

Design of QuadCopter for Pesticide Spraying

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ABSTRACT

Indian farming required generation just as assurance materials to accomplish high efficiency. Manure and compound as often as possible expected to murder creepy crawlies. The WHO (World Health Organization) evaluates there are more than 1 million pesticide full of feeling cases in consistently. In that around one lakh passings in every year, particularly because of the pesticides showered by person. The pesticide influences the sensory system and furthermore prompts issue. A Remote Controlled Unmanned Aerial Vehicle (UAV) is utilized to splash the Pesticide. The vertical take-off and landing quad copter is utilized to splash the pesticide. This paper depicts the advancement of quad copter UAV and the sprayer module, examines the mix of sprayer module to quad copter framework. All out payload lift off weight of quad copter is 1 kg.

Keywords: Unmanned Aerial Vehicle, drones, quadcopter, manual spraying, pesticide sprayer, pesticide spraying mechanism.

1: INTRODUCTION

Agriculture is the backbone of Indian economy as said by Mahatma Gandhi seven decades ago. Even today in the new millennium the situation is still the same with the almost the entire economy being sustained by agriculture which is the primary strength of the country.

Although agriculture contributes only 21% of India's Gross Domestic Product (GDP) its importance in the country's economic, social and political fabric goes well beyond this indicator. The rural areas are still home to some 72% of the India's 1.25 billion people mostly are poor. The sharp rise in food grain production during India's Green Revolution of the 1970s enabled the country to achieve self-sufficiency in food grains. Agriculture intensification in the 1970s to 1980s saw an increased demand for rural labour and raised rural wages and together with declining food prices reduced rural poverty. Sustained although much slower agriculture growth in the 1990s reduced rural poverty to 26.3 %. Since then, however the slowdown in agricultural growth has become a major cause for concern. India's rice yields are one-third of China's and about half of these in Vietnam and Indonesia. With the exception of sugarcane, potato and tea. Areca nut is also one of the most important commercial crops in the South-East Asia.

The Government of India places high priority on reducing poverty by raising agricultural productivity. However, bold action from policymakers will be required to shift away from the existing subsidy-based regime that is no longer sustainable to build a solid foundation for a highly productive, internationally competitive and diversified agricultural sector.

2: LITERATURE REVIEW SPRAYING METHODS

One of the most common forms of pesticide spraying especially in conventional agriculture is the use of mechanical sprayers with nozzle, controller and gutter pumps (both motorized and manual).

2.1 Backpack (knapsack) sprayer: One type of backpack sprayer is a compact compressor with pesticide sprayer which is to be carried on the operator's back. Another type of backpack sprayer has a hand-operated hydraulic pump that forces liquid pesticide through a hose and one or more nozzles. The pump is usually activated by moving a lever. A mechanical agitator plate may be attached to the pump plunger. Some of these sprayers can generate pressures of 100 pounds per square inch (psi) or more. Capacity of both these types of backpack sprayers is usually 5 gallons or less.

Hydraulic sprayers consist of a tank, pump, lance (for single nozzles) or boom and a nozzle (or multiple nozzles). Sprayers convert liquid pesticide often containing a mixture of water (or another liquid chemical carrier, such as fertilizer) and chemical into fine droplets, which can be rain-type drops or tiny almost-invisible particles. This conversion is accomplished by forcing the mixture through a spray nozzle under high pressure. The size of droplets can be altered through the use of different sized nozzle or by altering the pressure under which it is forced, or a combination of both.

Due to static electricity, small droplets are able to maximize contact with a target organism, but very lesser wind velocity regions. But, in this type of spraying, the labour has to carry all the weight of the machine along with pesticides filled tank which causes fatigue to labour and hence reduces the human efficiency of spraying.



Fig 2.1 Backpack type spraying

2.2 Lite-trac spray method: Lite-Trac is a trading name of Holme Farm Supplies Ltd, a manufacturer of agricultural machinery registered in England and based in Peterborough. The Lite-Trac name comes from "light tractor", due to the patented chassis design enabling the inherently very heavy machines manufactured by the company to have a light footprint for minimum soil compaction.

Earlier the foot walking pesticide spraying machine is fitted on the foot activated by kinetic force being applied on it, when we stamp our foot on the ground, pushing the assembly to pump air into the tank, the power is very less but sufficient enough to use the pressure for pesticide spraying. Since we are using two numbers of pumps which pumps the air into the tank and has two number of jet sprayers, we can cover two parallel rows simultaneously.



Fig 2.2 Lite-trac spraying

2.3 Manual spraying pesticides: In recent years, labour scarcity has emerged as one of the foremost challenges in farming. One crop that has been most affected by this is the supari, or areca nut. Areca nut trees attain a height of about 60-70 feet. It is mandatory to climb the trees a minimum of five times a year for a successful harvest - twice for the preventive spray against fungal disease, and thrice to harvest the areca bunches. The spraying is done in monsoon, while harvest time is typically in summer.

Only skilled labourers can carry out these farming operations. They have to climb the trees using muscle power. In an acre that has 550 trees, a labourer has to climb a minimum of 100 to 150 trees. As this involves real hard, physical exertion, younger generations of labourers are losing interest, with potentially harsh implications for areca nut cultivation.



Fig 2.3 Conventional spraying for areca nut

3: OBJECTIVE OF PROJECT

- To reduce number of labour required for spraying.
- To reduce human effort.
- Manual method of spraying requires large muscle power and skills to eliminate manual method of spraying.
- To make the system compact.
- To adopt the latest technology for spraying with ease.

4: COMPONENTS USED

1. Flight controller board: The ArduPilot Mega 2.8 is a complete open source autopilot system. This version is ready to use, with no assembly required. It allows the user to turn any fixed, rotary wing or multirotor vehicle (even cars and boats) into a fully autonomous vehicle; capable of performing programmed GPS missions with waypoints..

This revision of the board has no onboard compass, which is designed for vehicles (especially multicopters and rovers) where the compass should be placed as far from power and motor sources as possible to avoid magnetic interference. On fixed wing aircraft it's often easier to mount APM far enough away from the motors and ESCs to avoid magnetic interference, so this is not as critical, but APM 2.8 gives more flexibility in that positioning and is a good choice for them, too

2. Electronic speed controllers: An electronic speed control or ESC is an electronic circuit with the purpose to vary an electric motor's speed, its direction and possibly also to act as a dynamic brake. ESCs are often used on electrically powered radio controlled models, with the variety most often used for brushless motors essentially providing an electronically generated three-phase electric power low voltage source of energy for the motor.

3. Motors: A motor is a mechanical or electrical device that causes a rod to rotate. This means that the electrical energy going into the motor comes out as kinetic energy. Brushless DC electric motor (BLDC motors, BL motors) also known as electronically commutated motors (ECMs, EC motors) are synchronous motors that are powered by a DC electric source via an integrated inverter/switching power supply, which produces an AC electric signal to drive the motor. The motors used to this project are **Motrolfly A2212/10T KV1400** (4 Nos).

4. Propellers: An aircraft propeller or airscrew converts rotary motion from a piston engine, a turboprop or an electric motor, to provide propulsive force. Its pitch may be fixed or variable. Early aircraft propellers were carved by hand from solid or laminated wood, while later propellers were constructed of metal. Modern designs use high-technology composite materials.

5. Battery: A lithium polymer battery, or more correctly lithium-ion polymer battery (abbreviated variously as Li-Po, LIP, Li-poly and others), is a rechargeable battery of lithium-ion technology in a pouch format. Unlike cylindrical and prismatic cells, Li-Po's come in a soft package or pouch, which makes them lighter but also lack rigidity.

6. Pump: A pump is a device that moves fluids (liquids or gases), or sometimes slurries, by mechanical action. Pumps can be classified into three major groups according to the method they use to move the fluid: direct lift, displacement, and gravity pumps. Mechanical pumps serve in a wide range of applications such as pumping water from wells, aquarium filtering, pond filtering and aeration, in the car industry for water-cooling and fuel injection.

7. Flysky transmitter and receiver circuit (RF module): An RF module (radio frequency module) is a (usually) small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This wireless communication may be accomplished through optical communication or through Radio Radio Frequency (RF) communication. For many applications the medium of choice is RF since it does not require line of sight. RF communications incorporate a transmitter and/or receiver.

5: WORKING PRINCIPLE

After deciding to create the Quadcopter, we had to decide what electronics to use and which sensors we would incorporate into it. After a lot of research on the web, we found a couple forums that discussed open source electronic and software components suitable for making a Quadcopter. Also, very basic but highly customizable Quadcopter bodies were available that were suitable for us to use to create our baseline system.

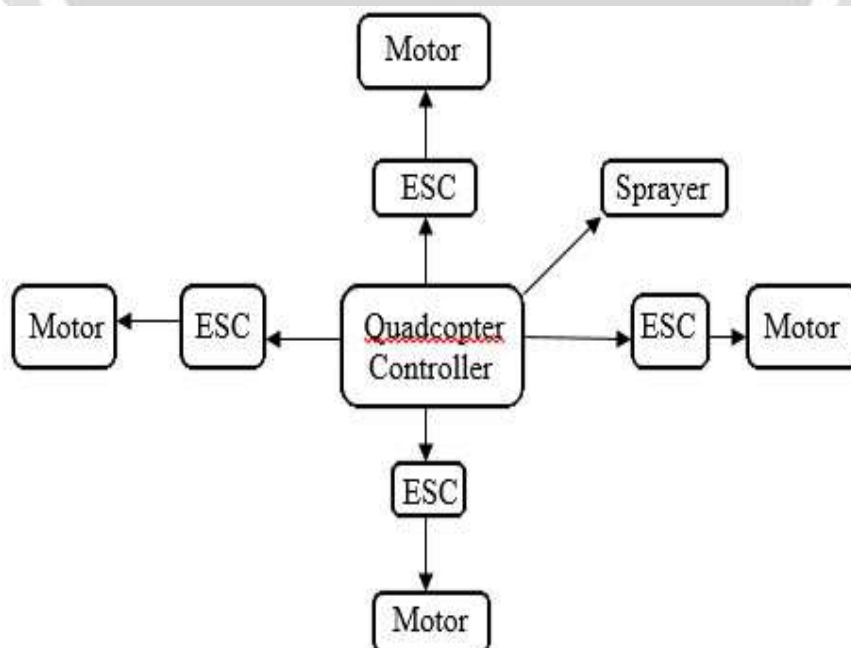


Fig5.1 Block Diagram of Agricopter

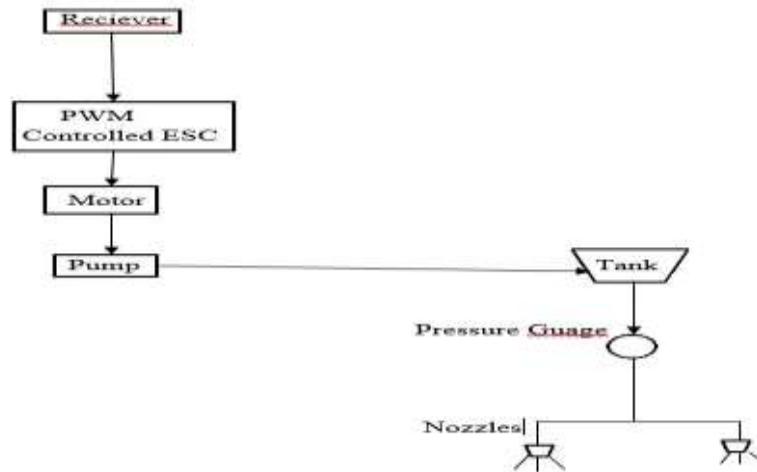


Fig 5.2 Block Diagram Of Sprayer Solution

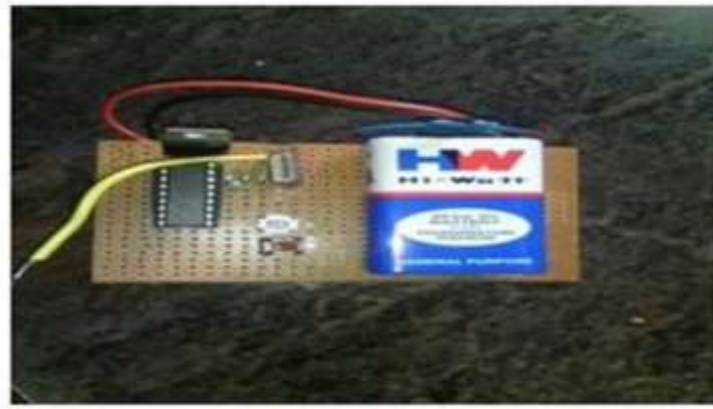


Fig 5.3 RF Transmitter

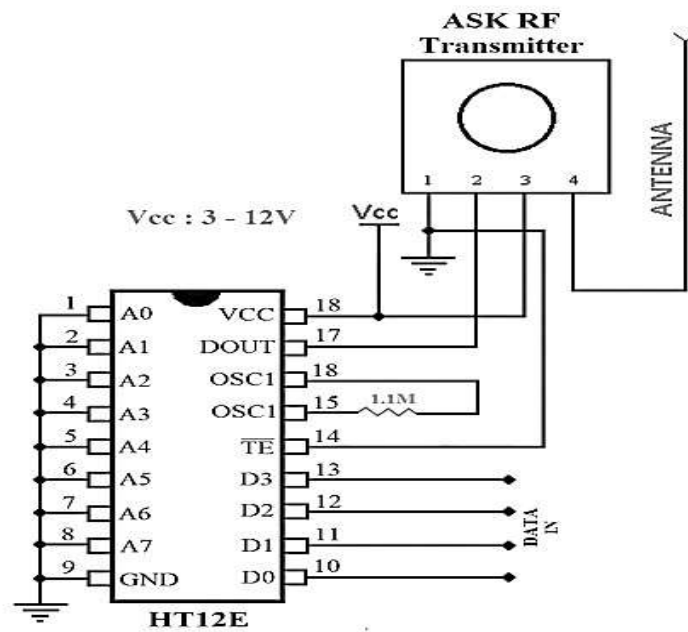


Fig 5.4: Circuit Diagram RF Transmitter

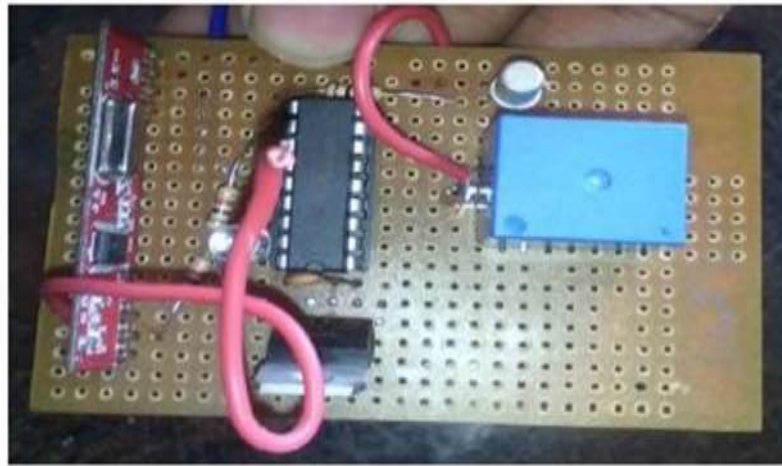


Fig 5.5 : RF Receiver

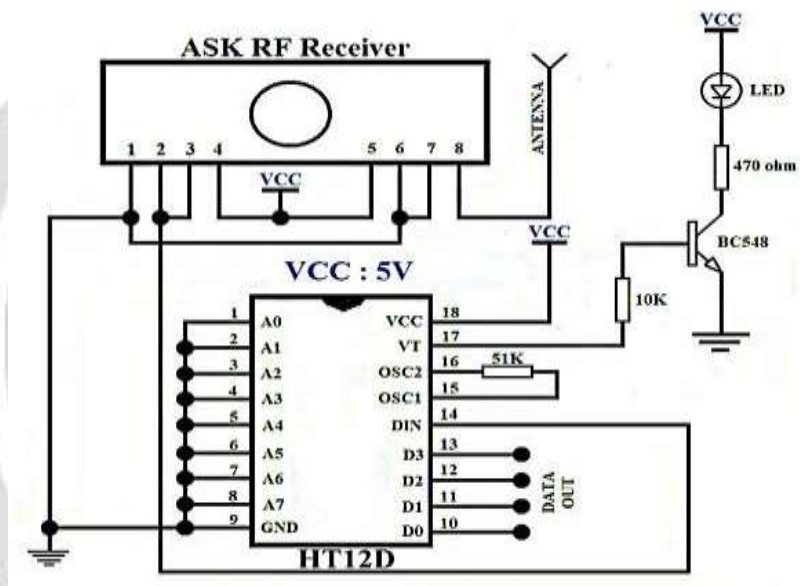


Fig 5.6: Circuit Diagram of RF receiver

An RF module (radio frequency module) is a small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This wireless communication may be accomplished through optical communication or through Radio Frequency (RF) communication. For many applications the medium of choice is RF since it does not require line of sight. RF communications incorporate a transmitter and/or receiver.

An RF Receiver module receives the modulated RF signal, and demodulates it. There are two types of RF receiver modules: superheterodyne receivers and superregenerative receivers. Super-regenerative modules are usually low cost and low power designs using a series of amplifiers to extract modulated data from a carrier wave. Super-regenerative modules are generally imprecise as their frequency of operation varies considerably with temperature and power supply voltage. Superheterodyne receivers have a performance advantage over super-regenerative; they offer increased accuracy and stability over a large voltage and temperature range.

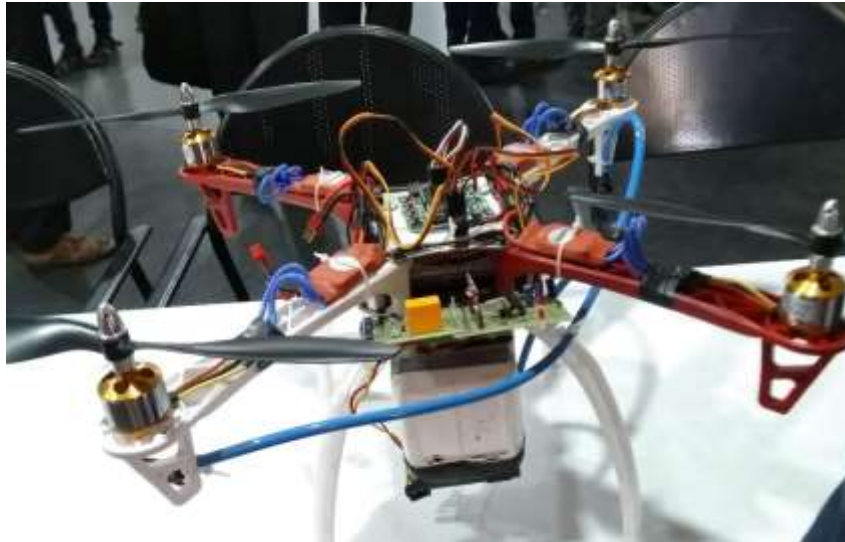


Fig 5.7 Quadcopter based pesticide spraring system

6: ADVANTAGES

- Avoid human contact with harmful pesticides.
- It is possible to spray pesticides on tall trees like areca nut, coconut etc.
- The UAV is portable and hence can be carried to remote places.
- UAV can be controlled from far places and also can be automated to spray on specific waypoints.
- UAV can lift a payload of 2kg i.e. approximately 1.5 kg of pesticide.
- Upon using a high storage capacity up to 1 hour of flight time can be achieved covering roughly 1 square km of area.
- This system brings modern technology to age old agricultural techniques thus bringing youth to the agricultural sector.

7: CONCLUSION

We have designed a system which can eliminate human exposure completely and also can partially reduce human intervention. This **Quadcopter based pesticide sprayer system** can be made autonomous with the help of GPS thus completely eliminating human intervention.

This method can be used for highly toxic pesticides. This can also be used in places where labourers are hard to find. They can hasten the pesticide spraying process thereby lowering the casualties due to pesticide exposure, preventing encounters with venomous snakes such as Russell's viper and cobra which can be found regularly in fields thereby reducing the amount of snake bite cases. Also keeps the food chain healthy. Since they are sprayed from lower altitude, environmental pollution can be reduced.

While designing this project we have noticed that even though the system is costly, it has an ample amount of scope in fast growing world. A fully autonomous UAV can effectively eliminate human intervention and can also speed up the process of spraying pesticides. Further research in the field can make UAV's faster, smarter and more efficient in many fields like aerial photography, surveillance, security, weather report, prediction of natural anomalies, swift product delivery etc.

This system may be further developed in many ways, by replacing the spraying system with other equipment's or systems like if cutter is placed then it will be used for cutting crops, if seeding module is attached to drone then it will be used as seeding drone, and also if provided with high equipment's and cost then it also performs scanning of plants, security causes, inspecting crop details with specified seeds, fertilizers,

pesticides as per soil condition suggested from scientists of agriculture on crops. The process of application is controlled by means of the feedback from the wireless sensors network developed aground level on the crop field.

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