

MONITORING AND DRIZZLING OF PESTICIDES IN AGRICULTURE SECTOR BY USING QUADCOPTER

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Abstract-The present work is aimed at developing an effective solution to the uneven spraying of pesticides faced in the farming sector. Employing drones in spraying pesticides is found to be one of the efficient solution and is in practice in the developed countries even though they found to be expensive. However, utilizing them in developing countries is difficult due to their cost. Therefore, the present work is focused on developing an in-house cost effective quad copter capable of lifting 1L pesticide up to a height of 6 m. A FPV camera mounted on the quad copter are processed using plantix application which aids in differentiating the infected and matured crop besides being providing aerial surveillance of the farm. The in-house quad copter is found to be efficient in terms of fabricating cost, spraying cost per square meter, and efficiency.

INDEX TERMS: Quad copter, Pesticide sprinkling, aerial surveillance, FPVcamera

1. COMMENCEMENT

THE evolution of drones named as OMNICEHEN 2 was invented by Etienne Omnichen in 1920. Within the past few years the drones were developed with new technology not only for military purpose but also to utilize in research developments, commercial and agriculture purpose. Drones with application towards agriculture sector are developed in 2015 and it is effective in countries like India where agriculture sector is still the backbone of the country. There are some couple of tons of food produced through crop yield. In conventional methods, there some cons which are crop infected by improper spraying of pesticides and famers are suffering with plethora of diseases. More over 1,000 farmers died and 1,00,000 farmers have been suffer with skin diseases, Eye problem and lung diseases.

By keeping the above problems we came with an idea, that is mounted sprayer of quad copter with inexpensive of 1.5 kg payload. With speed of 14 m/s and maximum height of spraying range is 30 m. the quad copter was figure out for is field performance in Arecaceae trees, Tropical trees, etc.

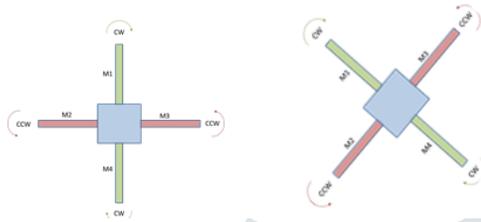
This UAV is also used for the surveillance of the agriculture fields. By this will help in monitoring of crop health and capture the pictures of the effected leaves. With the help of Android Mobile app "PLANTIX APP" we can recognize more than 240 plant pest and disease automatically.

1.1 EQUIPMENTS OF QUADCOPTER

1.1 .1 Design of the Quad captor

Quad captor are mainly consist of two configuration

- i. Plus configuration
- ii. X-configuration



We selected X-configuration frame for our Quad Rotor due to the following reasons

- a. High stability compared to Plus configuration
- b. High payload taking ability
- c. Aerodynamically efficient

Solids work is solid modeler and parametric feature-based. It is used to create 3D and 2D simulation. Quadcopter frame is modeled using Solid Works 17 student trial version.

1.1.2 Assembling of Frame

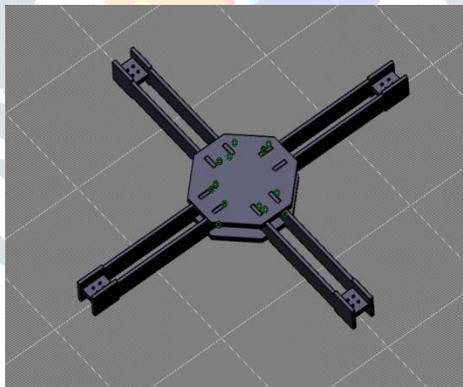


Fig. Frame Model

The following parameters are considered for the design considerations.

- a. Length of arms
- b. Breadth of arms
- c. Thickness of arms
- d. Length and breadth of arm holder
- e. Height of the landing gear
- f. Width of tank holder

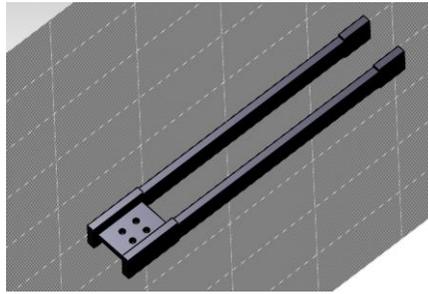


Fig. Arm

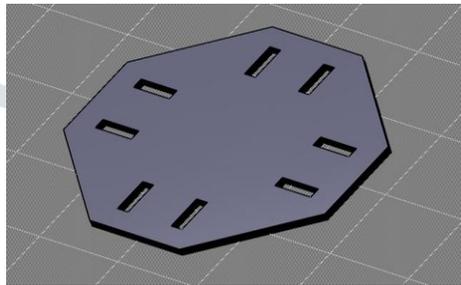


Fig. Central hub

The above design pictures are taken from [ISSN 2229-5519](https://doi.org/10.21961/ISSN.2229-5519)

2. BILL OF MATERIALS

TABLE 01 COMPONENTS LIST

S.NO	NAME OF THE COMPONENTS	SPECIFICATION	QUANTITY
01	FLIGHT CONTROLL BOARD	Main control with GPS Module	01
02	ESC	30A	04
03	PCB	30x30 35X35 PCB ESC	
04	MOTOR	4114/320KV MULTI-AXIS BRUSHLESS MOTORS	04
05	PROPELLER	1255 Carbon propeller	04
06	BATTERY	22.2V,6S 5000Mah LiPo	01
07	TRANSMITTER	FS-i6X	01
08	RECEIVER	FS-IA6B	01
09	PUMP	12V, Brushless pump	01
10	NOZZLE	1.5INCH	01

A. FLIGHT CONTROL BOARD:

Flight control board act as a brain of the quad copter which controls the Quad copter. It communicates with all ESCs and RC transmitter to carry out the autopilot functionality.



Fig. Flight Control Board

It has a built-in inertial measurement unit (IMU) consisting of one 3-axis accelerometer, one 3-axis gyroscope and a barometer for sensing the attitude and altitude.

B. ELECTRONIC SPEED CONTROLLER:

The Brushless system using high power RC model can be very hazardous, therefore, a 24A ESCs is employed to maintain the constant flow of current.



Fig. Electronic Speed Controller

The ESC's consists of Drive tube with high power MOS, and a MOS tube plus a separate heat, Extreme low output resistance to the PCB (printed circuit board), super current endurance and finally a safety electrical function (when the power is turned on to start the motor immediately, to avoid personal injury).

C. PRINTED CIRCUIT BOARD:

A printed circuit board (PCB) mechanically supports and electrically connects electronic components using conductive tracks, pads and other features etched from one or more sheet layers of copper laminates onto and between sheet layers of a non-conductive substrate. Components are generally soldered onto the PCB to connect them electrically and mechanically fasten them to it.

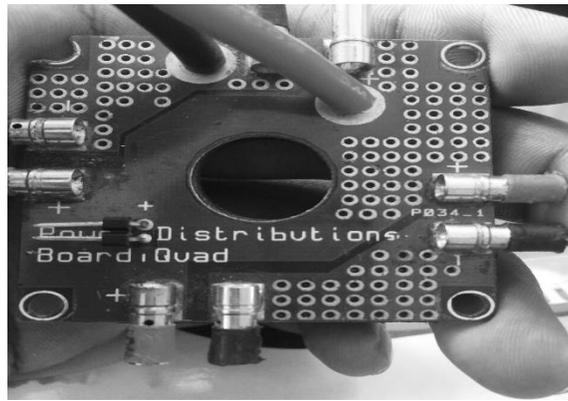


Fig. Printed Circuited Board

Printed circuit boards are used even in the simplest of electronic products. They are also used passive switch boxes.

D. MOTOR:

The next and probably most important component is the motor. The Motor is rated as “320kv” units, which is equivalent to the 320 revolutions per minute a motor can achieve per unit volt utilization.



Fig. Motor

When a 1v current is introduced to it unhindered, the higher the KV, the faster the motor can spin. However, your flight times to decrease. Motor RPMs also decrease the lift of the motor over a long run. You’ll see this typically referred as ‘burn out’.

E. PROPELLER:

Propellers largely effect the speed at which the quad copter fly, the load that they can carry, and the speed at which they can maneuver.



Fig. Propeller

To analyze these various attributes you can increase or decrease the length of the propellers and the pitch of the propeller. Pitch refers to the shape and slant of the propeller.

Longer propeller can achieve stronger lift at lower RPM than a shorter propeller, but takes a longer time to speed up or slow down. Beyond a certain size, they're literally unable to fly. For heavier weights, you'll typically see manufactures add more arms onto the frames. These longer propellers are used in hex copters and Octa copters.

Shorter propellers allow the quad copter to change speed quickly and tends to produce better maneuvering capabilities; however, they require more energy to spin them. This causes excess strain on the motors, which may lead to shorter life span of the motors. If you put everything together, an efficient quad will have properly sized, low RPM motors with very large props.

F. BATTERY AND BATTERY CHARGER:

Finally, to power the Quad copter power source is needed, which is typically a LIPO (lithium polymer) battery. Li-po batteries use a C rating, which stands for its capacity to discharge. You'll typically see a Li-po battery have "65c".



Fig. Lithium Polymer Battery

So if you see a 65C 5000mAh Li-Po battery, it signifies that you can get a maximum of $65C \times 4 = 260A$ (A standing for Amps). The power of the battery is usually dictated by the energy drawn required from the ESCs.

A lot of batteries can be fully discharged but the Li-Po's have a minimum voltage requirement, which if it crosses can cause damage to the battery. In most cases it is 3V but can vary from battery to battery this is generally about 80-85% usually of your battery. Once it passes this mark, battery power drops fairly quickly. So make sure you're landing or are about to land when you hit this mark.

You will also notice that most quad copters comes with a battery charger specially designed for the battery. It controls how much current is sent to the battery. Charging a LiPo battery past 100% could actually cause a fire. Make sure to charge batteries in a fire safe area (away from things that are flammable). Allow your battery time to cool before charging again.

G. TRANSMITTER AND RECIEVER:

Transmitter is a device to control the quad copter wirelessly. The FS-i6X transmitter and FS-iA6 receiver is a grate 10 channel telemetry and constitute a 2.4GHz AFHDS 2A (Automatic Frequency Hopping Digital System Second Generation) digital proportional computerized R/C system and is specially developed for all radio control models. It consist of four trims affecting stick functionality, one for ailerons (channel 1), elevator (channel 2), throttle (channel 3) and rudder (channel 4). Each trim is toggled, the trim will move one step. It is possible to make quicker trim adjustment by holding the trim in the desired direction.



Fig. Transmitter

The sticks are used for controlling the aircraft, each stick has 2 functions, the right stick controls pitch (Up/Down) and roll (Left/Right), the left stick controls throttle (Up/Down) and yaw (Left/Right). It consist of a display, which also helps in alerting when the drone is about to crossover the boundaries To ensure that the receiver is mounted away from motors, receiver antenna having best signal quality is provided.

H. PUMP AND NOZZLE:

Brushless pump is a mechanical device, used to discharge the water from pesticide tank to nozzle with high pressure 100PSI. For spraying with high pressure, pump consumes up to a voltage of 30V.



Fig. Pump with Nozzle

In order to convert high pressure and low velocity into low pressure and high velocity, a convergent nozzle is being employed.

I. FABRICATION OF QUADCOPTER

Fabrication of quad copter frame is mainly done by aluminum and glass fiber materials. The arms is manufactured with glass fiber. Motors are fixed at the end of the arms with the help of screws. Battery is fixed in the bottom of central hub by using zip tape, then the flight control board and PCB is attached to central hub



A receiver is attached to the flight control board which is fixed to the bottom of the frame. After connecting all the parts, quad copter is calibrated for various parameters like throttle calibration, potentiometer calibration, and gyro calibration. After performing calibration test, propellers are screwed to the motors

3. WORKING OF QUADCOPTER

Frame supports helps in holding up all the components of the quad copter. Power to the motors is supplied through the batteries.PSB distributes power from the battery to all the ESCs. ESCs control the flow of power to the motor according to the flight controller. Motors is used to produce the required thrust to lift the quad copter with the help of propellers (two clockwise, two anti-clockwise).Flight controller is controlled by transmitter using receiver.



Fig. Pesticide spraying with drone on paddy fields

The spraying tank is filled with the mixture of water and pesticide in a desired ratio and the battery is connected to PCB (printed circuit board). Quad copter is placed on a flat surface and it is engaged with transmitter for controlling purpose. Throttling is done gently to rise quad copter to a suitable height according to crop, it is directed to the affected zone in the plantation and the pesticide is sprinkled. The spraying process is carried out by a pump and nozzle is used to spray the pesticide.

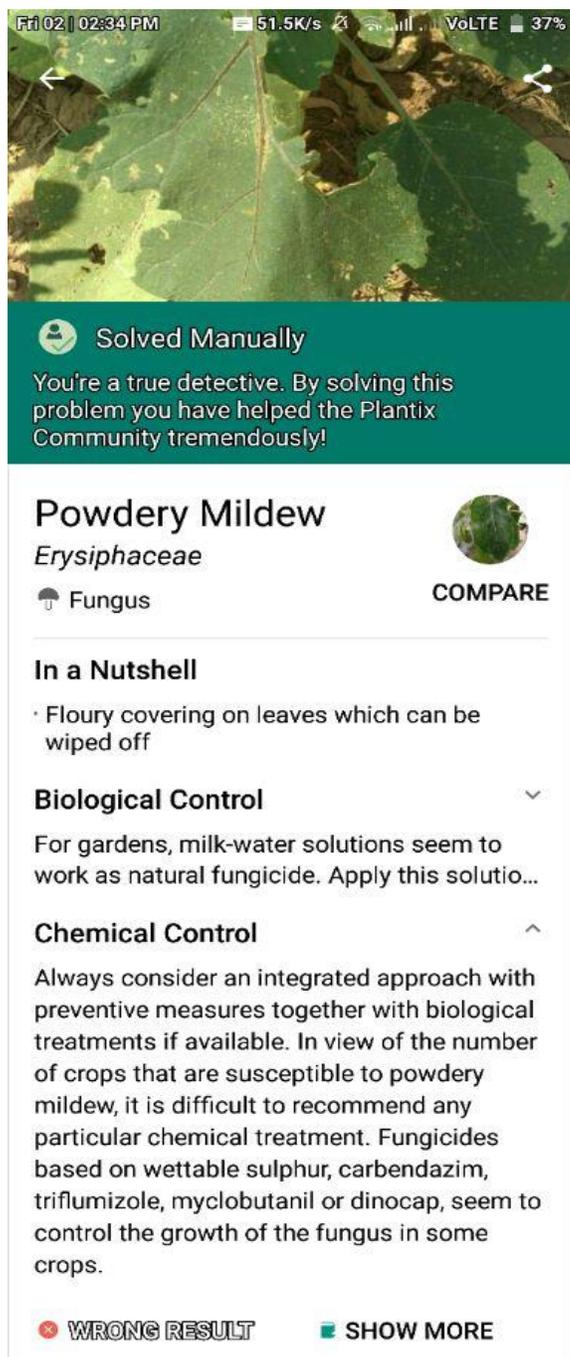


Fig. Pictures capture from flying camera

A FPV camera is mounted at the bottom of the frame, which is used to live stream the video to the PC or Mobile Phone. **Plantix mobile app** is used to detect the disease the crop is affected with.



Its other use also includes the surveillance of a big farm which is more efficient than human effort. The sample image is provided to show the application working.



4. EXPECTED OUTCOME

- It includes the design and development of Quad copter drone for effective and even sprinkling of pesticides compared to conventional methods.
- To increase the effective surveillance of farm from aerial view and help to capture the pictures of infected leaves.
- To monitoring the field at night times by the help of IR camera.

5. CONCLUSION

The market price of 5l to 25l pesticide carrying drones are in the range of Rs.2,50,000/- to Rs.9,85,565/- which is very expensive for farmers in India. Therefore, a compact cost efficient quad copter for the application of pesticide spraying and surveillance is developed in the present work. The results shows that the quad copter developed is efficient in terms of cost of spraying, efficiency.

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