Quadcopter for pesticide spraying

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Abstract— In agricultural fields, the use of pesticides is necessary for better crop yields. The use of aircrafts and drones has become common for carrying out this operation mainly because of its speed and effectiveness in the spraying operation. The disadvantages of manual spraying is that some factors may reduce the yield, or even cause damage (e.g. some crop areas may not be covered in the spraying process, overlapping spraying of crop areas, applying pesticides on the outer edge of the crop). Climatic condition, such as the intensity and direction of the wind while spraying add further complexity to the control problem.An Automated Aerial Pesticide Sprayer is basically Quad copter with pesticide spraying mechanism. This project is to mainly overcome the ill-effects of pesticides on human beings (manual pesticide sprayers) and also to cover larger areas of fields while spraying pesticides in a short span of time when compared to a manual sprayer.

Index Terms— aircrafts, automated aerial pesticide sprayer, drones, quadcopter, manual spraying, pesticide sprayer, pesticide spraying mechanism.

I. INTRODUCTION

The quadrotor or quadcopter is a unique type of Unmanned Aerial Vehicle (UAV) which has Vertical Take Off and Landing (VTOL) ability. It has an advantage of maneuverability due to its inherent dynamic nature. It has 4 arms each having a fixed pitched propellers arranged in a '+' or 'x' shaped configuration.It is lifted and propelled by four rotors and uses two sets of identical fixed pitched propellers 2 rotating in clock wise & 2 in counter clock wise direction which helps the machine to hover in a stable formation.Fig 1 shows the quadcopter with pesticide spraying mechanism.

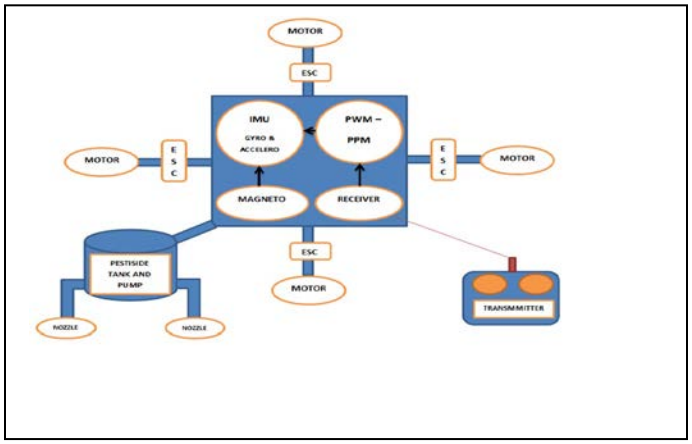

Fig 1:Quadcopter for pesticide spraying

II. LITERATURE SURVEY

The WHO estimates that there are 3 million cases of pesticide poison[2].Pesticide are linked to human health hazards. Carbaryl is an insecticide used on a variety of crops. Acute (short-term) and chronic (long-term) occupational exposure of humans to carbaryl has been observed to cause cholinesterase inhibition, and reduced levels of this enzyme in the blood cause neurological effects. . Headaches, memory loss, muscle weakness and cramps, and anorexia are caused by prolonged low-level exposure to carbaryl .

Organophosphates and carbonates, affect the nervous system. Others may irritate the skin or eyes. Some pesticides maybe carcinogens Others may affect the hormone or endocrine system in the body. Children, and indeed any young and developing organisms, are particularly vulnerable to the harmful effects of pesticides.

Pesticide exposure can cause a range of neurological health effects such as memory loss, loss of coordination, reduced speed of response to stimuli, reduced visual ability, altered or uncontrollable mood and general behavior, and reduced motor skills.
Two types sprayers are available Hydraulic and low volume sprayer. Groundnut,Cotton,Pomegranate, Grapes, Silkworm feed, etc require pesticide spraying

III. HARDWARE DESCRIPTION

1.ATmega168

- High Performance, Low Power AVR® 8Bit Microcontroller.
- Advanced RISC Architecture.
- 131 Powerful Instructions– Most Single Clock Cycle Execution
- Six PWM Channels.
- 6channel 10-bit ADC in PDIP Package.
- Programmable Serial USART
- High endurance non-volatile memory segments – 4/8/16 Kbytes of in-system self-programmable flash program memory

2. BLDC(2200mAh,20C)

Brushless DC electric motor also known as electronically commutated motors are synchronous motors that are powered by a DC electric source via integrated inverter/switching power supply, which produces an AC electric signal to drive the motor: The brushless motors are multi-phased, normally 3

phases, so direct supply of DC power will not turn the motors on.A BLDC motors for quadcopter is constructed with a permanent magnet rotor and wire wound stator poles

3. ESC

- ESC is used to control BLDC motor. It takes signal from microcontroller and breaks into 3 parts and sends it to the BLDC motor. We would require 4 ESCs as we are using 4 BLDC motor.
- Each ESC is controlled independently by a PPM signal (similar to PWM). The frequency of the signals vary, but for a Quadcopter it is recommended the controller should support high enough frequency signal, so the motor speeds can be adjusted quick enough for optimal stability.
- The ESC generates three high frequency signals with different but controllable phases continually to keep the motor turning. The ESC is also able to source a lot of current as the motors can draw a lot of power.

4. Accelerometer Sensor

- The accelerometer measures acceleration and also force, so the downwards gravity will also be sensed. As the accelerometer has three axis sensors, we can work out the orientation of the device.
- Digital-output triple-axis accelerometer with a programmable full scale range of ±2g, ±4g, ±8g and ±16g

☐ Integrated 16-bit ADCs enable simultaneous sampling of accelerometers while requiring no external multiplexer
☐ Accelerometer normal operating current500μA
☐ Low power accelerometer mode current: 10μA at 1.25Hz, 20μA at 5Hz, 60μA at 20Hz, 110μA at 40Hz
☐ Orientation detection and signalling
☐ Tap detection
☐ User-programmable interrupts
☐ High-G interrupt
☐ User self-test

5. Gyroscope Sensor

- A gyroscope measure angular velocity, in other words the rotational speed around the three axis. A gyroscope is a device that uses Earth's gravity to help determine orientation. Its design consists of a freely-rotating disk called a rotor, mounted onto a spinning axis in the center of a larger and more stable.
- Digital-output X-, Y-, and Z-Axis angular rate sensors (gyroscopes) with a user-programmable fullscale Range of ±250,±500,±1000,and ±2000°/sec

☐ External sync signal connected to the FSYNC pin supports image, video and GPS synchronization
☐ Integrated 16-bit ADCs enable simultaneous sampling of gyros
☐ Enhanced bias and sensitivity temperature stability reduces the need for user calibration Improved lowfrequency noise performance
☐ Digitally-programmable low-pass filter
☐ Gyroscope operating current: 3.6mA
☐ Standby current: 5μA
☐ Factory calibrated sensitivity scale factor
☐ User self-test

6. Radio receiver

This receives 2.4GHz signals coming from the transmitter side. It has got 6 independent channels to receive the signal from the transmitter and then send the signal to the microcontroller for further processing. Its current consumption is less than 40 mA and works on 5 volt power supply.

7. LIPO Battery

Lithium batteries are the preferred power sources for most electric modelers today. They offer high discharge rates and a high energy storage/weight ratio. However, using them properly and charging them correctly is no trivial task.

LiPo battery can be found in a single cell (3.7V) to in a pack of over 10 cells connected in series (37V). A popular choice of battery for a QuadCopter is the 3SP1 batteries which means three cells connected in series as one parallel, which should give us 11.1V.[1]

IV. PESTICIDE SPRAYING MECHANISM

Fig 2 shows the block diagram of pesticide spraying mechanism to be integrated with quadcopter.

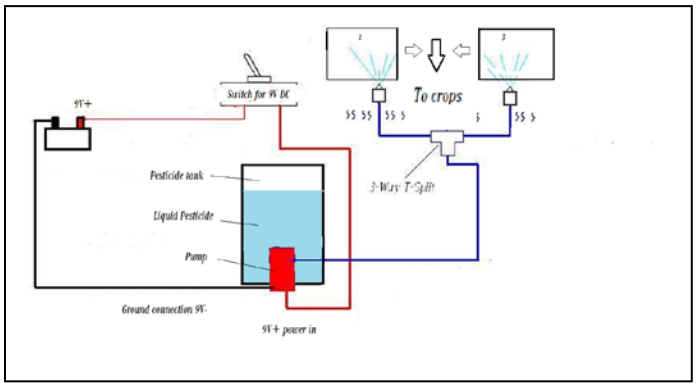

Fig 2:Block diagram of pesticide spraying mechanism

For the pesticide spraying mechanism we use pesticide tank of capacity 180 ml,submersible dc motor pump ,9 V battery,switch,pipes fitted to T-split and mini nozzles.When the switch is turned on,the motor pumps the pesticides through the pipe with the help of the battery.The pipes supply the pesticides to the nozzles via the T-split so that it sprays with a certain pressure and uniformity,thereby avoiding wastage.

V. RESULTS

The spraying time of pesticides is dependent on the quantity of pesticide to be sprayed.For example,for 1000 ml of pesticides,spraying time is around 5 minutes.If we want to increase the quantity of pesticide to be sprayed,the weight lifting capacity of the quadcopter must be increased.This is done by choosing higher specicification of BLDC i.e more than 1000 rpm/kV.

The flight time of the quadcopter is around 8 minutes.To increase the flight time we need to choose higher specification for LiPO battery.The height of spraying is around 6-7 feet.The area covered is 10 feet by 10 feet.

Table 1 shows various crops like cotton groundnut etc which are most affected by pests and the pesticides applied for each crop.

Table 1:Different crops and pesticides applied

Sl.no	Crops with applied pesticides	
	Crops	*Name of the pesticides applied*
1.	Cotton	aldicarb, carbaryl, carbofuran (Ib), chlorpyriphos, cypermethrin, decamethrin, demeton-S-methyl, dicofol (III), dimethoate, endosulfan, fenvalerate (II), monocrotophos, phosalone(II), phosphamidon, quinalphos
2.	Groundnut	Carbaryl
3.	Sugarcane	Ammonium nitrate,Atrazine
4.	Pomegranate	Carfenterazone-ethyl,glyphosate,isopropylamine salt

VI. CONCLUSION

1.In agriculture, application of pesticides and fertilizers is important at specific times and at specific locations to control pests.

2.Quadcopters are maneuverable, cheaper to operate, and require less capital costs

3.Quadrotor can be used to spray on hilly terrains.

4.Reduces ill effects to humans while spraying manually.

5.Increases the efficiency of spraying.

6.This can also be used in places where labourers are hard to find.

7.It can substitute 50 workers thus saving 50 workers from the harmful effects.

8.Reduces the time for spraying when compared to manual spraying

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