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# Review on Design and Development of Quadcopter for Smart Agriculture

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**Abstract –** *Agriculture in India constitutes more than 60% of occupation. It obliges to be the mainstay of Indian economy. It is vital to develop the yield and efficacy of agriculture by given that safe agriculture of the grower. Farmers especially when they spray urea, does not take precautions like wearing appropriate outfit masks and gloves. Which leads to harmful effect on the farmers, avoiding the pesticides is also not completely possible as the required result has to be met. Therefore, practice of robots in such circumstances provides the finest of the resolutions for this sort of complications, beside with the requisite output and effectiveness of the artefact. These missions' targets to daze the ill-effect of the insect repellent on human beings and similarly use of shower insect repellent over large area in short interludes of time compare to orthodox spraying by using automatic fertilizer sprinkler. This device is ultimately a permutation of spraying apparatus on a quad copter mount. This prototypical is used to shower the insect repellent content to the regions that cannot easily reachable by humans.*

*The adopted methodology is divided into three major categories the preliminary study, design and development stage, feedback and concept review. The study report consists the detailed analysis of each of the methodology steps. In the preliminary study the initial data was collected by the farmers through online surveys, face to face interactions, and even field test was conducted to inspect the real-time field conditions. Once the required data was collected the design and development stage was done based on the requirements of the farmers. In this stage the concept generation was done using the morph matrix and the concept selection was done using the pugh matrix. Once the final concept was selected the design and development of the Quadcopter was done using the solid works and the stress and deformation analysis was done using Ansys software. The next step is the fabrication of the Quadcopter. To achieve the goal of low cost we used aluminum for the construction of frame and using cheaper components that would serve our requirements.*

*The completed model of the Quadcopter integrated with the spray system can be used to spray Pesticide by small scale farmers having 1-2 acres of land. The design and functionality is proven by CAD design. The stability of the product is verified by the finite element analysis in both load and no load conditions.*

***Key Words*: Quadcopter, Ansys, Spraying mechanism, CAD design, Carbon fibre.**

## 1. INTRODUCTION

Agriculture has more than 60% employment in India. It serves as the backbone of the Indian economy. Improving efficiency and productivity of agriculture is essential by providing secure farming to farmer. Unscrewed aerial vehicles (UAV), also known as Quadcopter or unmanned aircraft systems, are one of the most promising innovations created in recent years

According to a WHO [World Health Organization] survey, it is evaluated that about three million work forces die from insect repellent annually, up to 18,000 people. Our protrude aims at mitigate impact of insect repellent on humans and compare it with conventional spraying of pesticides over a huge range in a petite period of interval and using automated fertilizer spraying. This expedient is basically a grouping of the spray apparatus in the Quadcopter frame.

Agriculture is the largest sector in India. But now it faces a lot of problems as it does not use modern techniques. Farmers take many precautions, especially when spraying urea, and wear suitable guise guises and scarves. This avoids any hurtful upshot on the planters. Avoiding pesticides is also absolutely impossible because it has to meet the desired result. Other issues include chemical contact with pesticides and the risk posed by insects and animals. The drone is useful for spraying pesticides and for crop protection. This can be done by controlling the UAV by one person standing at a safe distance. This will help to reduce the time taken by the farmer and also provide safety to the farmer. This drone system works mainly on the principle of thrust. The drone has four arms and the four motors of each arm are paired with a propeller that gives the lift effect. Drone movement is controlled by a radio controller and drone speed is also controlled.

To increase staple food production and reduce the shortage of agricultural workers, countries around the world have promoted the concepts of precision agriculture and smart

agriculture, emphasizing the use of emerging technologies such as robots to increase the production and sale of agricultural products. UAVs are considered a new generation tool for promoting precision farming and smart agriculture. Our prototype is used to shower insect repellent content into zones that are not certainly reachable to humans. A universal showerhead system is used to shower fluid and solid contents from a universal tube.

Pesticides are important for good crop yields. Manually spraying pesticides using a hand pump is very difficult and hazardous to health because of direct contact with that chemical. Manual spraying does not invariably spray, resulting in excess spraying which can lead to reduced crop yields. Our project aims to develop unmanned airborne vehicles (UAVs) that can remain used for farming applications, where UAVs are used to spray pesticides on crops. The spraying process is controlled by a drone-to-radio controller using wireless communication via a transmitter and receiver.

## 2. COMPONENTS

### 2.1 General Overview

The quadcopter, or multirotor, or quadrotor, may be a simple hovering mechanical vehicle with four arms, and every motor features a rotor attached to the propeller. Multicopters with three, six or eight arms are also possible, but work on an equivalent principal because the quadcopter. If two rotors rotate clockwise, the opposite two rotate anticlockwise. Quadcopters are aerodynamically unstable, and requires a flight processor that converts your input instructions into information that change the RPMs of the rotors to supply the specified motion.

Quadcopters vary within the way in which they produce lift and regulator forces from helicopters or fixed-wing aircraft. The lift for the aircraft is produced by the wings, while the lift is produced by the propellers on the quadcopter. The plane uses the rotor to supply lift, but it also has the influence to vary the pitch of the motor blades to supply control forces

The development of electronic machinery on the wing regulator computers, coreless or brushless motors, small cameras, accelerometers, batteries, microprocessors and GPS systems made it possible to style and fly quadcopters. The easiness of the quadcopter has made it the foremost efficient terrestrial photography and cinematic platform.

### 2.2 Applications in different sectors

1. Product / Food Delivery: One among the innovative advantages of quadcopter has rapidly gained media attention, which is product and food distribution through quadcopter. Leading companies like Flip-cart, FedEx, Amazon, DHL and Dominos are discovering the utilization of quadcopter for the local distribution of their products.
2. Geographic mapping: Quadcopter can reach tough locations like wind-swept seaside or mountain ridges, and obtain high-resolution data to make 3D maps. The technology is readily available to hobbyists and professionals, enabling them to gather data and download images instantly. Some also are using collected data to contribute to crowd sourced mapping applications.
3. Agricultural Uses: Farmers not to go to monitor their crops on field. They can collect all the information on land in minutes instead of hours or days. Agricultural quadcopters can do amazing things like count plants, test soil properties like moisture content, and analyze water usage. The results are more efficient and better yielding crop. They will be used for because the pesticide sprayer.
4. Medicine: The utilization of drones for medical purposes may be quick help, reducing time period for the patient, reducing the danger of injury, and may be short-term reason to attend for the rescue, support and improvement of basic operations in medical emergencies. Access to places where teams, and basic means of medical transportation, are inaccessible (eg thanks to flooding and blocked roads)
5. In Sports: Like several other camera systems, drones have the ability of taking the high-quality shots appropriate for live streaming by using light-quality high-quality cameras and instantaneous HD video downlinks. One among its greatest advantages, however, is its flexibility, which allows the operator to vary the situation of the shot at – available for diverse angles and closer chasing of the action than at fixed angles.

### 2.3 Materials properties

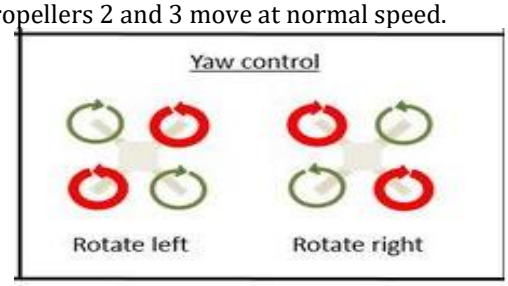
1. Carbon Fiber: Carbon fibres is 5-10 micrometre diameter fibres and are mostly composed of atoms of carbon. Fibers of carbon have several advantages, including high strength, chemical resistance, low weight, durability, heat resistance and low thermal expansion. These characteristics made carbon fiber very famous in other competitive sports such as aerospace, civil engineering, military and motor sports. However, glass fibers or plastic
2. Aluminium: Aluminium takes a big and positive history in the concept of aerospace. As early in 19th century, Count Ferdinand Zeppelin used to manufacture the aluminium frames of his conventional airships, demonstrating the low weight, good strength. More than a era later, it's the foremost used metal within the air. Marta Danilenko, Marketing Manager of the online Materials Database Mismatch, Common Aluminium Alloys for Aerospace Engineering
3. Thermoplastics: Thermoplastics also offer good strength and rarity, with several varieties having lastingness greater than 100 MPa and a density below 2 g / cm 3. Many thermoplastics are available

in filaments, which could be used for custom parts of 3D printing, making thermoplastics a well-liked component used in experimental drones.

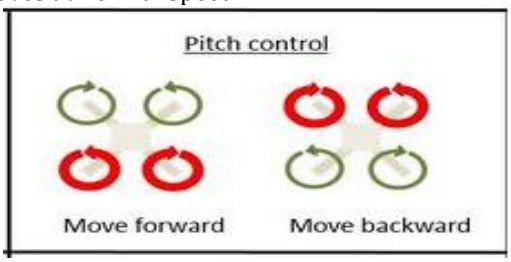
### 2.4 Basic motions of Quadcopter

There are four primary movements that a drone employs and they're controlled by each of the four propellers. Propellers 1 and 4 move in clockwise, while propellers 2 and 3 move counterclockwise.

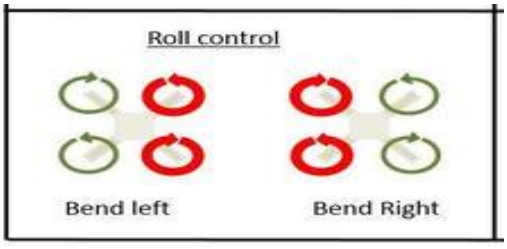
1. Yaw motion in a drone is the clockwise or clockwise rotation. If the drone is to be used to turn left, the number 1 and 4 propellers will move at normal speeds, while the number 2 and 3 propellers will move at higher speeds. To turn to the right, propellers 1 and 4 move at high speed, and propellers 2 and 3 move at normal speed.




2. The pitch tells the drone's front and back motion. To proceed, propellers 1 and a couple operate at usual speed, propeller 3 moves, and four moves at faster speed. To maneuver backwards, propellers 1 and 2 move at high speeds and propellers three and 4 moves at normal speed.




3. Roll is the rotation of the drone to the left or to the right. Propellers 2 and 4 move at higher speeds while Left Propellers 1 and 3 move at normal speed. To turn right, propellers 1 and 3 move at higher speeds, and propellers 2 and 4 move at normal speed.




Uplift is that the act of moving the drone up and down, raising or lowering the drone. All propellers move up and down at high speed, all propellers move at normal speed.

## 3. METHODOLOGY


**Fig -1**: Proposed methodology

**Data collection**

Data collection, which comes in the preliminary study. While doing preliminary study we conducted field survey. We checked with ground reality and field conditions. We collected several data from the farmers through online survey and face to face interactions we tried to reach around 50 farmers out of which 20 have responded.

**Design and Development Stage**

1. Market research
2. Customer requirements
3. Technical aspect
4. Concept generation
5. Concept selection

## 4. RESULTS

**FE Analysis:**

We did a stress analysis on the frame. And the first image on the shows the results we got. The frame is made up of aluminium which has a yield strength of 290 MPa. We took FOS huh factor of safety as2. So we applied a load of 2N. So on the left side of the first image, we can see that the maximum stress was 0.9 MPa. Which is not even 0.5% of yield strength of aluminium? So the we can say that the design is safe. Also if we see the figure we can see the areas of stress concentration is around the fasteners.

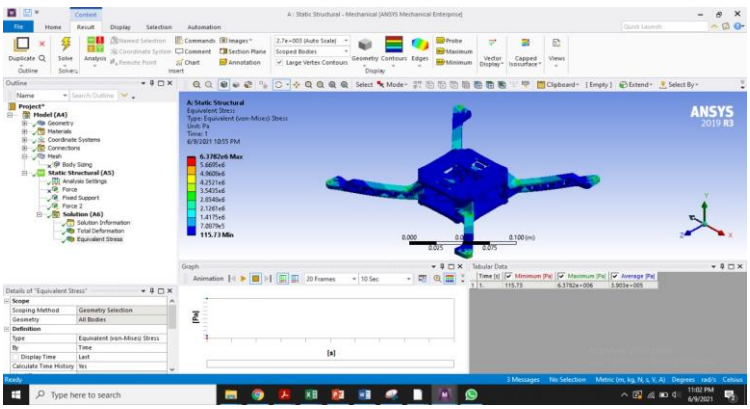


**Fig –2:** Finite element analysis

FE Analysis -Stress analysis on the frame is done as shown in fig -2. And the first image on the shows the results that have been obtained. The frame is made up of aluminium 6061 which has yield strength of 290 MPa. FOS, factor of safety is taken as 2. A load of 120 N is applied. On the left side of the first image, the maximum stress is shown as 0.9 MPa, which is not even 0.5% of yield strength of aluminium. Hence the design is safe. The areas of stress concentration are visible in fig -2, which is around the joints.

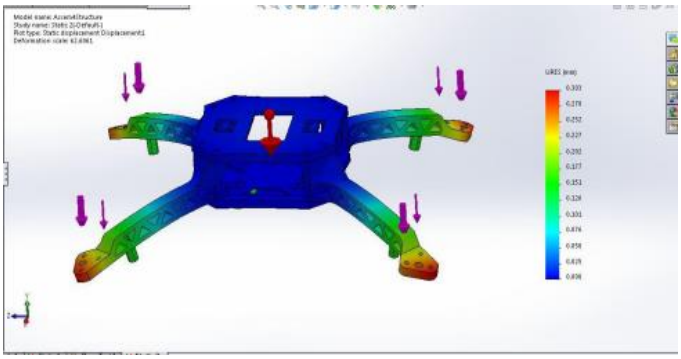
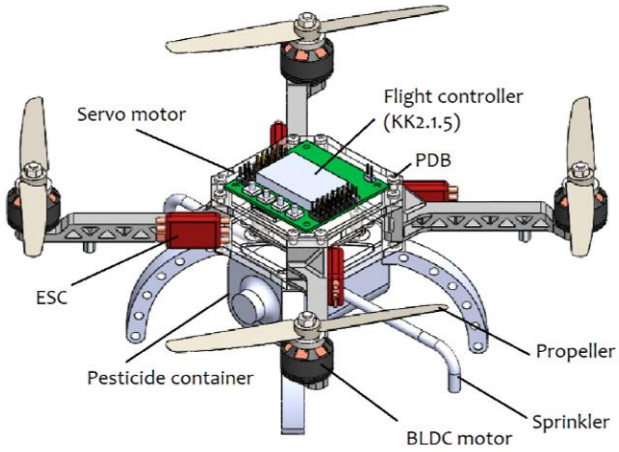


**Fig -3:** Static stress analysis using Ansys

## 5. CONCLUSIONS




The uses of thin hallow aluminum frames which provide a greater strength to the structure of the Quadcopter. Which is highly useful in carrying the load of pesticides and fertilizers?

The result of this project was to build a cost effective Quadcopter to make it economically feasible to build and use it and provide a modern solution to traditional farming. The design of the frame and parts of the structure are made strong and compact using aluminium and also using solid works and Ansys.

Our Quadcopter which has a flight time of 7.4min, which has a battery efficiency of 78%, with a full throttle of 5.7min, each motor can produce 1200g of thrust which is more than sufficient, the payload capacity if the Quadcopter comes out to be 1200g.

The main problem faced by farmers who use traditional farming methods are, while spraying pesticide the farmers are exposed to many skin problems and breathing difficulties caused while spraying pesticides. They also experience Sevier back pain problems while the carry the knap sack sprayer on their back. The design and development of the Quadcopter is purposely done for small scale farming for 1-2 acres on average. The Quadcopter integrated with the pesticide spray system helps farmers to overcome these issues and also helps in reducing the time required to spray pesticide. When manufactured in large scale the cost can also be greatly reduced. This Quadcopter can also be used in roof top gardening where it is very difficult to spray pesticides in these areas, and it can also be used in nursery.

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