

IMPLEMENTATION OF DRONE FOR FARMER'S

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ABSTRACT

The world receives more than 200 thousand people in a day and it is expected that the total world population will reach 9.6 billion by the year 2050. This will result in extra food demand, which can only be met from enhanced crop yield. Therefore, modernization of the agricultural sector becomes the need of the hour. There are many constraints that are responsible for the low production of crops, which can be overcome by using drone technology in the agriculture sector. This paper presents an analysis of drone technologies and their modifications with time in the agriculture sector in the last decade. The application of drones in the area of crop monitoring, and pesticide spraying for Precision Agriculture (PA) has been covered. Precision agriculture is an important part of drone research projects today. Agriculture needs commercial drones since the industry took off: and sophisticated analytics and software combine with evolved drone solutions to allow for breakthroughs. For future farming, drones are an essential tool in precision agriculture, as they allow farmers to monitor crop and livestock conditions by air. This paper also discusses the challenges associated with the implementation of drone technology in agriculture, such as regulatory issues, data privacy concerns, and initial investment costs. Strategies to overcome these challenges, including regulatory compliance, public awareness campaigns, and collaboration between agricultural and technology sectors. Furthermore, drones offer several advantages to farmers, including reduced labor costs, optimized resource management, timely detection of crop diseases, and precise application of inputs.

Keywords: Farming efficiency, remote sensing, pest and disease control, irrigation management, soil health assessment, cost efficient.

1. INTRODUCTION

Indian agriculture makes a substantial contribution to the nation's GDP, employment, and food security. It directly employs over half of the country's workforce, supporting the livelihoods of rural communities. Historically, Indian agriculture has been labor intensive and reliant on traditional practices, resulting in inefficient resource utilization. To address the numerous challenges facing the Indian agriculture sector, the adoption of emerging technologies, such as drones, is imperative. Drones have the capacity to significantly enhance agricultural practices, increasing productivity and reducing resource wastage.

They provide real-time data on crop health, soil conditions, and pest infestations, offering a promising solution to enhance decision-making for farmers, leading to higher yields and resource optimization. While the drone sector is still evolving in India, it is expected to experience substantial growth in the future, supported by new investments and government policies. Many private entities are investing in the agricultural drone sector, and government-private partnerships are playing a pivotal role in unlocking the true potential of the agriculture sector. However, several challenges impede the seamless integration of technology into Indian agriculture. Issues such as affordability, infrastructure, education, and policy bottlenecks need to be effectively addressed.

Moreover, concerns related to data security and privacy in the era of digital agriculture must be considered. Policy implications are of utmost importance in harnessing the full potential of drone technology in Indian agriculture. Government initiatives, subsidies, and regulatory frameworks should be designed to promote technology adoption while ensuring that small-scale farmers and marginalized communities are not left behind. Encouraging research and development, involving the private sector, and implementing skill development programs are essential components of a comprehensive policy approach.

Our project will explore the feasibility of using drones for crop dusting, providing farmers with a convenient and efficient alternative to traditional methods. Data-driven decision making: with the integration of drones, our project aims to provide farmers with valuable data and insights to make informed decisions.

By collecting and analysing data such as plant height, soil moisture levels, and yield predictions, farmers can optimize their farming practices and adjust accordingly. We explore the methods used by drones such as implementing for pesticide sprayers in Agriculture and area mapping.

2. Objective

Following are the objective of the project:

- Increased Efficiency: - drones can over large area quickly, reducing the time and labours required for tasks like crop scouting, spraying, and mapping.
- Crop Management:- drones can provide real-time data on crop growth, helping farmers identify problems early and apply intervention as needs.
- Cost Savings: -by reducing the need for manual labour and optimizing input like water and fertilizers, drones can lead to cost saving for farmers.
- Precision Agriculture: - drone can monitor crop health, soil conditions, and pest infestation, allowing farmers to make data-driven decision and optimize resource use.
- Improved crop health and yield: Properly applied fertilizers can enhance soil fertility, promote plant growth, and increase crop yields. Fertilizer spraying drones ensure that nutrients are delivered where they are needed most, leading to healthier plants and higher productivity.

3. LITERATURE SURVEY

- Subhranil Mustafi, Pritam Ghosh, Kunal Roy, Sanket Dan, Kaushik Mukherjee, and Satyendra Nath Mandal, "Drones for Intelligent Agricultural Management", ResearchGate ,29 June 2021 [1].
- Machine Learning for Precision Agriculture Using Imagery from Unmanned Aerial Vehicles (UAVs): Imran Zualkernan, DiaaAddeenAbuhani, Maya Haj Hussain, Jowaria Khan and Mohamed ElMohandes Publication IDPM , 6 June 2023 [2].
- Application of drone in agriculture International Journal of Chemical Studies Advances in Precision Agriculture ISSN : 2349–8528Volume 30 August 2021. [3].
- Freyr drone: Pesticide/fertilizers spraying drone - an agricultural approach. Second International Conference On Computing and Communications Technologies (ICCCT) 1 [4].
- Deployment and Performance of a UAV for Crop SprayingCHEMICAL ENGINEERING TRANSACTIONS ISSN. [5]
- The problem is exacerbated by the continuously diminishing natural resources used as inputs for farming. [2].
- The Japanese were the first to successfully apply UAS technology to agricultural chemical spraying applications in 1980's [3].
- The aircraft was a petrol-powered helicopter (RMAX, Yamaha Motor Co. USA, Cypress, CA USA) originally developed for spraying of rice fields in Asia [5].

Sri No	References	Strong points	Weak points
[1]	Subhranil Mustafi, Pritam Ghosh, Kunal Roy, Sanket Dan, Kaushik Mukherjee, and Satyendra Nath Mandal, "Drones for Intelligent Agricultural Management", ResearchGate ,29 June 2021	the payload can be improved with the increase in the power rating of the brushless DC motors	such as regulatory issues, cost, or technical limitations..
[2]	Imran Zualkernan, DiaaAddeenAbuhani, Maya Haj Hussain, Jowaria Khan and Mohamed ElMohandes, "Machine Learning for Precision Agriculture Using Imagery from Unmanned Aerial Vehicles (UAVs):"IDPM ,6 June 2023	UAVs for agricultural applications use multispectral UAVs for agricultural applications use multispectral images that capture different wavelength ranges across the electromagnetic spectrum	Primary challenges include detecting small trees and interleaved crops, as well as the high-power consumption of complex models..
[3]	S.Soothy,b.Shadaksharappa, s. Suraj, and v. K. Manasa "freyrdrone:pesticide /fertilizers spraying drone an agricultural approach," in proc. 2nd int. Conf Comput. Commun.Technol. (iccct), feb 2017	In the detailed description comparison with ground-based spraying	They have a limited data, incomplete comparative analysis, limited conclusion, lack of

			discussion on challenges
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4. METHODOLOGY

Addition to the drone components, a spraying system is integrated into the design. This includes a pump and its controlling device, which allows for the efficient and controlled spraying of pesticides or other agricultural chemicals. To estimate the payload capacity of the drone, calculations are made to determine the weight of the necessary components, such as the sensors, cameras, and spraying system. The drone's battery is selected based on the power requirements of these components. The methodology of a spraying drone involves the following steps:

1. **Planning and Preparation:** Before deploying the spraying drone, the user needs to plan the flight path and ensure that all safety measures are in place. This includes checking the weather conditions, ensuring that the drone is fully charged and calibrated, and confirming that the spraying equipment is properly attached.
2. **Flight Path Generation:** The flight path of the spraying drone is typically pre-programmed using software that allows the user to define the area to be sprayed and set parameters such as altitude, speed, and spray rate. This ensures that the drone covers the entire area efficiently and effectively.
3. **Autonomous Operation:** Once the flight path is programmed, the spraying drone can operate autonomously, following the pre-defined route and spraying the designated area with precision. The drone uses GPS technology and sensors to navigate and adjust its position in real-time, ensuring accurate coverage and minimizing overlaps or missed spots.
4. **Spraying Process:** The spraying drone is equipped with a tank containing the liquid pesticide or fertilizer to be sprayed. The spraying mechanism, such as nozzles or sprayers, is controlled by the onboard computer system to ensure even distribution of the spray over the target area. The drone may also be equipped with sensors to monitor environmental conditions and adjust the spraying parameters accordingly.
5. **Monitoring and Control:** Throughout the operation, the user can monitor the progress of the spraying mission in real-time using a ground control station or a mobile app. They can also make adjustments to the flight path or spraying parameters if necessary. Additionally, the drone may be equipped with sensors to detect obstacles or changes in environmental conditions and respond accordingly.
6. **Post-Flight Analysis:** After the spraying mission is completed, the user can analyze data collected during the operation, such as spray coverage maps, flight logs, and environmental conditions. This information can help optimize future spraying operations and improve overall efficiency.

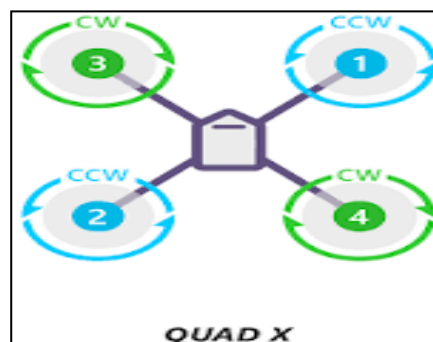


Fig.1 Motor Directions

Many problems are there in methodology those are following:

- **Regulatory Hurdles:** Drones are subject to strict regulations that vary by country and region. These rules can limit where drones can fly, how high they can go, and what tasks they can perform. Ensuring compliance with these regulations can be challenging and may hinder the deployment of spraying drones.
- **Safety Concerns:** The safety of people, animals, and property is a major concern when operating drones. There is a risk of accidents, especially if a drone malfunctions or is operated inappropriately. Additionally, there are security concerns regarding the potential misuse of drones for unauthorized surveillance or other malicious activities.
- **Technical Limitations:** Spraying drones can face technical issues like spray drift, which occurs when pesticides are carried away by the wind, leading to non-targeted areas being affected. This can result in uneven spraying and potential harm to the environment.
- **Operational Efficiency:** Spraying drones typically have a small payload capacity, which means they can carry only a limited amount of pesticide or fertilizer. This can lead to frequent refills and reduced efficiency, making them less

cost-effective compared to traditional spraying methods Therefore, the existing agriculture drones. It needs to be more optimized and more synchronized which will lead the management to have a more proficient system to support the total farmers.



Fig-2Radiolink crossflight flight controller

The frame of the drone is designed to accommodate the chosen components and payload. The number of arms and their configuration is determined based on the desired stability and maneuverability of the drone. In this particular study, a hex copter agricultural drone was used. The frame of the drone was made of fiber carbon, known for its strength and durability. The arms of the drone were constructed using tubeshaped fiber carbon, allowing for easy folding and transportation. The carbon fiber quadcopter agriculture drone is designed for low temperatures, improved drop and shock resistance, and return-to-launch functions. It features a built-in IMU heating system, sensors like compasses, position detectors, free fall detectors, and pedometers to calculate the drone's position and trajectory. The LSM303D sensor is used for 3D digital linear acceleration and 3D digital-magneto, while the L3GD20 sensor tracks device rotation based on motion. The MPU9250 sensor calculates the drone's acceleration and orientation, allowing it to find its position and trajectory without GPS. The MS5611 Barometer sensor measures air pressure, crucial for drone movement. The drone's trajectory mission is planned using Mission Planner software, which sends the mission to the drone. The drone must be calibrated beforehand. Finite Element Analysis (FEA) simulations are used to examine the drone's dynamic movement. The drone structure is made of metal, with a metal frame for the controller and rod arm for the motor driver. Structural constraints are applied at each servo, with a 1 kg electrical controller circuit placed as a structural load and a water tank and battery imitated by the drone shank.

The quadcopter drone is chosen for agricultural use due to its stability and ability to carry heavy loads. Attitude is controlled by adjusting the rotor angular velocity, with the first rotor being the right front rotor.

5. PROPOSED SYSTEM

Flow chat :-

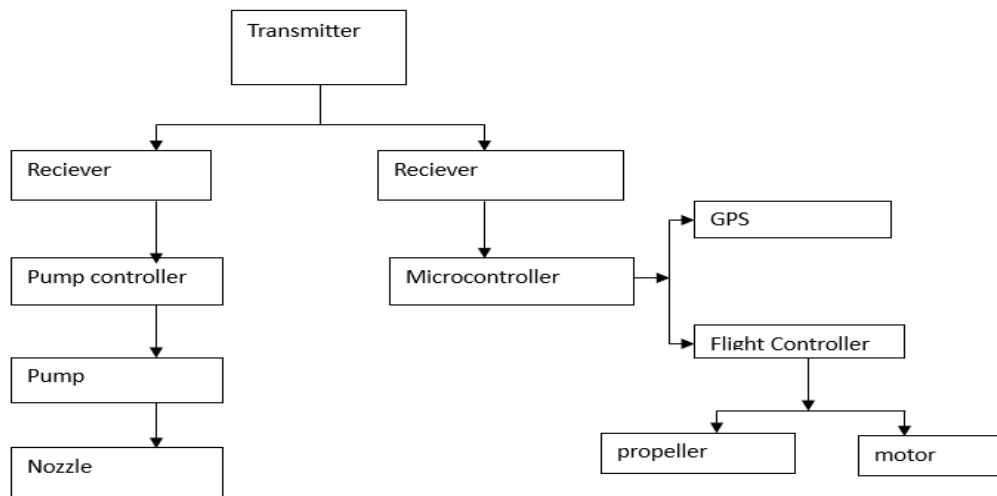


Fig.3 flow chat

The Quadcopter Frame is made of high-quality glass fiber and ultra-durable polyamide nylon, with reinforced arms for increased durability. It features integrated PCB connections for direct soldering of ESCs and colored arms for orientation. The frame has large mounting tabs for easy camera or accessory mounting and pre-threaded brass sleeves for all bolts. The Radiolink Crossflight Flight Controller is an advanced flight control system designed for unmanned aerial vehicles (UAVs) and drones. It employs a state-of-the-art flight control algorithm, providing exceptional stability and responsiveness. It is compatible with various UAV platforms and supports various flight modes. The controller is equipped with advanced sensors such as gyros, accelerometers, and magnetometers, ensuring accurate data feedback for precise flight control. It seamlessly integrates with an OSD display system, providing real-time flight information. The controller is user-friendly and supports firmware updates. It also offers fail-safe protection, including low battery return, signal loss protection, and emergency landing capabilities. It supports telemetry systems, enabling real-time communication between the UAV and ground control station. The quadcopter's remote control (RC) helps control flight movement, consisting of a transmitter (Tx) and receiver (Rx). The IMAX B3 AC Compact Charger is a compact Li-Po balance charger designed for 2-3s batteries. It features built-in plug ports and 3 LEDs for charge status. The R3853 requires 6-12 VDC and 0.5-0.7A power, and can pump heated liquids up to 80 degrees Celsius. The kit includes 4 x 1045 propellers, one rotating clockwise and one anticlockwise, and two propeller shaft adapters. These propellers can be used with various shaft diameters, making them suitable for aircraft positioning, flight route, and automatic return flight. The built-in compass reduces interference to the magnetic field sensor. To install the autopilot, connect it to your computer using a USB cable. If using Mission Planner as the GCS, select the COM port and set the Baud rate to 115200. In Mission Planner's SETUP | Install Firmware screen, select the appropriate icon for your vehicle or frame type and answer "Yes" when asked "Are you sure?". The diagrams show motor order for each frame type and the output pin from the autopilot should be connected to each motor/propeller.

6. RESULT OF APPLICATION

This article explains how to perform radio control calibration using Mission Planner RC transmitters. It explains how to set flight mode, control vehicle movement and orientation, and turn on/off auxiliary functions. RC calibration involves capturing the minimum, maximum, and "trim" values of each RC input channel to ensure ArduPilot can correctly interpret the input. To set up the transmitter, disconnect the battery and connect the RC receiver to the autopilot. Turn on the transmitter and ensure the trim tabs are in the middle. Connect the autopilot to the PC using a USB cable. Open Mission Planner's INITIAL SETUP | Mandatory Hardware | Radio Calibration screen. Check the channel mapping in the transmitter by moving the sticks, knobs, and switches. If the transmitter is new, change channel mapping using the built-in configuration menu. Determine if the transmitter is Mode1 or Mode2 and set a 3 or 6 position switch to control Channel 5 (default, Copter) or Channel 8 (default, Rover or Plane). The Copter and Rover can be calibrated using Mission Planner's INITIAL SETUP | Mandatory Hardware | Radio Calibration screen. To calibrate the transmitter, move the transmitter's roll, pitch, throttle, and yaw sticks and ensure the green bars move in the correct direction. If the channel is not possible to reverse in the transmitter, you can reverse it in ArduPilot by checking the "Reversed" checkbox. If the checkbox is not visible, you can reverse the channel by directly changing the RCx_REVERSED parameter. Click on the green "Calibrate Radio" button on the bottom right and press "OK" when prompted. Move the transmitter's control

sticks, knobs, and switches to their limits. Red lines will appear across the calibration bars to show minimum and maximum values. Click "Click when Done" and move the throttle to zero. Mission Planner will show a summary of the calibration data, with normal values around 1100 for minimums and 1900 for maximums. Automatic ESC-by-ESC calibration is also possible. Connect the autopilot from a ground station and set the ESC_CALIBRATION parameter to 3. Disconnect the battery and USB cable, connect the battery, and listen for a musical tone, two beeps, and a single long beep indicating the end points have been set and the ESC is calibrated. Calibrate Accel from the left-side menu and place the vehicle on each axis during the calibration process. Keep the vehicle still immediately after pressing the key for each step, as it is more important than getting the angle exactly right. The drone has 25 flight built-in flight modes, with 10 of them being regularly used. These modes support different levels of flight stabilization, a sophisticated autopilot, and a follow-me system. To calibrate the board before mounting, use Mission Planner after installing the autopilot and preparing to fly. The level position is crucial as it affects the controller's attitude during flight. The compass can be calibrated at startup and after takeoff. To set up flight modes, connect the flight controller to Mission Planner, select "Standard Params" in the "Config/Tuning" tab, and assign different flight modes to FLTMODE1 and FLTMODE2. You can also use the Radio Calibration screen to assign switches or channels on your transmitter to different flight modes. Flight modes can be controlled through the radio, mission commands, or commands from a ground station or companion computer. Test flight modes in a safe environment before flying. Battery capacity is in milliampere hours (mAh). The greater the value, the greater the capacity of the battery. For example, the total current strength = battery capacity $\times$ Crate = 22 Ah $\times$ 80 C = 176 A, meaning that the battery for the quadcopter drone can issue a current of 176 A continuously until the battery voltage reaches a safe lower limit to supply power to the rotor. The maximum voltage of each cell is 2.7 V. When it is full, the total battery voltage is 11.1 V (4×2.7 V). The constant voltage from the battery used to be 2.8 V per cell. During the flight, the drone has a battery voltage limit of 2.7 V per cell, or about 11.2 V in total. The flying operation of the drone must be stopped. Flying with voltage under the minimum voltage limit can make a drone fall. From the field test results, if there is no additional load or an empty tank, the drone can fly for 19 minutes, but if it carries 1 liters of liquid fertilizer (full tank) or a total weight of 1.05 Kg, the flight time is about 11.9 minutes. The relationship of the entire payload (drone weight + an additional weight) with the current, voltage, and flight time of agricultural drones in this study is presented in Table 1. If the payload is constant, the maximum flying time is also constant. If it is dynamic, the allowed flying duration will vary depending on the current payload, especially in the spraying activities where the additional load (fertilizer) will be reduced when the extra load is reduced

7. CONCLUSION

The drone project aims to revolutionize agriculture by providing farmers with real-time data on crop health, soil conditions, and pest infestations. This data enables targeted interventions, such as precise pesticide application, leading to optimized yields and reduced environmental impact. The use of advanced sensors and imaging technology further enhances precision agriculture practices. Drones provide cost-effective solutions for agricultural tasks like field monitoring, mapping, and crop spraying, reducing labor costs and reliance on expensive machinery. They also promote sustainability by minimizing chemical inputs and optimizing resource allocation, reducing ecological footprints and contributing to a more sustainable food production system. Drones can provide valuable insights into crop performance, enabling farmers to optimize their practices and improve productivity. However, implementing drone technology in agriculture faces challenges such as regulatory compliance, initial investment costs, technical expertise requirements, and data management complexities. Despite these, drones offer potential for enhancing agricultural productivity, sustainability, and profitability. By overcoming these challenges, farmers can unlock new opportunities for innovation and growth, contributing to food security and environmental stewardship

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