International Journal of Engineering Sciences & Emerging Technologies, Dec. 2024
ISSN: 22316604 Volume 11, Issue 4, pp: 804-810 ©IJESET

SMARTSPRAY: AUTONOMOUS PESTICIDE SPRAYING DRONE FOR PRECISION FARMING

Zubair Iqbal[1], Abhay Pratap Singh[2], Palak Rani[3],
Deepak Singh Chauhan[4], Abhay Bhatnagar[5]
[1]Assistant Professor, Computer Science and Engineering Department MIT, Moradabad, India [1]Zubairiqbal117@gmail.com
[2,3,4,5]Students, Computer Science and Engineering Department MIT, Moradabad, India [2]Thepratapabhay21@gmail.com
[3]Plknainna128125@gmail.com
[4]Thakurdeep3440@gmail.com
[5]Abhay123bha@gmail.com

ABSTRACT

Apart from military and commercial applications of drones. Unmanned aerial vehicles, or drones, are being used more and more often across a wide range of industries. To gain the greatest benefits in the future, developed nations like the USA have been spending more and more on their drone technology. Since the use of UAVs will usher in the next great revolution, emerging nations like India have begun to explore this sector's potential. This paper focuses on the applications of drones in the field of agriculture. We know and it has been evident that India is an Agriculture dependent country because almost 50% of its national income comes from agriculture and it is the biggest source of employment to the people of India directly or indirectly. Agriculture has been the main focus of the Government of India also since its Independence during the early 50s when the five-year plan was being implemented the main focus in the first five-year plan was on agriculture only and India produced a record number of crops led to the growth of the country and showed us the importance of agriculture in the development of the nation. But, with agriculture being the backbone of the country's economy, there are many challenges that we have to face to keep our crops protected from many environmental problems which are now being tackled with the use of various technologies. The problem of insects and pests is also one of the many problems that can be solved with the spreading of insecticides and pesticides with the help of drones that can perform the task with the least amount of manpower and time. Drones can aid the spreading of these insecticides more conveniently and efficiently.

KEYWORDS

Drone, Insecticide, SmartSpray, Controller, ESC, Transmitter.

1. INTRODUCTION

1.1. Overview

Any unpiloted aircraft is referred to by the technical term "Unmanned Aerial Vehicles (UAVs)," more commonly referred to as "drones."

We are going to build an IoT-based Drone that works and aims to help the farmers with their task of spraying insecticides and pesticides on the crops. We have named it SmartSpray: Autonomous Pesticide Spraying Drone for Precision Farming. The key purpose of the Drone is to provide aid to the farmers by giving an advantage of less time and less use of manpower in the spraying of insecticides and pesticides over the crops.

The diverse climate of India is helpful for agriculture as it provides suitable conditions to grow a variety of crops at various locations across India. Still, with this variable climate all over the country, there come various natural problems with it like unpredicted rainfall, soil infertility, insects and pests, etc. It

has been seen that insects and pests pose a greater risk of agricultural damage as they are hard to control. To tackle this farmers use various types of insecticides and pesticides to save the crops, but the main problem that arises with the spreading is time and the requirement of a large number of people to do a simple task of spraying only that can be mentally, physically, and economically exhausting.

firstly, we are going to create a drone which is a flying robot without a human pilot on board.In such situations, drones can be a savior and aid the modern agricultural process. Drone use and adoption have increased in the field of agriculture, similar to other technology. Drone use is anticipated in several industries in India, including geospatial mapping, infrastructure, emergency response, calamity relief, transportation, surveillance, delivery, etc.

1.2 Objectives

We are going to build an IoT-based Drone that works and aims to help the farmers with their task of spraying insecticides and pesticides on the crops. We have named it SmartSpray: Autonomous Pesticide Spraying Drone for Precision Farming. The key purpose of the Drone is to provide aid to the farmers by giving an advantage of less time and less use of manpower in the spraying of insecticides and pesticides over the crops.

2. LITERAL VIEW

According to Goldman Sachs, there has been a growth in drone use across a variety of industries, including urban services, agriculture, entertainment, marketing, medical services, disaster risk management, etc.

This has been made feasible in part because of the development of quick microprocessors, which permit sophisticated autonomous control of several systems, and in part because of the quickly evolving consumer market, which lives on quick decisions.

There is a lot of material about drones and how they can be used in different industries. Drones will be the main topic of discussion because they are a common tool for several applications including defence, agriculture, disaster management, entertainment, medical services, survey, etc.

Drones have been utilized for crop damage assessment, field soil analysis, planting, agricultural spraying, crop health monitoring and surveillance, etc in several real-world locations, including Ukraine, Russia, South Korea, Japan, China, Malaysia, and others. In addition, many nations, including India, have used drones to fight agricultural problems. South Korea has been using drones for 30% of its agricultural spraying. Around 50% of the Malaysian population depends on agriculture and Malaysia is drastically changing the way of agriculture by introducing many advanced UAVs. Since the last few years, Drones have been widely used in Malaysia for pest monitoring, paddy fertilizing, oil palm mapping, and yield monitoring. China is the largest and world's leading manufacturer of drone technology and has been using drone technology in the field of agriculture for seed planting, spraying, etc. Countries have been focusing on the further development of UAV technology keeping in mind the current needs and demands.

Locust swarms are known to feed on crops, plants, and vegetation. They feed on the crops and destroy the crops which can lead to the complete destruction of the agricultural produce and may lead to the starvation of the society. Recently, these locust swarms have invaded several parts of the country, especially in Rajasthan. With nearly 90,000 hectares of land being affected spread across 25 districts, these swarms are threatening the human consumption process.
Most of the countries use chemicals mounted over drones or by other aerial means to spray over the swarms to protect their crops from such swarm attacks. The Rajasthan has also stationed drones to counter the swarm attacks and carry out spraying efficiently. Drones can diffuse insecticides over acres of area in around 10-15 minutes. Using drones in combating locust swarms is an immediate, practical, and efficient approach.

Also, there is a growing understanding that agriculture and its problems need to be solved quickly and

efficiently with a need to do more technological advancement to tackle the various problems that are arising even at a faster rate than ever before because of the various global phenomena taking place like global warming, changing rain pattern, etc.

TNO publications have conducted substantial research on drone usage in recent years and have concluded that drones can be useful in a variety of situations where there are restrictions, prohibitions, or environmental issues that make access difficult. TNO also tested drones for drowning detection to show their usefulness (Scheveningen, 2021).

3. METHODOLOGY

3.1 Components

A small-scale drone for our proposed system is made up of The following components-: Brushless motors, A Flight Controller, a Quadcopter frame, an RC relay, an Electronic Speed Controller (ESC), Transmitter & Receiver

Fig 3.1 Drone Components

Brushless Motor: An electric motor known as a brushless DC electric motor (BLDC) is powered by a direct current voltage source and commutated electronically as opposed to using brushes like typical DC motors do. As no brushes are rubbing against anything, no energy is lost due to friction. High wattage ratio, high speed, almost immediate control of speed (rpm) and torque, efficiency, and cheap maintenance are all benefits of brushless motors over brushed motors.

Flight Controller: The drone's motors and ESCs are managed by the flight controller, which is often known as the drone's brain. Receiving and processing input signals from the receiver and carrying out the proper user commands are two of a flight controller's main responsibilities.

Expressed, one could relate aircraft controllers to the nervous system. Like how our brains instruct us on how to walk, flight controllers are the brains of quadcopters that instruct them on how to fly.

Quadcopter frame: A multi-rotor drone with four motors is called a quadcopter. Using an electronic sensor and control system, this drone stabilizes its flying. There are three different kinds of quadcopters: plus-shaped, cross-shaped, and h-shaped**.**

RC Relay: The module activates safe-protection mode if the pulse exceeds 1800 microseconds (us) at initial power-up or if a bad signal persists for 500 milliseconds (ms). In this mode, indicated by a rapidly blinking LED, the MOSFET switch opens until the condition resolves, ensuring safe and reliable operation.

Electronic Speed Controller (ESC): Electronic speed controllers (ESCs) are tools that drone flight controllers can use to regulate and manage the motor speed of the aircraft. The ESC adjusts the voltage to the motor in response to a signal received from the flight controller, adjusting the propeller's speed

as necessary.

Transmitter & Receiver: The Radio Receiver, which is attached to an aircraft or quadcopter that is being remotely controlled, receives commands from the Transmitter wirelessly over a predetermined radio frequency.

3.2. Proposed System

In the proposed system we are going to develop a drone to perform some special tasks like helping farmers spread fertilizer on their fields more precisely. We explain how this drone works and how it can make farming easier and more efficient. We tested it in fields and found it to be much better than traditional methods.

The proposed system will help us in various situations. A frame, four brushless motors, 4 ESCs (electronic speed controller), 4 propellers, a flight controller, a transmitter, a receiver, a power distribution board, an RC relay, a motor pump, and a battery for power supply are all necessary for the construction of a drone. Once these components are put together, the drone will be complete.

We will be going to perform basic operations like taking off, moving backward, moving forward, moving right, moving left, and landing so this is a basic drone now we need to add a spreading module. It's not too big, and it can carry fertilizers. We made sure that it could fly on its own and spread fertilizer evenly. We then tested the drone in real fields. We wanted to see if it could spread fertilizer well. As per our expectations, it did a good job and was much better than the old ways of spreading fertilizers, so our drone is aimed at supporting farmers and improving agricultural outcomes.

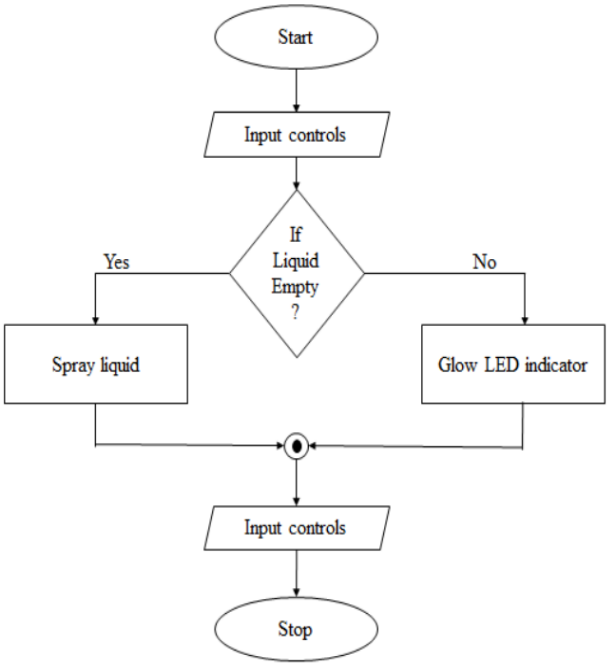

Fig 3.2 Flow Chart

3.3 Modules

The system is divided into two broad modules – the first module is concerned with drone construction and the other is with Fertilizer Spreading.

3.3.1 Drone Module

The quadcopter's four-armed frame is its major component. To support, four brushless DC motors (BLDC), a LIPO battery a controller board, and four propellers, the structure needs to be lightweight and sturdy. Electronic Speed Controllers can change the speed of BLDC motors (ESC). Batteries are positioned in the lower half of the system for more stability or a lower C.G. The motors are positioned on the opposite sides, equally spaced from the centre: a fertilizer tank, motor pump, and RC relay under

the main frame. The space between motors is generally regulated to prevent aerodynamic interaction between propeller blades. The quadcopter's main frame, or chassis, is where all components are.

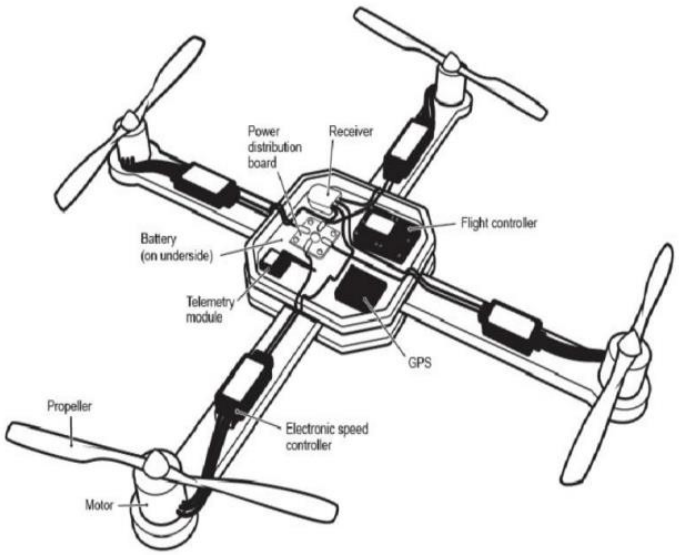

Fig 3.3 Structure of Drone

3.3.2 Spray Module

To enable precise fertilizer distribution, our drone incorporates an RC relay system cleverly situated beneath the main frame. This system utilizes a transmitter, with channel number 5 designated for activating the spreading mechanism. The integration of this mechanism within the drone's structure ensures both functionality and durability, shielding it from external elements while maintaining flight stability.

Operational simplicity is a cornerstone of our design philosophy, demonstrated by the manual activation of the spreading mechanism via the transmitter. This hands-on approach grants farmers direct control over fertilizer application, empowering them to adjust settings according to field conditions. An LED indicator linked to the RC relay further enhances user feedback, illuminating upon activation of channel number 5 and providing visual confirmation of system readiness.

By consolidating essential components and optimizing design, we maximize payload capacity and flight efficiency, enabling our drone to cover large areas with minimal energy consumption. This integration not only enhances operational efficiency but also aligns with our commitment to sustainable farming practices. In essence, our drone represents a significant advancement in precision agriculture, offering farmers a reliable and user-friendly tool for enhancing crop yields while minimizing environmental.

4. ADVANTAGES

A Quadcopter drone nowadays offers multiple advantages for example it makes inspection more efficient, it is also used in the military, and the most common advantage is capturing photos and videos more efficiently. Our proposed model “SmartSpray” is advantageous in the Spreading of insecticides. Some of the advantages are mentioned below:

- Efficient Spraying.
- Saves a lot of time.
- Minimizes manpower.
- Prevents from diseases caused by the contact of chemicals contained in the insecticides. • Reduces wastage of insecticides and pesticides.

5. CONCLUSION

This paper concludes that our agriculture drone stands as a testament to innovation in precision farming, leveraging advanced technology to revolutionize fertilizer application practices. The strategic placement of the spreading mechanism within the main frame ensures both functionality and durability, while manual activation provides operators with direct control over fertilizer application settings. The addition of an LED indicator further enhances user feedback, offering visual confirmation of system readiness. Moreover, our drone's streamlined design maximizes payload capacity and flight efficiency, enabling it to cover large areas with minimal energy consumption. Through thoughtful integration and meticulous attention to detail, our drone represents a significant advancement in precision agriculture, offering farmers a reliable and efficient solution for enhancing crop yields while minimizing environmental impact. As we continue to refine and expand upon its capabilities, we remain dedicated to driving innovation and sustainability in agriculture for the benefit of farmers and ecosystems alike.

6. USES

The usage of Drones can come in various ways including irrigation monitoring, crop health monitoring systems, crop damage assessment, field soil assessment, planting, agricultural spraying, etc.

But our drone “SmartSpray: Autonomous Pesticide Spraying Drone for Precision Farming” is concerned with the spraying of insecticide and pesticide as its key principle. So, considering the model, the main function of the drone is to facilitate the farmers with the process of spraying insecticides and pesticides more conveniently.

7. FUTURE WORK

The plans for our proposed system were excessively expensive. The objective of the group was to configuration, and manufacture a quadcopter unit, we intend to advance our agriculture drone by implementing autonomous navigation systems, reducing the need for manual control. Additionally, we aspire to integrate cutting-edge sensing technologies to enable real-time data collection for enhanced fertilizer application and crop monitoring. By refining these capabilities, we aim to further optimize farming practices, increase operational efficiency, and contribute to sustainable agricultural solutions that benefit both farmers and the environment.

REFERENCES

[1] Sarfaraz Jarda, Prashant Swadas, Nikesh Prajapati, “IOT: Application, Research, Issues”, Vol 6, April 2018: https://ijcrt.org/papers/IJCRT1892220.pdf [November 2023].

[2] Karim Rejeb, Alireza Abdollahi, “Drones in agriculture: A review and analysis” July 2022: https://shorturl.at/qwDY1 [November 2023]

[3] Jack Brown, “How to build a drone: construct your drone from scratch”, Dec 2021: http://www.mydronelab..com/blog/how-to-build-a-drone.html. [December 2023]

[4] Gopal Dutta, Purba Goswami, “ Application of drone in agriculture: A review”, October 2020: https://shorturl.at/fzK46. [December 2023]

[5] Abhishek Beriya, “Application of Drones in Indian Agriculture. Aug 2020: https://shorturl.at/AGLPT. [January 2024]

[6] Abhishek Kumar, Akshita Sharma, Ankit Agarwal, Ashish, Zubair Iqbal, “Vision- A drone for emergency operations”, June 2020: https://ijcrt.org/papers/IJCRT2006126.pdf. [January 2024]

[7] Syed Mohsan, Nawaf Hamood, Yanlog Li, “Unmanned aerial vehicles(UAVs): Practical aspects, applications, open challenges, issues, security threats, and future challenges”, January 2023: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9841964/. [January 2024]

[8] Dominique Chabot, Karen Anderson, “Drone System and Applications”, January 2024: https://cdnsciencepub.com/journal/dsa. [January 2024]

AUTHORS

Mr. Zubair Iqbal is an Assistant Professor at Moradabad Institute of Technology, Moradabad in the department of Computer Science and Engineering. He has worked as an author for many research paper earlier as well.

Mr. Abhay Pratap Singh is a student at Moradabad Institute of Technology, Moradabad in the department of Computer Science and Engineering. He has contributed in research work.

Mr. Deepak Singh Chauhan is a student at Moradabad Institute of Technology, Moradabad in the department of Computer Science and Engineering.

Mr. Abhay Bhatnagar is a student at Moradabad Institute of Technology, Moradabad in the department of Computer Science and Engineering.

Ms. Palak Rani is a student at Moradabad Institute of Technology, Moradabad in the department of Computer Science and Engineering.