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Satendra Kumar
Assistant Professor, Department of Agriculture, Dev Bhoomi Uttarakhand University, Dehradun, Uttarakhand, India

Amit Saini
Assistant Professor, Department of Electronics and Communications Engineering, U.I.T., Uttaranchal University, Dehradun, Uttarakhand, India

Dr. Awaneesh Kumar
Assistant Professor, Raffles University, Neemrana, Rajasthan, India

Ajay Prajapati
Research Scholar, Veer Chandra Singh Garhwali, Uttarakhand University of Horticulture and Forestry, Ranichauri Tehri Garhwal, Uttarakhand, India

Corresponding Author:
Satendra Kumar
Assistant Professor, Department of Agriculture, Dev Bhoomi Uttarakhand University, Dehradun, Uttarakhand, India

A comparative study on agriculture drone for monitoring and spraying pesticides

Satendra Kumar, Amit Saini, Dr. Awaneesh Kumar and Ajay Prajapati

Abstract
The use of drones in agriculture has indeed emerged as a promising technology, offering potential benefits such as increased efficiency, precision, and reduced human exposure to harmful substances. Drones equipped with pesticide spraying capabilities have gained traction as an alternative to manual spraying methods. By automatinsg tasks like fertilizer application, pesticide spraying, and field tracking, drones can revolutionize agricultural practices. In the agricultural sector, drones are increasingly being used for field inspection and pesticide spraying. This paper provides a concise review of the recent developments and implementations of UAV technology in the agricultural sector, focusing on their application in crop monitoring and pesticide spraying activities

Keywords: Drone technology, spray System pesticides, UAVs

1. Introduction
This paper provides a concise review of the recent developments and implementations of UAV technology in the agricultural sector, focusing on their application in crop monitoring and pesticide spraying activities.

Drones indeed offer numerous advantages in various industries, including agriculture. Their ability to automate tasks such as fertilizer application and pesticide spraying can greatly improve efficiency and reduce the health risks associated with manual application. By using drones, farmers can mitigate the negative impacts on human health caused by Direct exposure to pesticides and fertilizers.

One of the primary benefits of using drones in agriculture is their fast maneuverability, which allows them to cover large areas of farmland quickly and effectively. This capability enables timely and efficient application of fertilizers and pesticides, ensuring optimal crop health and productivity. Drones equipped with universal sprayers can handle both liquid and solid contents, providing flexibility in the types of substances that can be applied. Figure 1 Shows the pesticides UAV [1].

Fig 1: Pesticide spraying UAV

2. Related work and Objectives
Yallappa (2017) The hex copter is equipped with six BLDC (Brushless Direct Current) motors. This configuration provides better efficiency, stability, and control over the drone's flight. The drone is powered by two LiPo (Lithium Polymer) batteries, each consisting of 6 cells with a total capacity of 8000 mAh. This power setup ensures longer flight times and higher energy reserves for carrying the extra payload. The drone can carry 5.5 liters of liquidity can operate continuously for 16 minutes on a single battery charge [2].

Dongyan (2015) Based on the investigation of successful swath width and droplet distribution uniformity over aerial spraying systems, specifically the M-18B and Thrush 510G.The agricultural planes, M-18B, and Thrush 510G flew at different heights during the experiment. The M-18B flew at a height of 5 meters, while the Thrush 510G flew at a lower height of 4 meters [3].

Prof. B. Balaji (2018) That sounds like a fascinating project! Creating a hexacopter UAV for pesticide spraying and crop/environmental surveillance using Raspberry Pi and Python is a great example of how technology can be applied to benefit agriculture and environmental monitoring. The combination of the Raspberry Pi and Python provides a flexible and accessible platform for handling various tasks and sensor data.

Kurkute (2018) successful implementation of a cost-efficient UAV quadcopter spraying system using basic equipment and the Atmega644PA agricultural controller. The universal sprayer method, which allows spraying both liquid and solid materials, is a versatile approach that can greatly benefit agricultural operations. Quadcopters can navigate through fields with precision, ensuring that the right number of materials is applied only where needed. This targeted approach can result in reduced waste and increased efficiency. [4].

Sadhana (2017) The Brushless DC motors (BLDC) are suitable for this application due to their efficiency and power. Ensure the ESCs are compatible with your motors and provide a stable and precise control of the motor speed. The MPU6050 is used for an IMU (Inertial Measurement Unit) as it combines an accelerometer and a gyroscope in a single chip. This will provide essential data for flight stabilization and orientation. Choose a high-quality Lithium-Polymer (LiPo) battery with an appropriate capacity and discharge rate. it Use a reliable radio receiver that is compatible with your chosen flight controller [7].

3. Methodologies and Materials

It Construct with a micro-controller and connected to the four brushless motors. BLDC motor connect with the rotors in directions of the UAV Positioning model. These BLDC motors are controlled by the Electronic Speed controllers (ESC). The ESCs are responsible for controlling the speed and direction of the brushless motors. The RC transmitter has multiple channels, each dedicated to controlling a specific aspect of the UAV. Common channels include throttle (for controlling altitude), pitch, roll, yaw (for controlling orientation), and auxiliary channels for additional functionalities like camera tilt, modes, etc.

Fig 2. Shows block diagram and the methodologies and controllers of Drone are shown in Table 1

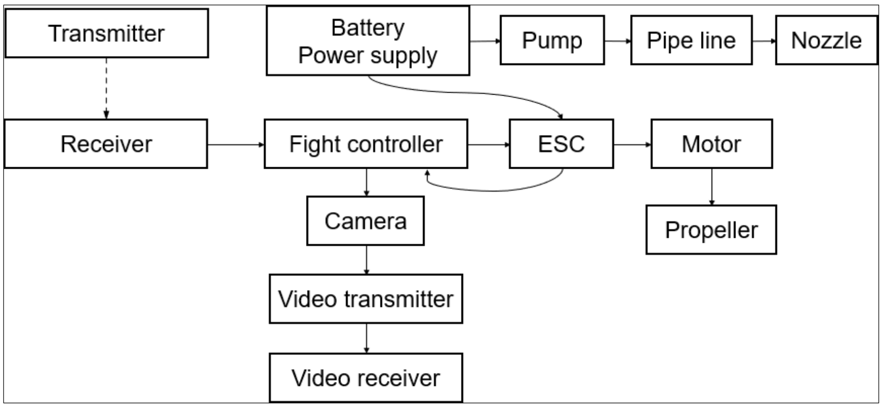

Fig 2: Block diagram

Table 1: Methodologies and controllers of Drone

Author Name	Elements used	Controller	Remarks	Load
Sadhana B (2017) [7]	ESC, BLDC, MPU 6050 sensors.	Arduino Uno ATmega328	High stability and increased power lifting.	1kg
Munmun Ghosal (2018) [8]	ESC, BLDC motor, sensor Like LM-35, AM-1001, LDR, MQ6, and MQ135.	Arduino ATmega328	low-cost with high-efficiency.	
Sabikan (2016) [9]	IMU, 2.4GHz telemetry, ESC.	ArduPilot Mega (APM) 2.6	The quad copter OSP have both software as well as hardware.	
Parth N. Patel (2016) [10]	Accelerometer, gyroscope, IMU, Infrared camera, BLDC, ESC	Atmel AVR microcontroller	It is adaptable, allows function performance to be modified and also allows technological integration.	
Weicai Qin (2019) [11]	GPS, temperature measurement in digital form, humidity indicator, sensitive to water.	N-3	The use of pesticides in low altitude and low volume in unmanned aerial vehicles (UAVs) is a common practice in modern agriculture	25 lit
Tanga (2018) [12]	Digital temperature, Humidity indicator, Water sensitive Sensors. Anemometer, Filter papers.	UAV ZHKU- 0404-01	An indicator used for air humidity measurement. And wind.	15 L
Xue, X (2016) [13]	Flight controller, laser lider,RTK mobile module	MSP430 single-chip	collaborative spraying	25 kg
Tejas S. Kabra (2017) [14]	BLDC		This reduces the medical problem.	1.5 to 3 L
Rahul Desale (2019) [15]	BLDC, ESC, ratio controller, Transmitter.	Flight Controller	Radio control.	

4. Hardware and software components

Drones are an array of sophisticated hardware, software and advanced technology. Here are some key software and hardware components commonly found in drones:

A. Hardware Components

Frame: The physical structure that holds all the components together, including the motors, propellers, and electronic components.

Motors and Propellers: Provide the necessary thrust and maneuverability for the drone's flight.

Electronic Speed Controllers (ESCs): Regulate the power supplied to the motors, enabling precise control of their speed and direction.

Flight Controller: The central processing unit that receives input from sensors and pilot commands and sends signals to the ESCs to control the drone's flight.

Camera and Gimbal: For capturing aerial photography or video footage, drones often include cameras mounted on gimbals to stabilize the camera's position.

B. Software Components

Firmware: The software embedded in the flight controller that controls the drone's basic functions, such as stabilization, flight modes, and safety features.

Flight Control Software: This software runs on the flight controller and handles tasks like interpreting pilot inputs, managing sensor data, and generating control signals for the motors.

Navigation and GPS Software: Enables the drone to navigate using GPS coordinates, perform autonomous flights, and follow predefined flight paths.

Image Processing Software: Used for analyzing and processing data from the drone's camera, enabling features like object detection, tracking, and computer vision-based applications.

Ground Control Station (GCS) Software: Allows the operator to monitor and control the drone remotely, providing real-time telemetry data, mission planning, and advanced flight settings.

Autonomous Flight Software: Enables drones to perform tasks automatically, such as waypoint navigation, follow-me mode, and obstacle avoidance.

The combination of these hardware and software components allows drones to operate efficiently and perform a wide range of tasks, from recreational flying and aerial photography to industrial applications like aerial mapping, surveillance, and

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The combination of these hardware and software components allows drones to operate efficiently and perform a wide range of tasks, from recreational flying and aerial photography to industrial applications like aerial mapping, surveillance, and delivery services. Tables 2 and 3 show some of the underlying hardware and software components respectively.

Table 2: The following are some of the most important drone hardware components and implementations

Name of the Element	Purpose	Reference
BLDC motor	Movement control	[2, 4, 6, 7, 8, 16]
Flight Controller	control fixed-wing drone	[7-11, 18]
Transmitter	Transmit commands wirelessly	[2, 3, 4, 5, 6, 17, 18]
ESC	Regulates the speed of BLDC	[2, 4, 6, 7, 8, 9, 10, 18]
Propeller	Movement of drone	[6]
Water Pump:	for spraying water	[1, 6, 7]
GPS	Navigating	[1, 2, 3, 4, 7, 15]
Camera	Record video or capture image	[4, 5, 7, 10, 18]
Accelerometer	For measure the acceleration	[2-7, 8, 14]
Gyroscopes	For rotational motion or Maintaining orientation and angular velocity	[2-7, 8, 10]
Magnetometer	Measuring the strength and direction of the magnetic field.	[2-7, 8]

Table 3: The following are some of the most important drone hardware components and implementations

Name of the Element	Purpose	Reference
MATLAB	Image-processing and analysis	[19, 20, 21]
Adobe Photoshop	Distortion emendation	[22, 23]
GIS	Capturing and analyzing spatial and geographic data.	[24, 25]
MAVLink	Communicating with UAVs	[26, 27]
Pix4D	calculation and 3-D models construction	[28, 29]
Arduino	Controlling	[6, 7, 8, 9, 10]
Python	Controlling	[3, 30]

5. Conclusion and future work

The provided information highlights the potential benefits and opportunities for Unmanned Aerial Vehicles (UAVs) or drones in precision agriculture. Table 1 suggests that the evaluation of UAVs in quadcopters can lead to improved accuracy in applying pesticides and fertilizers in various crops, which can have positive implications for agricultural productivity and sustainabilit Table 2 and Table 3 seem to focus on the hardware components and software aspects of drones. The hardware components are crucial for the drone's performance, such as flight stability, payload capacity, and endurance. The software, on the other hand, plays a critical role in determining the drone's behavior, making decisions about when and what actions to takethe future of drones in precision agriculture appears promising, and ongoing advancements in technology and agricultural practices are expected to drive further improvements in this field. As the technology matures and becomes more affordable and efficient, drones could play an increasingly significant role in optimizing agricultural practices and ensuring sustainable food production.

6. Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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