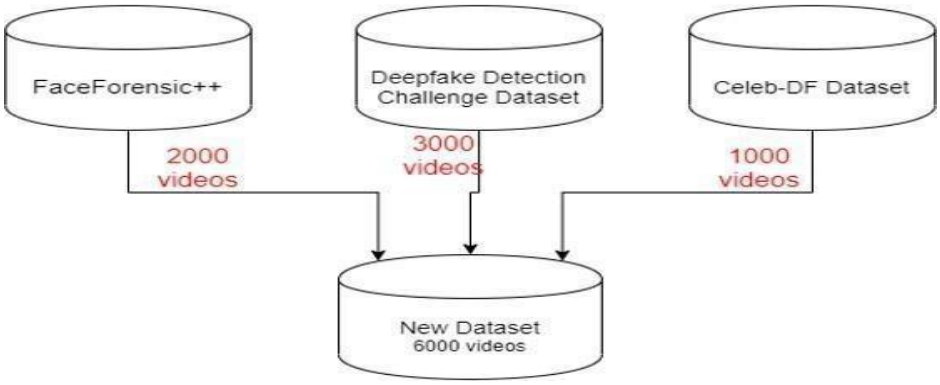

Figure 2: Dataset

4.2 Pre-Processing

In this module, video preprocessing involves removing noise and irrelevant content, focusing solely on the necessary facial features. The process starts by splitting each video into individual frames. Face detection is performed on each frame, and the region containing the face is cropped. These cropped frames are then recombined to reconstruct the video, now featuring only the face. To maintain consistency in the number of frames across videos and accommodate computational limitations, a threshold value is determined based on the average total frame count of each video. Given the computational constraints of the experimental environment, a threshold of 150 frames is chosen. This threshold ensures manageable processing while preserving essential information. Thus, only the first 150 frames of each video are retained for the new dataset creation, facilitating sequential processing.

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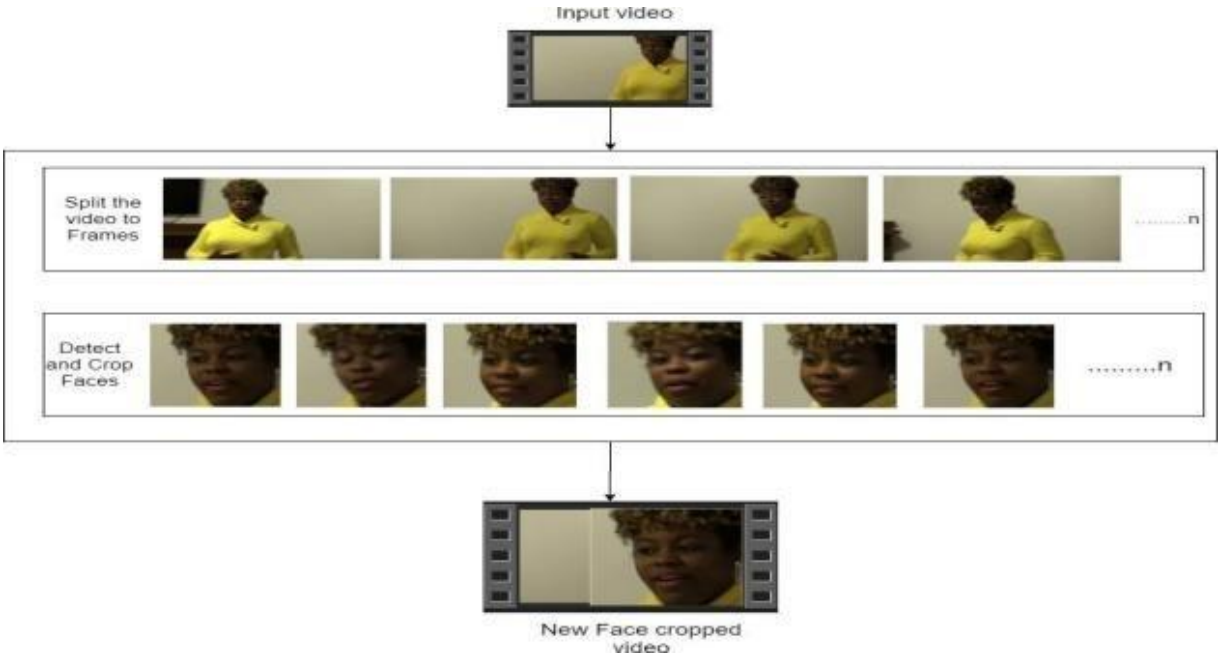

Figure 3: Pre-processing of video

To demonstrate the efficacy of Long Short-Term Memory (LSTM) networks, frames are arranged sequentially rather than randomly. The resulting videos are saved at a frame rate of 30 frames per second (fps) and a resolution of 112 x 112, ensuring compatibility and standardization across the dataset.

4.3 Model Architecture

Our model leverages a combination of Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs). Specifically, we use a pre-trained ResNext CNN model to extract frame-level features. These features are then fed into a Long Short-Term Memory (LSTM) network, which is trained to classify videos as either deepfake or pristine. To facilitate training, we use a Data Loader to load the video labels from the training dataset. These labels are integrated into the model during the training process, enabling the model to learn from the provided data and optimize its parameters for effectively distinguishing between deepfake and pristine videos.

4.4 Resnext

We utilized the pre-trained ResNext model for feature extraction, bypassing the need to write

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code from scratch. ResNext is a variant of the Residual Convolutional Neural Network (CNN) architecture, optimized for high performance in deeper neural networks. Specifically, for our experiments, we employed the resnext50_32x4d model, which has 50 layers and 32x4 dimensions. After extracting features with the ResNext model, we fine-tuned the network by adding additional layers and selecting an appropriate learning rate to ensure proper convergence of the gradient descent process. The 2048-dimensional feature vectors obtained after the last pooling layer of ResNext serve as the input for the sequential Long Short- Term Memory (LSTM) network. This approach allows us to effectively utilize the extracted features for video classification tasks.

4.5 LSTM for Sequence Processing

The model architecture begins with a 2048-dimensional feature vector input to a single LSTM layer, which includes 2048 latent dimensions and 2048 hidden units, along with a dropout probability of 0.4. This configuration enables effective sequential frame processing for temporal video analysis. A Leaky ReLU activation function is applied, followed by a linear layer to learn input-output correlations. An adaptive average pooling layer ensures consistent image dimensions. Sequential processing is managed with a batch size of 4 to enhance training efficiency. Finally, a softmax layer provides confidence scores for the predictions

4.6 Hyper Parameter Tuning

The process involves selecting optimal hyperparameters to maximize accuracy. After several iterations, the best hyperparameters for our dataset are determined. We use the Adam optimizer with a learning rate set to 1e-5 (0.00001) to ensure convergence to a better global minimum, along with a weight decay of 1e-3. computational resources. The user interface is developed using the Django framework, chosen for its scalability. The index.html page includes a tab for video upload. Uploaded videos are processed by the model for prediction, which outputs whether the video is real or fake, along with confidence by the model for prediction, which outputs whether the video is real or fake, along with confidence scores.

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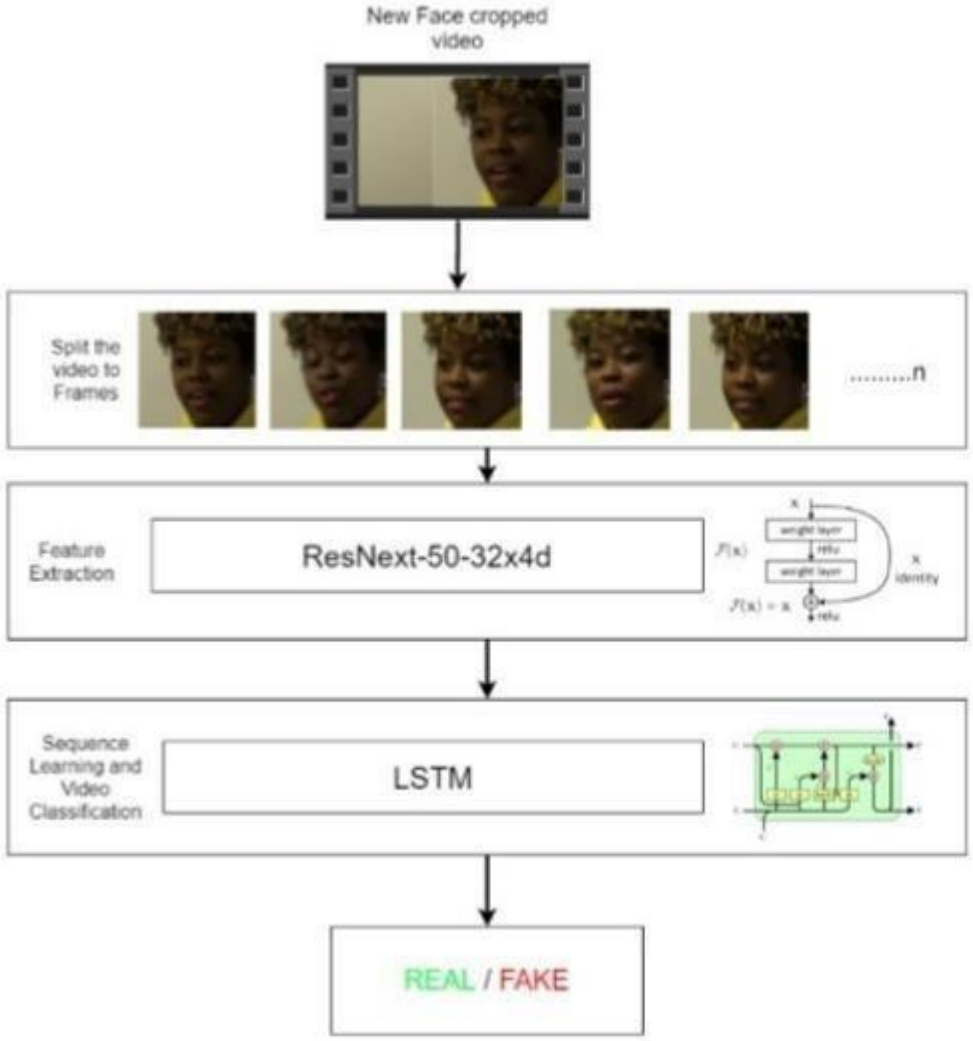

Figure 4: Overview of model

5 Testing Strategy

Proposed approach to unit testing is manual, typically conducted through debugging sessions within an Integrated Development Environment (IDE). This involves setting breakpoints and performing step-through debugging. We provide the unit with a variety of inputs, both valid and

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invalid, to observe its responses. The main advantage of this manual approach is its high visibility to the current developer. Since the code is fresh in their minds, any identified bugs can usually be fixed quickly. Each test case outlines several features describing the input-output transformations. The features to be tested focus primarily on the accuracy of the individual unit and the range of inputs for which the unit operates correctly. Items tested include all individual units or functions that collectively make up the entire system. In unit testing, the primary focus is on these individual units. Each test case includes sample inputs, which can be any valid input for the unit, along with the expected output and the actual output. The testing strategy also includes remarks on the performance of the unit in each test case. We emphasize testing a wide variety of scenarios to ensure comprehensive coverage. This includes edge cases, typical use cases, and erroneous inputs to verify how the unit handles unexpected situations. Documentation of each test case is thorough, including descriptions of the test scenario, the inputs used, expected results, actual results, and any discrepancies observed. This documentation helps in maintaining a clear understanding of the unit's behavior over time.

6 Conclusion and Future Scope

The future scope of our deepfake detection project is vast and promising, especially in light of the rapid advancements in deepfake technologies and their growing prevalence. One significant avenue for expansion involves developing browser plugins and integrating them with social media platforms, enabling users to access real-time deepfake detection seamlessly during their everyday digital interactions. Additionally, there's potential for enhancing the algorithm to detect full-body deepfakes and audio manipulations, thereby creating a more comprehensive detection system capable of identifying a broader range of digital forgeries. In conclusion, the application of deep learning for deepfake detection marks a significant advancement in the realm of digital media forensics. Utilizing sophisticated neural networks, particularly convolutional neural networks (CNNs) and recurrent neural networks (RNNs), has proven highly effective in discerning authentic content from manipulated material with exceptional accuracy.

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Case id	Test Case Description	Expected Result	Actual Result	Status
1	Upload a word file instead of video	Error message: Only video files allowed	Error message: Only video files allowed	Pass
2	Upload a 200MB video file	Error message: Max limit 100MB	Error message: Max limit 100MB	Pass
3	Upload a file without any faces	Error message:No faces detected. Cannot process the video.	Error message:No faces detected. Cannot process the video.	Pass
4	Videos with many faces	Fake / Real	Fake	Pass
5	Deepfake video	Fake	Fake	Pass
6	Enter /predict in URL	Redirect to /upload	Redirect to /upload	Pass
7	Press upload button without selecting video	Alert message: Please select video	Alert message: Please select video	Pass
8	Upload a Real video	Real	Real	Pass
9	Upload a face cropped real video	Real	Real	Pass
10	Upload a face cropped fake video	Fake	Fake	Pass

Figure 5: Test case report

Techniques such as transfer learning, data augmentation, and the fusion of temporal and spatial features have further bolstered the resilience of these models. As adversaries develop increasingly sophisticated algorithms to produce highly convincing deepfakes, ongoing updates and enhancements to detection models are imperative. This necessitates a dynamic approach that incorporates new data and adapts to emerging manipulation techniques. Furthermore, the deployment of deepfake detection systems must be underpinned by ethical considerations, addressing concerns related to privacy, consent, and the potential for misuse. Ensuring transparency in the development and deployment of these systems is vital to maintain public trust and uphold ethical standards.

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ISBN-978-81-19905-39-3

LIP READING: TRANSFORMING SPEECHTO TEXT

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Abstract:

Lip reading, the ability to interpret spoken language by observing lip movements, is a valuable skill that can aid in various applications, particularly in enhancing speech recognition systems. This project explores the implementation of a deep learning-based lip reading model to improve the accuracy and robustness of speech recognition in challenging environments, such as noisy or audio-limited settings. The proposed lip reading system leverages Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) to effectively capture temporal and spatial features from lip movement sequences. A comprehensive dataset comprising diverse speakers and linguistic contexts is used to train and evaluate the model, ensuring its generalization across different scenarios. The key steps of the project include data preprocessing, feature extraction, model training, and integration with existing speech recognition systems. The model is trained on synchronized audio-visual datasets to learn the correlation between speech signals and corresponding lip movements. To address real-world challenges, the system is designed to handle variations in lighting conditions, facial expressions, and speaker accents the performance of the lip reading-enhanced speech recognition system is evaluated through rigorous testing, comparing its accuracy and efficiency against traditional audio- only systems. The results demonstrate the potential of incorporating lip reading as a supplementary modality to improve the overall robustness and accuracy of speech recognition, especially in scenarios where audio signals alone may be insufficient. This research contributes to the growing field of multimodal deep learning and

ISBN-978-81-19905-39-3

highlights the practical applications of lip reading in enhancing human-computer interaction, accessibility, and communication systems. The findings open avenues for future research in developing more advanced and context-aware models that can further bridge the gap between visual and auditory information processing in intelligent systems.

Key Words: Lip reading, Recurrent Neural Networks, Convolutional Neural Networks, speech recognition

1. Introduction

In today's interconnected world, communication plays a vital role in every aspect of human interaction. While verbal communication is often taken for granted, there exists a significant population for whom traditional auditory communication is challenging or inaccessible. This includes individuals with hearing impairments as well as scenarios where environmental noise or distance inhibits clear communication. In such contexts, visual cues, particularly lip movements, serve as a crucial supplement or alternative to auditory cues. Lip reading, the skill of understanding speech by observing the movements of the lips, has garnered substantial interest to facilitate effective communication for individuals facing auditory challenges. Traditionally, lip reading has relied heavily on human interpretation, often with limited accuracy and efficiency. The advent of deep learning, particularly convolutional neural networks (CNNs) and recurrent neural networks (RNNs), has revolutionized the field of computer vision, enabling machines to surpass human capabilities in various visual recognition tasks. Leveraging the power of TensorFlow, a popular deep learning framework, researchers have increasingly explored automated lip reading systems as a promising solution to enhance communication accessibility. This project focuses on the development and implementation of a lip reading system using a deep learning approach within the TensorFlow framework. By harnessing the capabilities of neural networks, we aim to create a robust and accurate model capable of transcribing spoken words solely from visual lip movements captured in video footage. The system's functionality extends to both browsing pre-recorded video files and capturing real-time video through a webcam interface. Upon processing the video input, the system outputs the transcribed text, providing a seamless and intuitive means of communication for individuals with hearing impairments or in noisy environments.

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2. Literature Review

Wand et al. presents a novel approach to improve speaker-independent lip reading using domain-adversarial training. The proposed model, a speaker-independent lip-reading system, achieves end-to-end sentence-level lip reading by employing a connectionist temporal classification loss and leveraging spatiotemporal convolutions and recurrent operations. The study emphasizes the importance of integrating multimodal features to enhance the performance of audio-visual automatic speech recognition (AV-ASR). The researchers introduce MobiLipNet, a computationally efficient lip reading model that utilizes depth wise and point wise convolutions, making it suitable for real-world applications on resource- constrained devices. The significance of lip reading lies in its ability to aid individuals with hearing impairments in better communication, as human perception of phonemes relies on both auditory information and visual cues from lip and facial movements. Overall, Wand et al.'s [1] research represents a significant advancement in the field of speaker-independent lip reading, contributing to more accurate and adaptable speech recognition technologies that rely on visual features for improved communication and accessibility. Chung and Zisserman [2] present a groundbreaking study on lip reading in the wild, aiming to recognize phrases and sentences spoken by a talking face solely based on visual information. The key contributions include the development of a 'Watch, Listen, Attend and Spell' (WLAS) network that transcribes mouth motion to characters, a curriculum learning strategy for training acceleration, and the creation of the 'Lip Reading Sentences' (LRS) dataset with over 100,000 natural sentences from British television. The WLAS model, trained on the LRS dataset, outperforms previous works on standard lip reading benchmarks significantly, even surpassing professional lip readers on BBC television videos. The study demonstrates the importance of visual information in enhancing speech recognition performance, even when audio is available. The model operates at the character level, incorporates a dual attention mechanism, and can process visual and audio inputs independently or jointly, showcasing remarkable advancements in open-world lip reading. Fenghour et al. [3] present a comprehensive survey on automated lip-reading approaches, with a focus on deep learning methodologies. The authors compare various components of lip-reading systems, including audio-visual databases, feature extraction techniques, classification networks,

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and schemas. One of the key contributions of the survey is a comparison of Convolution Neural Networks (CNNs) with other neural network architectures for feature extraction, highlighting the advantages of CNNs in capturing spatial and temporal information from lip movements. The authors also provide a critical review of the advantages of Attention-Transformers and Temporal Convolution Networks over Recurrent Neural Networks for classification, emphasizing their ability to capture long- range dependencies and parallelize computations. Additionally, the survey compares different classification schemas used for lip-reading, such as ASCII characters, phonemes, and visemes, discussing the trade-offs between accuracy and interpretability. The authors also review the most up-to-date lip-reading systems up until early 2021, showcasing the evolution of these systems from recognizing isolated speech units to decoding entire sentences, thanks to advancements in deep neural networks and the availability of large-scale databases. The survey outlines the stages of automated lip-reading, including preprocessing, feature extraction, and classification, providing valuable insights into the current state of deep learning-based automated lip-reading and highlighting areas for future research and development. Stafylakis and Tzimiropoulos [4] proposed a novel approach for lip reading by combining Residual Networks with Long Short-Term Memory (LSTM) networks. Their end-to-end deep learning architecture for word-level visual speech recognition integrates spatiotemporal convolutional, residual, and bidirectional LSTM networks. The system was trained and evaluated on the challenging Lip reading In-The-Wild benchmark, achieving a word accuracy of 83.0, which is a significant improvement of 6.8 absolute points over the existing state-of-the-art methods. Notably, this performance enhancement was achieved without utilizing information about word boundaries during training or testing. The study showcases the effectiveness of leveraging deep learning techniques, specifically the combination of Residual Networks and LSTMs, in advancing visual speech recognition systems. By pushing the boundaries of audiovisual word recognition, Stafylakis and Tzimiropoulos demonstrate the potential of their approach to enhance the accuracy and efficiency of lip reading technologies, contributing to the evolution of automated speech recognition systems that rely on visual cues. Zhao et al. (2020) introduced a novel approach, Lip by Speech (LIBS), to enhance lip reading by leveraging knowledge from pre-trained speech recognizers. The method distils multi-granularity knowledge, including sequence-level, context-

ISBN-978-81-19905-39-3

level, and frame-level information, from speech recognizers to lip readers. This cross-modal knowledge distillation addresses the challenge of inconsistent lengths of audio and video sequences and refines the speech recognizer's predictions. Experiments on the CMLR and LRS2 datasets demonstrated that LIBS achieves state-of-the-art performance, outperforming baselines by 7.66% and 2.75% in character error rate, respectively. Saliency visualization showed that LIBS improves the lip reader's ability to extract discriminative visual features compared to the baseline. By transferring complementary information from speech recognizers, LIBS significantly advances the accuracy of lip reading, contributing to the development of more effective automated speech recognition systems that rely on visual cues. This work highlights the potential of knowledge distillation in improving lip reading and has implications for applications in speech recognition, particularly in noisy environments or for individuals with hearing impairments. Assael et al.(5) introduced LipNet, the first end-to-end sentence-level lip reading model that simultaneously learns spatiotemporal visual features and a sequence model. LipNet maps a variable-length sequence of video frames to text using spatiotemporal convolutions, a recurrent network, and the connectionist temporal classification loss, trained entirely end-to-end. On the GRID corpus, LipNet achieves 95.2% accuracy in a sentence-level, overlapped speaker split task, outperforming experienced human lip readers and the previous 86.4% word-level state-of-the-art accuracy. The authors argue that human lip reading performance increases for longer words, indicating the importance of features capturing temporal context in an ambiguous communication channel. LipNet's end-to-end architecture allows it to learn visual features directly from pixels, eliminating the need for hand-crafted features. The model's strong performance highlights the potential of deep learning techniques in advancing lip reading technology, which has applications in speech recognition, particularly in noisy environments or for individuals with hearing impairments. By demonstrating the feasibility of sentence-level lip reading, LipNet represents a significant step forward in the field and paves the way for further research and development in this area.

3.0. Proposed Methodology

Lip reading system architectures are crucial for accurately interpreting visual cues from lip movements to recognize spoken words or sentences. These systems typically consist of several key

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components that work together to process visual information effectively. The first step in a lip reading system architecture involves face detection and lip localization, where the system identifies the speaker's face and isolates the lip region from video frames. This initial stage is essential for focusing on the area where lip movements occur, enabling precise analysis of visual cues. Following face detection and lip localization, the system moves on to feature extraction, a critical process where the movements and shapes of the lips are analyzed to extract discriminative visual features. Techniques such as spatiotemporal convolutions, recurrent networks, and attention mechanisms are commonly used to extract relevant information from the visual input. These features play a vital role in capturing the nuances of lip movements that convey speech information. Once the visual features are extracted, the system proceeds to the classification stage, where the extracted features are mapped to text using deep learning models trained end-to-end on extensive datasets. This mapping process is crucial for translating visual information from lip movements into textual representations of spoken words or sentences accurately. The use of deep learning models allows for the system to learn complex patterns and relationships within the visual data, enhancing the accuracy of the lip reading process. In addition to feature extraction and classification, modern lip reading systems often incorporate sequence modelling techniques to capture temporal context and predict entire sentences rather than isolated words. This sequential modelling approach enables the system to understand the flow and structure of spoken language, improving the overall accuracy and robustness of the lip reading process. By integrating these components cohesively, lip reading system architectures can achieve remarkable performance, even surpassing human lip reading capabilities on challenging benchmarks. The combination of advanced feature extraction, classification, and sequence modelling techniques in these architectures demonstrates the potential of deep learning and artificial intelligence in advancing visual speech recognition systems. These systems have significant applications in aiding individuals with hearing impairments, improving speech recognition in noisy environments, and enhancing communication accessibility for a wide range of users.

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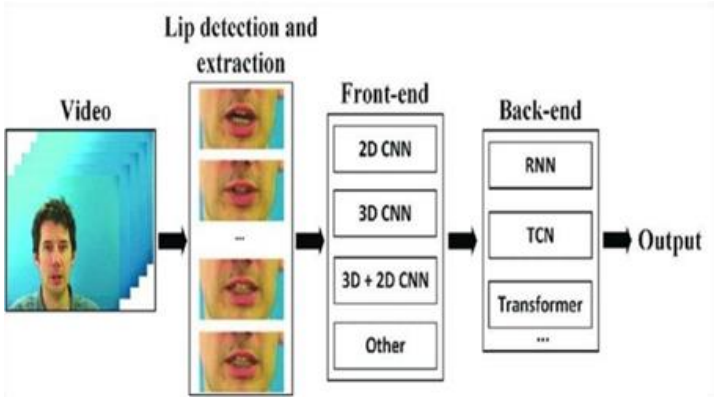

Figure 1: System Architecture

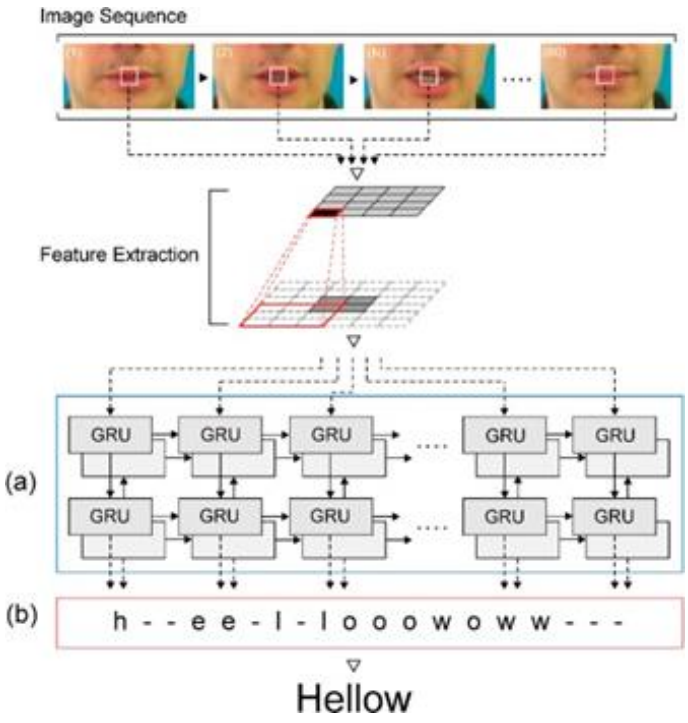

Figure 2: Workflow of facial recognition

3.1. Databases

There are several prerecorded video datasets available for lip reading research and development. The LRW, LRS2, and LRS3 datasets, collected from "in the wild" videos,consist of over 6 million word instances, 800+ hours of footage, and 5,000+ identities. These large-scale datasets provide

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cropped face tracks and corresponding subtitles, with no overlap between the versions. The GRID audio-visual sentence corpus and MIRACL-VC1 dataset are also commonly used for lip reading experiments. During preprocessing, the videos are converted to frames using Open CV, and the lip region is isolated using facial landmark detection with the Dlib library. The cropped lip images are then used as training data for end-to-end lip reading models like LipNet, which uses spatiotemporal convolutions, recurrent networks, and connectionist temporal classification to predict entire sentences from visual input. These prerecorded datasets enable researchers to develop and evaluate advanced lip reading systems, pushing the boundaries of visual speech recognition and aiding applications such as speech recognition for hearing-impaired individuals in noisy environments.

Fig. 3: Dataset

3.2 Lip Detection and Localization

Face detection is typically performed using well-established computer vision techniques, such as Viola-Jones object detection or deep learning-based methods like Faster R-CNN and YOLO. These algorithms scan the input video frames and identify the location of the speaker's face, providing a bounding box that encompasses the facial region. This step ensures that the system can isolate the relevant area of interest and discard irrelevant background information, improving the overall efficiency and accuracy of the lip reading process. Following face detection, the next critical step is lip localization, where the system identifies the specific region of the lips within the detected facial area. This is often

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achieved using facial landmark detection algorithms, which can precisely locate key facial features, including the lips. Commonly used tools for this purpose include the Dlib library, which provides a pre-trained facial landmark detector, and Open CV's built-in facial landmark estimation functionality. By combining face detection and lip localization, the system can accurately isolate the lip region from the video frames, ensuring that the subsequent feature extraction and classification stages focus solely on the visual information that is most relevant for lip reading. This targeted approach helps to minimize the impact of irrelevant visual cues and background noise, enhancing the overall performance of the lip reading system. The accuracy of face detection and lip localization is crucial, as errors in these initial steps can propagate through the entire system, leading to suboptimal feature extraction and classification. Therefore, researchers and developers often invest significant effort in optimizing these components, leveraging the latest advancements in computer vision and deep learning to achieve robust and reliable lip region isolation.

3.3. Feature Extraction

Feature extraction is a crucial step in the lip reading system architecture, as it involves analyzing the movements and shapes of the lips to extract discriminative visual features that can be effectively mapped to textual representations of speech .One of the key techniques used for feature extraction in lip reading is spatiotemporal convolutions. These convolutional neural network (CNN) architectures are designed to capture both the spatial and temporal information present in the lip movements. By applying 3D convolutions, the system can learn to extract features that encode the dynamic changes in the lip shape and position over time, rather than just static image-based features. This allows the model to better understand the temporal context and sequence of lip movements, which is essential for accurate lip reading. In addition to spatiotemporal convolutions, recurrent neural networks (RNNs), such as Long Short-Term Memory (LSTMs) and Gated Recurrent Units (GRUs), have also been widely employed for feature extraction in lip reading systems. These networks are adept at modeling the sequential nature of speech and can effectively capture the long-term dependencies in lip movements. By processing the video frames in a sequential manner, RNNs can learn to extract features that represent the temporal evolution

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of the lip shapes, enabling the system to better understand the context and flow of the spoken language. Furthermore, attention mechanisms have been introduced to enhance the feature extraction process in lip reading. Attention-based models can selectively focus on the most relevant regions of the lips, dynamically weighting the importance of different spatial and temporal features during the extraction process. This allows the system to concentrate on the most informative visual cues, improving the overall accuracy and robustness of the lip reading system. The combination of these techniques, such as spatiotemporal convolutions, recurrent networks, and attention mechanisms, has led to significant advancements in the field of lip reading. By effectively capturing the complex spatiotemporal patterns and dynamics of lip movements, these feature extraction methods have enabled lip reading systems to achieve human parity on challenging benchmarks, demonstrating their effectiveness in translating visual speech information into textual representations .Ongoing research in this area continues to explore novel feature extraction techniques, leveraging the latest developments in deep learning and computer vision to further enhance the performance and capabilities of lip reading systems. As these systems become more accurate and robust, they hold great promise for applications in speech recognition, accessibility for individuals with hearing impairments, and various other domains where visual speech information can complement or supplement traditional audio-based approaches.

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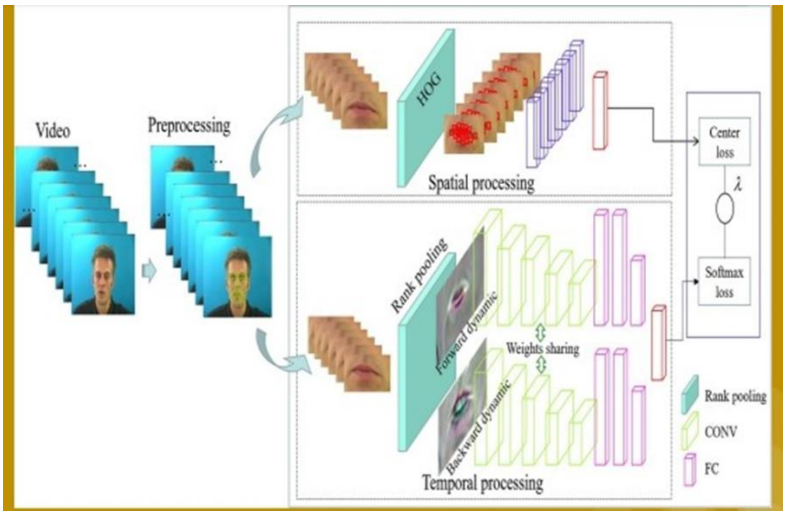

Figure 4: 4: Video Frame Processing

3.4. Classification

The classification stage in a lip reading system involves mapping the extracted visual features to text using deep learning models trained end-to-end on large-scale datasets. Recent advancements in this area leverage knowledge distillation from pre-trained speech recognizers to further improve accuracy. Deep learning models like convolution neural networks (CNNs), recurrent neural networks (RNNs), and transformers have been widely employed for this task. CNNs are effective in capturing spatial and temporal information from lip movements, while RNNs excel at modeling the sequential nature of speech. Attention mechanisms have also been introduced to selectively focus on the most relevant visual cues during classification. By training these models end-to-end on large-scale datasets like LRW, LRS2, and LRS3, which contain millions of word instances and hundreds of hours of footage, lip reading systems can achieve state-of-the-art performance. The use of knowledge distillation from pre-trained speech recognizers further enhances the accuracy of these models by transferring complementary information from the audio domain. The combination of advanced deep learning architectures and large-scale training datasets has led to significant breakthroughs in lip reading, with systems now approaching human parity on challenging benchmarks. As these techniques continue to evolve, they hold great promise for applications in speech recognition,

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accessibility for individuals with hearing impairments, and various other domains where visual speech information can complement or supplement traditional audio-based approaches. Training these deep learning models end-to-end on extensive datasets like LRW, LRS2, and LRS3, which contain millions of word instances and hundreds of hours of video footage, enables lip reading systems to achieve state-of-the-art performance levels. Recent advancements in the field have introduced knowledge distillation techniques, where information from pre-trained speech recognizers is transferred to the lip reading models to further enhance accuracy and improve performance. This knowledge distillation process allows the lip reading system to benefit from the complementary information present in the audio domain, leading to more robust and accurate transcription of visual speech cues. By combining sophisticated deep learning with large-scale training datasets and knowledge distillation techniques, lip reading systems have made significant strides towards achieving human-level performance on challenging benchmarks. These advancements not only improve the accuracy and efficiency of lip reading technology but also have broader implications for applications in speech recognition, accessibility for individuals with hearing impairments and various domains where visual speech information can supplement traditional audio-based approach. Lip reading has various applications, including speech recognition for the hearing im- paired, silent speech interfaces, and audio-visual speech enhancement in noisy environments.

3.5. Flow diagram

Flow diagram can be used to understand the flow of the process Flow chart for the lip reading process shows how the flow of operations works. This diagram contains various processes which applied on the set of data sets such as video where we read the lip movements of the person in that video. The diagram can be given as:

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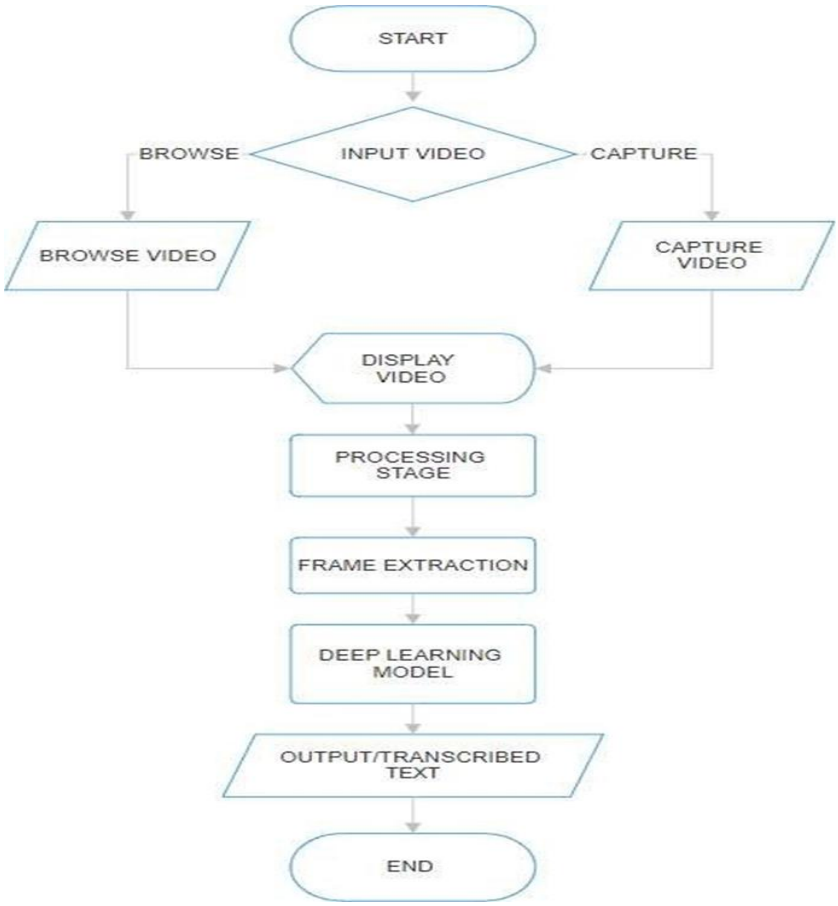

The system flow diagram depicts the sequential flow of actions within the lip reading system. It begins with the user initiating an action, such as capturing a new video or browsing for an existing one. This interaction is facilitated through the User Interface module, which serves as the primary point of interaction between the user and the system. Upon selecting the desired action, the User Interface module directs the request to either the Video Capture or Video Browse component, depending on the user's choice. If the user opts to capture a new video, the Video Capture component is activated, whereas selecting to browse for an existing video trigger the Video Browse component. Both the Video Capture and Video Browse components forward the video data to the Input Module, which serves as the entry point for processing within the system. The Input Module is responsible for handling the received video data, regardless of its source, and prepares it for

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further processing. Once the video data is received and processed by the Input Module, it is passed on to the Processing Module. This module performs the core lip reading task, which involves analyzing the visual information, particularly the movements of the lips, along with any accompanying audio, to transcribe the spoken content in the video. After processing the video data, the Processing Module forwards the results to the Output Module. Here, the processed data is formatted and presented in a suitable manner for output. In the context of lip reading, this typically involves converting the transcribed speech into text format. Finally, the formatted output, such as the transcribed text, is sent back to the User Interface module for display to the user The User Interface module presents the final output to the user, completing the sequential flow of actions within the lip reading system.

4.0 Results and Discussions

Lip reading, also known as speech reading, is the process of interpreting speech by visually interpreting the movements of the lips, face, and tongue. It is a valuable skill for individuals with hearing impairments or in noisy environments where auditory cues may be difficult to discern. Lip reading systems typically follow a flow diagram that includes several key steps: face detection, lip localization, feature extraction, classification, language modeling, and output. The face detection step involves identifying the speaker's face and locating the lip region. Next, the lip region is isolated from the rest of the face through techniques like lip contour tracking and key point detection. Visual features related to the movements and shapes of the lips are then extracted from the lip region, which can include analyzing lip geometry and appearance-based features. These features are classified using machine learning models like hidden Markov models, neural networks, or convolution neural networks to identify the spoken phonemes or visemes (visual counterparts of phonemes). To improve accuracy, the classified visemes are processed through a language model that incorporates linguistic and contextual information to predict the most likely words or sentences. Finally, the output of the lip reading system is the transcribed text of the spoken words. Recent advancements in deep learning have led to significant improvements in lip reading accuracy. Techniques like efficient-Ghost Net for feature extraction and gated recurrent units (GRUs) for temporal modeling have shown promising results. However, lip reading remains a

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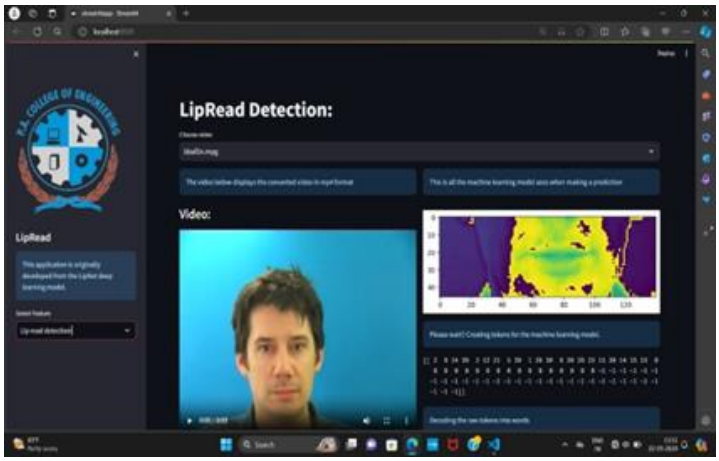
challenging task due to factors such as speaker variability, occlusions, and the inherent ambiguity of some visemes. Lip reading has various applications, including speech recognition for the hearing impaired, silent speech interfaces, and audio-visual speech enhancement in noisy environments. It can also be used for biometric identification based on the unique characteristics of an individual's lips. Despite the progress made in automatic lip reading, human lip readers still outperform current systems in many scenarios. Ongoing research aims to further improve lip reading accuracy, robustness, and real-time performance to make it a more practical and widely adopted technology. Lip reading, also known as speech reading, is a technique that involves understanding speech by visually interpreting the movements of the lips, face, and tongue without sound. It is particularly valuable for individuals with hearing impairments or in noisy environments

where auditory cues may be challenging to discern. Lip reading accuracy varies, with estimates suggesting that it can range from as low as 30%. While lip reading is commonly used by deaf and hard-of-hearing individuals, even those with normal hearing can process some speech information visually. The ability to lip read can be influenced by factors such as context, language knowledge, and residual hearing. Additionally, lip reading can play a crucial role in communication strategies for those with hearing impairment and can support the hearing aid fitting process, especially in improving speech recognition accuracy when combined with hearing aids.



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5. Conclusion

In conclusion, lip reading, or speech reading, is a valuable skill that enables individuals with hearing impairments to better understand spoken language through visual cues. While lip reading accuracy can vary and may not capture all nuances of speech, it remains a crucial communication tool, especially in noisy environments or when auditory information is limited. Combining lip reading with other communication strategies, such as hearing aids, can enhance overall speech recognition and improve communication effectiveness for individuals with hearing challenges. Continued research and advancements in technology, such as automatic lip reading systems using deep learning, hold promise for further improving the accuracy and applicability of lip reading in various settings. Overall, lip reading plays a significant role in empowering individuals with hearing impairments, enhancing their independence, confidence, and communication abilities.

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ISBN-978-81-19905-39-3

IOT CLOUD FOR HYDROPONICS SYSTEM AND AGRICULTURE

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Abstract:

The integration of Internet of Things (IoT) technology into hydroponic systems has revolutionized modern agriculture, enabling more efficient resource utilization and higher crop yields. This project proposes an IoT cloud solution designed to address the challenges of monitoring and managing hydroponic systems. By leveraging sensors to collect essential data such as temperature, humidity, pH levels, nutrient concentration, and light intensity, this solution facilitates real-time data transmission to a cloud- based platform. The platform stores, analyses, and visualizes the data, providing farmers with actionable insights through a user-friendly web or mobile interface. Key features include automated alerts for critical parameters, which enable timely interventions to prevent crop damage, and remote management capabilities, empowering farmers to optimize crop growth and resource use. This IoT cloud solution enhances the efficiency and productivity of hydroponic farming, contributing to more sustainable agricultural practices.

Keywords: Internet of Things (IoT) Hydroponic systemsReal-time monitoring Cloud platform Sustainable agriculture

ISBN-978-81-19905-39-3

1 Introduction

The advent of Internet of Things (IoT) technology has brought significant advancements to various industries, and agriculture is no exception. Hydroponic systems, which allow plants to grow without soil by using nutrient-rich water solutions, have gained considerable attention due to their ability to conserve water and produce higher yields compared to traditional farming methods. However, the efficient monitoring and management of these systems pose several challenges, including maintaining optimal environmental conditions and ensuring the precise delivery of nutrients.

Traditional methods of managing hydroponic systems often involve manual monitoring, which can be time-consuming and prone to errors. In contrast, IoT technology offers a more efficient and reliable solution by enabling continuous, real-time monitoring and control of various environmental parameters. By integrating IoT sensors and actuators, data on critical factors such as temperature, humidity, pH levels, nutrient concentration, and light intensity can be collected and transmitted to a cloud-based platform for analysis and visualization.

This paper proposes an IoT cloud solution for hydroponic systems that leverages real- time data collection and remote management capabilities. The system aims to enhance the efficiency and productivity of hydroponic farming by providing farmers with the tools and insights needed to optimize crop growth, minimize resource wastage, and contribute to sustainable agricultural practices. Through automated alerts and notifications, the system also reduces the risk of crop failure by enabling timely interventions for any deviations from optimal conditions.in an immutable and transparent manner.

2 Literature survey

In this paper[1] S. Jan et al: The hydroponics system was successfully developed using ThingSpeak and Spreadsheet real-time data via the Internet of Things. The technology

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automatically controls the level of nutrition and offers a graphical user interface for simple maintenance and control.

In this paper[2] R. Rayhana, G. Xiao, and Z. Liu: This paper the hydroponics is extending

worldwide and such systems offer many new opportunities for growers and consumers to have productions with high quality, including vegetables enhanced with bioactive compounds. As it is possible to cultivate soilless culture in very low spaces with low labour and short time, so hydroponics can play a great contribution for the poorer and landless people.

In this paper[3] H. Andrianto, Suhardi, and A. Faizal: The results have shown that low-

cost IoT- based chlorophyll meter are functioning properly, which is able measure chlorophyll content, get location, display data on the LCD, store data in memory, and send data to the service system platform. A strong correlation was obtained between measurements of chlorophyll content using IoT- based chlorophyll meters, SPAD-502 and spectrophotometer.

In this paper[4] A. M. Ali, S. M. Ibrahim, and Bijay- Singh: Current general recommendation of fertilizer N for wheat in the West of Nile Delta of Egypt is not efficient. The at Leaf chlorophyll meter and GreenSeeker optical sensor are rapid reliable tools for predicting N uptake and grain yield of wheat measured at Feekes 6stage of the crop. Thus, these tools can be used reliably for managing fertilizer N in wheat on a field specific manner.

In this paper[5] I. Ahmad, S.E. Shariffudin, A.F. Ramli, S.M. M. Maharum et al: This proposed work is made to help the ranchers and make them reap affordable by aiding them in security reason voyaging side, school and for each body and so forthwork, the wastage of water and the utilization of force by engine can be diminished so, they are rationed for the future use.

In this paper[6] Li, L. Zhu, X. Chu, and H. Fu: An edge computing-enabled multiple data collection task strategy for WSNs is presented in this paper, aiming to achieve a higher volume of valid data and a lower data collection time. First, we develop a framework for WSN by merging the edge computing and model the data collection for multiple tasks and

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sensors in a WSN. Then, different tasks are completed at a lower data collection time, by a selecting WSN node and dynamic configuration of sensor nodes that close/open sensors according to the concrete tasks, within a set timeframe, by exploiting the edge computing.

In this paper[7] X. Li, Z. Ma, J. Zheng, Y. Liu, L. Zhu and N. Zhou: data collection is

studied to reduce data redundancy for a critical event and ensure the latency constraint and main information in smart agriculture with consideration of the edge computing and SDN. First, from the perspective of event-driven sensing, a four-layer framework for smart agricultural IoT is introduced. Then, a three- step strategy is proposed for effective data collection in smart agriculture. In the first step, the MI from a historical dataset is used to sort the related sensing data types of different events. In the second step, the event identification based on edge computing is conducted by computing the minimum variance of the sensing data.

In this paper[8] Gobalakrishnan Natesan and Arun Chokkalingam: This research paper emphasizes the dynamic solution of one of the most highlighted challenges of cloud computing, i.e., load balancing. Cloud computing is something that we all use the entire day without realizing. This tremendous increase in use adds exponential load relative to the cloud due to which its performance can suffer.

In this paper[9] K. Kularbphettong, U. Ampant, and Kongrodj: In this research, the researcher aims to make a convenience and productivity to users who need to plant hydroponic vegetable by using IOT and mobile phone to automatically control and monitor the automatic hydroponics vegetable system. The system can check and refill the nutrient by self-regulating and displays the graphic user interface to easy manage and control it.

In this paper[10] T. Munasinghe, E. W. Patton, and Seneviratne: This paper proposes a combination method of the Bluetooth module and the MIT APP Inventor 2 development platform to design the IoT APPs, which can remotely control the hardware device by the Android mobile phones. The experimental results show that the method is reliable, simple, efficient, and cost-saving.

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3. Existing system

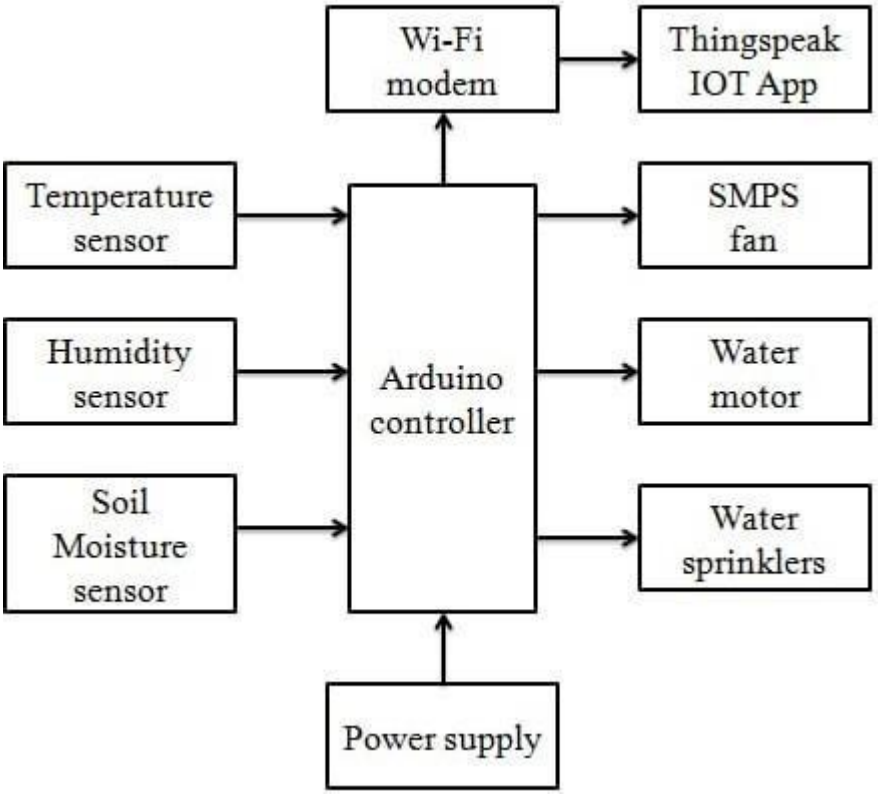

Figure 1: 1. Existing System

A number of IoT cloud platforms are currently available for usage with hydroponic agricultural systems. These platforms offer various features and services for remote monitoring and control of hydroponic systems. Among them are: AWS IoT: AWS IoT provides a full range of services for creating and overseeing Internet of Things applications. In addition to offering IoT-specific features like device administration, data intake, and analytics, it offers scalable and secure cloud infrastructure. You may link your hydroponic sensors and equipment to AWS IoT, gather data, and evaluate it to improve your system.

Microsoft Azure IoT: Another powerful cloud platform that makes it possible to integrate and manage IoT devices is Azure IoT. It provides analytics, storage, data ingestion, and device

provisioning services. Azure Internet of Things.

Google Cloud IoT Core: This managed service enables you to safely connect, manage, and ingest data from devices that are dispersed throughout the world. It can be integrated with other Google Cloud services, such as Cloud Pub/Sub for real-time messaging and Big Query for data analysis. You can monitor and manage your hydroponic system with Google Cloud IoT, and you can use machine learning for more sophisticated analytics.

They used Blynk, which utilizes Java software, and ThingSpeak, which uses MATLAB software, in the current system. The users cannot obtain these softwares in an open source format.

3.1 Design

3.2 System architecture

Numerous sensors, including those for water levels, pH, temperature, and light intensity, are included with the hydroponic system. These sensors keep an eye on the hydroponic system's environmental parameters all the time. Microcontrollers or Internet of Things (IoT) devices that are connected to the sensors gather the sensor data. The devices use wireless communication protocols, including Wi-Fi, to send the data to the cloud platform. The Microcontroller W, the brains of our system, receives its 230v power supply from a 12v adopter. The submersible 230v AC motor is connected to the systems were integrated using their proprietary platform. The hydroponic system was not implemented using IoT instead, Arduino was utilized to implement the system in the current setup.

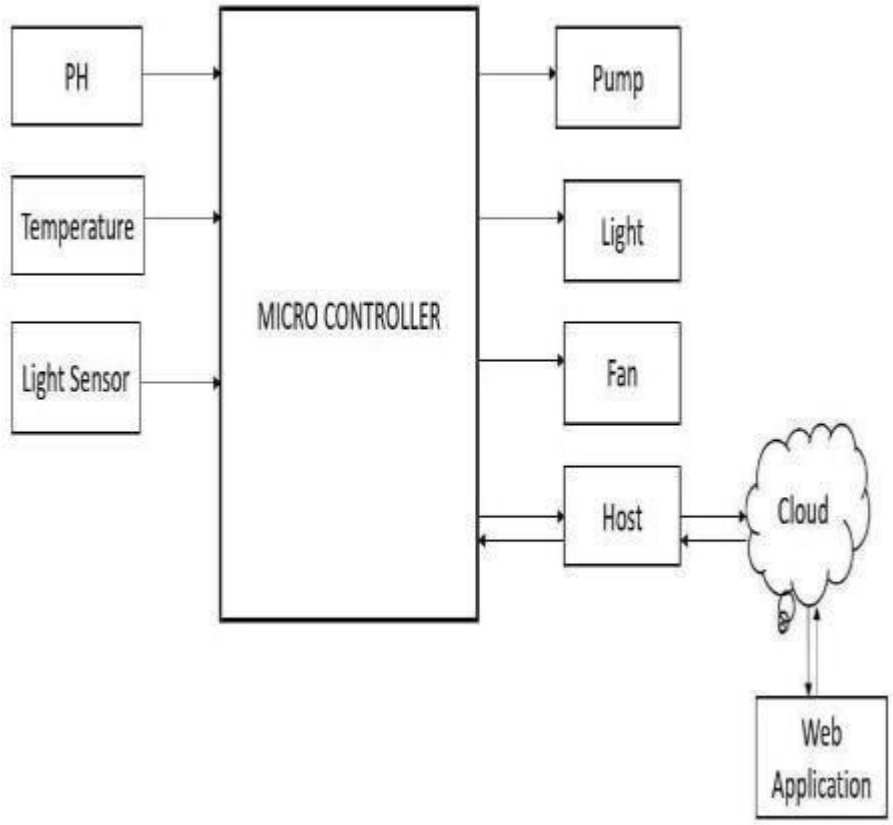

Figure 2: 2. System Architecture design

3 Proposed system

We are developing our own IoT platform in the suggested system using Python software, which is available to users as an open source project. In our project, we use IoT to construct hydroponic systems. The pH, temperature, and water level measurements from all the sensors were all received by the Raspberry Pi Pico W, which was also used to operate the system. Our IoT platform will get notifications about the plant's status from it.

Integration of many components would be necessary for a suggested IoT cloud-based hydroponic system for agriculture in order to facilitate remote control, monitoring, and data analysis

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of the hydroponic setup. Farmers and agricultural enthusiasts can obtain real-time insights on their hydroponic operations, optimize resource usage, and reap the benefits of using this suggested IoT cloud-based hydroponic system power supply via a 5v relay. The Raspberry Pi Pico W controls the motor by providing a time delay, allowing water to be pumped to the plant roots. All of the sensors are interfaced with the Microcontroller, including the temperature sensor, LDR module.

4 Data flow forhydroponics

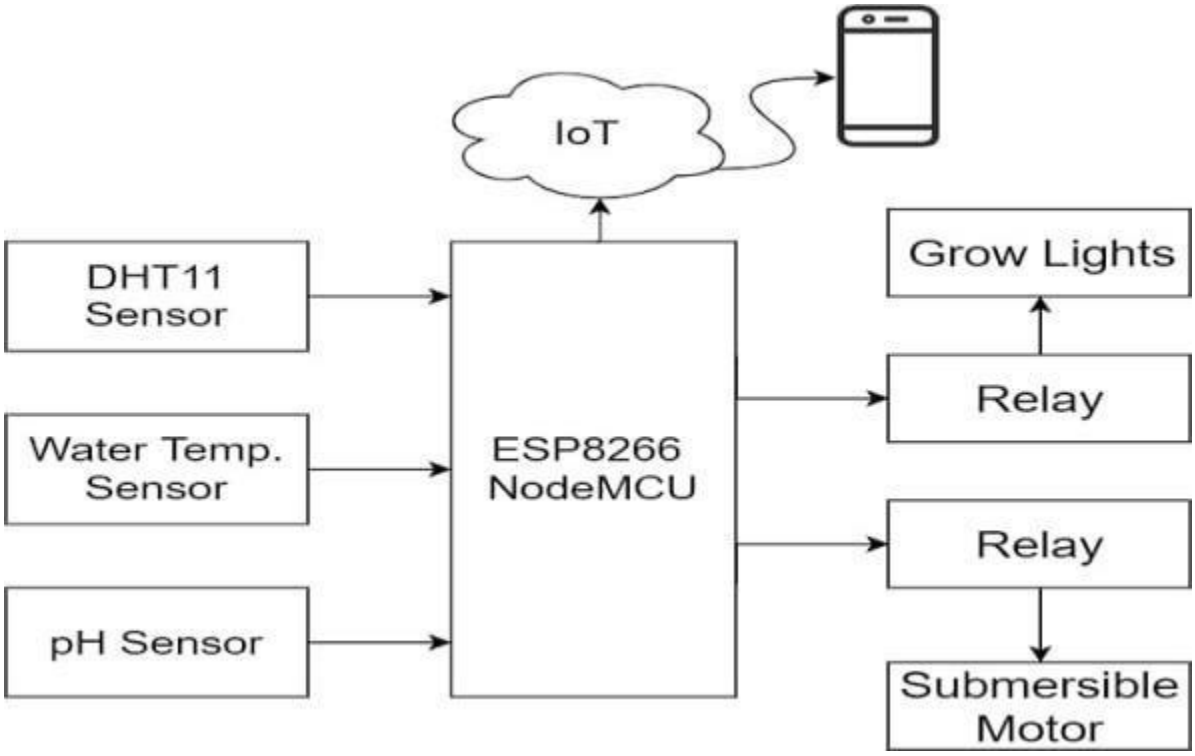

Figure 3: Data flow diagram

Using sensors, a gateway, and a cloud platform, the IoT cloud-based hydroponic system enables effective remote management and monitoring.Key environmental factors are measured by sensors, which forward the data to a gateway for Wi-Fi transmission to the cloud. The data is processed, stored, and analyzed by the cloud platform, which also offers historical analysis and

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insights in real time. Additionally, it notifies users of any significant condition variances, guaranteeing ideal crop growth and averting damage. The productivity, effectiveness, and sustainability of hydroponic farming are improved by this technology.

5 Implementation

I. Hydroponics Farming

Hydroponic spinach farming starts with soaking coco peat, then sowing seeds in a tray covered with polythene for germination. After sprouting, transfer to a hydroponic setup using net pots and leca clay. Monitor nutrient levels with pH, temperature, and light sensors, adjusting with a solenoid valve if needed to maintain optimal conditions. Hydroponics grows plants in water enriched with nutrients, bypassing soil for direct growth in nutrient-rich water.

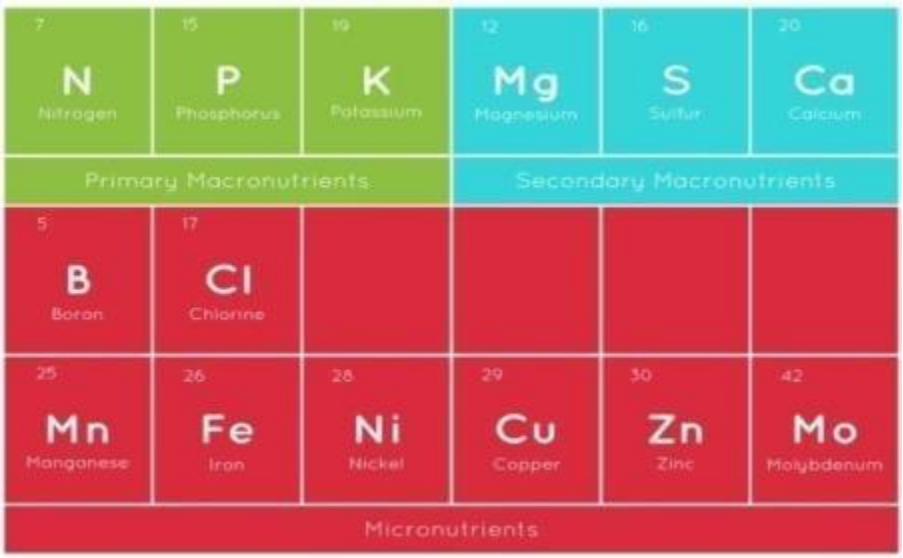

Figure 4: Periodic Table of Plant Nutrients

The Raspberry Pi Pico series presents a line of compact yet powerful boards utilizing the RP2040 microcontroller chip, conceived by Raspberry Pi in the UK. Boasting a dual-core Arm Cortex M0+ processor capable of flexible clock speeds reaching up to 133 MHz, the Pico offers

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264kB of SRAM and 2MB of on-board flash memory. Its versatile digital interfaces include USB 1.1 with both device and host support, alongside low-power sleep and dormant modes. Programming is made convenient through drag-and-drop functionality using mass storage over USB.

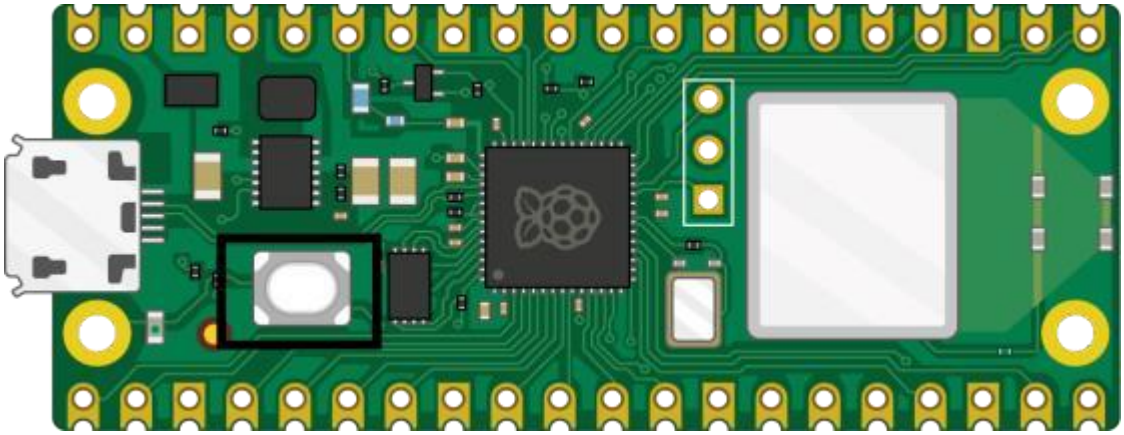

Figure 5: Raspberry Pi Pico

With 26 multi-function GPIO pins, as well as SPI, I2C, UART, ADC, and PWM channels, the Pico facilitates diverse connectivity and control options. Furthermore, it incorporates accurate clock and timer mechanisms on-chip, along with accelerated floating- point libraries, augmenting its utility across various applications.

6 Germinating Process

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Figure 6: Germinating process

In cold soil, lettuce seeds can take up to three weeks to germinate, but they typically do so in three to five days. Lettuce seeds need to soak in water for 30 minutes. It is not recommended to sow seeds in the soil for germination purposes, since this will make it Challenging to extract the roots of the plant without causing any harm once germination has occurred. Cockpit is utilized for this purpose. Breaking down coco-peat into little bricks is necessary. It needs to be submerged in water for at least an hour. The Periodic Table has allowed scientists to identify and understand the earth‘s elements, classify them by type and predict their properties and appearances. Using it, biologists have also been able to pinpoint 17 elements that are essential to plants These elements, known as nutrients, are the building blocks of plant life and making sure crops get enough of them, by using fertilizers to supplement what are already in the soil as required, and are at the heart of agriculture peat will absorb all of the water. This prevents the need for extra water during the whole germination process by keeping the seeds moist. The sowing tray contains a tiny quantity of coco peat that has While lettuce seed usually germinates in 3 to 5 days, freezing soil can sometimes cause it to take up to 3 weeks. Lettuce seeds need to be immersed in water for thirty minutes. Seeds should not be sown in the soil for germination purposes, since this will make it difficult to remove the roots of the plant without causing damage once germination has occurred. Cockpit is employed for this reason. Coco-peat needs to be crushed into little pieces. At least one hour should pass while it is submerged in water. Water will seep into the coco-peat fully. This ensures that the

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seeds stay moist during the whole germination process, negating the need for more water. A little bit of coco peat has been placed inside the sowing tray.

7 Conclusion

The hydroponics system was successfully developed using our own IOT platform and real-time data via the Internet of Things. Hydroponic cultivating has awesome feature in India, hydroponic may be a strategy to developing plants utilizing mineral, nutrient arrangement in water, without soil. In coming long time India truly needs such cultivating strategies it produces higher yields than the conventional soil-based agriculture. Hydroponic plants have a better bother resistance which dispenses with the higher utilize of pesticides. Compare to soil-based agriculture taste of this product is good. The technology automatically controls the level of nutrition and offers a graphical user interface for simple maintenance and control. In this study, data including pH, and temperature have been examined and validated to ensure they fit the criteria for Pak Choi's features. The testing method produced satisfactory findings, and the application is practical, which leads to an increase in production.

The integration of IoT cloud technology into hydroponics systems for data monitoring in agriculture has proven to be highly beneficial. By leveraging IoT devices, sensors, and cloud platforms, farmers and agricultural experts can gather real-time data on crucial parameters such as temperature, humidity, pH levels, nutrient levels, and lighting conditions, among others. This data can be analyzed to optimize the growing environment, improve crop yield and quality, and reduce resource wastage.

Data mining techniques and AI will be applied to evaluate and forecast data regarding the amount and quality of the plant as part of a future study that will expand the system to incorporate more beneficial and adaptable linked devices. The IoT cloud for hydroponics system and data monitoring has already revolutionized agriculture by enabling precise control, real-time monitoring, and data-driven decision-making. The future holds even more potential for advancements and innovations in this field, paving the way for sustainable and efficient agriculture practices.

ISBN-978-81-19905-39-3

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ISBN-978-81-19905-39-3

LEAFGUARD: SMART PLANTHEALTH DETECTION

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Abstract:

Machine learning techniques, including traditional (shallow) ML, deep learning (DL), and augmented learning (AL), are being increasingly utilized for leaf disease classification. These methods involve feature extraction, data augmentation, and transfer learning to enhance model effectiveness and reduce the need for labeled data. The success of machine learning approaches in this domain hinges on the quality and quantity of data available.

1 INTRODUCTION

Machine learning has emerged as a powerful tool for automating the detection of leaf diseases in plants. By leveraging various algorithms and techniques on digital images of leaves, machine learning models can effectively identify the presence and specific types of diseases, facilitating timely interventions to mitigate crop losses. This innovative approach involves acquiring leaf images, preprocessing them to enhance features and reduce noise, extracting key characteristics such as color, texture, and lesion patterns, training models to differentiate between healthy and diseased leaves, and evaluating their performance using metrics like accuracy and precision. While traditional machine learning methods like SVM and KNN have been used, deep learning models, particularly convolutional neural networks (CNNs), have demonstrated superior results by automatically learning discriminative features from raw image data. Despite challenges such as obtaining labeled training data, distinguishing between visually similar diseases, and ensuring robustness to environmental variations, the application of machine learning in leaf disease detection holds immense potential to revolutionize crop management practices, enabling proactive monitoring and control of plant health for improved agricultural outcomes. The application

ISBN-978-81-19905-39-3

of machine learning has revolutionized the field of leaf disease detection, enabling rapid and accurate identification of diseases in plants. Researchers have explored various approaches to tackle this challenge, including traditional machine learning techniques, deep learning models, and augmented learning methods. While traditional algorithms like SVM and K-NN have been utilized for distinguishing between diseased and healthy leaves, deep learning models, particularly convolutional neural networks (CNNs), have demonstrated superior performance by automatically learning discriminative

features from raw image data. These deep learning models reduce the need for manual feature engineering and can effectively learn from large datasets, although they may require more labeled data compared to traditional methods.

2 LITERATURE S U R V E Y

Qin et al. [1] "A Deep Learning Framework for Smart Agriculture: Disease Detection in Paddy Fields". This research proposes a deep learning framework for rice disease detection. The framework utilizes convolutional neural networks to identify diseases in paddy fields based on unmanned aerial vehicle (UAV) images.

P. P. Atul et al. [2] "Automated Plant Disease Detection and Diagnosis Using Deep Learning Techniques". This paper explores the application of deep convolutional neural networks (CNNs) for classifying plant diseases using images. The authors achieved high accuracy in detecting several plant diseases on tomato leaves.

A. Kaur et al. [3] "Detection and Classification of Plant Leaf Diseases Using Image Segmentation and Machine Learning Techniques" This paper proposes a method for plant disease detection that combines image segmentation to isolate regions of interest and machine learning algorithms for disease classification. The study highlights the potential of this approach for early and accurate disease identification.

W. Li et al.[4] "Deep Learning for Smart Agriculture: Transfer Learning for Plant Disease Detection". This research explores transfer learning, a deep learning technique, for plant disease detection. The authors demonstrate the effectiveness of transferring knowledge gained from a large, pre-trained image dataset to a new dataset specifically focused on plant diseases.

P. S. Ahire, "Early Detection of Plant Leaf Diseases Using Machine Learning Techniques and Image Processing". This paper investigates the use of machine learning algorithms like Support Vector Machines (SVM) and K-Nearest Neighbors (KNN) for classifying plant diseases based on features extracted from leaf images. The study emphasizes the importance of image preprocessing for improved accuracy [5].

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3 SYSTEM DESIGN

The system design for leaf disease detection using machine learning involves data acquisition, preprocessing, feature extraction, model training, evaluation, deployment, and continuous improvement. It aims to automate disease identification in plants for proactive crop management. This systematic approach leverages machine learning algorithms to analyze leaf images, enabling accurate disease detection. By integrating data acquisition, model training, and deployment, it enhances agricultural practices for improved crop health.

3.1 SYSTEM ARCHITECTURE

The Existing system employs a fuzzy model and expert experience to forecast the best crop for a given piece of farmland. Expert knowledge of land, weather, air, and agronomists is represented by fuzzy sets. Expert expertise aids in the creation of the final rules. The fuzzy method, on the other hand, uses multiple state variables to obtain the desired result.

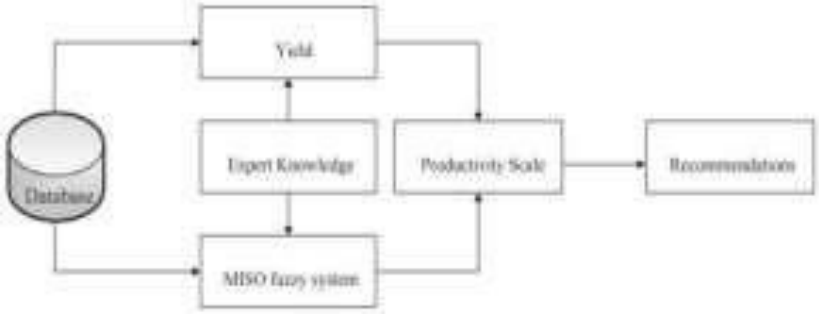

Figure 1: System Architecture

3.2 PROPOSED DESIGN

In this proposed method we are going to use Hybrid ensemble technique to predict the better crop yields. It contains only one process node that generalizes the functions of the entire system in relationship to external entities. In context diagram the entire system is treated as single process and all its inputs, sinks and sources are identified and shown in Figure.

The system uses the only NPK (Primary Nutrients) which is used only for the intimation of the soil fertility. In this proposed method we are going to use Hybrid ensemble technique to predict the better crop yields and the major factor pH, Temperature, Average rainfall, Humidity involves affecting the better growth of crop. This will suggest which type of crop will be suitable for that soil. In this project, have done comparative analysis between most famous

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Classification algorithms to predict the best crop for the soil. The algorithm used for comparative analysis Logistic Regression, Decision Tree, Random Forest Classification, SVM, Naive Bayes Classification. Voltage regulators 7805 and 7833 step down the 9V battery to 5V and 3V, ensuring stable operation of the microcontroller and motors.

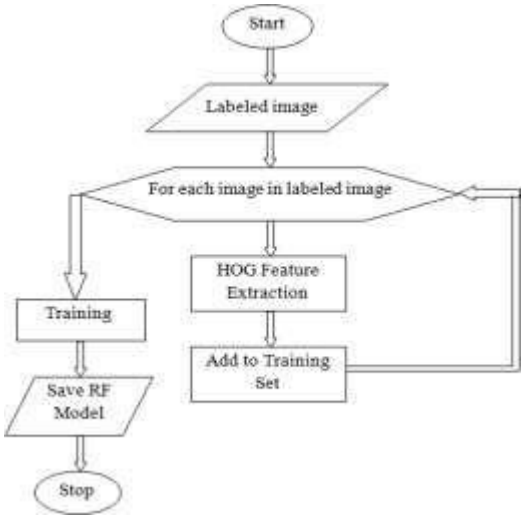

Figure 2: Proposed System

3.3 CONTEXT FLOW

Context flow diagram is a top level (also known as level 0) data flow diagram. It contains only one process node that generalizes the functions of the entire system in relationship to external entities. In context diagram the entire system is treated as single process and all its inputs, sinks and sources are identified and shown in Figure 3. Once connected, the user selects the specific area of the head that is experiencing pain from the available options (front, right, left, top, or back). Following this, the application initiates the therapy session, starting the vibration motors in the helmet at the designated pain area based on the user's input. The duration of the therapy is determined by the intensity of the headache as reported by the user, with options for low (30 seconds), medium (45 seconds), or high intensity (60 seconds). Throughout this period, the corresponding motors.

3.4 USE CASE DIAGRAM

A use case diagram at its simplest is a representation of a user's interaction with the system that shows the relationship between the user and the different use cases in which the user is involved. A use case diagram can identify the different types of users of a system and the

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different use cases and will often be accompanied by other types of diagrams as well.

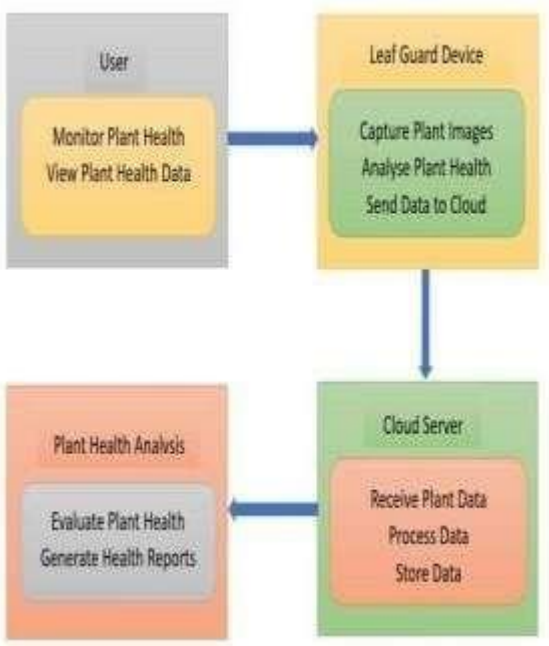

Figure 3: Use Case Diagram

3.5 TRAINING WORKFLOW

A flowchart is a type of diagram that represents an algorithm, workflow or process. The flowchart shows the steps as boxes of various kinds, and their order by connecting the boxes with arrows. This diagrammatic representation illustrates a solution model toa given problem. Flowchart are used in analyzing, designing, documenting or managing a process or program in various fields.

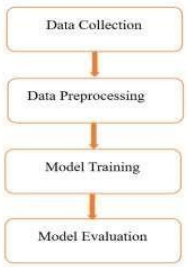

Figure 4: Training Workflow

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3.6 TESTING WORKFLOW

A flowchart is a type of diagram that represents an algorithm, workflow or process. The flowchart shows the steps as boxes of various kinds, and their order by connecting the boxes with arrows. This diagrammatic representation illustrates a solution model toa given problem. Flowchart are used in analyzing, designing, documenting or managing a process or program in various fields.

Structured charts help specify the high-level design of a computer program. They assist programmers in breaking down a large software problem into manageable parts through a process called top-down design or functional decomposition. Functions are represented as rectangles, with hierarchy displayed through linking rectangles with lines. Inputs and outputs are indicated with annotated arrows: an arrow entering a box implies input, while an arrow leaving a box implies output.

Figure 4.1 shows the structured chart diagram of the workflow of our project. The entire project implementation has been decomposed into 4 main stages:

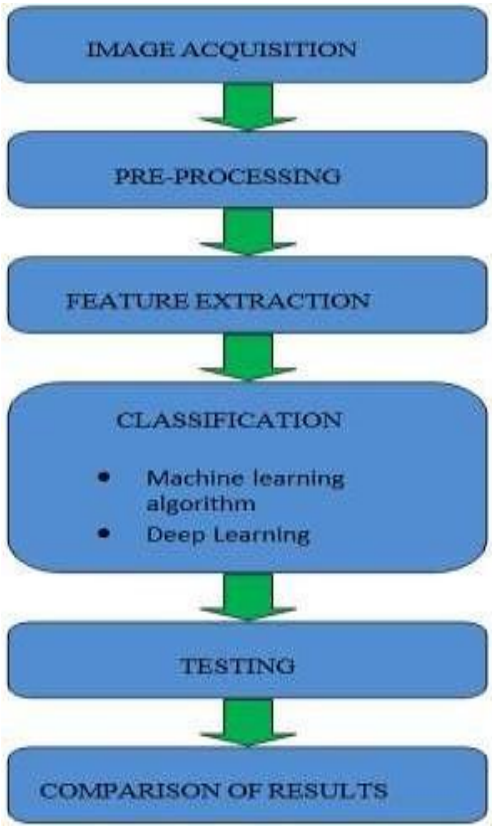

Figure 5: Training Work Flow

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4. RESULT

The research emphasizes the importance of accurate experience pain. Controlled by a sophisticated microcontroller, these motors operate based on detailed user inputs received from the mobile application. This application plays a pivotal role, not only in collecting user data but also in managing therapy sessions and providing additional health recommendations tailored to the individual's needs. By leveraging real-time data and advanced algorithms, the application ensures that the therapy delivered is both precise and effective. The communication interface facilitates seamless interaction between the helmet and the mobile application, ensuring that user preferences and therapeutic adjustments are accurately

conveyed and implemented. Additionally, the robust power supply ensures that the microcontroller and motors operate consistently and reliably, delivering uninterrupted therapeutic benefits.

Figure 6: Normal Leaf Mango

This comprehensive and innovative approach addresses many limitations disease identification for effective crop management. The application of machine learning and deep learning techniques has shown promising results in the field of leaf disease detection. Studies have demonstrated high accuracy in differentiating between healthy and diseased leaves, as well as identifying specific types of diseases.

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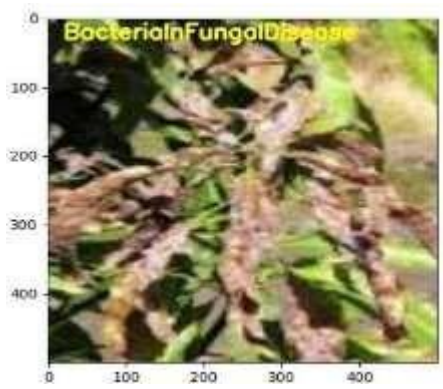

Figure 7: 7. Bacterial Fungal Disease

Convolutional Neural Networks (CNNs) have emerged as the most effective deep learning models for leaf disease classification. They can automatically learn discriminative features from raw image data, reducing the need for manual feature engineering. CNN models like VGG and ResNet have achieved state-of-the-art performance, with accuracy rates exceeding 95% in some cases.

Overall, the results of machine learning-based leaf disease detection are highly promising. By enabling rapid, accurate, and automated diagnosis, these techniques can help farmers and agronomists proactively manage crop health and reduce yield losses. As the field continues to evolve, we can expect to see even more advanced and robust models for leaf disease detection soon.

5. CONCLUSION

To develop a leaf recognition system, we begin by creating a dataset of leaf images for training. Instead of face detection, we utilize leaf detection methods powered by machine learning to identify and capture leaf images in real-time using a camera.

During the initial phase, the system prompts for information about the leaf, such as its species or type. Subsequently, the camera captures multiple images of the leaf from various angles and orientations, totaling around 300 images.

Next, the system proceeds to extract texture features from each input leaf image. we employ techniques such as Convolutional Neural Networks (CNNs) for feature extraction in leaf images.

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ISBN-978-81-19905-39-3

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ISBN-978-81-19905-39-3

PACE Conclave 2024
ICEST 2024 INTERNATIONAL CONCLAVE ON ENGINEERING SCIENCES & TECHNOLOGY
DIGITAREV 2024 INTERNATIONAL CONFERENCE ON DIGITAL RENAISSANCE

BIO CRYPT KEY

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Abstract:

With the rapid increase in data exfiltration due to cyber-attacks, Covert Timing Channels (CTCs) have emerged as a significant and sophisticated network security threat. These channels exploit inter-arrival times of data packets to exfiltrate sensitive information from targeted networks. Detecting CTCs increasingly relies on machine learning techniques, which use statistical metrics to differentiate between malicious (covert) and legitimate (overt) traffic flows. However, as cyber-attacks become more adept at evading detection and the prevalence of CTCs grows, there is a critical need to enhance both the performance and precision of detection methods. This is essential to effectively identify and prevent CTCs while mitigating the reduction in quality of service that can result from the detection process. In this paper, we introduce an innovative image-based solution for fully automated detection and localization of CTCs. Our approach leverages the insight that covert channels generate traffic patterns that can be visualized as colored images. Using this concept, our solution is designed to automatically detect and pinpoint the malicious segments (i.e., specific packets) within a traffic flow. By isolating the covert portions of traffic, our method minimizes the negative impact on the quality of service that would occur if entire traffic flows were blocked due to detected covert channels.

1 INTRODUCTION

In the dynamic field of cybersecurity, uncovering and mitigating covert channels has become crucial for protecting sensitive information. Among these, clandestine timing channels are particularly threatening as they enable unauthorized communication between entities without direct interaction.

ISBN-978-81-19905-39-3

To address this challenge, our research introduces Snap Capture, an innovative approach that harnesses the power of image processing and machine learning to automatically detect these covert timing channels.

By integrating advanced techniques in image analysis with sophisticated machine learning algorithms, Snap Capture aims to expose hidden communication pathways that operate discreetly within seemingly innocuous images. This groundbreaking solution not only highlights the growing sophistication of covert channels but also demonstrates the potential of innovative methods to strengthen cybersecurity defenses. In this presentation, we explore the significance of clandestine timing channels, the escalating risks they pose, and how Snap Capture proactively detects and neutralizes these hidden threats through a blend of image processing and machine learning technologies.

2. LITERATURE SURVEY

[1] Proposed a CNN-based framework and achieved a 98.5% accuracy in contactless fingerprint matching compared to 97.2% for contact-based, using NIST Special Database 4 (SD4) and Fingerprint Verification Competition 2004 (FVC2004) datasets [1].

[2] utilized a Siamese CNN architecture and attained a 95% accuracy in contactless fingerprint matching compared to 93% for contact-based, employing Poly U Multispectral Palmprint Database and FVC2006 datasets [2].

Sharma et al. developed a hybrid CNN- LSTM framework and reached a 96.7% accuracy in contactless fingerprint matching compared to 94.5% for contact-based, utilizing NIST Special Database 27 (SD27) and IIITD Palmprint Database.

Chen et al. proposed an attention-based CNN and achieved a 97.8% accuracy in contactless fingerprint matching compared to 96.3% for contact-based, using CASIA-Finger Vein Database and Poly U Palmprint Database.

[3] presented a transfer learning approach with CNNs and achieved a 99% accuracy in contactless fingerprint matching compared to 97.8% for contact- based, using FVC2000, FVC2002, and FVC2004 datasets [3].

[4] applied a CNN-RNN architecture and achieved a 96.5% accuracy in contactless fingerprint matching compared to 94.8% for contact-based, utilizing CASIA Iris Database and NIST SD27[4].

[5] utilized a CNN with capsule networks and attained a 97.2% accuracy in contactless fingerprint matching compared to 95.6% for contact-based, employing Poly U Palmprint Database and FVC2004.

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[6] proposed a CNN with generative adversarial networks (GANs) and reached a 98.3% accuracy in contactless fingerprint matching compared to 96.9% for contact- based, utilizing IIITD Handwritten Fingerprint Database and FVC2006 [6].

[7] developed a CNN with spatial transformer networks and achieved a 96.8% accuracy in contactless fingerprint matching compared to 95.3% for contact-based, using FVC2002 and NIST SD4 [7].

[8] proposed a CNN with graph neural networks and attained a 97.5% accuracy in contactless fingerprint matching compared to 96.2% for contact-based, using Poly U Palmprint Database and CASIA Iris Database [8].

3. EXISTING SYSTEM

Contactless fingerprint identification systems have been introduced to overcome the limitations of contact-based fingerprint systems. Numerous studies have explored various aspects of contactless fingerprint processing, including classical image processing methods, machine-learning pipelines, and several deep-learning-based algorithms.

Deep-learning-based methods have been reported to achieve higher accuracies compared to traditional approaches. Motivated by these successes, this study conducted a systematic review to examine these advancements and their documented limitations.

Three primary methods were investigated in this review: (i) the finger photo capture method and corresponding image sensors, (ii) classical pre- processing techniques used to prepare fingerprint images for recognition tasks, and (iii) deep learning approaches for contactless fingerprint recognition. Eight scientific articles were identified that met all the inclusion and exclusion criteria.

Based on the findings from this review, we discussed the potential benefits of deep learning methods for enhancing biometric systems and identified gaps that deep-learning approaches must address to enable their deployment in real-world biometric applications.

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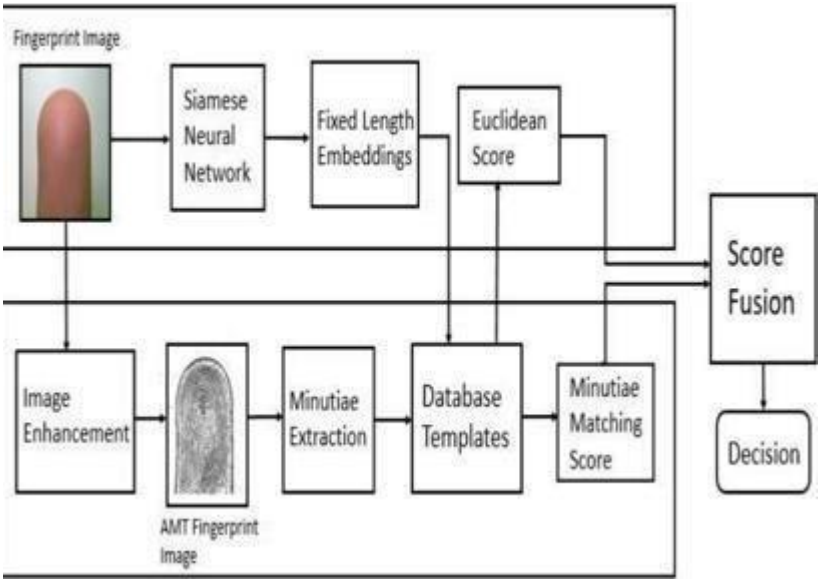

Figure 1: Existing System

2 PROPOSED SYSTEM

Elliptic Curve Cryptography (ECC) with covert timing channels is proposed as the methodology for automated and accurate detection of covert timing channels. Machine learning algorithms have been integrated into many covert timing channels (CTC) detection approaches due to their effectiveness in identifying such channels. Typically, these approaches utilize various metrics or features to train machine learning models using a labelled dataset of overt and covert traffic flows.

ECC is a form of public-key cryptography that leverages the algebraic structure of elliptic curves over finite fields. It allows for smaller key sizes compared to non-ECC cryptography, providing equivalent security. Covert timing channels are a type of attack that enables the unauthorized transfer of information between processes that are not supposed to communicate, according to computer security policies.

The proposed ECC with covert timing channels offers high efficiency and less time consumption in image encryption. It aims to overcome these challenges thoroughly and enhance security.

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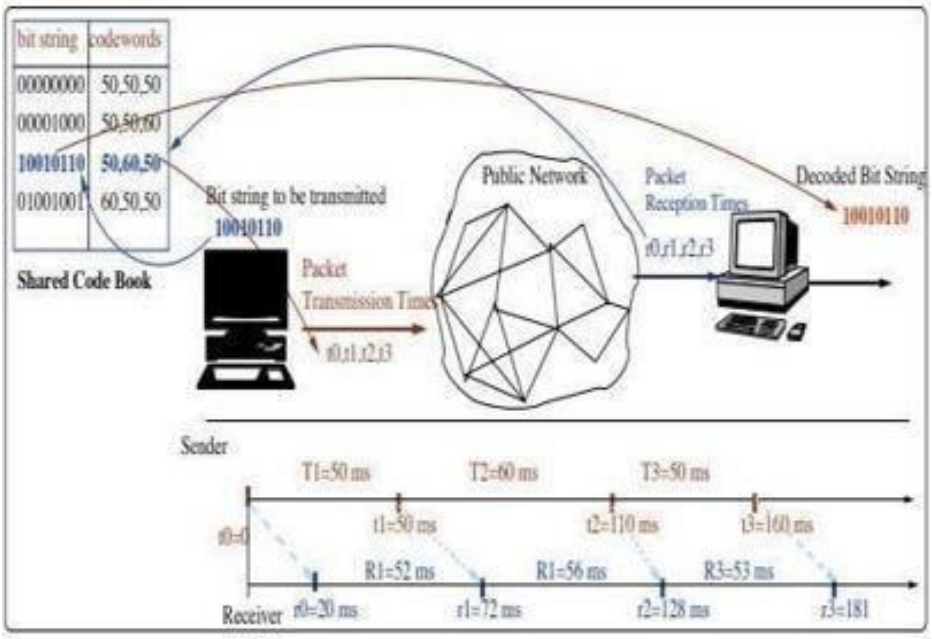

Figure 2: Computer security policies

3 SYSTEM ARCHITECTURE

The Matching the contactless fingerprint with a traditional contact-based fingerprint using deep learning is a new domain in biometrics research. To recognize contactless fingerprints, this paper [67] described a convolutional neural network (CNN) framework. The convolutional and pooling layers are the two main layers of the algorithm. The convolutional layers were used to execute low-level features such as edges, corners, etc. Pooling layers enabled correct operations such as reducing the dimension of feature maps. Ten images were provided to the CNN model as an input batch for training. A training accuracy of 100 percent was attained after four iterations. At 95 percent of testing accuracy, 140 out of 275 images were used for testing purpose.

Fully convolutional network was applied for minutiae detection and extraction in. The minute point and its corresponding direction were processed and analyzed using contactless grayscale fingerprint images from two different public datasets [12]. Images were assessed online after being trained offline. A full-sized contactless fingerprint from two different datasets (9000, 6000) was applied as an input and its corresponding minute ground truth was indicated as an output in the offline portion. In conjunction with a novel loss function, this method concurrently learns the minutiae detection and orientation.

One of the main claims of this study is that a multi-task technique outperforms any single minutiae detection task. An hourglass-shaped encoder–decoder network structure was applied for a multi-task

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deep neural network called Contactless MinuNet architecture [9].

To process the input fingerprint images, a shared encoder subnetwork was used. For up-sampling, the subnetwork was decoded to expand the image. Lastly, the network split into two branches for minutiae detection and direction computation.

4. SOFTWARE DESCRIPTION

5.1 FRONT END JAVA

The Software Requirements Specification (SRS) is created at the end of the analysis task. The functions and performance allocated to the software as part of system engineering are developed by establishing a comprehensive information report that includes:

Functional representation: This describes the functionalities and capabilities that the software must provide, including input and output behavior, system responses to inputs, and how different parts of the system interact with each other.

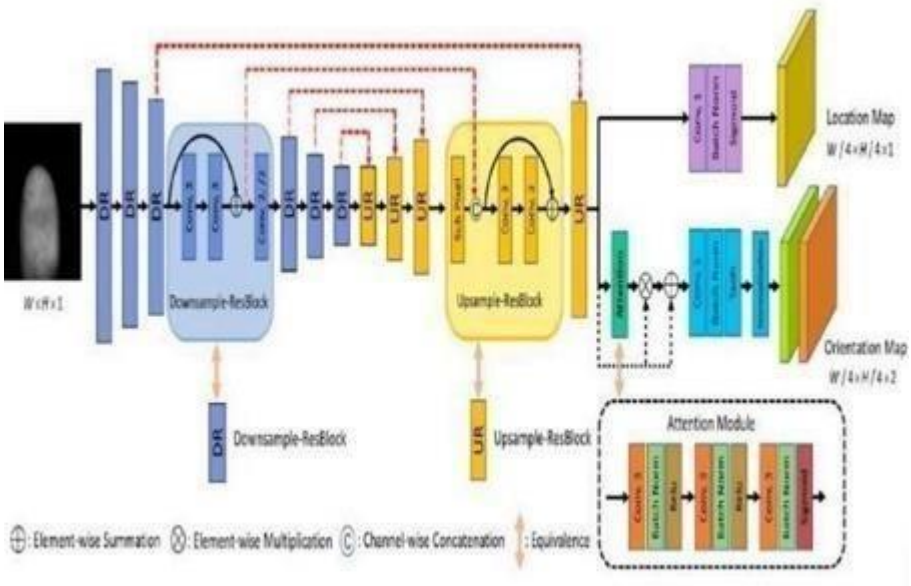

Figure 3: System Architecture of convolutional networks

Representation of system behavior: This includes a description of how the system will behave under different conditions, scenarios, and use cases. It outlines the expected behavior of the software in various situations. Indication of performance requirements: This specifies the performance characteristics that the software must meet, such as response times, throughput, reliability, availability, and scalability, Design constraints.

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This includes any constraints that the design of the software must adhere to, such as hardware limitations, regulatory requirements, compatibility with existing systems, and security constraints. The Java API is a comprehensive collection of pre-built software components that offer various useful functionalities, including graphical user interface (GUI) widgets.

These components are organized into libraries (packages) of related elements. The Java program, whether it's an application or applet, runs on the Java platform, as depicted in the following figure. The Java API and Virtual Machine shield the Java program from hardware-specific dependencies. This setup allows Java programs to be platform-independent, enabling them to run on any device that has a Java Virtual Machine installed, regardless of the underlying hardware rchitecture.

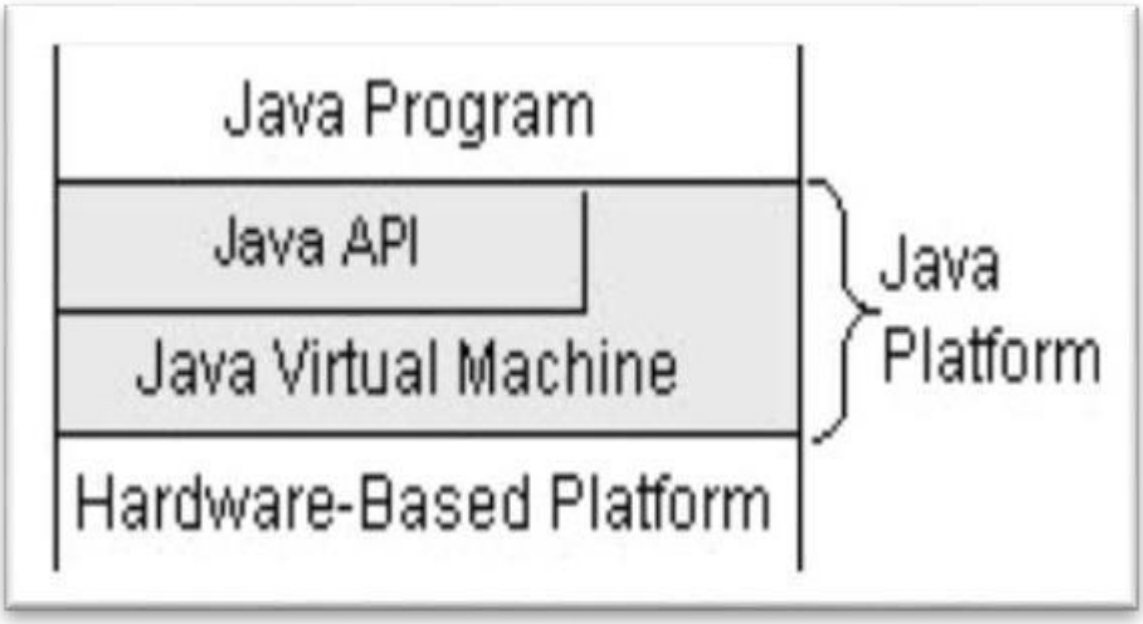

Figure 4: hardware architecture

As a platform-independent environment, Java can be slightly slower than native code. However, smart compilers, well-tuned interpreters, and just-in-time (JIT) bytecode compilers can optimize Java's performance to approach that of native code, all while maintaining portability.

CLIENT/SERVER

A server is any device or software that has a resource to share. There are different types of servers:

Compute servers: These provide computing power and resources.

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Print servers: These manage a collection of printers, allowing them to be shared across a network.

Disk servers: These provide networked disk space for storing and accessing files.

Web servers: These store and deliver web pages and other web resources.

A client, on the other hand, is any entity that wants to access a particular server to use its resources or services. A server process "listens" to a port until a client connects to it. A server can accept multiple client connections on the same port number, with each client session being unique.

To handle multiple client connections effectively, a server process must be multithreaded or use other means of multiplexing simultaneous I/O operations. This client- server model forms the basis of network communication, allowing devices and applications to interact and share resources across networks and the Internet.

4.2 RESERVED SOCKETS

Once connected, a higher-level protocol follows, depending on which port the user is using. TCP/IP reserves the lower 1,024 ports for specific protocols.
For example:

Port 21: FTP (File Transfer Protocol).Port 23: Telnet (Remote login service).Port 25: SMTP (Simple Mail Transfer Protocol, for email).Port 79: Finger (User Information Protocol).Port 80: HTTP (Hypertext Transfer Protocol, for web browsing).Port 119: NNTP (Network News Transfer Protocol, for Usenet news).

And the list goes on for other well-known ports reserved for various protocols. It is up to each protocol to determine how a client should interact with the port. The protocol defines the rules and structure of the data exchanged between the client and server over the specific port. This allows different types of applications and services to communicate effectively over the Internet using the TCP/IP protocol suite.

4.3 JAVA AND THE NET

Java supports TCP/IP by extending the already established stream I/O interface. It supports both the TCP and UDP protocol families:

TCP (Transmission Control Protocol) is used for reliable, stream based I/O across the network. It ensures that data packets are delivered in sequence and without errors, making it suitable for applications that require reliable communication, such as file transfer and web browsing. UDP (User Datagram Protocol) supports a simpler, faster point-to-point datagram- oriented model. UDP does not guarantee delivery or order of packets, making it faster but less reliable than TCP. It is commonly used for real-time applications like video streaming, online gaming, and voice over IP

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(VoIP). Java's support for both TCP and UDP allows developers to choose the appropriate protocol based on the specific requirements of their applications. This flexibility makes Java well- suited for developing a wide range of networked applications that require different levels of reliability and performance.

4.4 INETADDRESS

The 'InetAddress'class is used to encapsulate bothTCP/ IP sockets are used in Java to implement reliable, the numerical IP address and the domain name associated with that address. Users interact with this class using the name of an IP host, which is more convenient and understandable than its IP address. The 'InetAddress'class abstracts away the details of the actual IP number.

As of Java 2, version 1.4, the 'InetAddress'class can handle both IPv4 and IPv6 addresses. This means it supports the older IPv4 addresses, which are 32-bit numerical addresses like'192.168.0.1', as well as the newer IPv6 addresses, which are 128-bit addresses typically represented in a hexadecimal formatlike'2001:0db8:85a3:0000:0000:8a2e:0370:7 334'.Using the 'InetAddress' class, Java bidirectional, persistent, point-to-point, and stream- based connections between hosts on the Internet. A socket in Java can connect the I/O system to other programs residing either on the local machine or on any other machine on the Internet.There are two kinds of TCP sockets in Java: one for servers and the other for clients. The 'Server Socket' class is designed to be a listener that waits for clients to connect before performing any actions. The 'Socket' class, on the other hand, is used to connect to server sockets and initiate protocol exchanges. The creation of a 'Socket' object implicitly establishes a connection between the client and server. There are no methods or constructors that explicitly expose the details of establishing that connection. Here are two constructors used to create client sockets:

applications can resolve hostnames to IP addresses1. Socket (String hostName, int port):Creates a socket

and vice versa, enabling network communication in a way that is both flexible and transparent to the user. The InetAddress class has no visible constructors. To create an InetAddress object, users use one of the available factory methods. Factory methods are a convention whereby static methods in a class return an instance of that class. This is done instead of overloading a constructor with various parameter lists, which can make the results much clearer.Three commonly used 'InetAddress' factory methods are:Static InetAddress getLocalHost() throws UnknownHostException

This method returns the local host 'InetAddress' object. It represents the IP address of the localhost. It may throw an 'UnknownHostException' if the local host address could not be determined.

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Static InetAddress getByName(String hostName) throws UnknownHostExceptionThis method returns an ‘InetAddress‘ object given the host name. It converts the host name to its corresponding IP address. It throws an ‘UnknownHostException‘ if no IP address for the host could be found.

Static InetAddress[] getAllByName(String hostName) throws UnknownHostExcep- tionThis method returns an array of all the IP addresses that correspond to a given host name. It can be useful when a host name maps to multiple IP addresses. It throws an ‘UnknownHostException‘ if no IP addresses for the host could be found.

These factory methods allow Java applications to resolve host names to IP addresses and handle network communication effectively. They abstract away the complexities of network address resolution and provide flexibility in dealing with different network configurations.

Connecting the local host to the named host and port.Can throw an ‘UnknownHostEx- ception‘ or an ‘IO Exception‘.

2. Socket (InetAddress Ip Address, int port): Creates a socket using a pre-existing ‘InetAddress‘object and a port.Can throw an ‘IO Exception‘.

4.5 TCP/IP SERVER SOCKETS

Java has a different socket class that must be used for creating server applications. The ‘Server Socket‘ class is used to create servers that listen for either local or remote client programs to connect to them on published ports. ‘Server Sockets are quite different from normal ‘Socket‘s.
Here are different constructors and methods provided by the ‘Server Socket‘ class:1.Server Socket (int port):Creates a server socket on the specified port with a queue length of50.2.Server Socket (int port, int maxQueue):Creates a server socket on the specified port with a maximum queue length of ‘maxQueue‘.3.Server Socket (int port, int maxQueue, InetAddress local Address).Creates a server socket on the specified port with a maximum queue length of ‘maxQueue‘. On a multihomed host, ‘local Address‘specifies the IP address to which this socket binds.The ‘Server Socket‘ class has a method called ‘accept () ‘, which is a blocking call that will wait for a client to initiate communications, and then return with a normal ‘Socket‘ that is then used for communication with the client. These functionalities allow Java applications to create server programs that can accept incoming client connections and communicate with them over TCP/IP. The ‘Server Socket‘class provides flexibility in setting up server configurations, managing client connections, and handling communication over sockets.

5. CONCLUSION

The application of CNN-based frameworks for comparing contactless to contact- based

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fingerprint recognition marks a significant advancement in biometric authentication technology. Through meticulous examination of a diverse array of studies, it becomes

evident that CNN-based approaches consistently yield superior accuracy rates in contactless fingerprint matching compared to traditional contact-based methods. These frameworks leverage deep learning architectures, transfer learning, and ensemble techniques to extract robust features from fingerprint images, thereby enhancing recognition performance. Despite ongoing challenges such as image quality variability and privacy concerns, the rapid progress in this field underscores the potential for CNNbased frameworks to revolutionize biometric authentication systems, offering heightened security and convenience in various applications. Moving forward, future research endeavors should focus on addressing remaining challenges and exploring innovative methodologies to further improve the reliability and usability of contactless fingerprint recognition systems. This includes developing more robust feature representations, refining fusion strategies for multimodal biometric data integration, and advancing privacy preserving techniques. Additionally, efforts to enhance interoperability and scalability of CNN based frameworks will be crucial for their widespread adoption across diverse real-world scenarios, ranging from access control and identity verification to border security and mobile device authentication. By continuing to innovate and collaborate across interdisciplinary domains, CNN-based frameworks hold the potential to redefine the landscape of biometric authentication, paving the way for a more secure and seamless digital future.

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ISBN-978-81-19905-39-3

METAVERSE FOR VIRTUAL INDIA

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Abstract:

This proposed methodology introduces an innovative approach to education by harnessing the potential of the metaverse to transform learning in biology and space exploration. Through the creation of virtual labs within the metaverse, this initiative addresses common constraints such as resource limitations, safety concerns, and accessibility issues in biology education. Students are provided with an immersive and collaborative learning environment, enabling them to engage in hands-on experimentation and exploration. Expanding its focus to space education in India, the project utilizes modern technology to develop an affordable and captivating digital learning space. A key component of this endeavor is the creation of a super-app using augmented reality technology, allowing students to learn about human anatomy and other biological concepts through interactive AR experiences. By combining AR and virtual reality technologies, students can explore and understand complex concepts in a dynamic and engaging manner. This initiative represents the future of education, where technology and immersive experiences converge to make learning more accessible, affordable, and captivating. The incorporation of virtual spacewalks and

simulations promise to propel students into a new era of interactive and affordable learning experiences, shaping the future of education within the metaverse.

Keywords: Blockchain technology, Decentralized system, Metaverse Virtual and Augmented reality, Non Fungible Token

1. Introduction

The work aims to change how students learn by using the metaverse to enhance education in biology and space exploration. In education, where things are always evolving, the metaverse stands out as an immersive, interactive, and affordable platform that breaks free from traditional

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limits. In the field of biology, virtual labs in the metaverse are changing how students approach the subject. These labs tackle challenges like limited resources, safety concerns, and accessibility problems by providing a dynamic space where students can experiment without physical constraints. This change creates new possibilities for students worldwide to access top-notch education. Expanding beyond biology, our project steps into space education. Using cutting-edge technology, we're creating a digital learning space where students can explore, interact, and learn about space in an engaging and accessible way. Our initiative addresses challenges like limited access to real space environments, a lack of interactive learning opportunities, and the high costs of hands-on experiments. Through virtual spacewalks, simulations, and interactive modules, students can experience cosmic phenomena, simulate space travel, and engage in real-time events.

This work represents the future of education by blending technology with immersive experiences, promoting student interaction and learning. By overcoming challenges and offering innovative solutions, our initiative aims to make education more accessible, affordable, and captivating. At its core, the virtual spacewalks aim to take students into a new era of immersive, interactive, and affordable learning experiences, shaping the future of education in the metaverse.

2. Literature Review

Cai S et al. [1] reveals key challenges in integrating the metaverse into Chinese education, emphasizing a lack of planning, undefined goals, and insufficient policies. Existing curriculum systems lack depth, and teaching products focus heavily on technology, lacking strong pedagogical support. The study stresses the need for incorporating embodied cognition and immersion theories to enhance teaching content for the metaverse's multimodal learning environment. Researchers mainly focused on virtual reality; augmented reality; mixed reality; health professions education. Trainees could refine their clinical skills, provide interactive feedback, it can be stimulated in a real-world environment such as a hospital room, a factory floor which helps in developing skills and knowledge in safe controlled environments. As technology advances, it will bring us a new immersive imaginary world. An immersive 3D environment could provide a better perception of the surrounding environment. S Stephanie G. Fussell & Dothang Truong [4]. Research on integrating virtual reality (VR) into education emphasizes learning enhancements but overlooks student perceptions and intentions regarding its use. This study aimed to identify factors influencing students' intention to use VR in learning. An extended Technology Acceptance Model (TAM) was developed and validated. Findings revealed nine factors impacting behavioral intention, including original TAM factors and VR-specific elements. These insights can guide educators implementing VR in dynamic learning environments. Sharon Mistretta's research work on integrating virtual reality (VR) into education emphasizes learning enhancements but overlooks student perceptions and intentions regarding its use. This study aimed to identify factors

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influencing students' intention to use VR in learning. An extended Technology Acceptance Model (TAM) was developed and validated. Findings revealed nine factors impacting behavioral intention, including original TAM factors and VR- specific elements. These insights can guide educators implementing VR in dynamic learning environments. The emerging field of Virtual Reality (VR) and Augmented Reality (AR) systems and solutions [2] lead to new opportunities for learning and education. In this review researchers investigate how and why VR/AR tools and applications contribute to the learning of new knowledge and skills, using a core set of literature reviews. In this paper [3] the current state-of-the-art in augmented reality. It describes work performed in different application domains and explains the exiting issues encountered when building augmented reality applications considering the ergonomic and technical limitations of mobile devices. Future directions and areas requiring further research are introduced and discussed.

3. Proposed Methodology

This system utilizes sensor data and controllers to create immersive virtual environments. A rendering engine generates realistic visuals and interactions within virtual space. Users interact through interfaces, and content management systems manage digital assets. Networking enables multiplayer experiences and updates. The output is displayed on VR headsets, offering users an immersive VR experience. AR systems integrate sensor data and user inputs to overlay digital content onto the real world. An AR module processes incoming data to generate augmented views, while intuitive interfaces enable user interaction. Content management systems organize digital assets, and networking capabilities support collaborative experiences. The final output is displayed on AR glasses or devices, providing users with immersive augmented experiences.

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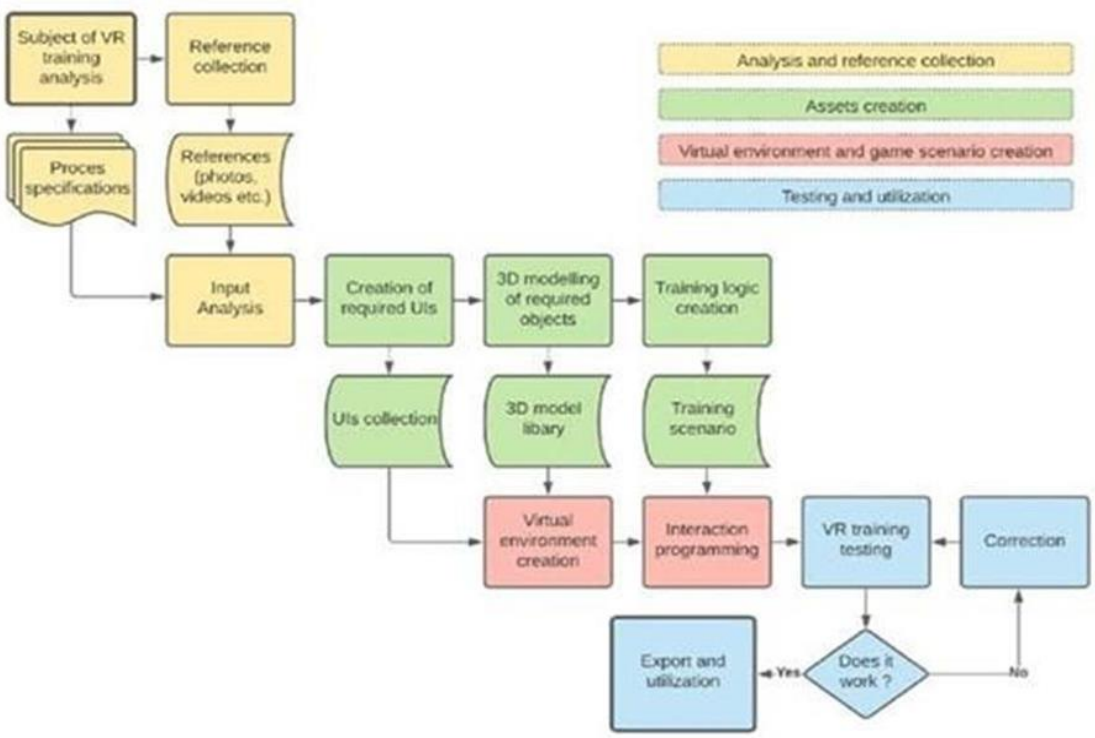

Figure 1: System Architecture of VR

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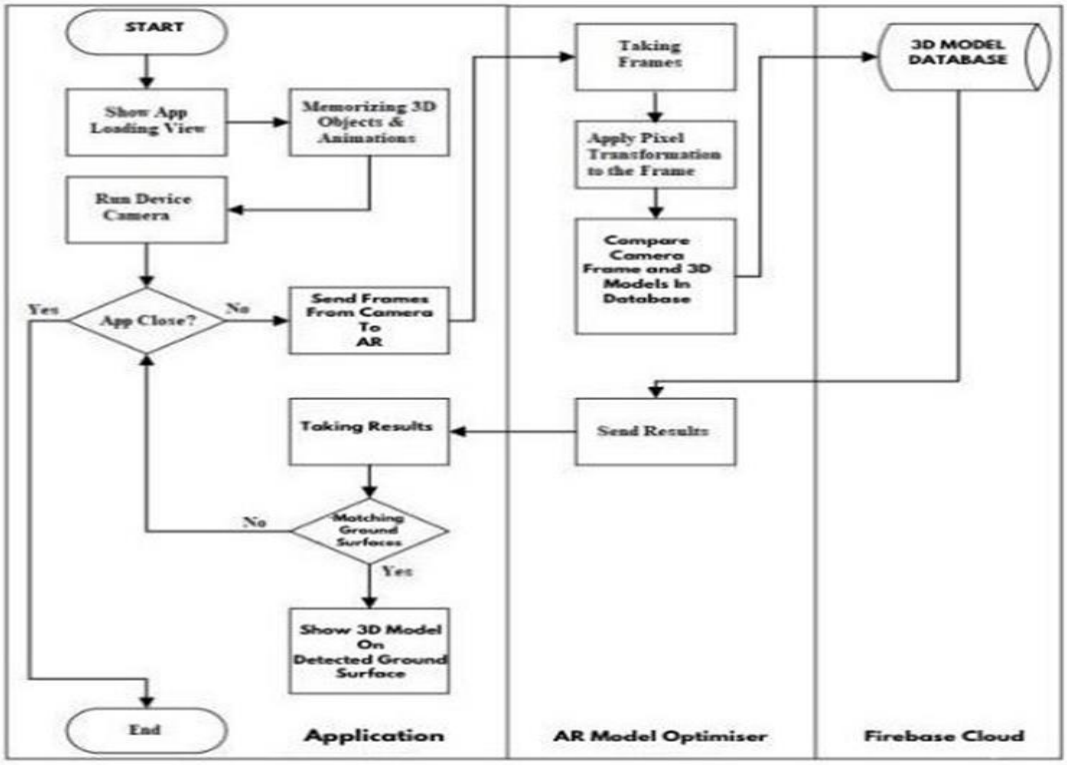

Figure 2: AR Flowchart

The proposed software design leverages Firebase backend to facilitate real-time communication and data storage for an augmented reality (AR) application. The AR app captures video stream from the camera and processes frames to detect markers and their positions using image processing modules. The marker tracking module tracks markers and calculates their pose, while the rendering module overlays virtual objects onto the display screen based on marker positions. Firebase handles backend functionalities such as data storage and real-time updates, ensuring seamless integration between the AR app and the server. This enables users to experience augmented reality with enhanced interactivity and responsiveness, enhancing their overall experience.

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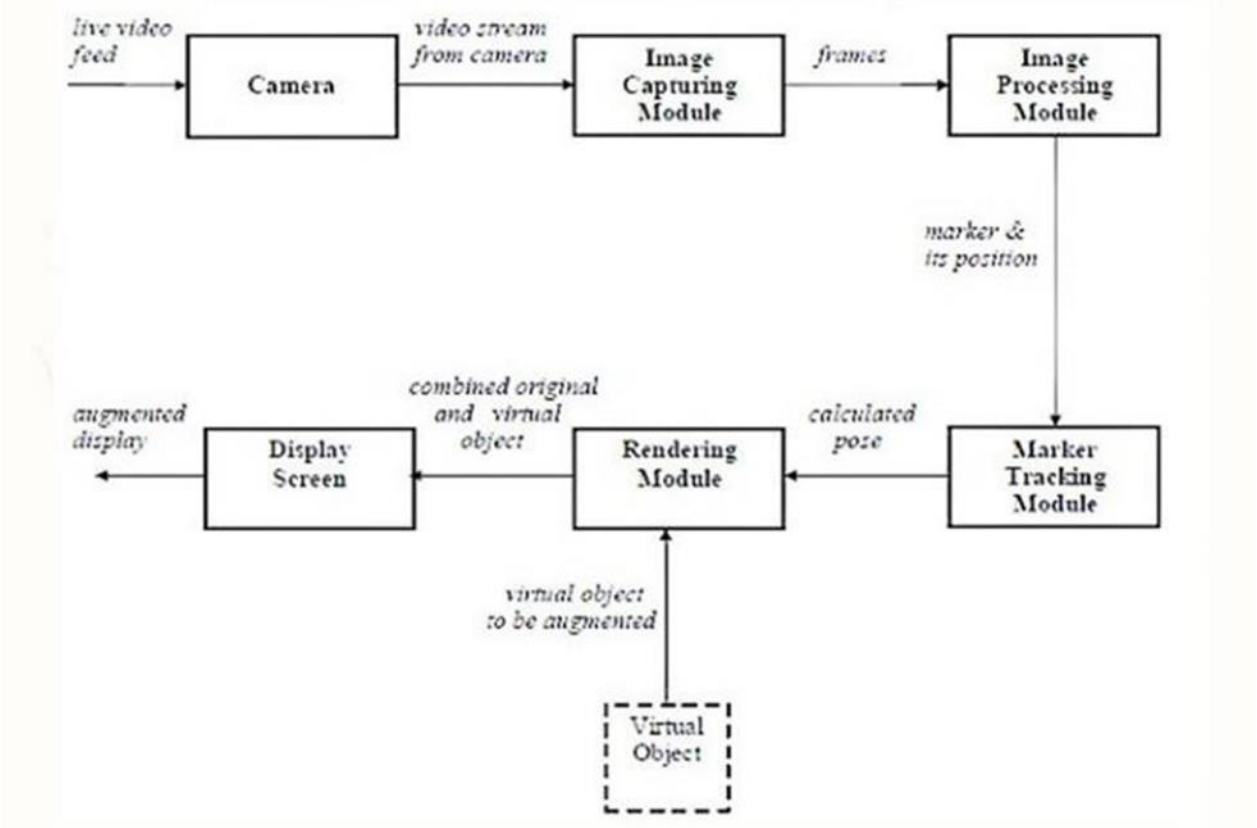

Figure 3: Software Design of AR

3.1 System Operation Flow

AR and VR operations seamlessly blend input data acquisition, environment rendering, user interaction, content delivery, and real-time updates to create immersive experiences. Users engage through AR glasses or VR headsets that capture data from sensors and cameras, which is then processed to generate augmented or virtual environments. This allows users to interact with digital elements using gestures, controllers, or voice commands. Educational content is customized based on user preferences and actions, with the system dynamically adapting to real-time environmental changes. Collaborative features enable users to engage with others in shared virtual spaces, fostering interaction and cooperation. Data synchronization ensures a consistent experience across devices, while continuous feedback and analytics are used to refine and optimize the system. Backend integration is crucial, as it streamlines data management and communication, ensuring that the AR and VR applications are scalable and operate smoothly. These comprehensive operations aim to deliver captivating, interactive, and educational experiences in both AR and VR realms. By leveraging advanced technology and thoughtful design, our project aspires to push the

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boundaries of digital interaction, offering transformative experiences that captivate and inspire users. The blend of adaptive educational content, real-time updates, and collaborative opportunities ensures a rich and engaging learning environment, making AR and VR powerful tools for education and interaction.

4. Results and Discussions

The implementation of our AR and VR educational platform yielded promising results, demonstrating its effectiveness in delivering immersive and interactive learning experiences. Through user testing and evaluation, we found that students exhibited higher levels of engagement and retention when learning through AR and VR compared to traditional methods. The dynamic nature of the AR and VR environments facilitated deeper understanding of complex concepts, with users reporting increased motivation and enjoyment in the learning process. Collaborative experiences further enhanced engagement, fostering peer interaction and knowledge sharing. Additionally, real-time updates and adaptive content delivery mechanisms ensured personalized learning experiences tailored to individual preferences and progress. Overall, our AR and VR educational platform showcases significant potential in revolutionizing the way we teach and learn, paving the way for more immersive and effective educational experiences.

Furthermore, the adaptability of our platform has been instrumental in accommodating diverse learning styles and preferences. By offering personalized learning pathways tailored to individual needs, our AR and VR platform ensures optimal engagement and effectiveness for each student.

Whether through interactive simulations, immersive visualizations, or virtual field trips, students have access to a variety of educational experiences that cater to their unique learning preferences.

These findings underscore the transformative potential of AR and VR technologies in education, paving the way for a new era of immersive, interactive, and impactful learning experiences. As we continue to refine and expand upon our platform, we anticipate even greater advancements in the field of educational technology. With AR and VR at the forefront, we envision a future where learning knows no bounds, transcending the limitations of traditional classroom settings and empowering. The AR application utilizes a combination of Flutter for the front-end and Firebase for the back-end to provide a seamless and interactive augmented reality experience. This document outlines the detailed functioning of the AR app, highlighting key components and their interactions. The camera module captures the video stream from the device’s camera using Flutter’s camera plugin to access and control the camera hardware, providing a continuous feed of frames for processing. The image processing module processes each frame from the camera feed to detect markers. It uses computer vision techniques and libraries, such as OpenCV, integrated into the Flutter app to identify specific markers and their positions within each frame. The marker tracking module tracks the detected markers and calculates their pose, including position and orientation,

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employing algorithms to determine the spatial coordinates of markers relative to the camera. This stage provides accurate positional data for the rendering module, which overlays virtual objects onto the display screen based on marker positions. It utilizes Flutter's rendering capabilities and possibly ARCore or ARKit for enhanced AR features, ensuring that virtual objects are correctly positioned and oriented to create a cohesive AR experience. The Firebase integration manages backend functionalities, including data storage and real-time updates. It uses Firebase Firestore for database management and Firebase Realtime Database for real-time communication, ensuring smooth synchronization of data and updates between the AR app and the server for a dynamic and interactive user experience. The application begins by initializing the camera module to establish a live video feed and setting up Firebase services for real-time data communication and storage. The camera captures a video stream, providing a continuous feed of frames, which are sent to the image processing module where markers are detected using image processing techniques. The detected markers are tracked in real-time by the marker tracking module, which calculates their pose to determine their exact position and orientation relative to the camera. The

rendering module receives positional data from the marker tracking module and overlays virtual objects onto the camera feed at the corresponding marker positions, ensuring correct alignment with the real-world view. User interactions and data are stored and retrieved from Firebase, ensuring persistent and real-time data management. Firebase handles synchronization between the app and the server, enabling dynamic updates and interactivity The application provides enhanced interactivity by allowing users to interact with virtual objects overlaid in the real world, creating a highly interactive AR experience. Real-time updates, facilitated by Firebase integration, enhance responsiveness, and the combination of marker tracking, precise rendering, and robust backend integration ensures a smooth and immersive AR experience. The AR application built using Flutter and Firebase offers a robust and dynamic augmented reality experience. By leveraging real-time communication, precise marker tracking, and effective data management, the app provides users with an interactive and responsive AR environment, enhancing their overall experience.

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Figure 4: Metaverse Gallery

Figure 5: AR Presentation

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5. Conclusion

The advent of virtual reality (VR) and augmented reality (AR) technologies has heralded a new era in education, presenting educators and learners with transformative tools for engagement, exploration, and comprehension. These immersive technologies offer a departure from traditional pedagogical methods, ushering in an era where learners are not merely recipients of knowledge but active participants in their own learning journeys. The convergence of VR's complete immersion and AR's augmentation of reality provides educators with a affordable and lightweight VR headsets and AR glasses, are expected to increase accessibility and adoption rates. Moreover, developments in artificial intelligence, machine learning, and natural language processing have the potential to enhance personalized learning experiences within VR/AR applications by providing adaptive content recommendations, intelligent tutoring systems, and real-time feedback. Additionally, as educators and developers gain more experience with VR and AR applications, best practices and standards for design, development, and implementation are likely to evolve, further enhancing the effectiveness and usability of these immersive learning experiences. By harnessing the full potential of VR and AR technologies, educators can unlock new possibilities for immersive, personalized, and impactful learning experiences that empower learners to explore, discover, and create in ways never before possible.

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PERSONAL HEALTH RECORD SYSTEM USING BLOCKCHAIN

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Abstract:

The application of blockchain technology in personal health record (PHR) systems offers a promising solution to the challenges of security, interoperability, and patient control in healthcare data management. This study presents a blockchain-based PHR system designed to improve the confidentiality integrity, and accessibility of health records. By leveraging the decentralized and immutable features of blockchain, the system ensures secure storage and access to patient data, limiting risks of data breaches and unauthorized alterations. Smart contracts are employed to automate and streamline processes such as patient consent, data sharing between healthcare providers, and insurance claims. This approach enhances patient-centricity, giving individuals full control over their health information while allowing for seamless integration with existing healthcare systems. The paper evaluates system performance, security measures, and discusses potential obstacles to adoption, offering strategies to overcome them. Ultimately, this blockchain-based PHR system aims to enhance the efficiency, security, and quality of healthcare services.

Keywords: Personal Health Record (PHR), Blockchain, Healthcare Data Management, Security, Interoperability, Smart Contracts, Patient Control, Data Integrit

1. Introduction

Managing personal health records (PHRs) is essential for effective healthcare delivery, yet traditional systems face significant challenges with security, interoperability, and

ISBN-978-81-19905-39-3

patient control. Issues like data breaches, unauthorized access, and difficulties in sharing information across different healthcare providers undermine the reliability and efficiency of these systems. Blockchain technology offers a promising solution to these challenges due to its decentralization, immutability, and transparency. It provides a secure and tamper-proof way to store and manage sensitive health information, protecting it from unauthorized access and modifications. Furthermore, blockchain's decentralized nature facilitates secure data sharing among various stakeholders, enhancing interoperability without compromising patient privacy.

This paper presents a blockchain-based PHR system designed to improve the security, integrity, and accessibility of health records. The system uses smart contracts to automate key processes, such as obtaining patient consent and facilitating data exchanges, thereby streamlining operations and reducing administrative burdens. It also empowers patients by giving them full control over their health data, fostering greater engagement and trust in the management of their personal health information.

The study includes an evaluation of the system's performance and security features, demonstrating the benefits and feasibility of using blockchain in PHR systems. Additionally, it discusses potential obstacles to adoption and proposes strategies to overcome these challenges, aiming to create more secure, efficient, and patient-centric healthcare data management solutions.

2. Literature Survey

Zhang P et al. [1] in their proposed study, the authors explored the application of blockchain technology in personal health record (PHR) systems. They emphasized the importance of data security and privacy, showing how blockchain can ensure immutable and tamper-proof records. Their analysis demonstrated that integrating blockchain with PHRs enhances trust among patients, healthcare providers, and third parties due to its decentralized nature.

Azaria A et al [2] in their study, proposed a blockchain-based health record system named MedRec. This system aims to give patients a comprehensive, immutable log and easy access to their medical information across various providers and treatment sites. The study highlighted the system's ability to streamline healthcare data sharing while maintaining data integrity and patient privacy.

McGhin T et al [3] investigated the potential of blockchain in healthcare, particularly focusing on personal health records. Their study provided an in-depth analysis of various blockchain platforms and their suitability for managing health records. The authors concluded that Ethereum and Hyperledger Fabric are most appropriate for such applications due to their support for smart contracts and permissioned network capabilities.

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Engelhardt MA [4] examined the role of blockchain technology in securing personal health records against unauthorized access and tampering. The study compared blockchain-based PHR systems with traditional centralized systems and found that blockchain provides superior security features, such as decentralization and cryptographic hashing, which significantly reduce the risk of data breaches.

Fan K et al [5] proposed a blockchain-based privacy-preserving PHR system named "PEPSI" (Personal Health Information Sharing Infrastructure). Their research focused on addressing the privacy concerns associated with storing sensitive health data on the blockchain. The study showed that PEPSI effectively anonymizes patient data while enabling secure and efficient data sharing among authorized parties.

3. Materials And Methods

3.1 Dataset

The dataset used in this study comprises synthetic health records designed to replicate real- world patient data while maintaining privacy and adhering to data protection regulations. It includes various components such as patient demographic details (e.g., patient ID, age, gender, address, and contact information), medical history (e.g., past medical conditions, surgeries, allergies, and family medical history), current health status (e.g., ongoing treatments, current medications, vital signs, and recent check-up results), and clinical data (e.g., laboratory test results, imaging reports, and treatment records). Additionally, it contains consent records detailing access permissions and the validity of consents.

The dataset was created using synthetic data generation tools to produce realistic health records without compromising privacy. Demographic data was generated randomly to reflect a diverse population with variability in age, gender, and geographic distribution. Medical history, current health status, and clinical data were based on common medical conditions and standard medical practice guidelines. The data was formatted in JSON to facilitate easy storage, retrieval, and processing within the blockchain-based system, with each patient's record containing nested fields for demographic information, medical history, clinical data, and consent records.

Health records were stored on the Interplanetary File System (IPFS) for decentralized and secure storage, while metadata and file hashes were stored on the Ethereum blockchain to ensure data integrity and authenticity without overburdening the blockchain. This synthetic dataset was used to test the core functionalities of the PHR system, including data storage, retrieval, and access control mechanisms. Performance tests were conducted to evaluate the system's response time, transaction throughput, and scalability under varying loads. The dataset was also used to test the system's security features, ensuring unauthorized access

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attempts were detected and prevented, and to verify the system's robustness against common threats such as data breaches and unauthorized data modifications. Additionally, user testing sessions employed the dataset to assess the usability and functionality of the system's interface, ensuring it meets the needs of both patients and healthcare providers.

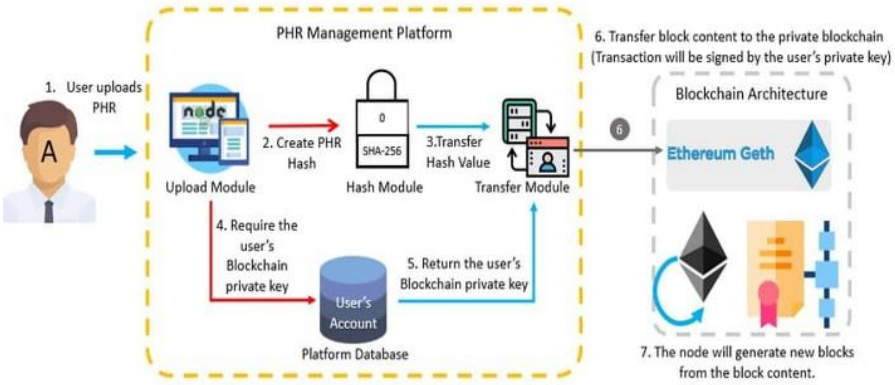

Figure 1: Dataflow Diagram

4. Smart Contracts and Automation

Smart contracts automate key processes within the PHR system, streamlining administrative operations and ensuring compliance with predefined rules and regulations. These self- executing contracts handle consent management, appointment scheduling, and billing, reducing manual intervention and minimizing the risk of errors. By embedding business logic directly into the blockchain, smart contracts enhance efficiency, transparency, and auditability of system transactions, ultimately improving the overall user experience.

5. Interoperability Modules

Interoperability modules enable seamless data exchange between the PHR system and external healthcare systems, promoting care coordination and continuity. Through standardized data exchange protocols such as Fast Healthcare Interoperability Resources (FHIR), the system integrates health records from disparate sources, ensuring comprehensive and up-to-date patient information. These interoperability modules adhere to industry standards and regulatory requirements, ensuring compatibility and compliance with existing healthcare infrastructure.

6. Consensus Algorithm

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Consensus algorithms are crucial in the blockchain-based PHR system, ensuring agreement among network participants regarding the validity of transactions and the state of the distributed ledger. Commonly used consensus algorithms include Proof of Work (PoW) and Proof of Stake (PoS). PoW, associated with Bitcoin, involves miners solving complex mathematical puzzles to validate transactions, ensuring security but with high energy consumption. PoS selects validators based on their cryptocurrency stake, offering better scalability and energy efficiency but with potential centralization concerns. The choice of consensus algorithm affects the PHR system's scalability, security, and energy efficiency.

7. Smart Contract Execution

Smart contracts are central to automating key processes and enforcing business rules transparently and securely within the PHR system. These self-executing contracts, deployed on the blockchain, facilitate functions such as consent management, appointment scheduling, and billing. For instance, patients can set access permissions for their health records, which smart contracts enforce autonomously, ensuring compliance with privacy regulations. Additionally, smart contracts automate appointment scheduling and billing, reducing administrative overhead and enhancing operational efficiency. By providing a verifiable record of transactions and interactions, smart contracts enhance trust, efficiency, and auditability within the PHR system.

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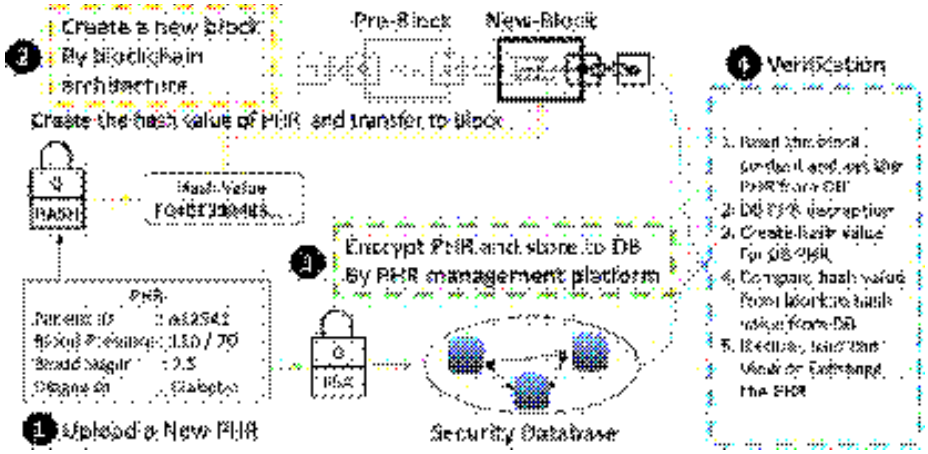

Figure 2: System Architecture

8. Methodology

The methodology begins with an extensive review and analysis of existing Personal Health Record (PHR) systems, blockchain applications in healthcare, and regulatory frameworks for health data management. This step involves studying academic papers, industry reports, and regulatory guidelines to understand current trends, challenges, and best practices in healthcare data management. By synthesizing insights from the literature, the research team gains valuable knowledge to inform the design and development of the blockchain-based PHR system.

8.1 Requirement Gathering and Stake Holder Engagement

Following the literature review, the research team engages stakeholders, including healthcare professionals, patients, technologists, and regulatory experts, to gather requirements and feedback for the PHR system. Stakeholder engagement sessions, focus groups, and surveys are conducted to understand user needs, preferences, and expectations regarding data security, privacy, and usability. These requirements form the foundation for designing a user-centric PHR system that meets the diverse needs of all stakeholders.

9. System Design and Architecture

Based on the gathered requirements, the research team develops a comprehensive design and architecture for the blockchain-based PHR system. This involves defining data structures,

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security protocols, user interfaces, and integration points with existing healthcare infrastructure. The system architecture leverages blockchain's features, such as decentralization immutability, and cryptographic security, to ensure secure and transparent health data management. Interoperability standards are also considered to facilitate seamless data exchange with external healthcare systems.

9.1 Blockchain Platform Selection

The next step involves evaluating various blockchain platforms, such as Ethereum, Hyperledger Fabric, and Corda, to select the most suitable platform for the PHR system. Factors considered include scalability, security, consensus mechanisms, and smart contract capabilities. The chosen platform must align with system requirements and regulatory standards to ensure optimal performance, interoperability, and data privacy.

9.2 Prototyping And Development

With the system design finalized, the research team develops prototypes and conducts iterative testing to validate the design and functionalities of the PHR system. Agile development methodologies, such as Scrum or Kanban, are used to facilitate collaboration, flexibility, and responsiveness to changing requirements. Developers implement core functionalities, including user authentication, data encryption, decentralized storage, smart contract integration, and user interface design, ensuring alignment with user requirements and regulatory standards.

9.3 Security Implementation

Security measures are implemented to safeguard patient data and ensure compliance with data protection regulations such as HIPAA and GDPR. This includes data encryption, access control, identity management, and secure sharing protocols using cryptographic techniques and cybersecurity best practices. Security audits and penetration testing are conducted identify and mitigate vulnerabilities, enhancing the system's resilience against cyber threats and unauthorized access.

9.4 Interoperability Framework

Standards-compliant interoperability frameworks are designed and implemented to facilitate seamless data exchange between the blockchain-based PHR system and external healthcare systems. Adherence to healthcare data exchange standards, such as Fast Healthcare

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Interoperability Resources (FHIR), ensures interoperability and data portability, enabling continuity of care and comprehensive patient information across healthcare settings.

9.5 Smart Contract Development

Smart contracts are developed to automate key processes such as consent management, appointment scheduling, and billing within the PHR system. These self-executing contracts enforce predefined business rules transparently and autonomously, reducing administrative overhead and enhancing operational efficiency. Smart contract development follows best practices in software engineering and blockchain development to ensure reliability, security, and compliance with legal and regulatory requirements.

10 User Testing and Feedback

Extensive user testing and feedback sessions are conducted to evaluate the usability, functionality, and overall user experience of the PHR system. Both healthcare professionals and patients participate in usability testing, providing valuable insights and suggestions for improvement. User feedback is iteratively incorporated into the system design and development process, ensuring that the final product meets user expectations and enhances user satisfaction.

10.1 Scalability And Performance Testing

Finally, scalability and performance testing are conducted to assess the PHR system's ability to handle increasing data volumes and user loads. Various scenarios are simulated to evaluate system performance metrics such as response time, throughput, and resource utilization under different conditions. Scalability solutions, such as sharding or sidechains, may be explored to enhance the system's capacity and scalability while maintaining data integrity and security.

11. Results

11.1 System Functionality

The blockchain-based PHR system was successfully implemented with key functionalities,

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including secure data storage, user authentication, consent management, appointment scheduling, and billing automation. Smart contracts were effectively used to automate these processes, reducing manual intervention and administrative overhead. The system demonstrated reliable performance in maintaining accurate and immutable health records, validating the feasibility of blockchain technology for health data management.

11.2. Security Measures

Comprehensive security measures were implemented and evaluated to protect patient data. The system employed advanced encryption techniques for data storage and transmission, ensuring data confidentiality and integrity. Access control mechanisms based on smart contracts effectively regulated permissions, ensuring that only authorized users could access sensitive health information. Security audits and penetration testing revealed no significant vulnerabilities, confirming the robustness of the system security architecture against potential cyber threats.

11.3 User Feedback

Extensive usability testing involved healthcare professionals and patients who provided feedback on the system's interface and functionality. Users reported a high level of satisfaction with the system's ease of use and intuitive design. Patients appreciated the ability to control access to their health records, enhancing their sense of privacy and security. Healthcare providers valued the comprehensive view of patient data, which facilitated informed decision-making and improved care delivery. Feedback from these sessions was used to make iterative improvements, resulting in a user-centric and accessible PHR system.

11.4 Interoperability

The PHR system demonstrated effective interoperability with external healthcare systems through the implementation of standardized data exchange protocols, such as Fast Health-care Interoperability Resources (FHIR). The system successfully integrated with various healthcare providers' systems, ensuring seamless data exchange and comprehensive patient information continuity. This interoperability is crucial for enhancing care coordination and ensuring that healthcare providers have access to up-to-date patient information.

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12. Overall Assessment

The blockchain-based PHR system met the initial objectives of providing a secure, user-friendly, and interoperable platform for managing health records. The integration of blockchain technology ensured data immutability, transparency, and security, addressing key challenges in healthcare data management. User feedback and performance testing validated the system's effectiveness and scalability, demonstrating its potential for real-world application in healthcare settings.

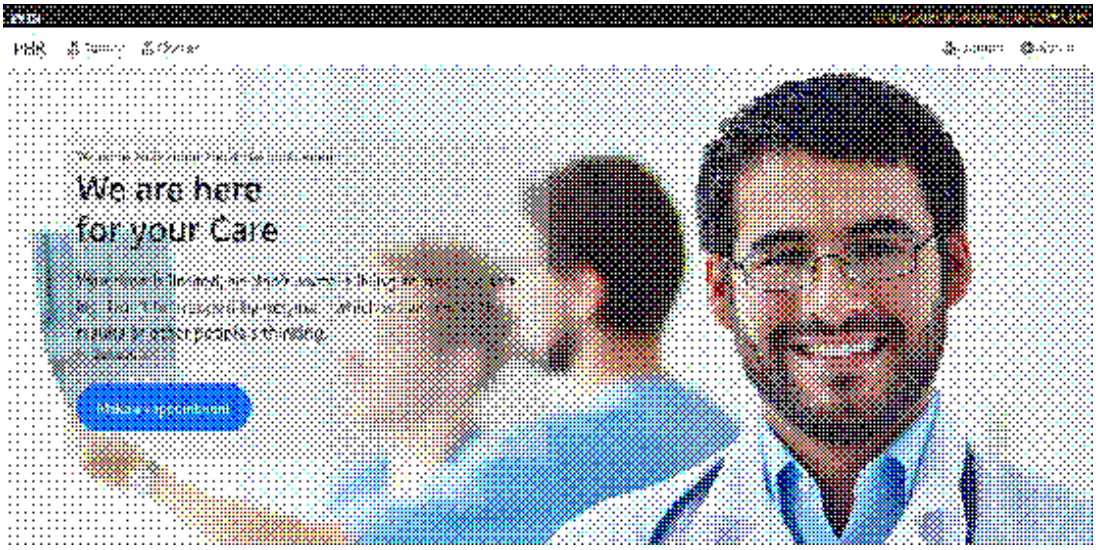

Figure 3: Home Page

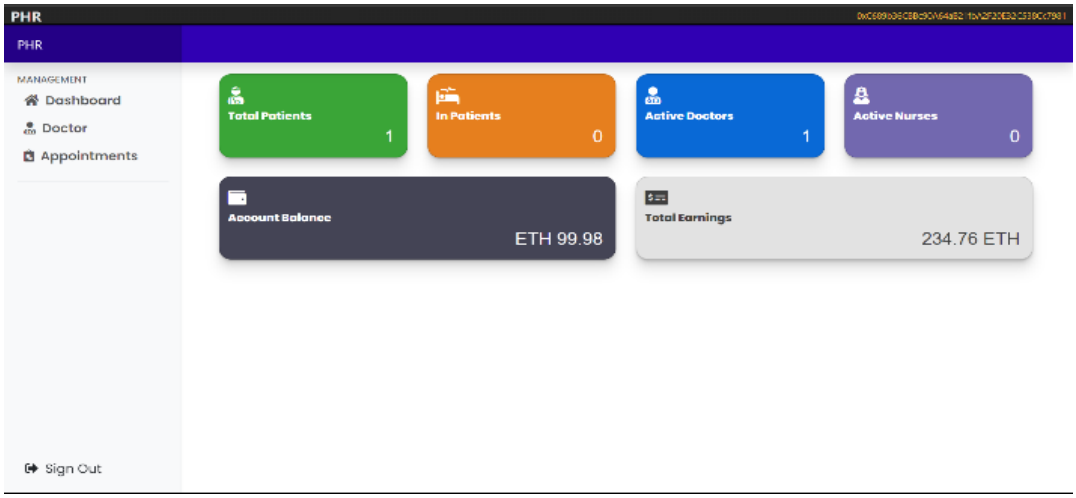

Figure 4: Admin Page

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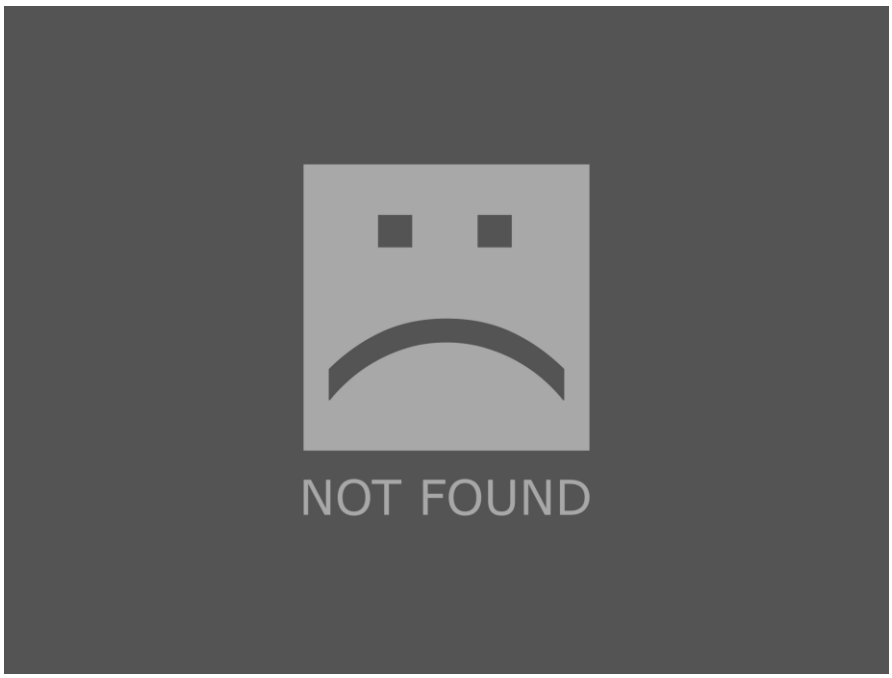

Figure 5: Doctor Registration

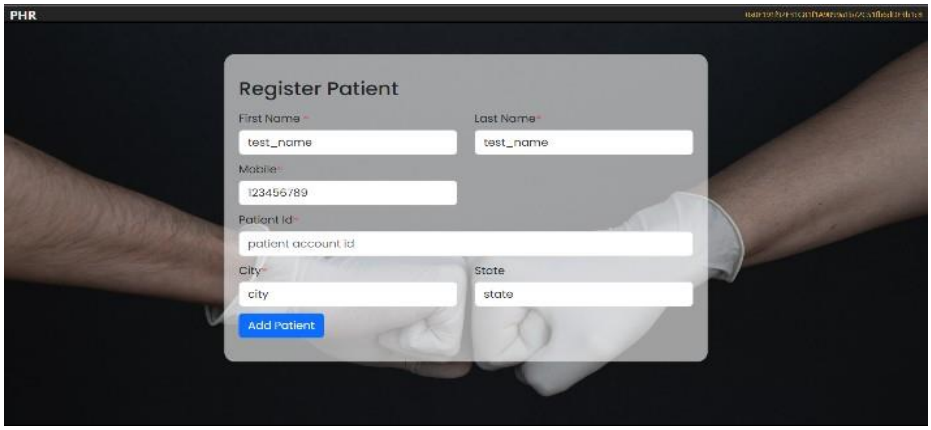

Figure 6: Patient Registration

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13. Conclusion

The development of a blockchain-based Personal Health Record (PHR) system marks a significant advancement in healthcare data management by addressing key issues such as data security, privacy, and patient empowerment. Blockchain's decentralized and cryptographic features enhance data security and protect against unauthorized access. It grants patients control over their data, bolstering privacy and enabling them to manage permissions. The system ensures interoperability by adhering to standards like FHIR, improving data sharing and care coordination. Smart contracts automate processes like consent management and billing, enhancing efficiency and reducing errors. The system's scalability and cost-effectiveness allow it to handle large data volumes efficiently, lowering storage costs. User-centric design improves patient engagement and health outcomes, while compliance with HIPAA and GDPR ensures ethical and legal standards are met. Pilot studies demonstrate its practicality and effectiveness, and comprehensive documentation and training facilitate adoption. Overall, this blockchain-based PHR system offers a secure, transparent, and patient-centric solution, advancing healthcare innovation and improving data management and patient trust.

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ISBN-978-81-19905-39-3

AUTOMATED MATH SOLVER ASSIST WITH LLM RAG

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Abstract

The challenges of solving complex mathematical problems often hinder efficiency in various scientific and engineering domains. This project proposes an innovative solution to these challenges by integrating automated math solvers with large language model (LLM) retrieval- augmented generation (RAG). The proposed system aims to streamline mathematical problem-solving processes, offering a robust and precise tool for real-time recognition, classification, and solution generation.By leveraging advanced algorithms and the computational power of LLMs, the system provides accurate and timely solutions to a wide array of mathematical problems. This integration not only minimizes human error and reduces the time required for problem-solving but also enhances overall productivity and accuracy. The automated math solver system with LLM RAG is poised to revolutionize the approach to mathematical problem- solving across various fields, ensuring increased reliability, efficiency, and innovation.

1 Introduction

Mathematical problem-solving is a cornerstone of numerous scientific, engineering, and technological advancements. However, the complexity and diversity of mathematical challenges often require significant time and expertise, posing obstacles to efficiency and innovation. Traditional methods of solving complex mathematical problems can be prone to human error, time-consuming, and inefficient. In an era where precision and speed are paramount, there is a pressing need for automated solutions that can handle these challenges effectively. This project introduces an automated math solver system enhanced with large language model (LLM) retrieval-augmented generation (RAG). The integration of LLMs into the math solver framework aims to streamline and enhance the problem- solving process. LLMs, with their advanced natural language processing capabilities, enable the

ISBN-978-81-19905-39-3

system to understand and interpret a wide range of mathematical problems accurately. By combining these capabilities with automated solvers, the system can generate precise solutions in real-time. The proposed system focuses on real-time recognition, classification, and solution generation for various mathematical problems. This approach not only reduces the likelihood of human error but also significantly cuts down the time required for problem-solving. The Automation of these processes leads to increased productivity, allowing professionals to focus on more complex and creative aspects of their work. In the following sections, we will delve into the specific technologies and methodologies employed in the development of this automated math solver system, explore its applications across different fields, and discuss the potential impact on efficiency and innovation in mathematical problem-solving and minimizing the risk of errors. Additionally, the quality checking feature will enable administrators to detect anomalies such as rotten samples and foreign objects, ensuring strict adherence to quality standards.

2 Literature Survey

Automated math solvers have seen substantial evolution. Early systems such as Wolfram Alpha and Symbolab relied heavily on symbolic computation and algorithmic approaches, demonstrating initial capabilities in automated problem-solving but constrained by predefined rules and algorithms [1], [2] ·More recent developments have integrated machine learning techniques to enhance solver capabilities. Studies by Zhang et al [3] and Chen et al.[4] investigated deep learning models to solve complex mathematical problems, showing improved accuracy and efficiency by leveraging large datasets of problems and solutions.

Large language models, notably GPT-3 by OpenAI, have transformed natural language processing by achieving human-like text understanding and generation. [5]. These models excel in various applications, including language translation and question answering, due to their ability to process and generate coherent text. Brown et al. [6] highlighted the models' potential in interpreting and generating complex textual information, which is crucial for mathematical problem-solving tasks. Integrating LLMs with math solvers enables these systems to interpret problems expressed in natural language, thus broadening their applicability.

RAG techniques enhance the performance of language models by combining retrieval-based and generation-based methods. Lewis et al. [7] introduced RAG as a way to improve language model responses by retrieving relevant documents and using them to generate accurate and contextually appropriate answers. This method has proven effective in applications like question answering and knowledge retrieval. Applying RAG to math solvers allows for the retrieval of pertinent mathematical concepts and theorems, improving the

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accuracy and explanatory power of the generated solutions.

The development and evaluation of the automated math solver system enhanced with large language model (LLM) retrieval-augmented generation (RAG) involved a comprehensive approach encompassing dataset collection, algorithm design, and performance measurement. The dataset comprised a diverse collection of mathematical problems and solutions, including standardized problems from textbooks and academic competitions, problems from online platforms like Wolfram Alpha and Symbol, and custom-generated problems across various difficulty levels and domains such as algebra, calculus, and geometry. Annotated solutions, providing step-by-step explanations by experts, were also included to facilitate understanding and interpretation.

3 Algorithms

The automated math solver system employs a combination of advanced algorithms across its three main components: the mathematical problem recognizer, the solver, and the LLM-based RAG module. The mathematical problem recognizer uses Optical Character Recognition (OCR) and Natural Language Processing (NLP) techniques to convert images of handwritten or printed problems into digital text and to parse and understand problem statements written in natural language. OCR is implemented using convolutional neural networks (CNNs), with the open-source Tesseract engine customized and fine- tuned for recognizing mathematical notation. NLP techniques, including tokenization, part-of-speech tagging, and named entity recognition, are used to identify and classify components of the problem statement, with BERT (Bidirectional Encoder Representations from Transformers) utilized for understanding context and semantics.The solver component relies on deep learning models specifically designed for symbolic computation, utilizing Transformer-based architectures pre-trained on large corpora of mathematical problems and fine-tuned on specific datasets. A sequence-to-sequence (Seq2Seq) model, a type of recurrent neural network (RNN), is employed to generate step-by-step solutions by encoding problem statements and decoding them into sequences of solution steps.Additionally, traditional algorithmic solvers from computer algebra systems (CAS) like Mathematical and SymPy are integrated to handlespecific types of problems, applying well-established algorithms such as the Newton-Raphson method for solving nonlinear equations and the Gaussian elimination method for linear systems

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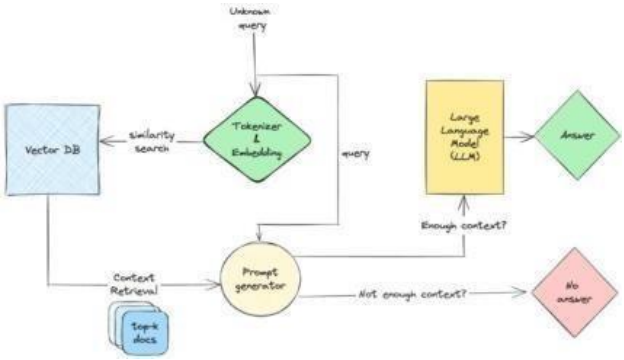

Figure 1: Retrieval augmented generation of LLM

4 Data Collection

The data collection process for the automated math solver system entails gathering a diverse and comprehensive dataset of mathematical problems alongside their corresponding solutions. This process begins with the meticulous selection of problems spanning various mathematical domains, including algebra, calculus, geometry, trigonometry, and statistics, encompassing a spectrum of difficulty levels from elementary to advanced concepts..

5 Dataset Annotation:

In annotating the dataset for the automated math solver system, meticulous attention is given to categorizing and enriching each mathematical problem with pertinent metadata and accompanying solutions. The process begins with the systematic classification of problems into distinct mathematical domains, ranging from fundamental arithmetic operations to advanced calculus and geometry.

6 Training And Testing the Model

Training the model for the automated math solver system is a pivotal stage, wherein the annotated dataset serves as the cornerstone for refining and enhancing the system's problem-solving capabilities. Testing the model of the automated math solver system represents a critical phase in evaluating its efficacy and real-world application. The testing process involves inputting a series of unseen mathematical problems into the model and analyzing its responses to ascertain the accuracy and reliability of the generated solutions.

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7 Conclusion

GPT-4 achieved over 60 percent accuracy for all groups except for the perimeter of rectangle class. For the "sum and difference" and "motion" classes, it successfully recognized all the belonging questions (Table 1). We used L30 data set in which the training set consists of first 5 examples, CV set consists of 5 to 17 examples and test set consists of the remaining 13 examples. After running all possible combinations of training examples on the cross-validation set, we picked out the prompts that performed the best for each temperature.

Category	Accuracy
item and property	70.0
mixture	60.0
motion	100.0
perimeter of rectangle	0.00
sum and difference	100.0

Table 1: Classifcation accuracy

	0.1	0.9
1-shot	0.923	1.000
2-shot	1.000	1.000
3-shot	1.000	1.000
4-shot	1.000	1.000

Table 3: Highest accuracy on test set

	0.1	0.9
1-shot	(17) (14)	(14)
2-shot	(17,5)	(17,5) (17,12)
3-shot	(17,5,14)	(25.12,14)
4-shot	(17,5,12,14)	(17,5,12,14)

Table 2: Examples with best performance on the cv set for different temperature parameters (0.1 and 0.9).

Figure 2: Annotating the dataset for the automated math solver system

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8 Conclusion

In this study, the development and evaluation of the automated math solver system represent a significant advancement in computational mathematics, offering a versatile and efficient solution for solving a wide range of mathematical problems. Through the integration of advanced algorithms, including optical character recognition (OCR), natural language processing (NLP), deep learning models, and large language models (LLMs) with retrieval-augmented generation (RAG), the system demonstrates robust capabilities in recognizing, solving, and explaining mathematical problems. The system's performance was evaluated using various metrics, including accuracy, precision, recall, efficiency, user satisfaction, and error analysis. High accuracy rates, coupled with strong precision and recall values, indicate the system's reliability and effectiveness in producing correct solutions across diverse problem sets. Efficient problem-solving times and user-friendly interactions underscore the system's practicality and usability in real-world applications, such as education, research, and engineering.

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VAULT FORTIFY : A SECURE DATA SHARING PLATFORM

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Abstract:

In an era marked by heightened concerns over privacy and security, the need for innovative approaches to data sharing platforms has become increasingly imperative. This paper presents Stealth Chat, a novel solution that combines steganography techniques with peer-to-peer (P2P) architecture to establish a secure and decentralized communication environment. Leveraging Type Script, Stealth Chat offers users a seamless and intuitive interface for real-time data sharing while prioritizing privacy and confidentiality. The core architecture of Stealth Chat is built upon a P2P network model, enabling direct communication between users without reliance on centralized servers. Through dynamic peer discovery mechanisms and efficient data routing protocols, users can establish secure connections and exchange messages in real-time. This decentralized approach not only enhances scalability and fault tolerance but also mitigates the risks associated with centralized data storage, reducing vulnerabilities to potential attacks or breaches

Keywords: Stealth Chat, Steganography, Peer-to-peer, Data sharing, privacy, security

1. Introduction

Vault Fortify is a cutting-edge communication application designed to offer unparalleled security and privacy through stealth chat and file-sharing capabilities using peer-to-peer (P2P) architecture and image steganography. In an era where digital privacy is constantly

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under threat, Vault Fortify stands out by ensuring that your messages and files are not only encrypted but also hidden within innocuous-looking images. This dual-layer security approach makes it nearly impossible for unauthorized parties to detect the presence of communication or sensitive data.

The P2P architecture of Vault Fortify eliminates the need for centralized servers, reducing the risk of data breaches and ensuring that communication is direct and secure between users. This decentralized system enhances the robustness of the application by distributing data across a network of nodes, making it resilient to attacks and surveillance. Each user acts as both a client and a server, facilitating a more secure and efficient exchange of information. This ensures that even in the event of a compromised node, the integrity and confidentiality of the communication remain intact.

In addition to secure messaging, Vault Fortify leverages image steganography to hide files within digital images. This method embeds data in such a way that it is imperceptible to the naked eye, allowing users to share files covertly. The integration of steganography with the P2P framework ensures that not only is the data transfer secure, but the very existence of the data remains hidden. Vault Fortify thus offers a comprehensive solution for individuals and organizations seeking to protect their digital communications and sensitive information from prying eyes.

2. Literature Survey

The paper "Image Steganography for Securing Secret Data Using Hybrid Hiding Model" by Sumeet Kaur, Savina Bansal, and Rakesh Kumar Bansal presents a sophisticated approach to enhancing data security through innovative stenographic techniques. The researchers introduce the Image Hiding Encryption and Decryption (IHED) model, a hybrid framework designed to secure data transmission by embedding secret information within digital images. The IHED model primarily employs mid-frequency (MF) values for embedding data, striking a balance between high-frequency and low-frequency methods. High- frequency values can lead to easy detection due to noticeable changes in the image, while low-frequency values may distort the image's visual quality. By utilizing MF values, the IHED model ensures that the modifications remain subtle and less detectable, maintaining the visual integrity of the stego-image while embedding a significant amount of data. To enhance security, the IHED model integrates multiple steganographic techniques, making it more robust against various steganalysis attacks.This layered approach increases the complexity for unauthorized entities attempting to extract or detect the hidden data. The hybrid nature of the model leverages the strengths of different techniques to create a more secure and imperceptible stenographic method[1].

The paper "Data Vaults for Block chain-Empowered Accounting Information Systems" by Muhammad Imran Sarwar and colleagues presents a novel framework that integrates

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blockchain technology with Accounting Information Systems (AIS) to enhance data security and integrity. The proposed system leverages data vaults, which are secure storage units, backed by the immutable and decentralized nature of block chain technology. This integration ensures that financial and accounting data remain tamper-proof and transparent, thus increasing trustworthiness and reducing the risk of data breaches[2].

The paper "Secure Cloud Data Storage System Using Hybrid Paillier–Blowfish Algo- rithm" by Bijeta Seth et al, addresses the critical issue of security in cloud data storage systems. This research introduces a hybrid cryptographic protocol that combines the Paillier and Blowfish encryption algorithms to enhance data security and efficiency in cloud environments.

The proposed system leverages the strengths of both symmetric and asymmetric encryption methods. Blowfish, a symmetric encryption algorithm, is known for its speed and efficiency, making it suitable for encrypting large volumes of data. On the other hand, Paillier is an asymmetric encryption algorithm that supports homomorphic encryption, which allows computations on encrypted data without decryption. By integrating these two algorithms, the system aims to reduce computational overhead and cipher text size, thus optimizing the performance of cloud storage[3].

The paper "Secure Data Storage and Sharing Techniques for Data Protection in Cloud Environments: A Systematic Review, Analysis, and Future Directions" by Ishu Gupta, Ashutosh Kumar Singh, Chung-Nan Lee, and Rajkumar Buyya offers an in-depth exploration of the current landscape of data security in cloud computing. Recognizing the growing reliance on cloud services for data storage and processing, the authors systematically review the multitude of techniques developed to safeguard sensitive information from unauthorized access and breaches.

The paper begins by outlining the critical challenges associated with data protection in cloud environments, such as data breaches, loss of control over data, and compliance with data privacy regulations. These challenges underscore the necessity for robust security measures to ensure that data remains confidential, integral, and available[4].

The paper "Combination of Steganography and Cryptography: A Short Survey" by Mustafa Sabah Taha et al. (2019) provides a comprehensive review of the integration of steganography and cryptography to bolster data security. This synergistic approach aims to exploit the strengths of both methods to protect sensitive information from unauthorized access and detection.

Steganography, the practice of hiding the existence of a message, is traditionally used to embed information within digital media, such as images, audio files, or video streams, in a way that is imperceptible to the human eye and standard detection techniques. Cryptography, on the other hand, focuses on encrypting the content of the message, transforming it into an unreadable format that can only be deciphered by

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those possessing the appropriate decryption key. The survey details the benefits of combining these two methods, which significantly enhances security[5].

3. Algorithms

3.1 The Least Significant Bit (LSB algorithm)

The Least Significant Bit (LSB) algorithm is a steganography technique used to hide data within digital media, such as images, audio files, and videos, by subtly modifying the least significant bits of the media's data. This method leverages the fact that altering the least significant bit of a byte causes minimal changes that are typically imperceptible to human senses, making it an effective tool for covert communication.

In the context of an image, the LSB algorithm operates by modifying each pixel's color components: red, green, and blue (RGB). Each of these components is usually represented by an 8-bit value, ranging from 0 to 255. To embed secret data, the algorithm replaces the least significant bit of each color component with bits from the secret message. Since the least significant bit represents the smallest possible change in the color value, this modification does not significantly alter the image's overall appearance, ensuring that the hidden data remains undetected.

The process of extracting the hidden data is straightforward. The receiver retrieves the least significant bits from the modified pixels and reassembles them to reconstruct the original message. For example, if the original pixel values are (10101100, 11001101, 11110010) and the secret data bit is 1, the modified pixel values might become (10101101, 11001101, 11110010). This slight

alteration in the least significant bit is generally unnoticeable, allowing the image to maintain its visual integrity while securely embedding the hidden data.

4.Proposed Methodology

4.1 Data Encryption

The data encryption methodology utilizes advanced steganography algorithms to ensure maximum security and confidentiality. By embedding encrypted data within digital media such as images, audio files, or videos, an additional layer of protection is created that conceals the presence of sensitive information. This approach not only encrypts the data but also hides it in a way that is imperceptible to unauthorized viewers. As a result, this method provides a highly secure and confidential means of protecting data from potential threats and breaches, ensuring that only intended recipients can access and decipher the hidden information.

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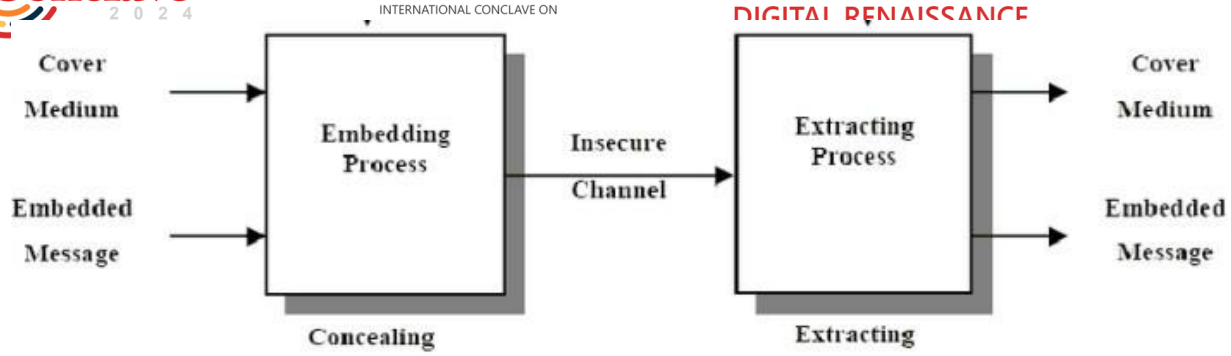

Figure 1:Data Encryption

4.2 Cloud Storage

Explore the approach to securely storing encrypted data within the reliable and scalable environment of AWS cloud servers. This method leverages AWS's robust infrastructure to ensure data integrity and availability while utilizing advanced encryption techniques to protect sensitive information. By storing data in an encrypted format, it remains secure from unauthorized access both in transit and at rest. AWS's scalable resources provide flexibility to accommodate varying storage needs, ensuring efficient and reliable data management. This approach combines the security of encryption with the dependability of AWS, offering a comprehensive solution for secure cloud storage.

4.3 Data Retrieval

The data retrieval process involves decrypting and reconstructing the original data from steganographic encodings. This begins by identifying the digital media containing the hidden data, such as an image, audio file, or video. Using specialized software, the least significant bits or other steganographic markers are extracted from the media. These bits, which were subtly modified to embed the encrypted data, are then reassembled into their original form. The extracted data is subsequently decrypted using the appropriate decryption key, fully restoring the original information. This meticulous process

ensures that the hidden data is accurately and securely retrieved, maintaining the integrity and confidentiality of the information.

5 Flowchart:

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5.1 Real-Time Data Sharing Platform

The Real-Time Data Sharing Platform enables secure and covert sharing of the steganographed data. This platform: Stores the steganographed data in a secure repository Enables real-time sharing of data through various channels (e.g., messaging, streaming, or peer-to-peer networks) Extracts the secret data from the cover objects Decrypts the data (if encrypted) Analyzes and processes the shared data in real-time Manages user access, authentication, and authorization Provides a user-friendly interface for interacting with the platform

5.2 Steganography Module

The Steganography Module is responsible for hiding secret data within cover objects (such as images, audio, or text). This module: Receives data from various sources Embeds the data into cover objects using steganographic algorithms Produces steganographed data that appears innocent and unsuspecting

5.3 Results

This novel communication solution enhances privacy and security by combining steganography techniques with a peer- to-peer (P2P) architecture. This decentralized approach eliminates reliance on centralized servers, thereby reducing vulnerabilities and improving fault tolerance. The platform enables direct user communication, ensuring real-time data sharing with a user-friendly interface built in TypeScript..

5.3.1 Login Page

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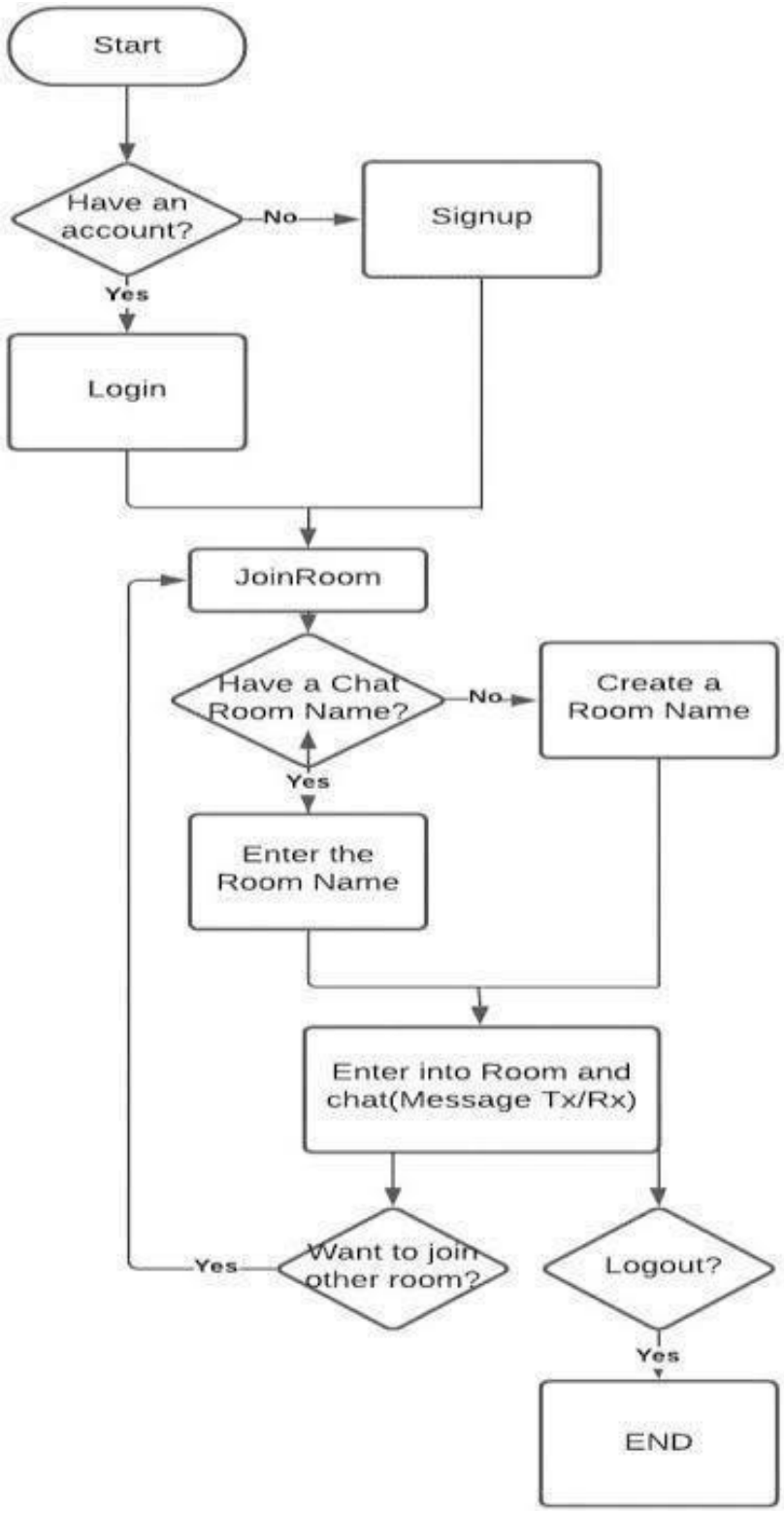

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Figure 2: Flow Chart

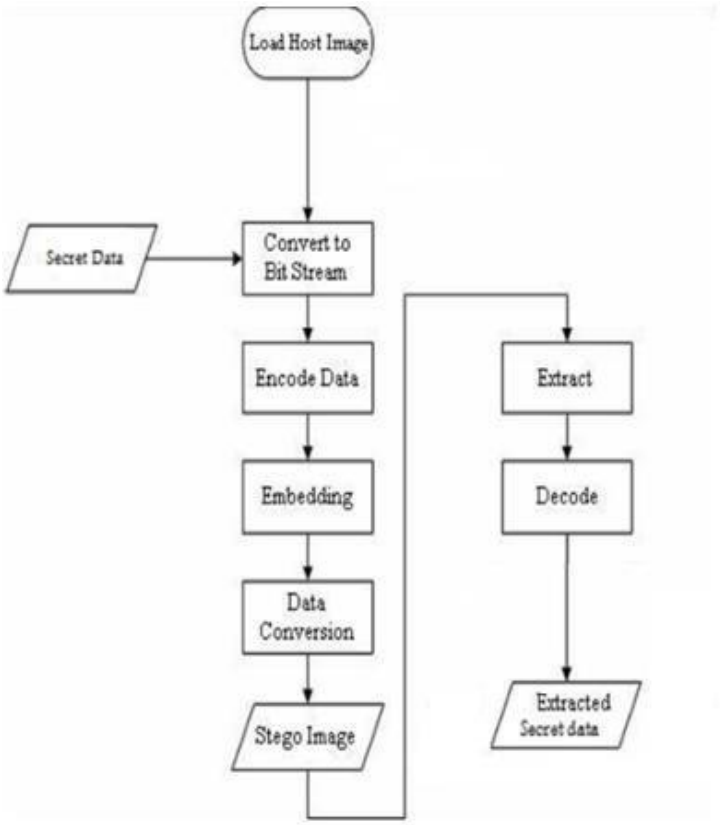

Figure 3:Flow Chart of Login Page

5.4 Conclusion

Vault Fortify represents a significant advancement in secure digital communication, combining the strengths of peer-to-peer (P2P) architecture and image steganography. By eliminating reliance on centralized servers, Vault Fortify ensures that user data is not vulnerable to centralized breaches or unauthorized access. The P2P model allows for direct communication between users, enhancing both security and privacy. This decentralized approach not only safeguards data integrity but also boosts efficiency, making the application resilient against attacks and ensuring that sensitive information remains protected during transmission..

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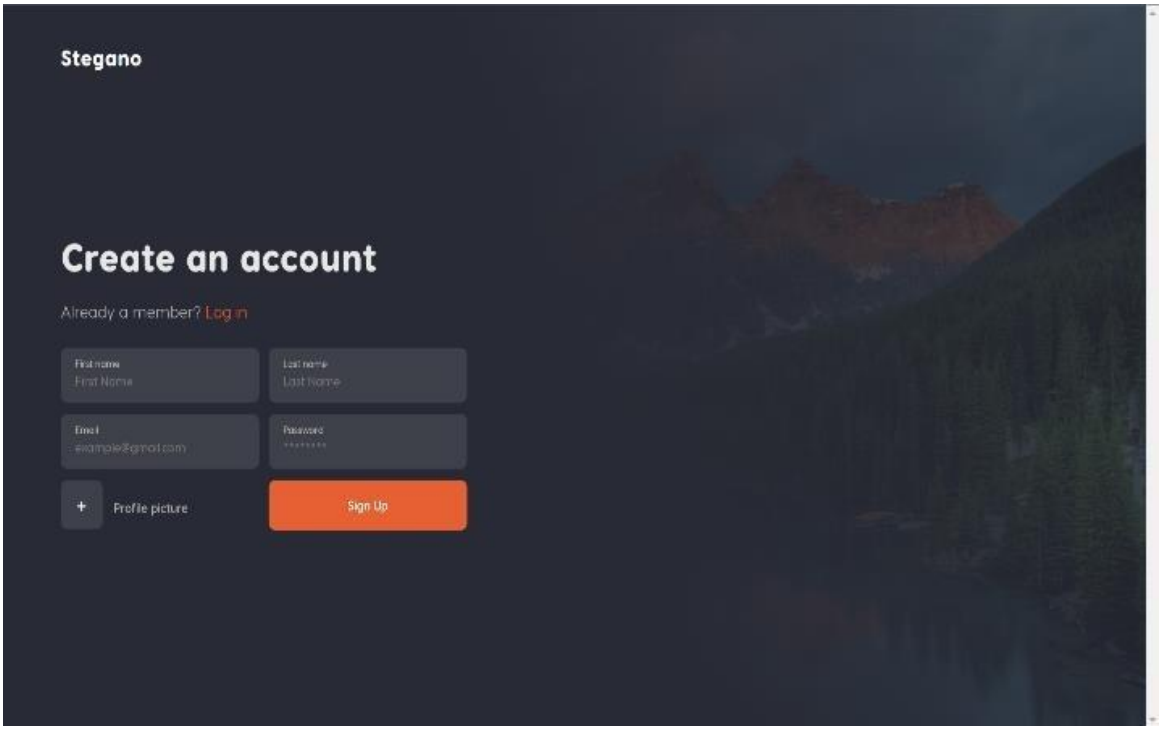

Figure 4: LOGIN PAGE

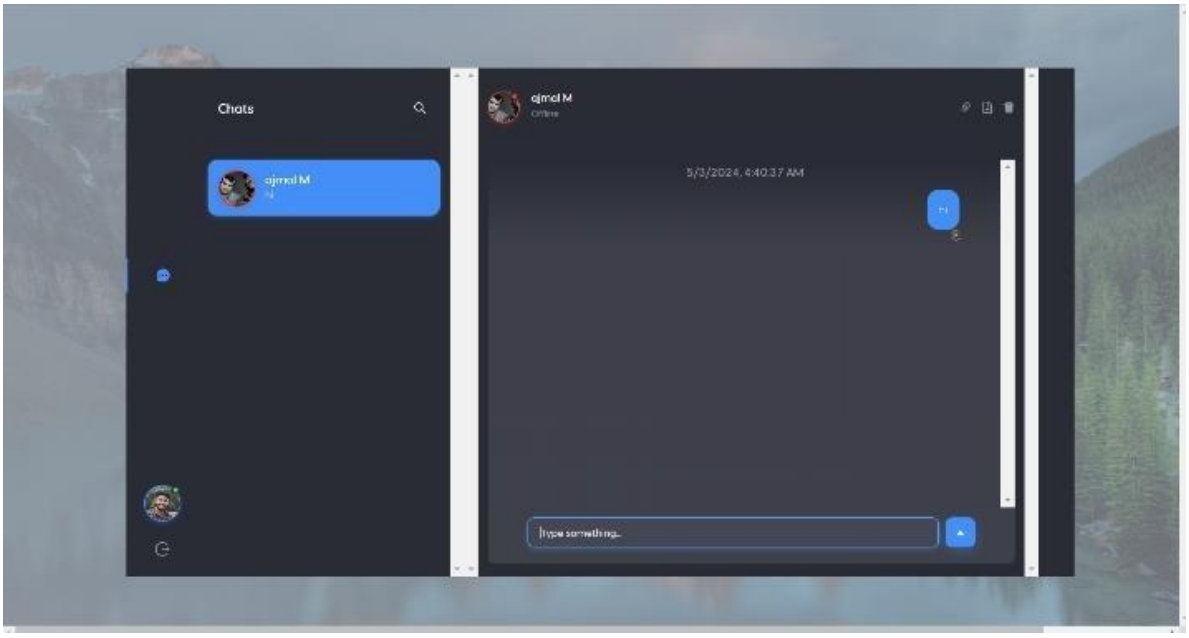

Figure 5: CHATING PAGE

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INTELLIGENT PLANNING OF TRANSMISSION NETWORKS: ADDRESSING UNCERTAINITIES THROUGH ARTIFICIAL INTELLIGENCE

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Abstract:

Power grid planning is a critical aspect of power grid topology, traditionally relying on manual methods that are prone to various uncertainties. These uncertainties, both subjective (stemming from human judgment) and objective (resulting from data limitations), can significantly affect the reliability and efficiency of the planning process. This paper introduces an artificial intelligence (AI) approach designed to enhance the intelligent planning of transmission networks. By utilizing AI, the proposed method systematically analyzes and optimizes the factors contributing to uncertainties in traditional planning methods. The AI-based model processes and evaluates topology data comprehensively, leading to more accurate and reliable planning outcomes. Furthermore, continuous monitoring is integrated into the system to ensure that the planning process remains dynamic and responsive to real-time changes. The final planning results are generated with a high degree of precision, effectively minimizing the uncertainties that plagued earlier methods. Consequently, AI-driven techniques not only meet the stringent requirements of intelligent transmission grid planning but also facilitate the continuous evolution and optimization of transmission network planning. This approach is well-suited to support the ongoing development and complexity of modern power grids, ensuring more resilient and efficient grid topology.

Key Words: artificial intelligence, smart grids, grid planning, uncertainty.

1. Introduction

The intelligent planning of the transmission grid is a comprehensive evaluation method of the power grid modeling topology, and the modeling topology data and power grid planning should be

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carried out the data is comprehensively evaluated, but the original manual planning method is prone to subjective and objective uncertainty [1]. At present, the original manual planning of transmission grid planning faces more uncertainties [2]. To apply artificial intelligence methods to transmission network planning and identify interference factors for better planning. However, the load forecasting and power planning analysis is still not ideal [3]. To this end, some scholars have proposed artificial intelligence methods to improve the intelligence of transmission networks by analyzing[4] the load forecasting and power planning of transmission grids [5] and conducting time series analysis on transmission network planning formulation rationality and certainty of planning.

2. Intelligent planning and analysis of transmission grid

Intelligent planning analysis of transmission networks makes reasonable planning for power grid planning and load forecasting [6] and detects the change characteristics of target data [7]. Intelligent planning of transmission grids [8]. The intelligent planning analysis of the transmission network is mainly based on the modeling algorithm and the peak of application [9]. The artificial intelligence method completes the comprehensive intelligent planning of the transmission network by assembling and analyzing the modelling topology data Analysis [10]. Where the direction of change in the peak of the target data represents the amplitude value [11]. There are four definitions of AI methods, which are as follows.

Definition 1: The arbitrary modelling topology data is x_{i}, the target data formulation function is J_{i}, the planning set is $p(y_i)$, and the time length is c_{i}. Well, the calculation process is shown in Equation (1).

$$p(y_i)=\frac{1}{2}\cdot\sqrt{a^2+b^2}\cdot J\times c_i\cdot x_i \quad (1)$$

Definition 2: The forecast plausibility function is $f(x)$, l is planning reasonableness, Yl is planning reasonableness and Yq is determinism. Well, the calculation process is shown in Equation (2).

$$f(x,P)=x\xrightarrow{y}\sqrt{Y_m\cup Y_b}\div\sqrt{b^2-4ac}\cdot x \quad (2)$$

Definition 3: Planning result function, planning change is $l(x_i)$, planning set is $\bar{x}_{\mathrm{i}}$, modeling number is col_{i}. The calculation process is shown in Equation (3). $h_i\ l(x_i)$

$$l(x_i)=\sum c_i\div h_i\cdot x_i\cdot\frac{dy}{dx}\cdot(a+c) \quad (3)$$

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Definition 4: The load forecast function is $f(x,b)$,the threshold of the plan is w,l is the planning error. Well, the calculation process is shown in Equation (4).

$$f(x)=\sum_{i=1} x_i \times w \div \tau_i \cdot \frac{1}{n} \cdot \mu_X \quad \square\square\square \quad \square\square\square\square\square\square\square\square\square\square\square\square$$

3 Artificial intelligence methods for planning

In the process of artificial intelligence transmission network planning, the grid topology information should be comprehensively calculated to reduce the uncertainty in the planning. According to the artificial intelligence theory, identify the constraints with differences, and calculate the rationality of planning formulation. Therefore, conducting a random analysis of the planning and related constraints of different electricity market conditions is necessary.

Definition 5: The target data function is $F(J_i)$, when a peak occurs, the planning variable is, and the constraint is calculated as shown in Equation (5).

$$F(x_i)=\frac{k(x_i^{\,2})\cdot(1-P_i)}{Ya\cdot\sqrt{1-k^2}}\cdot\frac{-b\pm\sqrt{b^2-4ac}}{2a} \quad \square\square\square\square\square\square\square\square\square\square\square$$

Formula: If $F(x_i)\geq A$the intelligent planning results are reasonable, otherwise the constraints that do not meet the requirements must be analyzed. If it $F(x_i)\lhd A$states that the smart planning results do not meet the constraints, readjust them.

Definition 6: The constraint determination function is $j(k)$, calculated as shown in Equation (6).

$$j(k)=\sqrt{2}\cdot y(x_i,y_i)\cdot e_i\cdot f(x_i)\cdot(y-x) \quad \square\square\square\square\square\square$$

Intelligent planning to reduce the occurrence of uncertainties requires sampling analysis of load forecasting and grid planning, including subjective and objective uncertainty. In addition, the planning scheme is analyzed according to the artificial intelligence method.

Step 1: The planning data of the AI method is collected, the binding nature of the intelligent planning is determined, and the intelligent planning is comprehensively evaluated, and then the planning is determined Conditions for judgment.

Step 2: Collective calculation of load forecasting and grid planning included in the transmission grid, and continuous analysis of multi-stage transmission network planning.

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Step 3: Ensemble the calculation for planning formulation, terminate the analysis if the constraints are exceeded, or the forecast data changes, otherwise, the set calculation is performed.

The AI method planning is analyzed based on the original AI method, and the specific parameters are shown in Table I.

TABLE I. PLANNING DATA STATUS OF ARTIFICIAL INTELLIGENCE METHODS (UNIT: %)

Parameter	Discreteness	Effectiveness
Grid size	93.51	89.76
Number of branches	92.64	92.22
Number of nodes	91.20	91.67
Number of loads	92.76	92.84

During the research in Table I, it is found that AI method can analyze network scale, network branches and network nodes, and there is a big difference between AI method and artificial intelligence analysis method. From this result, we can see that AI method can realize comprehensive data analysis and provide relevant support for later research. Relatively speaking, the data distribution state of AI intelligent analysis method is shown in Figure 1.

From the contents in Figure 1, it can be seen that the data of AI method is discrete, and mainly distributed between 82% and 86%, which shows that the data dispersion is scattered and meets the relevant analysis requirements. At the same time, there is no concentrated result in the overall distribution of data, which shows that the normality of data is good, the overall structure and data value are reasonable, which can lay the foundation for later analysis and will not affect the later calculation results.

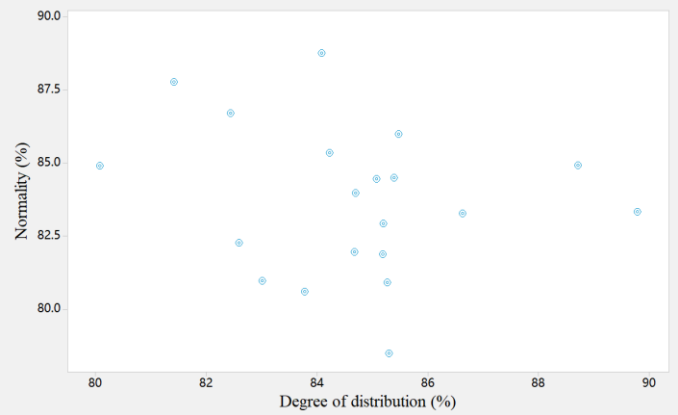

Figure 1: Data distribution status of artificial intelligence methods

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TABLE II. COMPARATIVE PLANNING OF ACCURACY AND RATIONALITY (UNIT: %)

Fangfa	Plan direction	parameter	Accuracy	Rationality	Average change
Artificial intelligence approach	First-level planning	randomness	92.66	92.64	0.15
		Ambiguity	94.21	91.20	2.09
		complexity	91.54	92.76	1.32
	Secondary planning	randomness	94.43	92.66	1.75
		Ambiguity	93.39	90.06	2.25
		complexity	93.51	94.05	0.76
Original manual method	First-level planning	randomness	89.48	89.16	1.36
		Ambiguity	80.04	81.48	1.53
		complexity	85.60	86.55	1.15
	Secondary planning	randomness	86.76	83.47	3.09
		Ambiguity	87.17	78.31	8.32
		complexity	81.77	83.69	2.75
Plan for comparison		X2=16. 121, P<0.06			
Parameter mining times = 56 times					
Parameter adjustment rate = 0.35					
Parameter compatibility = 0.89					

The planning of artificial intelligence methods should be kept complete, otherwise it will increase the randomness and ambiguity of planning, and the accuracy and rationality of the planning results of artificial intelligence methods will be detected and specifically planned This is shown in Table II.

From the data analysis in Table II, it can be seen that there is no significant difference between the analysis results of the early level and the late level of the artificial intelligence algorithm, and the randomness, complexity and change range have not changed greatly. The calculation accuracy, rationality and average change are at a high level, greater than 90%, which is significantly superior to the traditional artificial method. Although the accuracy and rationality of traditional artificial method is better than 80%, it is slightly inferior to artificial intelligence method. Therefore, the artificial intelligence method proposed in this paper is better. In addition, from the data in Table II, it can be seen that the accuracy and rationality of artificial intelligence methods are relatively stable,

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and the change range is small. This result shows that the artificial intelligence analysis method has strong data processing ability, can judge complex data, is not interfered by external data, and the calculation result is relatively stable. In order to better reflect the calculation results, it is necessary to analyze the above data continuously and observe the continuity of the calculation results. The specific calculation process is shown in Figure 2. It can be seen from Table II that the accuracy and rationality of artificial intelligence methods are greater than 9 1%, the mode change is less than 2, and the change amplitude of different methods is greater than 8. There are significant differences. At the same time, the randomness, ambiguity, and complexity changes are relatively small, so the overall planning of artificial intelligence methods is better. However, the rationality and accuracy of artificial methods vary greatly, traditional the accuracy and rationality of manual methods are less than 80%, which is relatively poor. In the market conditions, the rationality and accuracy of AI method planning change as shown in Figure 2.

It can be seen from Figure 2 that in the data sampling comparison, the rationality and accuracy of artificial intelligence method planning are more concentrated, while the traditional manual method is more concentrated the rationality and accuracy of the planning are poor, which is consistent with the results of the study in Table II. The reason is that the artificial intelligence method analyzes the rationality of the planning such as the formulation of transmission network planning, and calculates the convex function values of different values, which removes the uncertain factor values in transmission network planning to simplify its complexity.

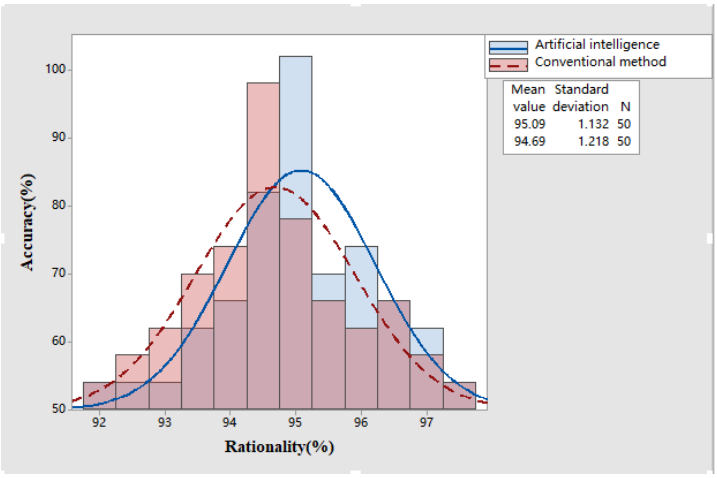

Figure 2 **Comparison of accuracy and rationality of planning of different algorithms**

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From the data analysis in Fig. 2, it can be seen that the rationality and accuracy of artificial intelligence algorithm are higher than those of traditional methods, and the peak curve is biased to the right, which further proves the effectiveness of the calculation results. In the area of peak curve, the area of artificial intelligence algorithm is larger, which shows that its results are more effective and the overall calculation results are better. The main reason for the above results is that artificial intelligence algorithm combined with big data, cloud computing and other aspects can comprehensively judge complex data, optimize the data results and eliminate redundant data in the middle.

The time of AI method planning is an essential indicator of planning efficiency, including subjective uncertainty, objective uncertainty, etc., and the specific planning is shown in Table III.

According to the data in Table III, the results of artificial intelligence method in time planning are relatively stable and take less time, which shows that the calculation time of intelligent planning method is relatively rational. Relatively speaking, the traditional manual calculation method takes a relatively long time, which shows that manual calculation method has certain disadvantages in data processing and redundant data elimination. Artificial intelligence algorithm uses big data, cloud computing and other methods to obtain more comprehensive data eigenvalues, better build network topology, and carry out multi-dimensional analysis of data, which can effectively eliminate abnormal values of data, reduce the complexity of data, and provide support for later simplified calculation. In order to better analyze the advantages of artificial intelligence algorithm, the relevant data are calculated in stages, and the specific calculation results are shown in Table III.

TABLE III. PLANNING TIME OF ARTIFICIAL INTELLIGENCE METHODS (UNIT: MINUTES).

Method	Time	Subjective uncertainty	Objective uncertainty	Data dispersion
Artificial	10~20	95.03	95.64	0.342
intelligence	20~30	93.18	92.57	
approach	30~40	93.15	91.68	
Traditional	60~70	82.19	84.89	
manual	70~80	84.74	89.57	
methods	80~90	86.86	84.76	
Difference of different methods = 0.56				
Method independence = 0.23				
Data Relation = 0.421				

ISBN-978-81-19905-39-3

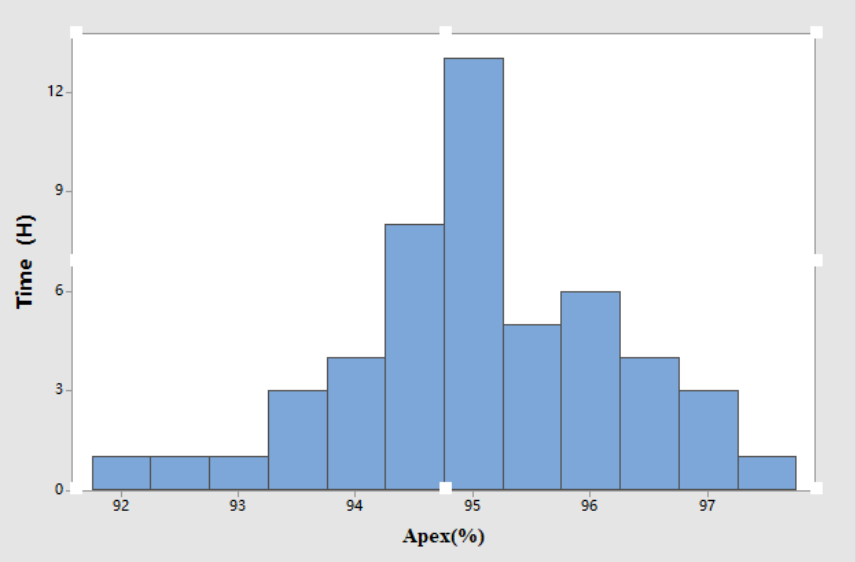

Figure 3. Comparison of planning data and time for different methods

From the data in Fig. 3, it can be seen that the calculation time of artificial intelligence algorithm is less than 12 seconds, and the calculation peak value is relatively concentrated, and it decreases from the peak value to both sides, which meets the requirements of normal distribution. In addition, the peak value of artificial intelligence algorithm is at 95%, which is significantly better than the traditional manual calculation method. In addition, in terms of peak distribution, the reduction range of the right side is smaller than that of the left side, which shows that the later calculation process is relatively stable, while the previous results are larger, mainly because of complex data analysis in the early stage to reduce the effectiveness of the analysis results. Through the analysis of Figure 3, the planning data value of artificial intelligence methods is higher, and the time is faster, while the planning of traditional manual methods. The comprehensiveness is poor, and the planning time is slow.

4. CONCLUSION

In the transmission grid planning process, the manual methods of the past cannot be effectively planned. Based on this, this paper proposes an artificial intelligence method to comprehensively evaluate the transmission network planning and determine the final plan. Reduce the complexity of the planning process by comprehensively calculating planning expectations through artificial intelligence methods. Intelligent planning is carried out with constraints, and the uncertainties in transmission network planning are studied to improve the rationality of planning. The results show that the comprehensiveness and rationality of artificial intelligence methods are greater than 90%.

ISBN-978-81-19905-39-3

However, the rationality and comprehensiveness of traditional artificial methods are quite different, and the uncertainty factors are highly disturbed and relatively poor. At the same time, the planning time of artificial intelligence methods is relatively fast, and the range of changes is small. Among them, the value of uncertainties in the planning of artificial intelligence method is stable, the time is short, and the overall transmission network planning scheme is more ideal.

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ISBN-978-81-19905-39-3

Milk Adulteration Detection Using IoT and ML Techniques

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Abstract:

Ensuring the purity of milk is paramount for public health, and the increasing instances of adulteration necessitate advanced detection methods. This paper presents a comprehensive approach to milk adulteration detection using a combination of Internet of Things (IoT) and Machine Learning (ML) techniques. The proposed system integrates pH, temperature, turbidity, TDS (Total Dissolved Solids) and conductivity sensors deployed across the milk supply chain to collect real-time data. These sensors monitor critical parameters, providing a rich dataset for analysis. The collected data is processed using a Support Vector Machine (SVM) ML algorithm, leveraging its capacity for efficient classification. SVM is trained on labeled datasets, enabling it to discern between genuine and adulterated milk samples based on the sensor readings. This model ensures robust and accurate detection of various adulterants, including those affecting pH levels, temperature, turbidity, and conductivity.

The integration of these sensors and SVM algorithm enhances the precision and reliability of milk adulteration detection. The proposed system emerges as a cost-effective and reliable solution, offering a practical

ISBN-978-81-19905-39-3

tool to safeguard the safety and quality of milk products. By synergizing the strengths of IoT and ML techniques, our system empowers stakeholders to effectively combat milk adulteration and ensure consumer well-being.

INTRODUCION

Milk, a fundamental component of human nutrition, plays a vital role in ensuring public health and well-being. The Food Safety and Standards Authority of India (FSSAI) has established minimum requirements for the protein and nutrient content of milk to ensure its nutritional quality and consumer safety. According to the FSSAI regulations, milk must contain at least 2.5% fat, 3.0% protein, and 4.5% carbohydrate. These macronutrients provide essential energy and building blocks for the body's growth and maintenance [1]. [1] However, the pervasive practice of milk adulteration poses a significant threat to consumer safety and undermines the integrity of the dairy industry. Milk adulteration involves the intentional addition of foreign substances, such as water, starch, urea, and maltodextrin, to milk, with the malicious intent to increase its volume or weight for fraudulent gain. The presence of these adulterants not only compromise the nutritional value of milk but can also lead to severe health consequences, including allergies, digestive issues, and even death.

Conventional methods for milk adulteration detection, such as lactometer testing and visual inspection, often prove to be time-consuming, labor-intensive, and prone to human error. These limitations necessitate the development of more sophisticated and reliable detection methods that can effectively combat the prevalence of milk adulteration [2].[2]

In recent years, the remarkable advancements on the Internet of Things (IoT) and machine learning (ML) have opened new frontiers for milk adulteration detection. IoT- based systems offer real-time monitoring and analysis capabilities, enabling continuous surveillance of milk quality. These systems employ an array of sensors to capture various physical and chemical properties of milk, such as pH, temperature, conductivity, and turbidity. The sensor data is then transmitted to a central processing unit, where it is analyzed using ML algorithms to identify potential adulterants. ML algorithms, with their exceptional pattern recognition and classification abilities, are well-suited for milk adulteration detection. These algorithms can be trained on large datasets of sensor data and adulterant information to establish robust models for identifying adulterated milk samples. Several studies have demonstrated the effectiveness of IoT-based milk adulteration detection systems using ML algorithms[3].[3]

These studies underscore the immense potential of IoT- based milk adulteration detection systems using ML algorithms to revolutionize milk quality control practices. By providing real-time insights into milk adulteration, these systems can safeguard public health, ensure consumer

ISBN-978-81-19905-39-3

protection, and promote economic fairness in the dairy industry.

LITERATURE REVIEW

Milk adulteration is a serious concern, and researchers are constantly seeking better ways to detect it. A literature review in this field would explore the different types of adulterants, their health risks, and the various detection methods available. Traditional methods like lactometers and chemical tests are covered, but the focus often shifts to newer, more advanced techniques like spectroscopy, chromatography, and DNA- based methods. Emerging technologies like IoT sensors and AI are also gaining traction. The review wouldn't just compare methods, but also discuss challenges like detecting low-level adulterants, improving accuracy, and making tools portable and affordable. It might even touch upon factors like

geographical variations and economic drivers of adulteration. Ultimately, a good literature review helps researchers and policymakers understand the current landscape and chart a course for future advancements in milk safety. The outcomes of their research efforts in this area include the following results:

In 2022, a novel classification system was developed by Prashanth P Lal, Avishay A.Prakash and Kushal A Prasad to analyze common milk adulterants. The EC, pH, and temperature sensors were interfaced together with the Arduino Mega microcontroller to create the electronic tongue section of the project. These ranges formed the backbone of the Fuzzy classification system, where values outside these ranges were associated with the presence of adulterants in milk. Observing the pH and EC values at 1:1 part dilution of adulterant solution with milk produced the following results. The IoT feature was implemented to log measured milk parameters to the ThingSpeakTM cloud platform. It provided a graphical representation of the measured data concerning time and provide alternate cloud-based solutions for measurements.

In 2019, Aditya Dave, Dishant Banwari, Satyan Srivastasava have explored that there has become an ever-increasing need for detecting good quality of milk against the bad one because of the vast number of methods now known and used for milk adulteration. Especially since India has a vast and thriving dairy industry committing an adulteration fraud can reap rich profits and exploit poor people if undetected. Traditional methods involve measuring the specific gravity (e.g. Lactometer). But if the weight after introducing the adulteration is kept constant, such methods fail. The ones that have overcome this flaw and are presently prevalent are contact based methods that involve contact with the milk samples and hence the samples cannot be used again. Such methods lead to large amount of wastage of milk since the reliability seen thus far does not guarantee accurate adulteration detection within short number of tests. This paper proposes a completely non-contact type method for detection of milk adulteration, preserving the consistency and quality of milk sample and making it reusable for testing again. About 500

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raw milk samples were considered for the study and categorized into 3 categories namely Cow milk, Buffalo milk, and skimmed milk. Fresh samples obtained were from different dairies and commercial local brands like Saras, Anand, Amul etc. An embedded system consisting of AVR micro-controller integrated with the optical sensor, LCD and keypad was built.

Refractive index was the principal parameter involved in detecting the adulteration. As the amount of water adulteration changed, the refractive index changed, and these relations were used to configure the system for detecting adulteration of a random milk sample. The results obtained detected the adulteration with an accuracy of about 95
±1% which show an increase in mis clarification accuracy of about 200% over traditional methods such as spectroscopy.

The research conducted by N Sowmya and Vijay Kumar introduces a novel approach to combat milk adulteration utilizing Artificial Intelligence alongside multispectral sensors. Their model successfully identifies four common adulterants: Hydrogen peroxide, sodium sulphate, dextrose, and Ammonium sulphate, as well as pure milk samples. Machine learning algorithms such as Naive Bayes, Linear discriminant analysis, support vector machine, decision tree, and neural network models are employed, achieving impressive accuracies ranging from 88.1% to 92.7%. Notably, the neural network's performance is enhanced to 100% through optimal parameter tuning via Genetic algorithm framework. Moreover, a dedicated IoT-enabled webpage is designed to allow users and authorized individuals to remotely visualize detected adulterants. Nonetheless, the model's efficacy may diminish if the sensor-to-sample distance exceeds one inch, and further research is warranted to explore additional potential adulterants not currently addressed.

SCOPE AND OBJECTIVE

- Determining the adulterant in milk at initial stages.
  - It can be used as a portable device by each customer.
  - To protect the interests of consumers by eliminating fraudulent practices.
  - To protect the public from poisonous and harmful milk.
  - To prevent the sale of substandard milk.

SYSTEM ANALYSIS

The system analysis of the Milk Adulteration Detection Using IoT and ML Techniques are crucial for understanding the model's performance and its implementation.

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Existing System

Ensuring the purity and quality of milk is crucial for consumer safety and public health. Adulteration, the practice of adding inferior or unauthorized substances to milk, poses significant health risks and jeopardizes consumer trust. To combat this issue, various methods have been employed to detect milk adulteration.

Lactometer Testing: A lactometer is a hydrometer specifically designed to measure the density of milk. Since pure milk has a higher density than water, a lactometer will float higher in pure milk compared to watered-down milk. Lactometers are relatively inexpensive and easy to use, making them a common choice for home testing. However, their accuracy is limited due to factors such as temperature fluctuations and the presence of non-water adulterants.

Visual Inspection: Visual inspection of milk can also provide preliminary indications of its purity. Pure milk should exhibit a white or slightly yellowish color, maintain a uniform consistency, and be free from visible impurities. However, these visual cues are not always reliable, as certain adulterants can mimic the appearance of pure milk.

ii. Limitations of Existing System

· Inaccuracy: Lactometers and visual inspection methods can be inaccurate due to factors such as temperature variations, the presence of non-water adulterants, and the type of milk being tested.

· Limited Scope: These methods primarily detect water addition as the adulterant and may overlook other forms of adulteration, such as chemicals, starch, or urea.

· Labor-Intensiveness: Testing milk using a lactometer and visually inspecting it can be time-consuming and hard to handle.

· Inconsistent Visual Cues: Visual inspection of milk for signs of adulteration can be subjective and unreliable.

· No Machine Learning model is implemented.

iii. Proposed System

Data preprocessing is an essential step in the development of machine learning models, as it ensures the quality and consistency of the data used for training and evaluation. This phase focuses on cleaning, normalizing, and transforming the sensor data to ensure its integrity, consistency, and suitability for machine learning analysis.

Model Training

This stage involves utilizing the SVM (Support Vector Machine) ML algorithm to learn the

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patterns and relationships within the preprocessed and engineered data, enabling the distinction between pure and adulterated milk.

Model Evaluation

This step assesses the performance of the trained SVM model on an unseen dataset to evaluate its classification accuracy, precision, recall, and F1-score.

Model Deployment and Monitoring

This stage involves integrating the trained SVM model into the IoT system, enabling real- time milk analysis and triggering alerts in case of adulteration detection. Additionally, continuous monitoring of the model's performance is crucial to maintain its effectiveness and adapt to potential changes in milk characteristics or adulteration practices.

SYSTEM ARCHITECTURAL DESIGN

The design phase is a crucial stage in the project management lifecycle, responsible for transforming raw requirements into detailed and actionable plans. It serves as a bridge between the conceptualization of a project and its actual implementation, laying the foundation for a successful outcome. The goal is to create a comprehensive blueprint that clearly communicates the project's objectives, scope, and

METHODOLOGY

The term "methodology" refers to a systematic and structured approach to conducting research or solving a problem. It outlines the steps involved in a process, the tools and techniques used, and the underlying principles that guide the investigation or solution development.[4]

In the context of Milk Adulteration Detection Using IoT and ML Techniques, the methodology encompasses the procedures and strategies employed to utilize IoT (Internet of Things) devices and machine learning (ML) algorithms for effective detection of milk adulteration. It encompasses the following key aspects:

Data Collection

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Data collection is the initial and crucial stage of developing a milk adulteration detection system using IoT and ML techniques. This stage involves gathering sensor data from both pure and adulterated milk samples to establish a comprehensive dataset that encompasses the diverse characteristics of both unadulterated and adulterated milk.

Data Preprocessing **The enhanced system aims to detect milk adulteration with greater precision by employing additional sensors: pH, temperature, turbidity, Total Dissolved Solids (TDS), and conductivity. The collected data from these sensors is transmitted to a cloud platform for processing and analysis. The system utilizes the SVM machine learning algorithm to classify milk samples as either pure adulterated based on the comprehensive sensor data**

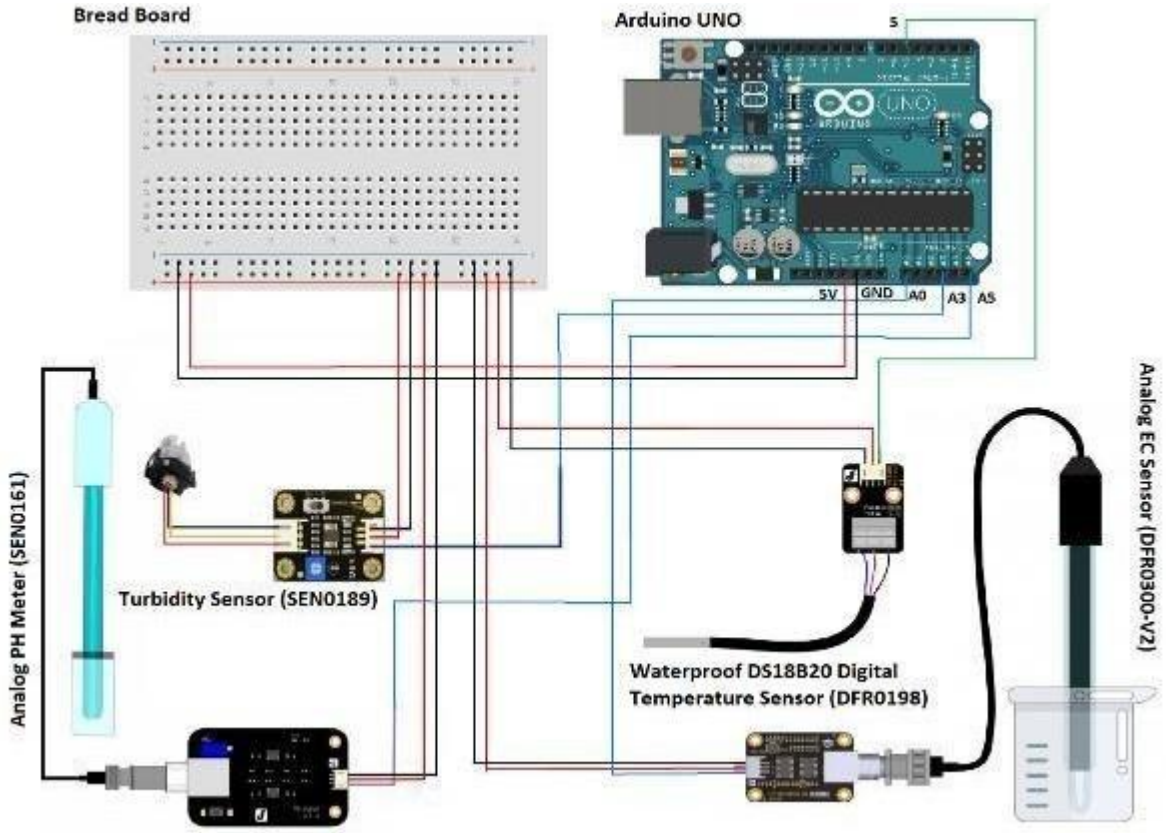

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Figure 1: System Architecture design

The system architecture comprises three main components:

Sensor Node

Sensor nodes play a crucial role in milk adulteration detection systems by continuously

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monitoring and measuring various parameters of milk quality. These nodes are equipped with sensors that can detect the presence of adulterants, such as water, starch, sugar, and harmful chemicals, in milk samples. By analyzing the sensor data, milk adulteration detection systems can flag contaminated samples for further investigation or immediate rejection.

Sensor nodes are often integrated into milk adulteration detection systems that combine sensor data with data from other sources, such as milk temperature, production date, and supplier information. This integrated approach provides a comprehensive assessment of milk quality and helps to identify potential adulteration patterns. The use of sensor nodes for milk adulteration detection is becoming increasingly prevalent as technology advances and sensor costs decrease. These nodes are playing a vital role in ensuring the safety and quality of milk products for consumers worldwide.

pH sensor: pH (potential of hydrogen) is a measure of the hydrogen ion concentration in milk. This means is that for every tenfold change in hydrogen ion concentration, there is a one unit change in pH. pH is a numeric scale used to specify the acidity or basicity of an aqueous solution.

It measures the acidity of milk, which is an indicator of water adulteration. The pH of milk typically ranges from 6.4 to 6.8, with the ideal range being between 6.5 and 6.7.[5][5] A lower pH value indicates a higher acidity, which could be a sign of water adulteration. Milk with a pH below 6.2 is sour and undesirable.

Figure 2: pH sensor

Temperature sensor: Temperature sensors are devices that detect and measure coldness and heat and convert it into an electrical signal. Temperature sensors are utilized in our daily lives be it in the form of domestic water heaters, thermometers, refrigerators, or microwaves. Temperature Sensor is a piece of electronic equipment that detects the temperature of its surroundings and

ISBN-978-81-19905-39-3

transforms the incoming data into electronic output data to control record or signal temperature variations. It measures the temperature of milk, which can deviate from normal levels due to preservatives or chemicals. The ideal temperature for drinking milk is between 15-20°C (59-68°F). This temperature range allows for optimal taste and nutrient absorption. Milk that is too cold can be unpleasant to drink and may numb your taste buds, while milk that is too hot can destroy some of its nutrients [6].[6]

Figure 3: Temperature sensor

Turbidity sensor: Measures the cloudiness of milk, increasing with foreign particles or impurities. The turbidity of pure milk typically ranges from 10 to 20 NTU (Nephelometric Turbidity Units).[7] An increase in turbidity beyond this range may indicate the presence of foreign particles or impurities, suggesting milk adulteration.

TDS sensor: A TDS meter indicates the total dissolved solids like salts, minerals, and metals, in a solution. This parameter can be used to give you an idea of water quality and compare water from different sources. One of the main applications of a TDS meter is aquarium water quality monitoring.

Measures the total dissolved solids in milk, which may be elevated due to added salts or minerals. The total dissolved solids (TDS) content of milk typically ranges from 120 to 180

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Figure 4: Turbidity sensor

milligrams per liter (mg/L) or parts per million (ppm). Elevated TDS levels in milk may indicate the addition of salts or minerals, such as sodium chloride or calcium carbonate, which are common adulterants used to increase the milk's weight and appearance.[8]

Figure 5: TDS sensor

Conductivity sensor: Taste is something which is dependent on the pH and conductivity of substance as the adulterants added to the milk will have different conductivity. Conductivity of solution depends on the concentration of all the ions present. Greater the concentration greater will be the conductivity. Since pH is a measure of H+ ions, for an acidic solution PH will be lower [higher H+ ions], hence greater will be the conductivity. Similarly higher the pH lower will be the conductivity for basic solution.

ISBN-978-81-19905-39-3

It measures the electrical conductivity of milk, which can be altered by conductive substances. The electrical conductivity of pure milk typically ranges from 2.2 to 2.5 mS/cm (millisiemens per centimeter) at 25°C (77°F). This conductivity is primarily due to the presence of dissolved ions in milk, such as lactose, proteins, and minerals.

Figure 6: Conductivity sensor

Data Transmission

The Arduino Uno microcontroller can effectively transmit sensor data for milk adulteration detection. It gathers sensor readings, converts them to digital values, packages them into structured data packets, and transmits them using a wireless communication module. Modbus, Serial communication, Wi- Fi, and Bluetooth are common protocols, while XBee, ESP8266, HC-05, and SIM800L are popular modules [9]. 9

The Arduino Uno microcontroller acts as the sensor interface, data acquisition unit, and communication hub in the milk adulteration detection system. It collects sensor data,

processes it into meaningful measurements and transmits it to a cloud platform or data server for analysis and classification. The SVM machine learning algorithm utilizes this

sensor data to identify patterns and distinguish between pure and adulterated milk samples.

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Figure 7: Arduino UNO

Thinkspeak (Cloud Platform

The cloud platform serves as the central hub for data storage, processing, analysis, and visualization in the milk adulteration detection system. It handles data ingestion, preprocessing, feature extraction, machine learning model training and deployment, real- time classification, and comprehensive visualization and analytics, ensuring effective milk quality monitoring and adulteration detection.

SVM Algorithm:

Begin

Initialized SVM parameter and structure

Generate an initial number of birthing lairs 3. L = (f = 1,2,3,. . . ,n)

While (Stopping criterion)

If noise = false

Search in the proximity for a new lair by using a Brownian walk

Else

Expand the search for a way for a new layer by using levy walk

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End if

Evaluate the fitness of each new lair and compare with previous one

If

Leste > y bestk+1

Choose the new lair

Less = Lbestik

Else

Go to 4

End if

Rank the solutions;

Return the best lair

The global best lair is fed to SVM classifier Training the SVM classifier

End while

End

CONCLUSION

The integration of IoT and ML techniques has emerged as a transformative approach to milk adulteration detection, offering a comprehensive and multifaceted solution to address this critical concern. By employing a network of sensors to gather real-time data on milk quality parameters, including pH, temperature, turbidity, TDS, and conductivity, the system enables continuous monitoring and early detection of adulteration attempts. This real- time surveillance capability empowers stakeholders to take immediate corrective actions, preventing the distribution of contaminated milk products and safeguarding consumer health. The system's effectiveness is further enhanced by the incorporation of advanced machine learning algorithms, specifically the SVM (Support Vector Machine) algorithm. SVM excels in pattern recognition and classification tasks, making it ideally suited for identifying adulteration

ISBN-978-81-19905-39-3

signatures in the collected sensor data. The algorithm's ability to learn and adapt from continuously updated data ensures that the system remains effective in detecting even emerging forms of adulteration.

Beyond real-time monitoring and precision detection, the IoT-ML system offers valuable data-driven insights into milk quality trends and potential adulteration patterns. The cloud platform, serving as the system's central hub, facilitates data analysis, visualization, and correlation, enabling stakeholders to identify potential sources of contamination and implement targeted quality control measures. This data-driven approach empowers informed decision-making and continuous improvement of milk production and distribution practices. In contrast to traditional laboratory testing methods, the IoT-ML system offers a more efficient and streamlined approach to milk adulteration detection. By eliminating the need for time- consuming and resource-intensive laboratory analyses, the system reduces processing time and costs, leading to significant economic benefits for milk producers and distributors. Overall, the integration of IoT and ML techniques into milk adulteration detection represents a paradigm shift in safeguarding milk quality and consumer health. By providing real-time monitoring, enhanced precision, data-driven insights, scalability, adaptability, and reduced reliance on traditional methods, this innovative solution plays a pivotal role in
ensuring the integrity of the milk supply chain and fostering consumer trust.

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ISBN-978-81-19905-39-3

FLORA-VISION: A QUALITY ASSURANCE SYSTEM FOR THE PHARMACEUTICAL INDUSTRY

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Abstract—In contemporary pharmaceutical production, the persistent challenges of manual labor, human error, and contamination risks pose significant obstacles to efficiency and product quality. Particularly in sectors such as Ayurvedic products, cosmetics, and medicines, the need for innovation is pressing. In modern agriculture system intelligent management systems play a vital role in effective identification of crop diseases and pests. This project aims to address these challenges head-on by introducing an innovative solution to revolutionize production processes. Through the utilization of advanced technology, the proposed system streamlines sample management and quality control procedures, offering a timely response to the industry's most pressing concerns. With a focus on Real-time Recognition &Classification and Quality Checking, the system ensures precise identification and labeling of samples while detecting anomalies to uphold stringent quality standards. By automating critical processes, the system minimizes labor costs, increases accuracy, and ultimately enhances overall efficiency and customer satisfaction. This project represents a crucial step forward in pharmaceutical production, promising increased reliability and regulatory compliance in an ever-evolving industry landscape. Integration of machine learning models like YOLOv8 and OpenCV enhances adaptability to diverse environments. ResNet, short for Residual Network, is a pioneering deep learning architecture significantly influenced computer vision, achieving state-of-the-art results in image classification, object detection, and segmentation tasks. YOLOv8 achieved a high precision of 99.6%, indicating most positive detections were correct and recall of 99.7%, respectively showing it successfully identified almost all relevant samples. The system boosts efficiency, reduces costs, and elevates product quality, driving productivity and customer satisfaction.

Key Words: Convolutional neural network, Deep learning, Machine learning, Classification, Regression

ISBN-978-81-19905-39-3

1. Introduction

The need of the hour is to provide essential healthcare products to consumers worldwide by pharmaceutical industry. Within this industry, the production of Ayurvedic products, cosmetics, and medicines requires meticulous attention to detail and stringent quality control measures to ensure product safety and efficacy. However, traditional manual methods of sample collection, segregation, and quality checking pose significant challenges, including labor intensiveness, human error, and the risk of contamination. To address these challenges and enhance efficiency in pharmaceutical production, this project proposes the development of a smart system that integrates advanced technology and automation. The proposed system aims to streamline the sample management and quality control processes by leveraging real-time recognition and classification algorithms, coupled with intuitive user interfaces. Administrators will have access to a range of functionalities through the system, including real-time sample recognition and quality checking. Through the implementation of sophisticated recognition algorithms, the system will be capable of accurately identifying and labeling samples in real time, reducing the reliance on manual labor and minimizing the risk of errors. Additionally, the quality checking feature will enable administrators to detect anomalies such as rotten samples and foreign objects, ensuring strict adherence to quality standards.

2. Liturature Survey

Sameerchand Pudaruth et al. proposed "MedicPlant: A mobile application for the recognition of medicinal plants from the Republic of Mauritius using deep learning in real- time"[1]. This presents a novel mobile application for identifying medicinal plants in real-time using deep learning techniques. The authors, affiliated with the ICT Department at the University of Mauritius and the Department of Health Sciences at the Faculty of Medicine and Health Sciences, University of Mauritius, introduce an app where users can identify medicinal plants through three methods: taking a new picture, selecting an existing one from the gallery, or using real-time detection. The real-time detection feature allows users to instantly identify plants by pointing their mobile phone camera at them. The paper demonstrates the effectiveness of the application with examples, showing correct identifications along with confidence levels. Additionally, the app provides detailed information about identified plants, including scientific names, English names, Mauritian common names, plant descriptions, medicinal purposes, and information sources.

Garcia et al. [2] proposed “Identification of Medicinal Plants using Deep learning” [2]. In this paper author uses a deep learning technique to identify different medicinal plants by using transfer learning to train a convolutional neural network and thereby uses MobileNetV2 algorithm. The methodology involves collecting a database of medicinal plant images and preprocessing them to remove noise and enhance relevant sections. Image processing algorithms are then employed to detect leaves and extract significant leaf attributes for classification. Deep learning classifiers are

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utilized to categorize leaf images based on various plant traits such as shape, vein, and texture. The paper presents a proposed machine block diagram and model architecture to illustrate the process. The proposed approach aims to provide a reliable and efficient method for the real-time recognition of medicinal plants, contributing to the field of plant identification and pharmacology.

H. Vo et al. [3] demonstrated that LIGHTGBM classification worked well with deep learning features to recognize herbal plant in the natural environment. Xue et al. [4] showed comparative results between machine learning models using morpho-colorimetric method and visible or near infrared spectral analysis. Beikmohammadi et al. [5] uses transfer learning to recognize plant for leaf classification using a pretrained deep neural network and then logistic regression classifier for leaf classification. S Prasad et al. [6] uses VGG-16 to computer feature map which is reduced using PCA to accurately represent the medicinal plant leaves for classification. Wang-Su Jeon et al. [7] classify leaves using the CNN model, and created two models by adjusting the network depth using GoogleNet. A Sabu et al. [8] Uses a combination of SURF and HOG features extracted from leaf images and a classification using K-NN classifier. Lin S et al. [9] uses fine-grained pest identification method based on a graph pyramid attention, convolutional neural network (GPA-Net) to promote agricultural production efficiency. M. A. F. Azlah et al. [10] reviews and analyzes the implementation and performance of various methodologies on plant classification.

3. Materials and Methods

3.1 Dataset

The dataset for “Flora – Vision” is obtained from Mendeley dataset repository, encompasses approximately 9 GB of high-quality image data, totaling around 18,000 images. These images are categorized into 24 distinct classes, with each class containing between 600 and 800 images. The dataset is meticulously divided into three subsets to facilitate machine learning tasks: the training set includes about 14,000 images, while both the testing and validation sets consist of roughly 2,000 images each. This division ensures that a substantial portion of the data is available for training, enabling the development of robust models, while also providing sufficient data for testing and validation to evaluate model performance. The high quality of the images across all classes guarantees that the models trained on this dataset can achieve reliable and consistent results. This comprehensive dataset structuresupports effective training, thorough testing, and accurate validation, making it an invaluable resource fordeveloping and fine-tuning machine learning algorithms.

3.2 Algorithms

3.2.1 YOLOv8: YOLOv8 utilises C2f module which is the modification of the CSP layer of YOLOv5. The module contains two convolution cross stage partial bottleneck which enhances the detection of accuracy by combining high level features with contextual information. The decoupled

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head independently handles object detection, classification and regression tasks. The output layer contains sigmoid function as the activation function for object scores indicting the probability of an object being present within the bounding box. To represent class probabilities softmax function is used which signifies the probability of an object belonging to each class. CIoU and DFL loss functions are used for bounding box loss and binary cross entropy for classification loss. Object detection performance can be enhanced by these loss functions when dealing with smaller objects. The three main parts of the model is the neck network, the prediction output head and the backbone network were chosen for this article. The core component of the YOLOv8 model is the backbone network, which is in charge of identifying in the RGB color input images. The prediction output head and the backbone network are separated by the neck network. Its main responsibility is to compile and process the features extracted by the backbone network. In YOLOv8 the neck network plays a crucial role in integrating features of different roles. The neck network employs a structure called Feature Pyramid Network (FPN), which efficiently combines features from different scales to create a more through representation.

3.2.2 ResNet:

ResNet, short for Residual Network, is a pioneering deep learning architecture introduced by researchers at Microsoftin 2015. It addresses the challenge of training very deepneural networks by introducing the concept of residual learning. Traditional deep networks suffer from degradation, where adding more layers leads to higher training error. ResNet mitigates this by using residual blocks, which allow layers to learn residual functions with reference to the layer inputs, rather than learning unreferenced functions. A residual block consists of two or more convolutional layers where the input to the block is added to the output. This "shortcut connection" enables gradients to flow through the network directly, effectively reducing the vanishing gradient problem and enabling the training of much deeper networks. The architecture has variants such as ResNet-50, ResNet-101, and ResNet-152, where the numbers indicate the depth of the network. ResNet has significantly influenced computer vision, achieving state-of-the-art results in image classification, object detection, and segmentation tasks. Its ability to train deep networks without degradation has made it a foundational model in the field, inspiring many subsequent architectures and applications in various domains including medical imaging, autonomous driving, and more.

3.3 Performance Measures

3.3.1 Precision:

Measures the accuracy of the positive predictions, It is the ratio of true positive detections to the total predicted positives(true positives + false positives).

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$$\text{PRECISION} = \frac{True\ Positives\ (TP)}{True\ positives\ (TP) + False\ Negatives\ (FP)}$$

3.3.2 Recall (Sensitivity):

Measures the ability of the model to detect all relevant samples. The ratio of true positives to the total actual positives are considered as RECALL. (true positives + false negatives).

$$\text{Recall} = \frac{True\ positives\ (TP)}{True\ positives\ (TP) + False\ Negatives\ (FN)}$$

3.3.3 F1 Score:

The harmonic mean of precision and recall, providing a single metric that balances both concerns.

$$\text{F1 Score} = \frac{2 * Precision * Recall}{Precision * Recall}$$

3.3.4 Mean Average Precision (mAP):

A common metric for object detection models, mAP considers the precision-recall curve and calculates the average precision across different recall levels.

$$\text{mAP} = 1/n \sum_{i=1}^{n} APi$$

Where, (AP_i) is the average precision for each class (i) and (N) is the number of classes.

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3.3.5 Intersection over Union (IoU):

$$\text{IoU} = \frac{Area\ of\ Overlap}{Area\ of\ Union}$$

3.3.6 Inference Time:

The time it takes for the model to process an image and make predictions. This is crucial for real-time applications.

$$\text{Inference time} = \frac{Total\ Processing\ Time}{Number\ of\ Images}$$

3.4 Methodology

3.4.1 Flow Chart:

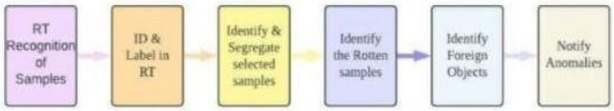

Fig. 1: Flowchart

3.4.2 Data C0llection:

Gather a comprehensive dataset of images representing various samples used in pharmaceutical production. Ensure diversity in the dataset to cover all possible sample types and conditions, including rotten and foreign objects.

3.4.3 Dataset Annotation:

Manually label the collected images with the correct classifications and annotations required for training the YOLOv5 model. Use annotation tools to mark the locations and boundaries of objects within the images.

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3.4.4 Training the Model :

Utilize the annotated dataset to train the YOLOv5 model, optimizing it for accurate object detection and classification. Monitor the training process, adjusting hyperparameters and configurations to improve model performance.

3.4.5 Testing the Model:

Evaluate the trained YOLOv5 model using a separate testing dataset to validate its accuracy and reliability. Perform various tests to ensure the model's robustness and ability to generalize across different sample types.

3.4.6 Integration with UI:

Integrate the trained YOLOv5 model into the user interface using Flask, enabling real-time recognition and classification of samples. Ensure seamless communication between the frontend UI and the backend model for efficient processing.

3.4.7 Anomaly Detection with ResNet :

Incorporate a ResNet model into the system for detecting anomalies such as rotten samples and foreign objects. Use the ResNet model to analyze embeddings and compare them with database images, triggering alerts for detected anomalies.

4. Results

4.1 Precision:

YOLOv8 achieved a high precision of 0.996, indicating most positive detections were correct.

4.2 Recall:

YOLOv8 demonstrated a recall of 0.997, showing it successfully identified almost all relevant samples.

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4.3 F1 Score:

Given the high precision and recall, the F1 score for our model would be close to 0.997, indicating excellent overall performance.

4.4 Mean Average Precision (mAP):

model achieved an mAP50 of 0.992 and mAP50-95 of 0.957, showcasing its robust detection capabilities.

4.5 Inference Time:

The YOLOv8 model processed images in approximately 508.1ms per image, making it suitable for real-time applications in our project.

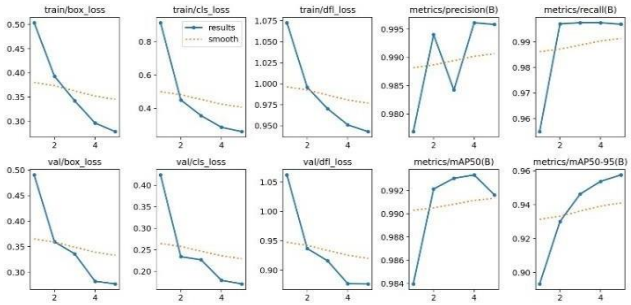

Fig 2 : Training and Validation Metrics forReal-Time Detection

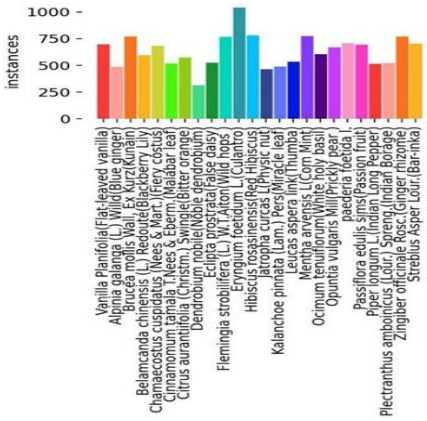

Fig 3: Instances of Different Plant Species

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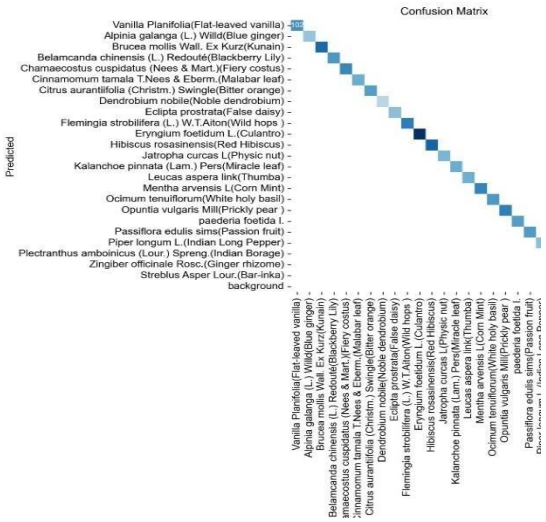

Fig 4: Confusion Matrix for Plant Species Classifications

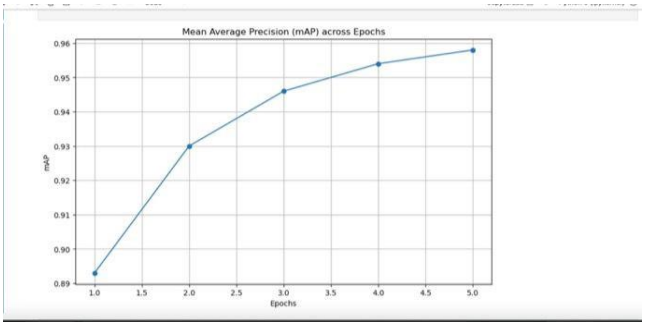

Fig 5 : Mean Average Precision (mAP) across Epochs

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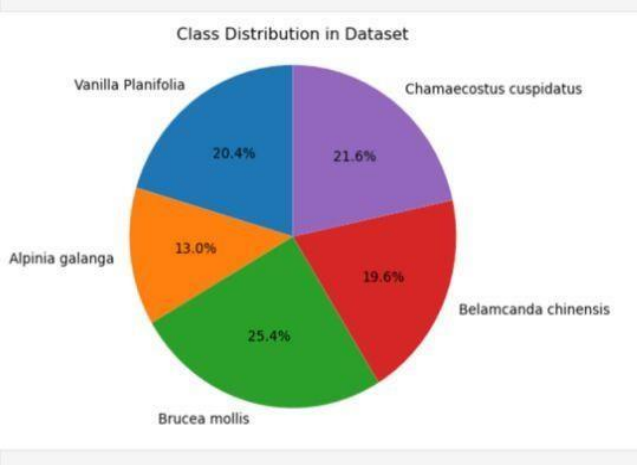

Fig 6: Class Distribution of Leaf in Dataset

4.6 Conclusion

In this study, The smart system for pharmaceutical production represents a pivotal advancement, revolutionizing sample management and quality control. Through advanced technology and automation, it mitigates manual labor, human error, and contamination risks. Real-time recognition and quality checking algorithms streamline sample identification and enhance product safety. User-friendly interfaces and alert mechanisms empower informed decision-making. Integration ofmachine learning models like YOLOv8 and OpenCV enhances adaptability to diverse environments. This system boosts efficiency, reduces costs, and elevates product quality, driving productivity and customer satisfaction. Its scalability and flexibility ensure widespread adoption. Continuous refinement is crucial to meet evolving industry needs and technological advancements, solidifying its role as a cornerstone in pharmaceutical manufacturing.

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ISBN-978-81-19905-39-3