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IoT Based Drone for Pesticides Spraying

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Abstract: *The drones will carry pesticides to spray all over the farm, reducing the work of farmers and completing their tasks faster. Pesticides and fertilizer spraying are most important process in the agriculture field for good production of crop. This application provides the user-friendly interface for farmers. Drone is a pesticide spraying quadcopter for agriculture purpose which reduce the amount of work required by the farmer by allowing him to spray pesticides evenly over all the land. Using an Android app, the farmer can operate the drone, and he can connect to the app using a Wi-Fi module in the drone. Regardless of the shape of the field or type of crop, the drone will spray pesticide it will precisely route the area of that farmer's land. This project uses the Nodemcu board, which is an open source electronics prototype platform with an inbuilt Wi-Fi module. Using the accelerometer and gyro (MPU6050), we have balanced the directions and orientations.*

Keywords: MPU 6050, Nodemcu, ESC

I. INTRODUCTION

It is an agriculture-based country, where more than half the population is dependent on agriculture. As the population increases, agricultural productivity and protection levels improve. Insects tend to damage crops, which decreases productivity, so pesticides are used to kill them. Often, diseases in crops lead to destruction losses in the agricultural field. Fertilizers and pesticides are crucial tools for killing insects and growing crops. Human beings are affected by spraying pesticides, and fertilizers manually, leading to cancer, hypersensitivity, asthma, and other illnesses. The quadcopter can therefore be used to automatically spray fertilizer and monitor crops, as well as for other applications such as search and rescue, Hazmat, police, code inspections, Emergency Management, etc. The advantages of quadrotors include their swift manoeuvrability, increased payload, high lifting power, and stability. Controlling quad copters is easier than controlling other aircraft. In addition to being used indoors and outdoors, quadcopters are used in risky areas. The sprayer sprays both liquids and solids, including liquids and solids. Pesticides and fertilizers are sprayed together by the global nozzle, but stress pumps are only used during spraying pesticides, and not during fertilizer spraying. In large areas the quad copter can be remotely controlled and guided automatically using GPS. A quad copter controlled by autopilot controller and payload is controlled by Android Mobile and motors. Initial cost of the quadcopter is very high when it's comes to the high weight lifting drone which is not affordable by our Indian Farmers. So here our main motive is to reduce the cost of drone So, every farmer can afford it and give very easy operating environment for the operation of drone so farmer can easily control drone. Also, our system is communicating through internet so it is easy to maintain the all data about pesticide and fertilizer which is sprayed by drone. Our approach to develop this method in Indian agriculture field tend to increase protective and productivity of crop and improve the crop's growth towards fertilizer and pesticides spraying based on the crops damage.

II. LITERATURE REVIEW

M. M. Vihari et al [1] Proposed This article discusses In India agriculture plays a pivotal role and provides a principal means of livelihood. Pesticides save the crop from pests and improve the yield. At present pesticides and fertilizers are sprayed manually, which affect the human nervous system and causes many deaths every year.

S. Meivel et al [2] proposed An automatic agricultural system with an automated irrigation system having a universal nozzle for spraying water, fertilizer, pesticides based on the need is implemented

N. J. Chapungo et al [3] explained a Precision Agriculture (PA) review and the main elements of Internet of Things (IoT) ecosystem for PA- design and implementation.

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D. Yallappa et al [4] proposed about Application of crop protection materials is one of the crucial operations in agriculture to meet ever demanding food production. The drone mounted sprayer mainly consists of BLDC motors, LiPo (Lithium polymer) batteries, pesticide tank, pump, and supporting frame.
Soothe S et al [5] explained the purpose of FREYR drone is to develop a quad-copter which carries pesticides to spray all over the farm which reduces the work of farmers as well as it finishes his work soon.
F. Sarghini et al [6] explained about Pesticide application using UAV is gaining momentum as a possible crucial technical approach to control insect, diseases and weeds population on the field.
G. S. Prabhu et al [7] The main concept of this paper is to reduce farmer's time and increase the yield by implementing IOT in the field. It checks the moisture level in the soil and the values are viewed by farmer in his mobile.
S. Meivel et al [8] Proposed an automatic agricultural system with an automated irrigation system having a universal nozzle for spraying water, fertilizer, pesticides based on the need is implemented.
P. Kundu et al [9] Proposed the study has implemented a smart soil conditions monitoring system in which the IoT sensors located in the field furnishes the demanded data, processes it and advances it into the PUBSUB , from where the data flows to get stored in the Google Cloud Console which is a virtual store to prevent data loss and difficulties in maintaining data storage offline.
S. Sontowski et al [10] explained about Cyber Attacks on Smart Farming Infrastructure.
D. Murugan et al [11] In this paper, a methodology has been proposed for precision agriculture monitoring i.e., to classify vegetation into sparse and dense vegetation classes by employing fusion of freely available satellite data (Landsat 8) and drone imagery.
F. Sarghini et al [12] proposed a measurements of spray deposition obtained from UAV spray application technique.

III. Materials and Methods

Table 1: Hardware Components Required

Component Name	Specification
Brushless DC Motors (out runners)	1000KV
NodeMcu board Flight Controller	-
Transmitter and Receiver	2.4GHz
Frame(glass fibre and polyamidenylon)	Length: Width: 450mm:450mm Height:55mm
Electronic Speed Controllers (ESC)	20 Amp
Propellers	1045R,1045 Diameter:10-inch Pitch: 4.5 inch
3s Li-Po Battery	11.1(nominal) 12.6V(max) 2200mAh30C
Flight Time	8min (avg)

Table 2: Average Weight Calculation of a Drone System

Part Description	Avg. Weight (gms)	Quantity	FinalAvg. Weight (gms)
Flight Controller	23	1	23
Propellers	7.5	4	30
Receiver	7	1	7
Motors	30	4	120
ESC	11	4	44
Battery	180	1	180
Frame	250	1	250
Sprayer Tank with load	400	1	400

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Table 3: Propeller Size VS Thrust Generated

	Propeller Size	Thrust Produced (approx.)
3SLi-Po battery withESC of 30A	10-inch 4.5 pitch(1045)	800 gms
	9-inch 4.5 pitch(0945)	475 gms
	8-inch 4.5 pitch(0845)	475 gms

3.1 Design Aspects

The main design aspect of a quad copter is that the thrust to weight ratio must be generally greater than or equal to 2:1[3]. Based on the Table.2 the average weight of the drone (with the load) is 1300gms. The following steps determine the thrust required to hover a quadcopter at half throttle when the control is on.

- **Step1:** Multiply the average weight with 2. So, the thrust required is 1300*2=2600gms In order to eliminate difficulty of hovering during winds we bump the result by a factor of 20%. 2600*(20/100) =520gms, Total thrust required is 2600+520=3120gms IoT based Unmanned Aerial Vehicle system for Agriculture applications International Conference on Smart Systems and Inventive Technology On an average 3100 grams of thrust is required to hover the drone.
- **Step2:** Since this is a quad copter, we use 4 motors so the average thrust on each motor is given as 3100/4=775gms the motors and propellers required to lift the drone are chosen according to the Table III

3.2 Block Diagram

- **Propellers and Motors**: Based on the thrust required the motors and the propellers can be determined using the Table.3. Considering the average estimated weights, the motors used here are 1000kv with propeller length of 10 inch and 4.5-inch slope.
- **Flight Controller**: In this we use NodeMcu board as a flight controller along with MPU6050 IMU sensor which has inbuilt gyro sensor and accelerometer sensor which automatically stabilizes the drone flight.
- **Android App**: Android App is used to send instruction to drone through internet.
- **ESC:** Electronic speed controller of 30Amperes. It controls the speed of the motors based on the instruction received from the flight controller.

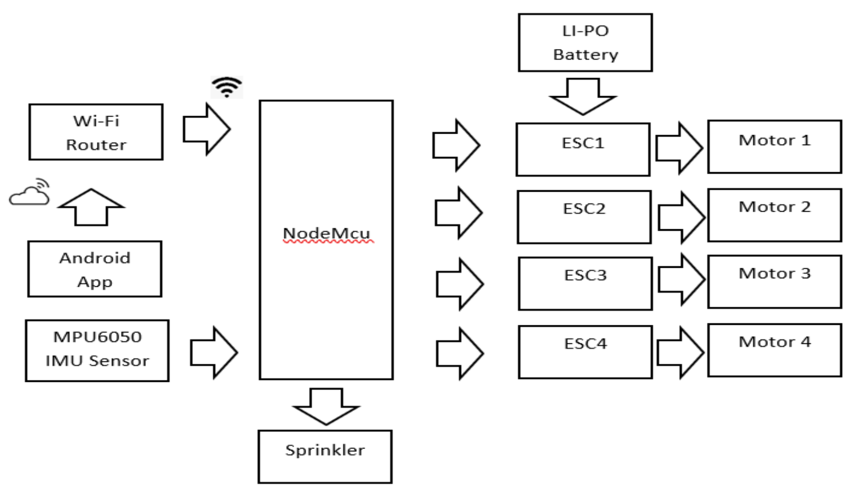

Figure 1: Block Diagram

- **Sprayer Module:** The sprayer mainly consists of a tank to carry the load. Here we use a 250ml tank and a pump attached to a nozzle is inserted in the tank to spray the content. This pump is driven by a motor driver connected to the flight controller and it can be switched ON or OFF using Android App.

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3.3 Circuit Diagram

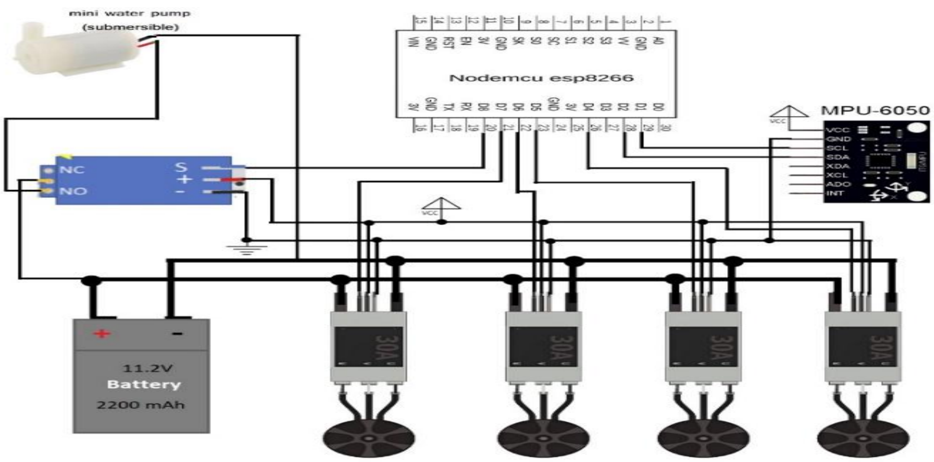

Figure 2: Circuit Diagram

In above circuit diagram our Nodemcu board is acting as our flight controller. NodeMcu is responsible for process all data. System is powered up using 11.2V battery. The IMU sensor MPU6050 (Gyroscope + Accelerometer + Temperature) is connected to our controller through i2c protocol. Serial data (SDA) and serial clock (SCL) is connected to pin D1 and D2 respectively. This sensor is responsible for calculating drone angle and maintain stability. Electronic speed control boards are connected to battery for power and data pin of all esc's is connected to D5, D6, D7 and D8 respectively. Which control speed of motors using PWM method. BLDC motors are connected to ESC's which change speed of motors according to signal from app. A 12 V pump is connected to D8 pin through relay which pump water from tank and spray pesticide when signal is comes from app.

3.4 Algorithm

- Step 1: Start
- Step 2: Initialize the NodeMcu
- Step 3: Initialize the Blink IoT App
- Step 4: Connect NodeMcu and App
- Step 5: Send Command through App
- Step 6: NodeMCU Receive Command from Blink Server
- Step 7: NodeMCU Receive Data from MPU6050
- Step 8: Send signal to ESC's
- Step 9: ESC's Vary Motor speed according signal

3.5 Working

We are using Blynk IoT Android app as a transmitter. Using this app, we developed virtual remote control which has joystick controls for drone movement control and button control to start or stop pesticide spraying pump. At first any user (farmer) must on the system so that system will get connected to Wi-Fi router mounted on drone and System get connected to transmitter remote through internet. Once system get ready flight controller start receiving controlling signals from Android mobile by Blynk IoT platform.

LiPo rechargeable battery is connected to run motors. We use Node MCU which helps in interfacing the app with the motors of drone that is interfacing software with hardware. An android app Blynk is interfaced with the Node MCU board through internet Using Wi-Fi router mounted on drone which provide internet connection.

Once drone receiver block receives signal from transmitter the received signal is processed by the processor and output is send to the ESC's which controls the speed of the motors according to signal using PWM technique Initially drone is on ground so when we pass flying signal through mobile. The drone motor gets started which get power from ESC's connected to LI-PO battery and controls the speed of motors and the controlling signal to ESC's is provided by flight controller. Flight controller controls the flight angle and maintain the drone stability of drone by calculating the angle of 3 axis gyroscope and 3 axis accelerometer sensors. The data of this sensor is provided to microcontroller. Microcontroller will process this data and produce appropriate PWM signal for ESC's which controls the speed of the BLDC motors and maintain the stability of drone. Drone has one fluid tank mounted on it which contain liquid of pesticides the tank is connected to 12 V DC pump which pump the mixture from tank when drone is at desired position and received spraying signal from user through remote controller once pump get started it will pump the pesticide from tank increase its pressure and supply to nozzle. In last through nozzle pesticides is evenly sprayed over a field.

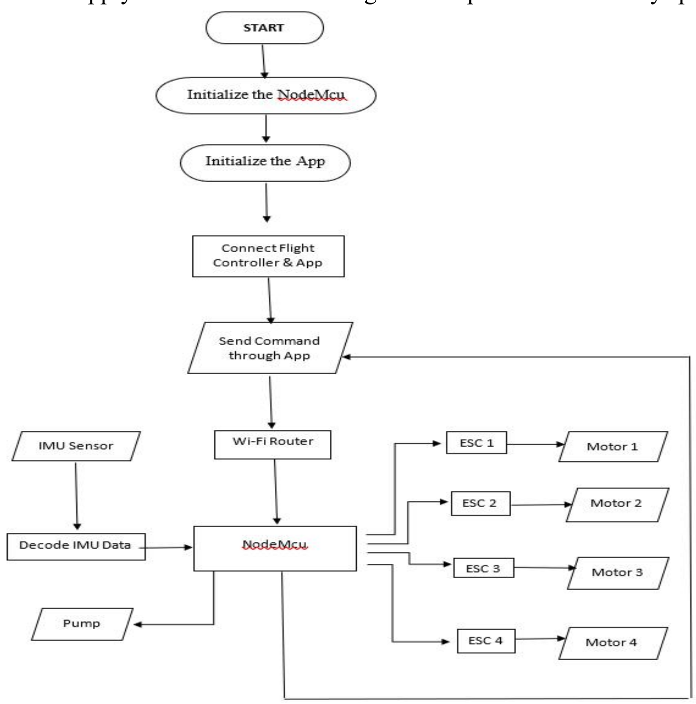

Figure 3: Flowchart

IV. RESULT

Drone system was assembled along with sprayer system using NodeMcu controller as is a quad copter. It is able to fly for 6 to 8 min with coverage of 50sq.mt. Drone with Sprayer during Flight The agricultural drone developed is more efficient for spraying in the fields than the conventional spraying. The main advantage of this drone is reduction of spraying time. It can fly across different terrains and there will be even spraying of the fertilizers from a single safe place. The average area covered by the prototype system is around 3 feet by 3 feet at a height of 6 feet. The spray time is about 1 minute for the 250 ml of content. The quantity of pesticide spraying can be increased by increasing the drone lift capacity and this can be achieved by choosing higher specifications of the motors and the flight time can be increased by increasing the battery capacity.

V. CONCLUSION

UAV based single point-controlled sprayer system was implemented using Quad- copter. The main advantage of this system is that it is very helpful to the farmers for spraying pesticides and fertilizers. It reduces the amount of spray, with less time without human intervention. Spray flow rate can be varied by varying speed of the servo motor. Drones can be treated as the best of technological Table I achievement in this era and have readily explored by a variety of users with lot of applications. Unmanned drone. Aircraft is a transformational has revolutionized the agricultural industry in a multiple way, resulting in increased profits, substantial growth of healthy and viable crops. They also decrease in the dependency of human being in farm work.

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