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Design and Implementation of Agricultural Spraying Drone

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Abstract

In this brief an attempt has been made to develop an agricultural drone to spray pesticides in an agricultural farm. In India, agriculture is one of the key economic sectors. Crop production rates are influenced by factors such as temperature, moisture content, rainfall, etc. The field of husbandry is also influenced by other elements, such as pests, complaints, diseases, etc., which can be managed by giving crops the right care. Fungicides may increase crop production, but they may also have an effect on people's health. Now-a-days to reduce the burden on the growers, remote controlled drones should be used to spot fungicides and germicides. This design deals with design and development of a drone to spray fungicides and germicides to kill the pests and insects to boost the crop of crop in our land. In this work, we developed the hexa-copter agricultural drone sprayer. Pesticides up to 0.5 liters in volume can be carried by the drone. A pesticide spraying tool is part of the drone, and the ground control station uses a remote control to operate it. Pesticides can be released from the spraying equipment at a rate of 0.0166 liters per second. The drone can fly for about 8 minutes. The planned drone will lessen the amount of labour needed and the amount of time needed to spray pesticides as well as the health risks to the farmers.

Keyword: Hexa–copter drone, BLDC motor, esc, spraying system

INTRODUCTION

Over sixty percent of Indians are employed in farming. It acts as the foundation of the Indian market. By ensuring that farmers practice safety harvesting, it is imperative to increase the yield and effectiveness of agriculture. The numerous tasks, such as applying insecticides with a sprayer and sprinkling chemicals, are crucial. Even though pesticide spraying is now required, farmers nonetheless suffer negative effects from the practice. Farmers wear the appropriate gear, masks, and gloves, among other safety precautions, especially when spraying urea [1]. It will prevent any negative impact on the farmers. Since the desired outcome must be achieved, totally avoiding pesticides is also not practicable. Robotics have historically provided the greatest answers for these kinds of issues, as well as the necessary efficiency and productivity of the final output [2]. The goal of this research is to reduce the negative effects that pesticides have on people while simultaneously employing an automated fertilizer sprayer to apply pesticides across a larger are a more often than in the past. Basically, this invention is a spraying mechanism mounted on a hexa-copter frame [3]. The use of pesticides and fertilizers in agricultural areas has a significant impact on crop yields. Because of the speed, accuracy, and efficacy of the spraying operation, using aircraft is becoming more and more prevalent. Pesticides are being sprayed all over the land by the farmers using spraying bags. Farmers must carry a bag for spraying pesticides,

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which strains them. Even then, the farmers are unable to apply pesticides uniformly a cross the entire land. Additionally, it will take a lot of time. Using a drone, the farmer can evenly spray insecticides throughout the entire field. The farmers' workload is reduced, and the work is finished quickly [4].

LITERATURESURVEY

The authors of the study by Prof. P. P. Mone, Chavhan Priyanka Shivaji, Jagtap Komal Tanaji, and Nimbalkar Aishwarya Satishare Agricultural Drone for Pesticide and Fertilizer Spraying. The authors of this publication go into great depth concerning the use of agricultural drones for autonomous spraying systems. They included a WHO issue report in this article. While it is estimated that each year, particularly in underdeveloped nations, there are three million reported cases of poisoning with pesticides and up to 220,000 fatalities. In addition, they discuss affordable equipment that uses PIC microcontrollers to operate agricultural robots as well as the measures that farmers should take top revent the negative impacts of pesticides and fertilizers. You may get the published article at IJRTI, Volume 2. Issue 6, 2017 [2].

In an article named "An Automatically Controlled Drone based Aerial Pesticide Sprayer," authors Prof. K. B. Korlahalli, Mr. Mazhar Ahmed Hangal, Mr. Nitin Jituri, Mr. Prakash Frances Rego, and Mr. Sachin M. Raykar published their research. The deployment of the Agricultural Wonder UAV System is covered in great detail by the writers of this paper. The frame, battery, wireless transceiver, electronic speed control (ESC), and flight-controlled board (FCB)-based wireless drone system are all described in this study. They used a flight controller board to control the drone's movements, lifting, positioning, and other tasks. In this project, FCB is written to manage a variety of sensors, including motors and other parts as well as GPS, barometer, accelerometer, and gyroscope, among others. There are two modes for this drone: manual mode and autonomous mode. The K. L. E. Institute of Technology, Hubballi, released this work under the designation 39S_BE_0564 [3].

WORKINGPRINCIPAL OF DRONE

The UAV operates according to the principle of aerodynamics. The control of drone depends on transmitter and receiver. When the transmitter signal is transmitted, the receiver receives the signal and sends it to the ESC through the flight controller. The is connected to BLDC motor hence propeller rotates. The propeller speed depends on the throttle handle. The block diagram of drone sprayer. is shown in Figure 1.

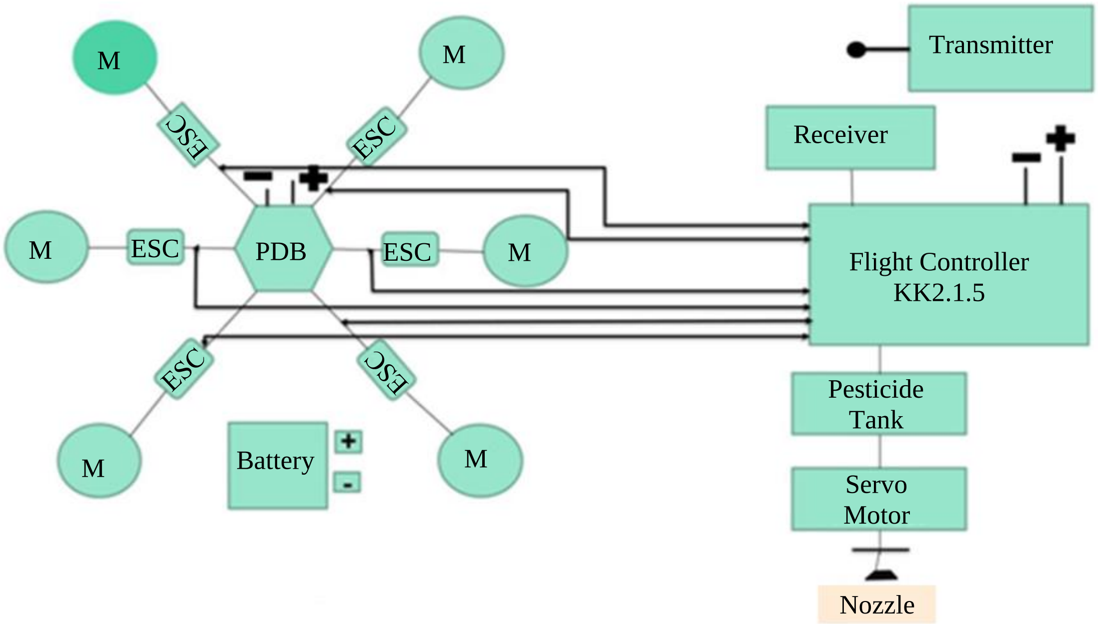

Figure 1. Block Diagram of Agricultural Drone Sprayer.

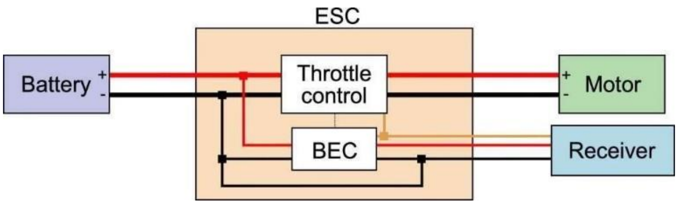

Figure 2. Block diagram of ESC.

BLDC Motor

We are using brushless DC motor because of they are powerful and energy efficient. Weare using 1000 kv12212/13TBLDCMOTOR. Weareused 6 BLDC motors [5].

1. Out runner BLDC motor
2. In runner BLDC motor

Out runner BLDC Motor

These BLDC motors belong to a class where the outer shell revolves around the windings. Conventional DC brushless motor controllers activate the stationary (stator) windings of an out runner motor. Three or more non-adjacent windings are often paired with a direct current that is cycled on and off at a high frequency to provide voltage modulation. The group thus electrified is then swapped electronically based on feedback from the rotor position. However, there are not an equal amount of permanent magnets in the stat or and rotor poles. Do this to generate a sinusoidal back emf and reduce cogging torque. One can calculate the magnetic field frequency to motor rotation frequency ratio by dividing the total number of magnet poles by two.

In runner BLDC Motor

The rotating rotor of an in-runner BLDC motor is located in the middle of the housing. This suggests that all rotating components, excluding the shaft end, are contained within the motor. The rotor is encircled by the stator, which is attached to the motor housing. The permanent magnets are buried in the rotor or are found on the rotor's surface. A connecting component, often composed of aluminium, is used to join the shaft to the interior of the rotor. When compared to an out runner with the same motor diameter, the rotor of a conventional in-runner has a much smaller diameter. The in runner resembles brushed AC or DC motors from the outside.

Electronic Speed Controller

Drone flight controllers can regulate and control the motor speed of the air craft by utilizing electronic speed controllers (ESCs) (Figure 2). In response to a command from the flight controller, the ESC modifies the voltage of the motor and, if necessary, n the speed of the propeller. For powering the motor, an ESC is attached between the battery and the BLDC motor. It is used for control the speed of the motor by using throttle. Weare using 30AESC [6].

Flight Controller

It is the main part of drone. It will process the signal received from receiver and done the operation according to the transmitted signal. The flight controller we used is ATMEL6448.

LIPO Battery

The power supply is given to the drone by using this battery, lithium polymer batteries are used foremost of the drones. We are using 5200 mAh 3 celllipo battery [7].

Propeller

Carbon fibre and plastic are used to make propellers. The rotating rotor of an in-runner BLDC motor is located in the middle of the housing. This suggests that all rotating components, excluding the shaft end, are contained within the motor. The rotor is encircled by the stator, which his attached to the motor housing. The permanent magnets are buried in the rotoror are found on the rotor's surface.

A connecting component, often composed of aluminium, is used to join the shaft to the interior of the rotor. When compared to an out runner with the same motor diameter, the rotor of a conventional in-runner has a much smaller diameter. The in-runner resembles brushed AC or DC motors from the outside. The speed and load lifting ability depends on shape, size, and number of propellers. We are using 10 Inch dia meter and 4.5 pitch.

LIMITATIONS OF CURRENT AGRICULTURAL UAVs

UAVs are useful instruments for enhancing farm management. However, based on our observations, the following restrictions prevent the practical use of UAV technologies in agriculture.

Technical Decisions

There are many producers and sellers of different UAVs on the market, ranging from commercial goods to model aircraft used for recreational purposes. It can be challenging to choose which UAV is best for a given project from a technical and financial standpoint because there are no established standards for UAV development for agricultural applications [8].

Cost

For individual farms, the industrial systems especially spray UAVs are frequently pricey. To receive the service, interested farmers may need to enter into a group contract. Cheap airframes can be bought and put together with engine and avionics parts in hobby shops. This system can be equipped with a light weight, inexpensive camera to create a short endurance UAV LARS platform. Even for highly qualified technicians and engineers, installation and integration of the aircraft and camera need a significant amount of labour and time.

Pay Load

For UAVs, payload size and weight are crucial variables. The targeted payload must be carefully set to ascertain whether the UAV structure needs to be adjusted or optimized to accept it before choosing the best UAV for a certain application. Mechanical and electrical systems must be set up when the UAV is ready. There are no standardised engineering procedures for the design of payloads or mechanical and electrical accommodations for UAVs [9].

OPERATION

The majority of UAVs lack the capabilities for automatic take-off and landing. As a result, expert operators are needed for RC control. Autonomous flight utilizing geo referenced coordinates is thus a highly desired capability for the use of UAV sin agriculture [10]. Table 1 shows the components.

Table 1. Components and their weights

Component	Weight (grams)
Flight controller	50
Receiver	40
Motors	60 × 6 = 360
ESCs	15 × 6 = 90
Frame	300
Battery	300
Propellers	60

Calculations

- Power to Weight ratio = 2
- From the table vi Total Thrust = 3825 grams
- The thrust to be generated by each motor is 637.5 grams
- By considering all these conditions A2212/13T1000 kv motor is selected.

Flight time calculation:

- The LiPo battery selected has 5200 mAh and 40 crating the voltage of single LiPo cell is 3.7 V
- The average current drawn by single BLDC motor is 7 A
- Therefore, total current drawn by all six motors = 42 A
- Therefore, the total load current is 42 A
- The total hover time = (battery capacity in amp hour)/(total load current) ≅ 8 min

CONCLUSION

In this study, we designed and built a hexa-copter agricultural drone that flew between 5 and 100 meters over crop fields to spray pesticides there. This drone carried 0.5 litres of insecticides at its full capacity. With drone the amount of pesticides used in agricultural field was reduced and crop yielding was found to increase in the field and it sprayed in agriculture all and of area 5 cents and the flight time of this drone was observed to be around 8 minutes at full charge.

FUTURE SCOPE

Drones for agricultural spraying are increasingly gaining popularity as equipment in contemporary farming techniques. The use of these unmanned aerial vehicles (UAVs) to spray crops with fertilisers, insecticides, and other chemicals greatly reduces the need for manual labour and increases productivity.

Agriculture spraying drones have a promising future, and a number of advancements are likely to have an impact on the market in the years to come. Among the major development areas are:

1. *Improved accuracy and precision:* The ability of drones used for agricultural spraying to precisely apply chemicals is one of its most important features. With the development of sensors, mapping technology, and artificial intelligence, we can anticipate even better precision and accuracy in the future.
2. *Greater efficiency:* Drones for agricultural spraying will improve and be able to cover more ground in less time, which will lower the overall cost of spraying. Large-scale farms, where labour costs and time are important considerations, will benefit most from this improved efficiency.
3. *Autonomous operation:* Currently, human operators are needed to operate the majority of agricultural spraying drones. However, in the future, we can anticipate increased autonomy, with drones that can work on their own and navigate and spray crops using sophisticated algorithms and sensors.
4. *Integration with other technologies:* Drones used for agricultural spraying are just one example of a larger trend known as precision agriculture, which aims to employ technology and data to improve farming methods. Agriculture spraying drones and other technology, such soil sensors, weather stations, and crop modelling tools, will likely integrate more in the future.

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