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IoT based Unmanned Aerial Vehicle system for Agriculture applications

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Abstract*— 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. WHO declared there are more than one million pesticide cases present every year. This paper explains about remote controlled drone based sprayer system used in precision agriculture which avoids the direct spraying by humans. This system has advantage of reducing labor workers, spraying time and resources like water and chemicals over conventional spraying methods and also can improve yield and crop health.

Keywords—*UAV, Quad copter, Sprayer, GPS*

I. INTRODUCTION

Agriculture is the backbone of India's economy. In India people still believe that earth is our mother that will feed us. Contribution of Agriculture to GDP has fallen between 17% to 18% from 50% in the 1950s which employs more than 50% manpower. Many of the agricultural products yield is low due to farming dependent upon environmental conditions and diseases caused by pests. Moreover, most of the agricultural practices used today are also are manual which consumes more time and also need more resources. This needs to adopt mechanization at various levels. Mechanization with big machines will not serve in our context since field areas are small.

Pesticides and fertilizers help to maintain the health of the crops and avoid the damage caused by pests respectively. Using Unmanned Aerial Vehicles (UAV) for spraying pesticides can cover large area in short time with reduced use of chemicals and water. A sprayer mechanism was added to the body of Quad copter. They can spray the pesticides uniformly to nook and corner of the field without need of a farmer. It reduces time, man power and labor cost and also protects farmers from toxic pesticides, animals and snake bites.

Basically it consists of a Quad copter and sprayer mechanism. UAV fly along with the sprayer on the crop was manually controlled by the operator on the ground. UAV can be configured by placing frame either in ' +' or X' on which the DC motors and propellers are placed. Due to propellers rotary motion the UAV gets thrust and it can take off vertically. The spraying mechanism connected to the drone was programmed and by giving proper commands, it can be operated The batteries and electronic speed controllers are used to control the speed of the motors [1]. Controlling the UAV is the main task and then spraying is done accordingly.

II. PROPOSED SYSTEM

UAV based sprayer system is shown in Fig.1. It comprises kk 2.1.5 flight controller which has ATMEL Mega 644PA 8bit AVR RISC micro controller. It is a quad copter consisting of four BLDC motors, four ESCs and correspondingly four propellers.

When the switch is ON at the radio controller the receiver receives the signal and corresponding signal is sent to the motor driver. This motor driver drives the pump present in the tank. The pump expels the content in the tank through the host and a sprayer. The proposed system has two basic components, drone and a sprayer.

DRONE: The quad copter works with the help of forces thrust and lift and also three rotary motions pitch, yaw and roll. The quad copter contains of four rotors with four propellers. The thrust can be varied by varying the speed of rotors using controller. Technical specifications of drone are specified in the Table.1. The weight of the system including all the components along with the sprayer weighs about 1300gms. Detailed average weight computation details of a system based on individual components is shown in the Table.2 [2] .

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. Hence, thrust required to hover the quad copter when the control is at half throttle is calculated by following steps mentioned below.

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

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.3.

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 kk2.1.5 flight controller which has inbuilt gyro sensor and accelerometer sensor which automatically stabilizes the drone flight.

Transmitter & Receiver: Fly sky CT6B six channel 2.4GHz transmitter and receiver is used to fly the drone. to the flight controller and it can be switched ON or OFF using radio controller. It is binded to the flight controller and the calibrations are made using the T6 config software on a PC.

ESC: Electronic speed controller of 20Amperes. It controls the speed of the motors based on the instruction received from the flight controller.

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 radio controller.

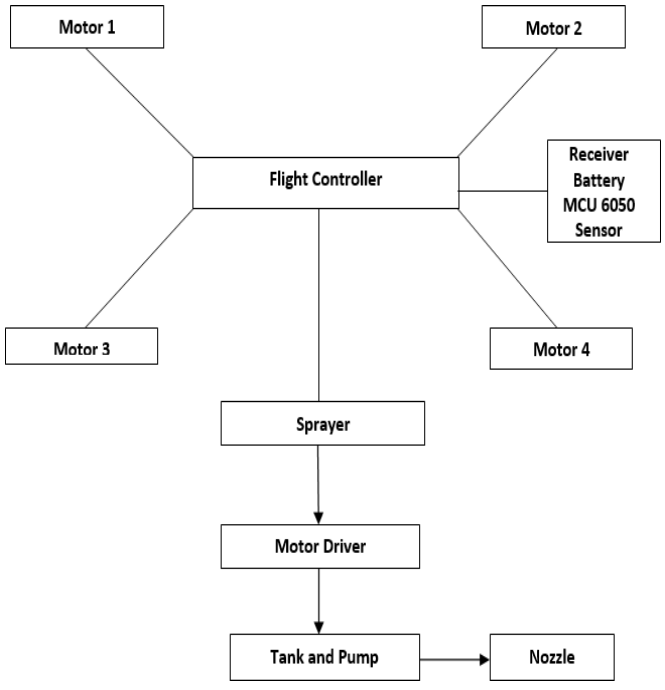

Fig.1. Block Diagram of drone with Sprayer

III. RESULT

Drone system was assembled along with sprayer system using Atmel controller as is a quad copter. This prototype system is shown in Fig.2 and Fig.3. It is able to fly for 6 to b7 min with coverage of 50sq.mt. The agriculture sprayer drone during flight is shown in

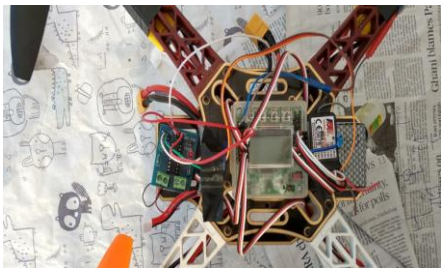

Fig.2. Drone with Sprayer (Top View)

Fig.3. Drone with Sprayer (Side View)

Fig.4. Drone with Sprayer during Flight

The agricultural drone developed is more efficient for spraying in the fields than the conventional spraying [2] . 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 [2]. 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 .The prototype is shown in the Figure 2 and Figure 3. The result is shown in Figure 4.

IV. 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.1.Taachievement 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 ways, resulting in increased profits, substantial growth of healthy and viable crops. They also decrease in the dependency of human being in farm work. It is estimated that percentage of agricultural workers of total work force would drop to 25.7 per cent by 2050 from 58.2 per cent in 2001.

V. FUTURE SCOPE

This concept can be further developed by equipping the drone with the sensors like surveillance cameras and LIDAR' s crops can be monitored by the farmer from a distant and safe place. The captured images can be processed and crop diseases can be identified and it can suggest the appropriate fertilizers to be used to the farmer. Using this results the required amount of fertilizers can be supplied to the crop with precision spraying. By this yield can be enhanced. Drone can also assist the farmers to reduce water and chemical usage which helps the environment can be considered as a green technology.

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Table.1. **Technical Specifications**

Component Name	Specifications
Brushless DC Motors(out runners)	1000KV
KK 2.1.5 Flight Controller	-
Transmitter and Receiver	2.4GHz
Frame (glassfibre and polyamide nylon)	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) 2200 mAh 30C
Flight Time	8min(avg)

Table.2. **Average Weight Calculation of a Drone System**

Part Description	Avg. Weight (gms)	Quantity	Final Avg. 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

Table.3. **Propeller Size VS Thrust Generated**

	Propeller Size	Thrust Produced (approx.)
3S Li-Po battery with ESC of 20A	10-inch 4.5 pitch (1045)	800gms
	9-inch 4.5 pitch (0945)	475gms
	8-inch 4.5 pitch (0845)	475gms