DRONE AS PESTICIDE SPRAYER

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Abstract

Drones, also known as additionally called Unmanned Aerial Vehicles (UAVs), have revolutionized various sectors, inclusive of agriculture. One of the sizeable packages of drones in agriculture is pesticide spraying. This era gives several benefits over conventional methods, together with multiplied efficiency, decreased hard work costs, and minimized environmental effect.

The integration of drones in agriculture, specifically for pesticide spraying, represents a sizeable development in precision farming. Drones ready with superior technologies, together with GPS navigation, multispectral imaging, and precision spraying systems, offer a greater green and centered method to pesticide application.

This summary opinions the key components of pesticide spraying drones, inclusive of their effect on present day agriculture, recent technological developments, and the regulatory demanding situations related to their deployment.

However, there are nonetheless demanding situations that want to be addressed, inclusive of regulatory y problems and technical limitations. Continued studies and improvement on this subject will assist triumph over those demanding situations and in addition decorate the abilities of pesticide spraying drones.

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1 Introduction

The use of drones as pesticide sprayers represents a transformative innovation in modern agriculture, offering farmers a more efficient, precise, and environmentally friendly alternative to traditional pesticide application methods. These unmanned aerial vehicles (UAVs) are equipped with advanced spraying mechanisms, sensors, and GPS technology, enabling them to distribute pesticides evenly across fields while minimizing waste and exposure to harmful chemicals. Drones can target specific areas with great accuracy, reducing the overuse of chemicals and preventing drift to unintended areas. This precision minimizes environmental contamination and protects beneficial insects and surrounding ecosystems. By optimizing pesticide utilization and lowering wastage, drones decrease operational fees in the lengthy term. Their cappotential to spray with precision additionally complements crop yield through making sure the uniform software of important treatments.

[1] Shi et al. found a 20% reduction in pesticide usage compared to traditional methods, with better pest control outcomes. used CFD (Computational Fluid Dynamics) simulation conditions in Ansys Fluent software to investigate optimal droplet deposition results for UAVs. Lv et al. (2019) conducted indoor simulation experiments on the influence of flight speed on droplet deposition, concluding that higher flight speeds resulted in lower droplet deposition performance. They observed that when flight speed reached 1 m/s, the deposition density decreased to 41.4%, and coverage decreased to 3.9%. Research emphasizes understanding droplet movement, reducing evaporation and drift, and enhancing droplet deposition to decrease pesticide waste2. Pesticide droplets can be thrown into the air by air currents and evaporate before reaching the ground, especially in high temperatures. These droplets can then follow rainfall into rivers or land, causing environmental pollution.

[2] Kim et al. investigated the effectiveness of electrostatic spraying drones, which charge pesticide droplets to ensure better adhesion to plant surfaces. The study reported reduced drift and increased pesticide efficacy. Electrostatic spraying involves charging pesticide liquid droplets to improve adsorption and accuracy. It offers high deposition efficiency,

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comprehensive and uniform adhesion, pesticide savings, and environmental protection. Air-assisted electrostatic spraying improves pesticide droplet deposition in the crop canopy, increasing pesticide utilization and pest control. Electrostatic spray systems may not be effective due to the complex operating environment of agriculture.

[3] Huang et al. demonstrated that drone-based spraying significantly reduces pesticide runoff into water bodies, lowering environmental contamination risks. Drone spraying can reduce pesticide use by up to 30%, resulting in huge reductions in chemical runoff and soil infection. By precisely targeting areas in need of treatment, drones minimize chemical runoff and overspray, contributing to environmental sustainability and minimizing the negative effects on surrounding ecosystems.

2 Project Requirements

Drones are revolutionizing pesticide application by offering a more precise, efficient, and environmentally conscious method compared to traditional techniques. To legally and effectively operate a pesticide-spraying drone, you need proper licensing (FAA Part 107, Part 137, and potentially a state applicator license), a drone suited for the task (considering weight, tank size, and battery life), and adherence to strict operational guidelines. These guidelines include swath testing, careful selection of spray parameters, and close attention to environmental conditions to minimize drift. By following these requirements and staying up-to-date with regulations, drone-based pesticide application can significantly reduce chemical use, minimize environmental impact, and improve crop health.

2.1 Hardware requirements

2.1.1 Arduino Uno:

Using an Arduino Uno as the primary controller for a pesticide-spraying drone is feasible for basic operations, but its limitations in processing power, memory, and features make it more

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suitable for small-scale or educational prototypes rather than fully functional, large-scale agricultural drones. Below is a guide on how the Arduino Uno can be integrated into such a project and the challenges you may encounter.

Figure 1: 1: Arduino Uno

2.1.2 MPU-6050 6DOF 3 Axis Gyro With Accelerometer Sensor:

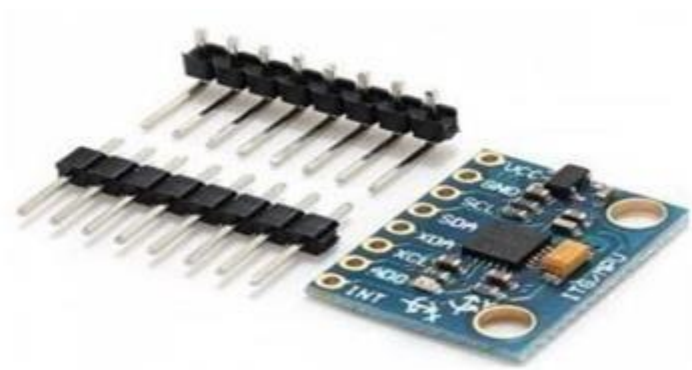

Figure 2: 2: MPU-6050 With Accelerometer Sensor

The MPU-6050 is a widely used sensor that combines a 3-axis gyroscope and a 3-axis accelerometer, providing a 6 Degrees of Freedom (6DOF) measurement system. This sensor is popular in robotics, drones, and various motion detection applications due to its compact size and affordability.

2.1.3 FlySky FS-i6 2 4G 6CH AFHDS RC Transmitter With FS-iA6 Receiver:

The FlySky FS-i6 is a 2.4GHz 6-channel AFHDS (Automatic Frequency Hopping Digital System) RC transmitter that comes bundled with the FS-iA6 receiver. Here are the key

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Figure 3: 3: FlySky FS-i6 Transmitter With FS-iA6 Receiver

features and of this transmitter-receiver combo:

4GHz Frequency: Operates on the 2.4GHz band, providing a stable and interference-free signal, which is essential for reliable control of RC models.

Channels: Supports up to 6 channels, allowing control of multiple functions in various types of RC vehicles, including drones, airplanes, and helicopters.

AFHDS Technology: Utilizes Automatic Frequency Hopping Digital System (AFHDS) for enhanced communique reliability and decreased danger of interference.

Display: Features an easy-to-read LCD screen that displays essential information, making it userfriendly for setup and adjustments.

Model Memory: Capable of storing multiple model configurations, allowing users to switch between different setups without needing to reprogram.

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Telemetry Support: Some versions support telemetry, enabling real-time data feedback from the model to the transmitter for enhanced control and monitoring.

Programmable Features: Offers various programmable functions, including mixing, dual rates, and exponential settings, allowing for customization based on user preference and model requirements.

Ergonomic Design: Designed for comfortable handling, with well-placed controls and a lightweight build for extended use without fatigue.

FS-iA6 Receiver: Comes with the FS-iA6 receiver, that is like minded with the transmitter and provides dependable sign reception with twin antennas for progressed variety and reliability.

Easy Setup: Simple binding process between the transmitter and receiver, making it accessible for beginners and experienced users alike.

2.1.4 A2212 1000KV Brushless Motor:

Figure 4: 4: A2212 Brushless Motor

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The A2212 1000KV brushless motor is a popular choice for various remote-controlled applications, particularly in quadcopters and multirotors. Here's a detailed overview of its specifications and features.

Propeller: The 1045 propeller is a commonly used propeller size for drones and multirotor aircraft.

Figure 5: 5: 1045 Propeller

2.2 Software requirement

2.2.1 Arduino IDE or ArduinoDroid Arduino IDE:

The Arduino Integrated Development Environment (IDE) is a software platform for programming and interfacing with Arduino microcontroller boards. It enables users to write code, compile it, and upload it to an Arduino board for execution. Designed to be straightforward and user-friendly, it has become a preferred option for both novice hobbyists and seasoned engineers in the embedded systems and electronics field.

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2.2.2 ArduinoDroid:

ArduinoDroid is a mobile application that enables users to write, compile, and upload code (sketches) to Arduino boards directly from an Android device. The app allows users to develop Arduino projects without a desktop computer, offering a portable and convenient solution for those who prefer to code and experiment while on the move.

2.3 Circuit Diagram

2.3.1 Implementation steps

2.3.1.1 **Frame Assembly:** Attach drone frame arms, Connect top and bottom plates and Install landing gear.

2.3.1.2 **Motor and ESC Setup:** Mount 4 brushless motors on frame arms, Connect each motor to corresponding 30A Electronic Speed Controller, Ensure proper motor rotation directions.

2.3.1.3 **Electronics Integration:** Install Arduino Uno as flight controller, connect MPU-6050 sensor for stability and balance, Wire ESCs to Arduino board, Attach LiPo battery to power the system.

2.3.1.4 **Calibration and Programming:** Upload drone control code to Arduino, Calibrate MPU-6050 sensor, Test motor movements and drone balance.

3 Results and Discussions

3.1 Working Prototype

3.1 Conclusion and Future Work

The use of drones as pesticide sprayers has proven to be a transformative approach to modern agriculture, offering significant advantages in efficiency, precision, and environmental

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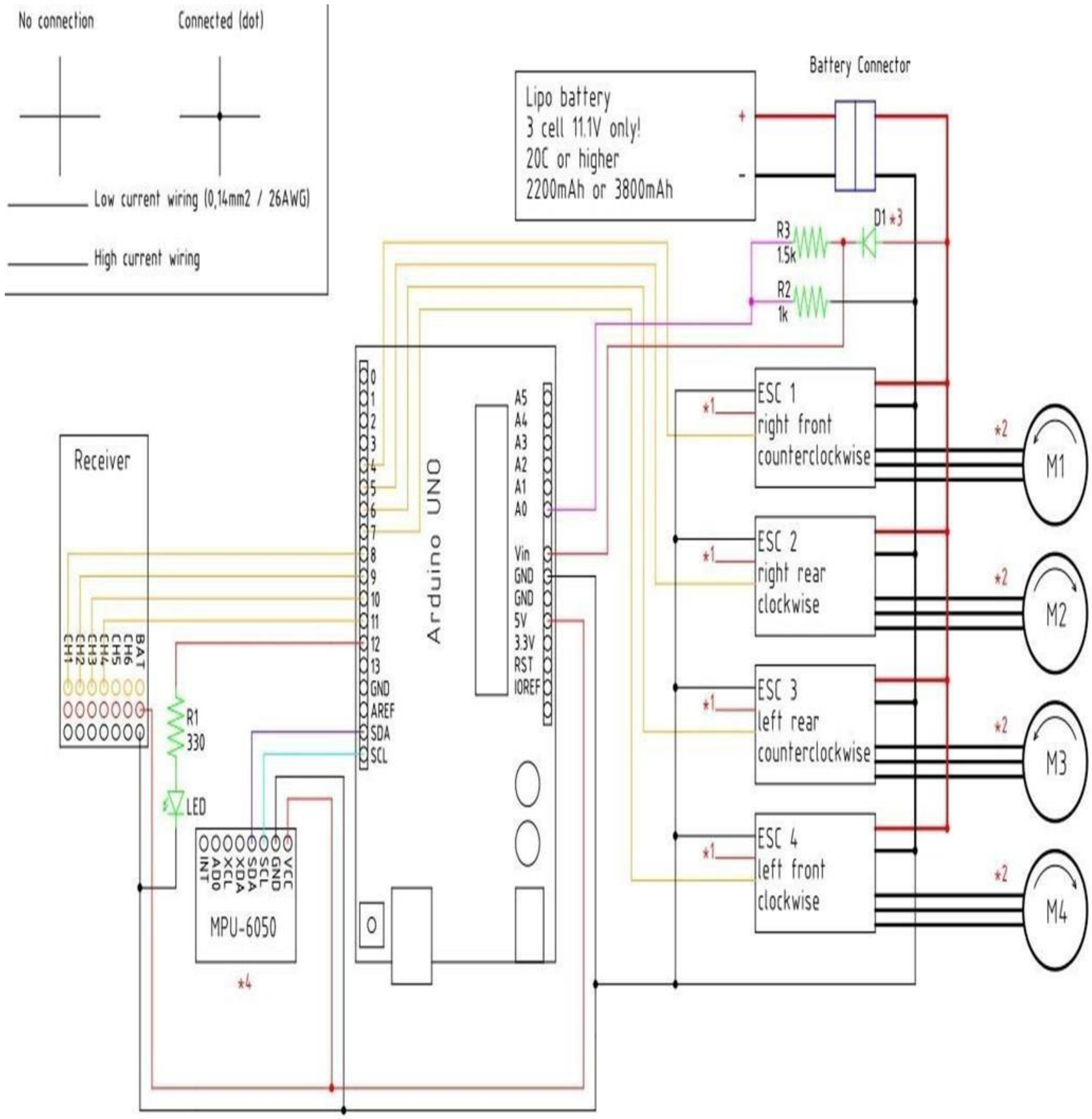

Figure 6: 6: Circuit Diagram

sustainability. Drones significantly reduce the time required for Pesticide application, is more efficient than traditional methods, making it suitable for large-scale farming operations. Their ability to cover areas quickly while maintaining uniform spray distribution enhances productivity. The drone's GPS-based navigation and calibrated nozzles ensure targeted spraying, minimizing pesticide wastage and improving pest control effectiveness. This

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Figure 7: 7: Prototype

precision contributes to better crop health and reduced over-application risks. The reduced spray drift and minimal soil compaction highlight the drone's environmentally friendly nature. Its ability to lower chemical runoff and prevent contamination of surrounding ecosystems further supports sustainable farming practices. While the initial investment in drone technology is relatively high, the long-term savings in labor, pesticide usage, and operational costs make it a cost-effective solution for many farmers.

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3.1.1 Challenges and Limitations

Despite its advantages, the technology faces challenges such as limited battery life, payload capacity, and sensitivity to weather conditions. These factors currently restrict its application in larger fields or under unfavorable weather scenarios.

3.1.2 Overall Assessment

Drones represent a promising advancement in agricultural technology, offering a reliable and efficient alternative to traditional pesticide application methods. With ongoing improvements in battery technology, payload capacity, and automation, drones are expected to become an indispensable tool in precision agriculture.

3.1.3 Future work

In future we are planning to implement: Camera

GPS

And other applications such as delivery purpose, fire extinguisher, etc. . .

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