International Research Journal of Engineering and Technology (IRJET) e-ISSN:2395-0056
Volume: 09 Issue: 06 | Jun 2022 www.irjet.net p-ISSN:2395-0072

DESIGN AND ANALYSIS OF MULTITASKING AGRICULTURAL DRONE

Adnan Inamdar[1], Vedat Aher[2], Sonal Dangare[3], Devyani Deshmukh[4], Saurabh Solanke[5], Dr. Laxmikant D Mangate[6]

[1-5]UG student Vishwakarma Institute of Technology, Pune
[6]Assistant Professor, Mechanical Engineering Department, Vishwakarma Institute of Technology, Pune, Maharashtra, India

---***---

Abstract— *Quadcopters are unmanned Ariel Vehicle (UAV), generally small helicopter that is lifted and propelled by four rotors. Initially they were used as toys, later they gained importance and recent research on multi-copters have received growing attention for military, agriculture, photography, surveillance, news, sports, search/rescue missions and much more. The widespread use of unmanned vehicles and its growing applications in various domains can be attributed to their ability to operate in inaccessible areas, thus decreasing the human loss in major accidents, and making access easy to dangerous conditions. We have proposed an idea about how quadcopter can be used for the agricultural applications. The target of this paper is to explain briefly to prepare a quadcopter so that it could be used in agricultural and can help our society, we have also explained working and manufacturing of quadcopters in detail so that it can help in agricultural domain to increase the efficiency and productivity.*

Keywords—Unmanned Ariel Vehicle (UAV), Vertical Take-off and Landing (VTOL), remotely piloted vehicles (RPV), Clockwise (CW), Counter-clockwise (CCW).

1. INTRODUCTION

According to a survey conducted by WHO (world health organization) it is estimated that every year about 3 million workers are affected by poisoning from pesticides of which 18000 die. This project aims to overcome the ill-effect of the pesticides on human beings and also use to spray pesticides over large area in short intervals of time compare to conventional spraying by using automatic fertilizer sprayer. This device is basically combination of a spraying mechanisms on a quad copter frame. This model is used to spray the pesticides content to the areas that cannot easily accessible by humans. The universal sprayer system uses to spray liquid as well as solid contents which are done by the universal nozzle.

1.1 Types Of Drones

Depending on the Type of Aerial Platform

The classification of drones based on how they manage to stay up in the air:

Multi-Rotor:

These drones have multiple motors on their bodies. They are popular for aerial photography and surveillance because they can stay in the air for long periods of time in one place.

Fig. 1 Multi Rotor Drone

Fixed Wing:

Other major drone designs consist of fixed-wing models where the drone mimics the engineering style of an airplane. These drones can't stay in one place, but they will glide along a designated path, as long as power allows.

Fig. 2 Fixed Wing Drone

Single Rotor:

A single rotor is used to fly the drone, and another small rotor near the tail controls the direction. These drones, also known as RC helicopters, are more efficient than multirotor drones. They can fly higher, stay in one position without rotating, and often use gas instead of electricity to power their bodies.

Fig. 3 Single Rotor Drone

2. QUADCOPTER

2.1 Principle of Quadcopter

A quadcopter is a device that is a concentrated combination of electrical equipment and mechanical engineering, primarily based on aviation principles. To keep the plane flying, there are four major forces that work for the plane to fly. Two of these forces are generated by the relative motion of air with respect to the aircraft. The first is the elevator. This force is directed upwards and acts perpendicular to the displacement of the plane. Thanks to this power, the plane is kept in the air. The second is resistance. It acts in the opposite direction to the displacement of the plane. This is due to the refraction effect of air on the aircraft, which hinders the aircraft from moving forward.

Lift and drag are called aerodynamic forces because they result from the action of air due to the displacement of the aircraft. Gravity, the weight of the aircraft, counteracts lift. The balance between lift and weight tends to keep the aircraft at a constant altitude. To ensure that the aircraft keeps moving forward, a force that offsets what is known as drag must be provided. This force is called thrust.

Thrust is generated by the engine, which is the propulsion system of the aircraft.

2.2 Movement Mechanism

A quadcopter can be described as a small vehicle with four propellers mounted on a rotor located in a horizontal frame. This fixed pitch rotor target is used to control the movement of the vehicle. The speeds of these four rotors are independent of each other. Independent pitch, roll and yaw postures allow easy control of the vehicle. The figure shows the pitch, roll, and yaw movements of a quadcopter.

Fig. 4 Different types of motion

Different types of motion

1. Yaw motion (ψ): Rotation around the vertical axis is called yaw. The rudder controls the yaw (left and right).

2. Tilt movement (ɵ): Rotation around the left and right axes is called tilt. H. Vertical movement around the horizontal axis. The elevator controls the pitch.

3. Roll motion (Φ): Rotation around the axis is called roll. H. Rather than tilting around the axis. Ailerons control the roll axes (left and right).

4. Takeoff and landing movement mechanism: Takeoff is the movement of a quadcopter to take off from the ground to the hovering position, where the landing position is the opposite of the takeoff position.

6. Left and right motion: For left and right motion, it can control by changing the yaw angle of Quadcopter. Yaw angle can control by increasing (decreasing) counter-clockwise rotors speed while decreasing (increasing) clockwise rotor speed. Hovering or static position the hovering or static position of Quadcopter is done by two pairs of rotors are rotating in clockwise and counter clockwise respectively with same speed. If the two rotors are rotating clockwise and counterclockwise, the total reaction torque is zero, which puts the quadcopter in the hovering position.

Frame Sizes

Table -1: Frame sizes

FRAME SIZE (WHEELBASE)	PROP SIZE	MOTOR	kilovolt (kV)
100mm	2 inches	1102-1104	6000+
120mm	3 inches	1104-106	4000+
150mm – 180mm	4 inches	1306-1408	3000+
200mm – 220mm	5 inches	2204-2306	2100-2800
235mm – 280mm	6 inches	2205-2308	1600-2500
330mm – 350mm	7-8 inches	2208-2212	1500-1600
450mm – 500mm	9-10 inches	2212-2216	800-1000

2.3 Calculation

2.4 Static Thrust Calculation

A static thrust calculation is required to ensure that the correct propeller and engine are selected. Static thrust is defined as the thrust produced by a propeller that is stationary with respect to the earth. This calculation is especially important for this project, as quadcopter helicopters tend to operate slower than Earth. This low speed performance allows static thrust calculations to be applied to a wide range of flight conditions. It is also important to note that the final static thrust calculation is an estimate, not an actual value.

The first step in calculating static thrust is to determine the output in revolutions per minute transmitted from the engine to the propellers. Aircraft-world.com has compiled empirical data used to calculate horsepower [1] and the formula used for their datasheet is given in Equation 1.

$$Power = Prop\ Const * rpm^{Powerfactor} \qquad [1]$$

Here, the horsepower is watts and the RPM is a thousand. For example, a 6X4 APC propeller has a propeller constant of 0.015 and a power factor of 3.2. At a speed of 10,000 rpm, the following calculation results are obtained.

$$Power = 0.015 \times 10^{3.2} = 24\ W$$

The next step is to determine the thrust produced by a propeller. Equation 2 gives thrust based on the Momentum Theory.

$$T = \pi/4\ D^2\ \rho v w \Delta v \qquad [2]$$

Where,

T=thrust [N]

D= Propeller Diameter [m]

v= velocity of air at the propeller [m/s]

Δv = velocity of air accelerated by propeller [m/s]

ρ = density of air [1.225 kg/m3]

A commonly used rule is that velocity of the air at the propeller is v=½Δv of the total change in air velocity: Therefore, and equation 3 is derived.

$$T = \pi/8\ D^2\ \rho (\Delta v)^2 \qquad [3]$$

Equation 4 gives the power that is absorbed by the propeller from the motor. Equation 5 shows the result of solving equation 4 for Δv and substituting it into equation 3. In doing so, Δv is eliminated and torque can be calculated.

$$P = (T\ \Delta v)/2 \Rightarrow \Delta v = 2P/T \qquad [4]$$

$$T = [(\pi/2)\ D^2\ \rho P^2]^{1/3} \qquad [5]$$

Finally, it is advantageous to express the results of equation 5 in terms of mass. Newton's Law, F=ma, is used to obtain equation 6.

$$m = ([(\pi/2)\ D^2\ \rho P^2]^{1/3})/g \qquad [6]$$

where, g= 9.81 m/s 2 Solving for mass is useful for quadrotor helicopters because it can be directly related to the mass of the aircraft. In particular, a thrust (mass) that equals the mass of the aircraft is needed for hovering.

2.5 DC Motor

This section provides an overview of DC motors and the importance of DC motor performance in relation to the quadcopter's levitation capability. Brushless DC motors are the most commonly used motors in RC hobbies because of their availability, price, and performance.

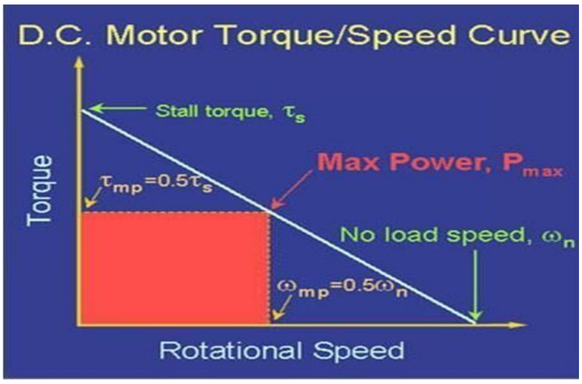

Fig. 5 Generalized torque vs. speed curve of a DC motor with a constant applied voltage

Maximum torque can be reached when the engine is fully braked and no torque is generated when the engine is running at maximum speed. DC motors perform best when producing the most mechanical power. Power is the product of torque and velocity given in Equation 7.

$$Power = Torque * Rotational\ Speed \qquad [7]$$

To determine the maximum output of an engine, you only need to determine the speed at which the maximum output occurs. Figure 5.1 shows that maximum power is obtained at torque and speed equal to half the maximum motor power at constant voltage. Maximum power is important because it is desirable to match the optimum power range of the engine to the most common flight conditions of the aircraft. In this case, the most common type of flight for quadcopter helicopters is hover flight. Hovering occurs when the propeller / motorset produces thrust (mass) equal to the weight of the aircraft. Hovering should be done at 50% of the motor's maximum capacity. This is directly related to the equivalent of half the battery voltage. Since the DC motor is rated at kV (rpm / v), the speed at which maximum power is achieved is calculated by multiplying the motor's kV by half the battery voltage and dividing the result by two.

$$rpm_{maxPower} = (kV * 0.5 * Battery\_Volts)/2 \qquad [8]$$

The desired resulting speed occurs at 1/4 of the motor's maximum speed at full voltage. RPMs for this purpose are used in the Propeller and Engine Selection section of this report. However, before choosing the right propeller and engine, you need to estimate the mass of the aircraft.

2.6 SELECTION OF COMPONENTS

2.7 Propeller and Motor

Now that a method for calculating static thrust, an understanding of DC motor power, and an estimated aircraft weight has been established, the proper propellers and motors can be determined.

Table 2: Ideal motor rpm from motor specifications

Motor	kV(rpm/v)	Max rpm	Ideal rpm
2822/14 Brushless Out runner 1450 kV	1450	16095	4024
TURNIGY 2204-14T 19g Outrunner	1450	16095	4024
TURNIGY 1811 Brushless Indoor Motor 1500 kV	1500	16650	4163
TURNIGY 2730 Brushless Motor 1500 kV	1500	16650	4163
Hobby King Donkey ST2004-1550 kV Brushless Motor	1550	17205	4301
AP19 Brushless Motor	1580	17538	4385
C2024 Micro Brushless Out runner 1600 kV (17 kg)	1600	17760	4440

The next step is to determine the ideal rpm of the propeller. Ideal rpm for a propeller is found by combining Equations 1 and 6 and solving for rpm. Equation 9 shows the result of this mathematical manipulation.

$$rpm_{ideal} = \left(\frac{2}{\pi}\right)^{\frac{1}{2\omega}} \left(\frac{g^{\frac{3}{2}} m^{\frac{3}{2}}}{\alpha D \sqrt{\rho}}\right)^{\frac{1}{\omega}}$$

⍰=Power Factor from Aircraft-world.com
α=Power Coefficient from Aircraft-world.com
D= Diameter [m]
p = Air Density [1.225 kg/m^3]
m = Mass [kg]
g=Gravity [9.81m/s^2]

The mass entered in Equation 9 is the estimated mass of 809g divided by 4 because there are four engine / propeller sets that contribute to the lift. Table 3 shows the results of Equation 9 for various APCE propellers.

Ideal Thrust (mass kg)	Propeller	Diameter (m)	PC	PF	Ideal rpm
0.20225	6x4	0.1524	0.015	3.2	8324
	7x5	0.1778	0.042	3.2	5750
Air Density [kg/m^3]	8x4	0.2032	0.06	3.2	4934
1.225	8x6	0.2032	0.106	3.2	4130
	8x8	0.2032	0.148	3.2	3721
Gravity [m/s^2]	9x4.5	0.2286	0.09	3.2	4189
9.81	9x6	0.2286	0.129	3.2	3744
	9x7.5	0.2286	0.352	2.9	3036
	9x9	0.2286	0.448	2.9	2794
	10x5	0.254	0.144	3.2	3500
	10x7	0.254	0.223	3.2	3053
	10x10	0.254	0.68	2.9	2333
	11x5.5	0.2794	0.222	3.2	2967
	11x7	0.2794	0.301	3.2	2698
	11x8	0.2794	0.357	3.2	2558
	11x8.5	0.2794	0.383	3.2	2502
	11x10	0.2794	0.589	3.2	2188

Fig 6: Ideal motor rpm from momentum theory calculations

2.7.1 Battery and Flight Time

The most common battery type used in the hobby market today is Lithium Polymer (LiPo), which was selected for this project. The popularity of LiPo batteries is due to their large capacity, light weight and excellent discharge capacity. Here is some general information about LiPo batteries:

• Each cell of the LiPo battery is rated at 3.6 V, and when each cell reaches 3.0 V, it is fully discharged and the battery usually contains 1 to 3 cells. (Note: If the LiPo battery is discharged below 3V / cell, it will not be able to be charged.)

• Current is represented by C and corresponds to the maximum discharge rate of the battery. For example, a 1C battery can handle a current that takes an hour to fully discharge, and a 2C battery can discharge in 30 minutes.

• Battery capacity is expressed in milliamp hours (mAh). Flight time will be analyzed to determine the appropriate battery. Flight time, which is directly proportional to battery capacity, can be found by dividing battery capacity by the amount of amps being drawn from the battery.

Flight Time = Battery Capacity/amps… ....[10]
According to our project,
Flight Time= 11.1 V/2.1 amp = 5.2 min

Table 4: Flight time w.r.t battery capacity and discharge rate

Capacity [mAh]	Flight time at 100% Discharge Rate [min]	Flight time at 50% Discharge Rate [min]
1000	1.5	3
1200	1.8	3.6
1400	2.1	4.2
1600	2.4	4.8
1800	2.7	5.4
2000	3	6
2200	3.3	6.6

2400	3.6	7.2
2600	3.9	7.8

2.8 COMPONENTS

2.8.1 Chassis

A drone skeleton to which all components are connected. The chassis design is a compromise between strength (especially when extra weight like a camera is attached) and extra weight that requires a longer propeller and a more powerful engine to lift. The base of the drone, made of strong fibers with four arms. Each arm consists of a BLDC motor that helps the drone fly.

Fig. 7 Chassis

2.8.2 Propellers

This mainly affects the load that a quadcopter can carry, the speed at which it can fly, and the speed at which it can be maneuvered. You can change the length. Longer propellers can provide more lift with lower RPM, but slower acceleration / deceleration. Short propellers are more maneuverable because they can change speeds faster, but they require higher RPM to achieve the same performance as long blades. This leads to excessive engine stress and thus shortens engine life. A more aggressive tilt allows for faster movements, but reduces hover efficiency.

These generate thrust and torque that allow the drone to fly. The upward thrust generated by the propeller is usually measured in pounds or grams. In order for the drone to stay on the hover, the upward thrust must match the weight of the drone. Thrust-to-weight ratio TWR (thrust divided by weight) indicates how much thrust the drone produces for that weight.

Fig. 8 Propellers

2.8.3 Motors

One for each propeller, the rating of the drone motor is in "Kv" units. This is the number of revolutions per minute that can be achieved when a voltage of 1 volt is applied to the motor with no load. Faster motor rotation improves flight performance, but requires more power from the battery, which reduces flight time.

BLDC Motor: This is a high-performance motor with excellent efficiency. The motor is rated at kilovolts, and the higher the kV rating, the faster the motor will rotate at a constant voltage. The purpose of the engine is to rotate the propeller. Brushless DC motors provide the thrust needed to move the vehicle forward. I am using a 1000kV motor. Propeller Two types of propeller pushers and pullers are used. Pusher: The pusher gives thrust when turned clockwise. Puller: The puller gives thrust when turned counterclockwise. Propellers are available in a variety of diameters and pitches (tilt effect). The larger the diameter and pitch, the greater the thrust the propeller can generate. It also requires more force to propel it, but it will be able to lift more weight. Small or medium propellers when using high speed (revolutions per minute) motors. If you use a low speed motor, you can use a large propeller as it can cause problems if the small propeller cannot lift the quadcopter at low speeds.

Fig. 9 Motor

2.8.4 Electronic Speed Controller (ESC)

The electronic speed controller controls the speed of the motor and tells the motor the speed of rotation at any point in time. The quadcopter requires four ESCs, one connected to each motor. The ESC is then connected directly to the battery using either a wire harness or a switchboard. The Electronic Speed Controller (ESC) is an electronic circuit that changes the speed and direction of a brushless motor and can act as a dynamic brake. The maximum current flowing through the ESC is 30-40 amps.

Fig. 10 ESC

2.8.5 Flight Controller

The onboard computer which interprets incoming signals sent from the pilot and sends corresponding inputs to the ESC to control the quadcopter.

2.8.6 Transmitter and Receiver

Transmitter uses radio signals to transmit commands wirelessly via a set radio frequency over to the radio receiver, which is connected to drone being remotely controlled

Fig. 11 Transmitter and receiver

2.8.7 Battery

The battery is the power source that powers all other systems in the drone. Battery chargers help charge the battery. Lithium polymer batteries are commonly used because of their high power density and rechargeability.

Fig. 12 Battery

The most common battery type used in the hobby market today is Lithium Polymer (LiPo), which was selected for this project. The popularity of LiPo batteries comes from their high capacity, light weight and excellent discharge capacity. Here is some general information about LiPo batteries:

• Each cell of the LiPo battery is rated at 3.6 V, and when each cell reaches 3.0 V, it is fully discharged and the battery usually contains 1 to 3 cells. (Note: If the LiPo battery is discharged below 3V / cell, it will not be able to be charged.)

• Current is represented by C and corresponds to the maximum discharge rate of the battery. For example, a 1C battery can handle a current that takes an hour to fully discharge, and a 2C battery can discharge in 30 minutes.

• Battery capacity is expressed in milliamp hours (mAh).

Camera

Helps to know the crop health through visuals and can also capture images which will help farmer to analyze crop health easily.

Fig. 13 Camera

2.8.8 Water Pump

This will suck pesticides from container and will transfer it to the sprayers through the water hoses i.e. hoses are generally transparent pipes used in transferring the pesticides from the container to the sprinkler.

2.8.9 Container

Store the pesticides in liquid form. Generally, a storage for pesticides hanged below the drone's base. From here the pump suck and transfer the pesticides to the sprinkler which are placed at the end of every wings.

Fig. 14 Container

2.8.10 Sprinkler

Sprinkle pesticides to the crops. Placed in the end of every wings, below the BLDC motor. Sprinklers sprinkle the pesticides provided by the pump from the container.

Fig. 15 Sprinkler

3. WORKING

3.1 Quadcopter

The quadcopter is manually controlled using a handheld radio transmitter that manually controls the propeller. The controller stick allows you to move in different directions, and the trim button allows you to adjust the trim to balance the drone. You can also use the screen to receive live video footage from the dashcam and display sensor data.

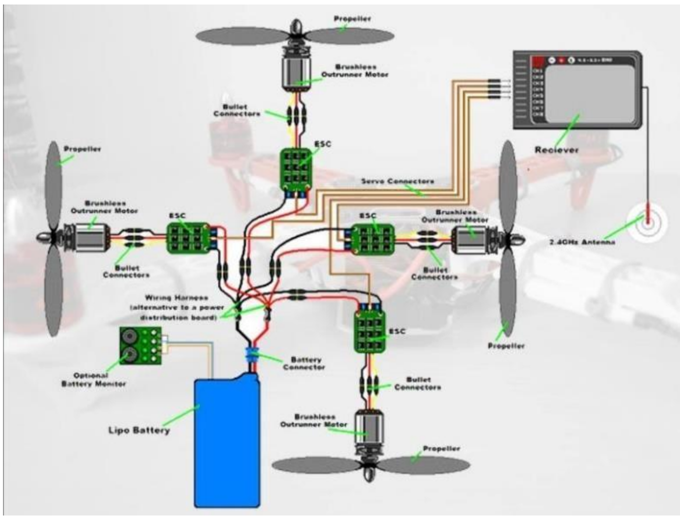

Fig. 16: Layout of Quadcopter

In addition, the onboard sensor can provide useful settings such as:

1) GPS hold where the quadcopter stays in a fixed GPS position.

Quadcopters can also fly autonomously, and modern air traffic controllers use software to mark GPS waypoints where vehicles land or move at set altitudes. This type of autonomy is becoming more and more common and has contributed significantly to the growing interest in civilian drone technology that has been observed in recent years.

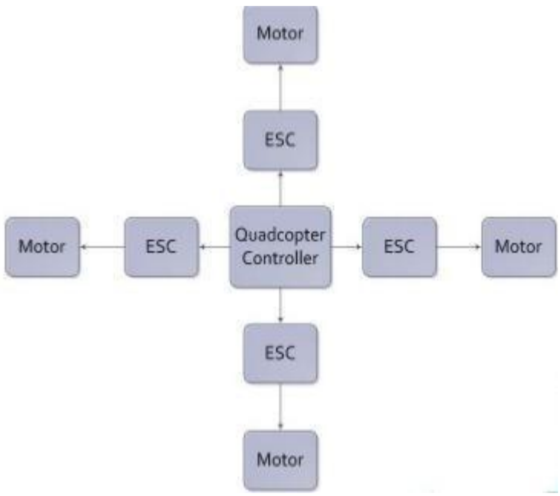

Fig. 17: Block diagram of quadcopter

3.2 Spraying Mechanism

The spraying mechanism mainly consists of an APM board which is programmed to perform various functions. It also contains a tank of 2000ml capacity to which a water pump is connected. To this water pump, a splitter is connected which spits the pesticide to the four nozzles which are connected below every motor and spraying is achieved. It also contains a motor driver circuit to control speed of spraying and pesticide level indicator circuit with buzzer, for detecting when the pesticide is empty.

The spraying mechanism performs the following functions.

- Pump ON/OFF control:

It is used to turn on/off the water pump which is used to spray. This is done by sending control signal to the motor.

- Spraying Speed Control:

The speed of spraying is achieved by sending a PWM signal to the motor driver IC. Based on the t(on) time of this signal, speed of spraying can be controlled.

- Tank status:

The status of the tank will be monitored using water level sensor. If the pesticide level reaches below the threshold, say 25ml in the prototype it can be notified to operator by sending a control signal which in return turns on the buzzer. Hence, when the buzzer is heard by the operator, he can land the quadcopter for refilling

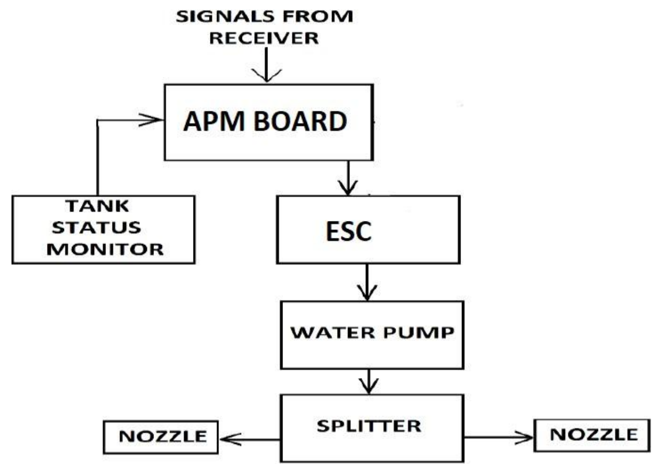

Fig. 18 Spraying Mechanism

4. DESIGN

For designing of our quadcopter, we have used CATIA V5 Software where we have designed chassis for quadcopter.

1) Quadcopter lower Base

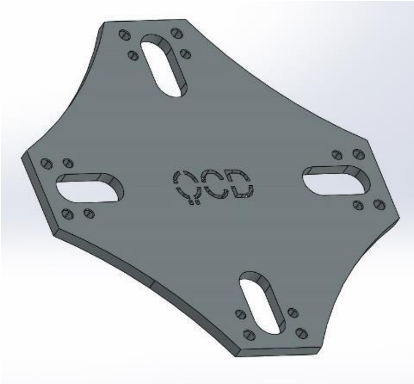

Fig. 19 Lower Base

2) Quadcopter upper Base

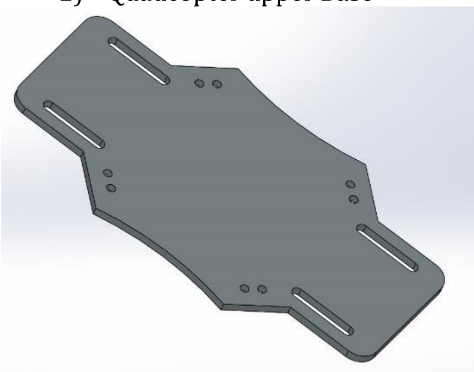

Fig. 20 Upper Base

3) Quadcopter side arms

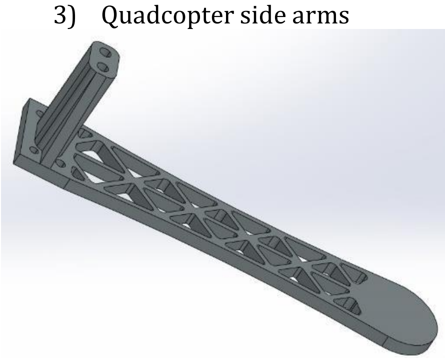

Fig. 21 Side Arm

4) Quadcopter Assembly

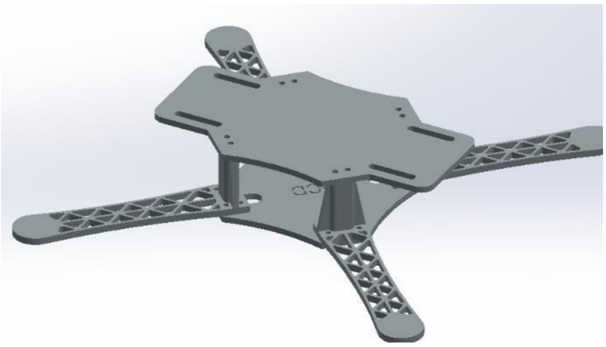

Fig. 22 Assembly

5. ANALYSIS

All the parts and assembly are well within the structural safety range

1) Total Deformation

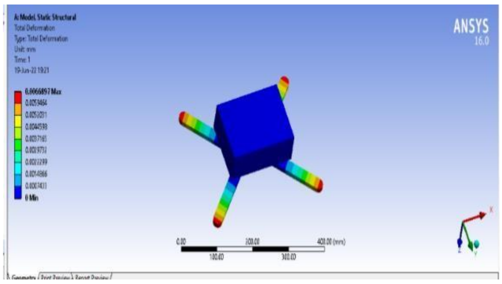

Fig. 23 Total Deformation

2) Equivalent Stress

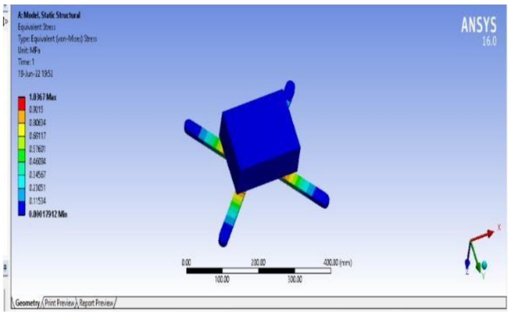

Fig. 24 Equivalent stress

6. CHALLENGES

There are several challenges in the deployment of UAVs in precision agriculture:

• Thermal cameras have poor resolution and they are expensive. The price ranges from Rs6000-Rs40000 depending on the quality and functionality, and the majority of thermal cameras have resolution of 640 pixels by 480 pixels.

• Thermal aerial images can be affected by many factors, such as the moisture in the atmosphere, shooting distance, and other sources of emitted and reflected thermal radiation. Therefore, calibration of aerial sensors is critical to extract scientifically reliable surface temperatures of Objects.

• Temperature readings through aerial sensors can be affected by crop growth stages. At the beginning of the growing season, when plants are small and sparse, temperature measurements can be influenced by reflectance from the soil surface.

• In the event of adverse weather, such as extreme wind, rain and storms, there is a big challenge of UAVs deployment in PA applications. In these conditions, UAVs may fail in their missions. Therefore, small UAVs cannot operate in extreme weather conditions and even cannot take readings during these conditions.

• One of the key challenges is the ability of lightweight UAVs to carry a high- weight payload, which will limit the ability of UAVs to carry an integrated system that includes multiple sensors, high-resolution and thermal cameras.

• UAVs have short battery life time, usually less than one hour. Therefore, the power limitations of UAVs are one of the challenges of using UAVs in PA. Another challenge, when UAVs are used to cover large areas, is that it needs to return many times to the charging station for recharging.

7. ADVANTAGES AND DISADVANTAGES

7.1 Advantages

1. It helps in achieving more yields by using resources effectively.

2. Drones are used in large scale farming for spraying of insecticides and pesticides due to its remote-control operation from distant.

3. It helps in monitoring environmental data which helps in smart farming.

4. It helps farmers in scouting their fields quickly and efficiently.

5. Latest agriculture drones help in collecting data which helps in improving crop health.

6. It helps farmers in mapping in order to boost yields and in cutting costs to take business forward.

7. Thermal cameras help in finding wet and dry patches. This helps farmers avoid wastage of water.

7.2 Disadvantages

1. Basic knowledge and skills are required to operate an agricultural drone.

2. Most drones have shorter flight times and less coverage. Drones with long flight times and long range are more expensive. Drones with more features are also more expensive.

3. Use requires regulatory approval.

4. Since it shares the same airspace as commercial aircraft, it may interfere with manned aircraft entering the flight path.

5. It is difficult to fly in extreme conditions.

8. RESEARCH TRENDS AND FUTURE INSIGHTS

8.1 Research Trends

1. Machine Learning

The next generation of UAVs will utilize the new technologies in precision agriculture, such as machine learning. Hummingbird is a UAV-enabled data and imagery analytics business for precision agriculture. It utilizes machine learning to deliver actionable insights on crop health directly to the field. The process flow begins by performing UAV surveys on the agricultural land at critical decision-making points in the growing season. Then, UAV images is uploaded to the cloud, before being processed with machine learning techniques. Finally, the mobile app and web-based platform provides farmers with actionable insights on crop health. The advantages of utilizing UAVs with machine learning technology in precision agriculture are:

- Early detection of crop diseases
- Precision weed mapping
- Accurate yield forecasting;
- Nutrient optimization and planting
- Plant growth monitoring

2. Image Processing

UAV-based systems can be used in PA to acquire high-resolution images for farms, crops and rangeland. It can also be utilized as an alternative to satellite and manned aircraft imaging system. Processing of these images is one of the most rapidly developing fields in PA applications. The Vegetation Indices (VI) can be produced using image processing techniques for the prediction of the agricultural crop yield, agricultural analysis, crop and weed management and in diseases detection. Moreover, the Vis can be used to create vigor maps of the specific-site and for vegetative covers evaluation using spectral measurements.

9. Future Insights

1. With relaxed flight regulations and improvement in image processing, geo- referencing, mosaicking, and classification algorithms, UAV can provide a great potential for soil and crop monitoring.

2. The next generation of UAV sensors, such as 3p sensor, with built-in image processing and field analysis capabilities, farmers can instantly see the field without the need for cellular and cloud connectivity.

3. More precision agricultural researches are required towards designing and implementing special types of cameras and sensors on- board UAVs, which have the ability of remote crop monitoring and detection of soil and other agricultural characteristics in real time scenarios.

4. UAVs can be used for obtaining high-resolution images for plants to study plant diseases and traits using image processing techniques.

10. CONCLUSION

Information technologies provide new possibilities for a lot of problems. Agricultural drones are an incredible technology advanced in just a few years. Drones are crucial to farmers because they will no longer have to walk around their farms surveying soils, crops and buildings. Farmers, now, have the best surveillance and inspection technology for their farms. It's true to say that farming has become technically advanced for commercial farmers who have enormous chunks of land.

Perhaps one day, these drones will be fully automated, monitored, and then provide farmers with accurate data on the number of pesticides, fungicides, or fertilizers applied to a particular area or crop. It shall be a new dawn for farmers. On the flip side, drones have their shortfalls. For example, drones are not completely safe, raise privacy concerns and may put countries in serious security risks. Hence, information technology experts have their work cut out in ensuring that the next generation of agricultural drones addresses these issues. Security measures must be prioritized because extremist groups or other people who want to cause harm to the general public may take advantage of the drones. Generally, anything that threatens to derail the adoption and the advancement of agricultural drones should be addressed.

ACKNOWLEDGMENT

It gives us immense pleasure and satisfaction in presenting this project report on "Design And Analysis of Multitasking Agricultural Drone". This report work has opened up new vistas of knowledge for us. We can now justifiably claim that this experience will stand us in good stead in the years to come. There are a large number of people without them this large and unique learning experience would be a nonstarter.

We wish to express our deep sense of gratitude to our internal guide Dr. Laxmikant D. Mangate, Mechanical Engineering, for his valuable guidance and useful suggestions which helped in completing the project and this report work in time. Without his cooperation, it would have been extremely difficult for us to complete this report.

We are grateful to other staff members of the Department for giving us important suggestions. We also heartily thank our Director Dr. Rajesh Jalnekar for giving us an opportunity to make work a success.

REFERENCES

[1] S. R. Kurkute, B. D. Deore, P. Kasar, M. Bhamare, M. Sahane, "Drones for Smart Agriculture: A Technical Report", IJRASET, vol.6, April 2018.

[2] S. Nappaphol, K. Assadarat, F. Doudo, K.Shigeru, "Distinguishing Drone Types Based on Acoustic Wave by IoT Device", ICSEC, Nov. 2018.

[3] P.Parihar, P.Bhawsar, P.Hargod, "Design & Development Analysis of Quadcopter", COMPUSOFT , vol. V, issue-VI, Jun.2016

[4] E.L. Peponakis, A.G. Paspatis, R. D. Oikonomidis, G. A. Barzegkar-Ntovom, K.E. Bampouras" A Simple Low-Cost Setup for Thrust and Energy Efficiency Calculation for Small Brushless DC Motors", ECESCON, vol9, pp.85-89.

[5] D.Krishna, Dr. Jayaraman,C. Satheesh, K. Sunil "Selection of BLDC Motor and Propeller for Autonomous Amphibious Unmanned Aerial Vehicle" IRJET, vol.04 issue-04, pg.3345-3348, Apr.2017

[6] P.A. Avinash, "Agricultural drone interaction tank interface", IJARIIT, Vol.5, issue.3, pg. 1776.

[7] P. Tripicchio, M. Satler, G. Dabisias, E. Ruffaldi, C.A. Avizzano, "Towards smart farming and sustainable agriculture with drones", IEEE, pp. 140-143, Jul, 2015.

[8] D. Yallappa, M. Veerangouda, M. Devanand, P. Vijayakumar, M. Bheemanna, "Development and evaluation of drone mounted sprayer for pesticide applications to crops", IEEE, Dec, 2017.

[9] L. Karim, A. Anpalagan, N. Nasser and J. Almhana, "Sensor-based M2M Agriculture Monitoring Systems for Developing Countries: State and Challenges". Network Protocols & Algorithms, vol.5, issue-3, pp.78-79, Oct2013.