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AGRICULTURAL DRONE SPRAYER

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ABSTRACT:
Agricultural drone is an unmanned aerial vehicle (UAV) that is used in the field of agriculture to provide farmers with valuable information relating to crop health, yield mapping, soil analysis, and other relevant data. UAVs have emerged as a tool for precision agriculture that can help farmers optimize their operation in a sustainable and efficient manner. Agricultural drones come with a variety of sensors and cameras that can capture data relating to plant health, irrigation, nutrient levels, temperature, and field topography, among others. This data can be used to optimize crop yields, reduce costs and resources, and even support the implementation of sustainable farming practices. This paper discusses the current state of agricultural drones, their applications, and benefits, as well as the challenges and limitations to their use. The paper further explores how drones can be integrated into current farming practices and the future of agricultural drone technology.

INTRODUCTION:
Drones are more farmally known as (UAV) unmanned aerial vehicles. Agriculture drones, also known as ag drones, are unmanned aerial vehicles (UAVs) designed for use in farming and agriculture. These drones are equipped with various sensors and cameras that capture high-resolution images of crops, soil, and other agricultural environments. The data gathered by agriculture drones is then processed and analyzed to assist farmers in making informed decisions about crop health, irrigation, and other factors that can impact crop yield and quality. Agriculture drones are revolutionizing the way farmers manage their crops, helping them increase efficiency, productivity, and profitability.

Agricultural spraying drones are unmanned aerial vehicles (UAVs) that have revolutionized the way farmers apply pesticides, herbicides, and fertilizers to crops. These drones offer a more efficient and precise alternative to traditional spraying methods, reducing the amount of chemicals needed and minimizing environmental damage. With the help of advanced sensors and software, these drones can accurately map out fields and adjust spraying rates based on the specific needs of each crop. They also provide real-time data on crop health and growth, enabling farmers to make more informed decisions about their operations. However, as technology continues to improve and costs decrease, it is likely that these drones will become an increasingly important tool for modern agriculture [1].

LITERATURE SURVEY:

1. "Agriculture Drones: A Review" (2017) by R. Krishna and V. N. Das.

This paper provides an overview of the various types of agriculture drones and their applications in the agriculture industry. The authors also discuss the challenges faced by farmers and drone manufacturers in implementing agriculture drones and suggest potential solutions.

2. "A Review of Vision-based Sensing for Agriculture" (2020) by N. Y. Li, X. X. Zhu, and J. N. Westberg.

This paper focuses on the use of vision-based sensing technology in agriculture drones for crop monitoring and management. The authors discuss the benefits and limitations of this technology and suggest future directions for research and development.

3. "Drone-based Agriculture in Developing Countries: Opportunities and Challenges" (2019) by S. Subbiah and P. Vasudevan.

This paper explores the potential of agriculture drones in developing countries and the challenges faced in implementing this technology. The authors suggest strategies to overcome these challenges and improve the adoption of agriculture drones in these regions.

4. "Agriculture Drones: Applications and Economic Implications" (2020) by D. G. Abasolo and D. N. Munoz.

This paper compares the costs and benefits of using agriculture drones versus traditional farming methods. The authors also discuss the potential economic implications of widespread adoption of agriculture drones in the agriculture industry.

5. "Unmanned Aerial Vehicles for Agriculture: A Review" (2018) by V. K. Ajay and G. S. Surya.

This paper provides a comprehensive review of the history and development of agriculture drones, as well as their current and future applications in the agriculture industry. The authors also discuss the potential benefits of agriculture drones, such as increased productivity and reduced environmental impact.

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SYSTEM DEVELOPMENT:

BLOCK DIAGRAM

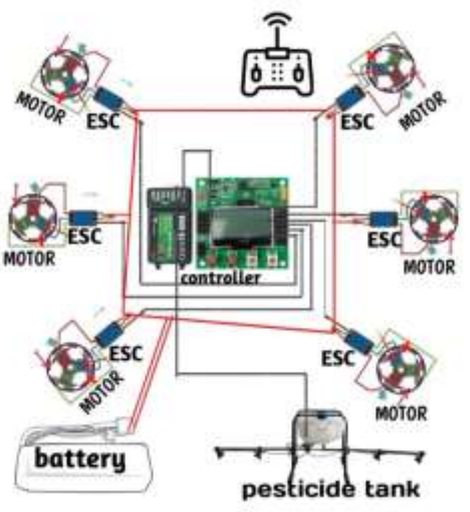

Figure_1: The block diagram of agricultural drone

Flight controller

From fig 2, The flight controller is the brain of aircraft. All flight controller is a circuit which ranges with a graph of basic sensors like gyroscope, accelerometer, barometer and magnetometer. Flight controllers also contains a processor [3].

Glyroscope: Helps to detect the angular orientations

Accelerometer: Helps to measure the vibration

Barometer: Measure the altitude of drone

A flight controller consists of extra items like:

PMU, LED, GPS.

Figure_2: Flight controller

MOTORS

There are two types of motors

1.Brushed motor

2.Brushless motor

Difference between brushless motor and brushed motors

From fig 3, Brushless motors are more powerfull when compared with brushed motors. Brushless motors are durable and long lasting. The efficiency of brushed motor is 75-80%. Whereas the efficiency of brushless motor is 85-90%. Brushless motors are costlier when compared with brushed motors. For both the motors the electromagnetism is same [4].

For bigger drones brushless motors are used and brushed motors are used in micro drones.

Brushless motors are divided into 2 catagories:

1.Inrunner

2.Outrunner

Two terms are used, they are stator and rotor:

Stator means the stationary part of the motor. Rotor means the rotating part of the motor. Inrunner means the rotor is inside the stator. Outrunner means the rotor is outside, stator is inside.

BLDC MOTOR KV RATING:

For example if we use 4S lipo battery voltage is 14.8v and the rated KV is 2300kv.

2300*14.8 = 34040RPM

This RPM is in idle condition. Motors with higher KV rotates more faster when compared with motor with lower KV. Lower KV motors will have more torque and higher KV motor will have less torque. So if we are using big propellers we have to use less KV motors. For small propellers we have to use

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more KV motors.

Fifure_3: Motors

ESC (Electronic speed controller):

From fig 4, ESC receives the throttle signal from flight controller and runs the brushless motor at its desired speed. Esc converts the dc power to ac power and controls the speed of motors by receiving the signals from RC. There are different esc in the market 10amp, 30amp, 80amp, 100amp.

Figure_4: Electronic speed controller

PMU (Power management unit):

PMU is a device which regulates power being fed to the flight controller. PMU also detects the power in the battery and sound the information to ground station through telimentry.

GPS (Global positioning system):

GPS module allows the drone to know their location relative to a network of orbiting satellites.

LED:

LED consists of 3 colours. Green, Red, Orange with the help of these 3 lights drone can communicate with the pilot.

SPRAYING MECHANISM:

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1. Sprayer tank: This is the container that holds the chemical solution to be sprayed onto the crops. It can hold anywhere from a few liters to over 20 liters of liquid, depending on the size of the drone.

2. Sprayer pump: This is the component that pressurizes the liquid in the sprayer tank and pumps it through the spray nozzles [5].

3. Spray nozzles: From fig 5, these are the small openings in the sprayer boom that release the liquid in a fine mist or droplets over the crops. They are usually made of high-quality materials to withstand the harsh environment of agricultural spraying and can be adjusted to optimize droplet size and spray pattern.

4. Sprayer boom: This is the long, light-weight arm that extends from the drone and holds the spray nozzles. It can be adjusted to various angles and heights to ensure the crop coverage [5].

5. Flow control system: This is the part of the spraying mechanism that regulates the flow rate of the chemical solution and ensures consistent coverage.

6. GPS system: This is an important component that enables the drone to map the field and spray the crops in a precise and efficient manner. It helps the drone to prevent overlaps or gaps in coverage, and avoid spraying the same spot twice.

7. Control unit: This is the interface that the operator uses to command the drone to take off, land, and perform the spraying. It is usually a remote or a tablet-based app that provides real-time information on the drone's location and status, enabling the operator to monitor the spraying process seamlessly.

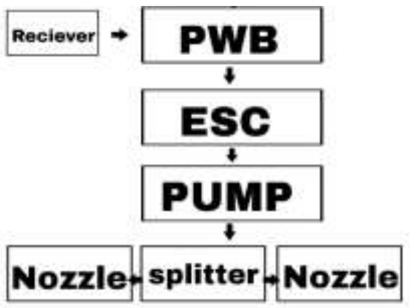

Figure_5: Spraying mechanism

CALCULATION:

Drone Motor Calculations:

The formula for calculating the thrust required is:

Thrust (in Newtons) = Weight (in kg) x 9.81 m/s^2

Thrust (in Newtons) = Motor Constant x (Motor RPM)^2 x Propeller Diameter (in meters)^4

Here, Motor Constant is a factor that depends on the motor and propeller combination, and you can find it in the motor manufacturer's specifications.

• Thrust Calculations:

The formula for calculating the thrust generated by a propeller is:

Thrust (in Newtons) = (2 x pi x Pitch x (Diameter/2))^2 x Air Density x Propeller Efficiency

Here, Air Density is the density of air in kg/m^3, which is approximately 1.225 kg/m^3 at sea level. Propeller Efficiency is the efficiency of the propeller and can be found in its specifications.

• ESC Calculations:

, you need to calculate the maximum current draw of your motor. The formula for calculating the maximum current draw is:

Maximum Current Draw (in Amps) = Motor Constant x (Motor RPM)^3 x Propeller Diameter (in meters)^5

• Flight Time Calculations with Payload:

To calculate the flight time of your drone with a payload, you need to consider the weight of the drone, the weight of the payload, and the battery capacity. The formula for calculating the flight time is:

Flight Time (in minutes) = (Battery Capacity (in mAh) x Battery Voltage (in volts)) / (Total Weight (in kg) x 1000 x Current Draw (in Amps)).

FUTURE SCOPE:

Drones equipped with advanced sensors and software can help farmers optimize the use of pesticides and herbicides, reduce waste, improve crop yields, and reduce labor costs.

Some potential future developments and applications for agricultural drone sprayers include:

1. Autonomous operation: Currently, most agricultural drone sprayers require a human operator to fly and control them. However, advances in artificial intelligence and machine learning could enable drones to fly autonomously and perform tasks based on pre-programmed instructions or real-time data analysis.

2. Advanced sensors: Drones equipped with sensors that can detect soil moisture, nutrient levels, and other environmental factors could help farmers make more informed decisions about where and when to apply pesticides and herbicides.

3. Crop monitoring: Drones equipped with cameras and other sensors can be used to monitor crops

and identify areas that require attention, such as areas with poor soil quality or signs of disease [2].

Overall, the future of agricultural drone sprayers is likely to involve more advanced technologies and greater integration with other precision agriculture tools to help farmers optimize their crop management practices.

CONCLUSION:

agricultural drone sprayers have emerged as a promising technology for precision agriculture. They have the potential to reduce labor costs, increase efficiency and accuracy in pesticide and herbicide application, optimize crop management practices, and improve crop yields. With continued advancements in sensors, software, and artificial intelligence, agricultural drone sprayers are likely to play an increasingly important role in the future of agriculture. They offer a valuable solution to address the challenges facing modern agriculture while promoting sustainable farming practices.

Figure_6: Agricultural drone

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