DESIGN AND FABRICATION OF CUTTING MECHANISM OF AGRICULTURAL DRONE

Submitted in partial fulfillment of the requirements for the award of

Bachelor of Engineering Degree in
Mechanical Engineering.

By

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **SHANJIIT.B (38150709)** who carried out the Project work entitled **"DESIGN AND FABRICATION OF CUTTING MECHANISM OF AGRICULTURAL DRONE"** under my supervision from Nov 2021 to March 2022.

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DECLARATION

I **SHANJIIT.B (38150709)** hereby declare that the Project Report entitled **"DESIGN AND FABRICATION OF CUTTING MECHANISM OF AGRICULTURAL DRONE**" done by me under the guidance **of Dr. J. Hemanandh M.E., Ph.D.,** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Mechanical Engineering.

DATE: 09/05/2022 **SIGNATURE OF THE CANDIDATE**

PLACE:CHENNAI **SIGNATURE OF THE CANDIDATE**

ACKNOWLEDGEMENT

I'd like to express my gratitude to the Board of Management of the **SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY** for their support and encouragement in finishing this project.

Dr.S.PRAKASH, M.E., Ph.D., Dean, School of Mechanical Engineering, and **Dr.G.ARUN KUMAR, M.E., Ph.D., Head of the Department, Department of Mechanical Engineering**, for giving me with the essential assistance and details at the appropriate times throughout the progressive reviews.

I'd like to convey my heartfelt thanks to my Project Guide, **Dr.J.HEMANANDH, M.E., Ph.D., Associate Professor, Department of Mechanical Engineering**, for his invaluable direction, recommendations, and persistent support, which paved the path for my project's successful completion.

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ABSTRACT

Owing to the growing risk of manual labour, a better alternative is the need of the hour to steer clear of opportunities for human errors to occur. Moreover, competent labour is becoming scarcer by the day. In order to avoid this, drones have become a smarter and an effective alternative. The frame was constructed, which was then attached to a hobby wing, which was driven by 180 kv kde motors. It was connected to the connecting rod to mount the circular saw blade. The connections were checked after mounting the circular saw blade. Calculations were carried out in order to measure the elevation of the drone with respect to the Gravitational Constant. The drone can travel for a 1 km radius and at an altitude of 30 m, which is sufficient enough to cut down their harvests at high altitudes. A camera can also be attached to the drone so that the necessary produce can be identified and cut down accordingly.

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LIST OF ABBREVIATIONS

AC	Alternate Current
AUV	Autonomous Underwater Vehicle
BLDC	Brush Less Direct Current
CW	Clock Wise
CCW	Counter Clock Wise
DC	Direct Current
EMC	Electro Magnetic Compatibility
ESC	Electronic Speed Controller
FC	Flight Controller
FPV	First Person View
DRONE	Dynamic Remotely Operated Navigation Equipment
GPS	Global Positioning System
LED	Light Emitting Diode
Li-Po	Lithium Polymer
PDB	Power Distribution Board
PWM	Pulse Width Modulation
ROV	Remotely Operated Vehicle
RTK	Real-time Kinematic positioning
GCS	Ground Control Station

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CHAPTER - 1

INTRODUCTION

People who labour in agriculture and raise animals for food or raw materials are known as farmers. The term "farmer" is used to describe those who cultivate fields of crops, orchards, vineyards, poultry, or other livestock. A farmer may own the land he or she farms or work as a laborer on property owned by others, although in most industrialized economies, a farmer is generally a farm owner, with farm laborers, or farmhands, as employees. In the same way there are many drones which can be used for the purpose of agriculture. It's less likely that the system will be able to entirely replace human labor since it can't manage the circumstance as well as people can. Agriculture is the oldest and most dynamic occupation throughout the world. Because the world's population is expanding and land is becoming scarce, there is an urgent need for the whole society to think creatively and come up with innovative methods to farm utilizing less area to produce more crops while boosting the productivity and output of those farmed acres. Increasing agricultural output will be critical in the future decades. Poor soil quality, drought, floods, rising temperatures, and new plant diseases are all having a detrimental influence on yields as the world's population grows fast, placing additional pressure on food supplies. With the increasing growth of the population, competent labour is becoming scarcer by the day. And it’s quite difficult to find the skilled labour to climb up the trees and cutting the high altitude fruits. The frame was constructed, which was then attached to a hobby wing, which was driven by 180 kv kde motors. It was connected to the connecting rod to mount the circular saw blade. The connections were checked after mounting the circular saw blade. Calculations were carried out in order to measure the elevation of the drone with respect to the Gravitational Constant. The drone can travel for a 1 km radius and at an altitude of 30 m, which is sufficient enough to cut down their harvests at high altitudes. A camera can also be attached to the drone so that the necessary produce can be identified and cut down accordingly.

This drone can help our farmers and reduces human risks. The drone can also reach high altitudes where farmers wouldn’t be able to climb, and it reduces the time and risk factors involved in the cutting process. These type of drones can be used under any conditions and it’s possible to make it work.

Surface erosion is reduced and slope stability is improved by the intricate interactions between tree roots and the soil. Estimating root reinforcement is generally done using in situ pullout tests, which include pulling roots out of the soil to provide an accurate reading of root strength in compacted soils. Slope failures in a succession of slump blocks, such as at streambanks and road cuttings where the soil lacks compressive strength at the foot of a hillslope, can't be tested using this method. We are unaware of any root reinforcement study that examines the additional strength provided by roots in this setting, and we are not aware of any studies on this topic. As a result, we devised two separate laboratory tests to measure the amount of force necessary to pull the root out.

Coconut plantations are one of the agricultural activities in the south of India. Planters were able to make a profit from crops like coconut due to sociocultural compulsions. Professional labourers are required for the hand harvesting of coconuts and the frequent application of pesticides to coconut trees. Low-income communities have long used this practise, where prospective climbers are trained to climb trees swiftly to collect coconuts or spray pesticides. These settlements may be found in areas where huge numbers of coconut trees are grown as coconut farms. With a series of upward hops, a tree may be climbed by ascending the vertical trunk. Hip flexion, abduction, extension, lateral rotation, knee flexion, ankle plantarflexion and dorsiflexion at the ankle, subtalar joint inversion, flexion at metatarsophalangeal and interphalangeal joints of the foot are all required to climb a vertically growing coconut tree. The arms flex, rotate medially, and grasp the tree trunk as the body rises.

A coir loop is wrapped around the waist or between the hands to provide leverage, and this loop is then coiled around the tree trunk. A similar loop placed around the ankles stops the feet from splaying out and keeps them close to the trunk surface during climb and descent. The tibiotalar and intertarsal joints are subjected to a tremendous deal of gravitational stress since experienced climbers spend an average of four hours a day ascending 25-30 trees. India is in the midst of an

economic transformation, therefore an occupational research strategy would strike a balance between studying current industrial exposures and the health risks associated with traditional industries such as agriculture and plantations. Agriculture is the most ancient and active activity on the planet.

CHAPTER - 2

LITERATURE SURVEY

1. Bhalshankar,S.S. and Thorat,C.S., 2017 said that for metre manipulation and direct joining of overhead wires, new method of power theft detection can be found out. The new system requires less upkeep, is simple to use, and saves money. By preventing income leaks, the utility saves both time and money.

2. Jun, B.S., Kook, Y.S., Park, J.S., and Won, C.Y studied the development of electronic speed control (ESC). Drones that have lately been created have size, volume, and cost limitations. As a consequence, an all-in-one model with a propeller, electric motor, and electronic speed control is being developed. Drone PMSMs with high efficiency, density, controllability, and rotation speed are all characteristics. Furthermore, there is no sensor to determine speed in order to keep the drone's volume and weight down.

3. Kangunde, V., Jamisola, R.S. and Theophilus, E.K., 2021, have articulated upon the technique that can be used to collect honey which can eliminate the need for manual collection of bee hives. Honey is traditionally collected by hand. Honey collection gets more difficult at greater heights, such as mountains, long trees, etc. Using a manual technique is time consuming and risky, as well. An efficient honey harvesting approach is required to make honey gathering simpler without the need for human participation. More honey collection machines make it simpler to harvest honey from highland hives.

4. Kardasz.P, J. Doskocz, M. Hejduk, P. Wiejkut, and H. Zarzycki, 2016, have articulated that drones is mostly due to their limited flight range, which is connected to the battery depleting and the necessity to recharge them. Without a doubt, the threat to privacy and citizen rights, as was previously mentioned, is a substantial deterrent to the use of drones.

5. Krishnan.R stated that because of this comparison and evaluation process, the problem's complexity may be decreased significantly. Ac servos are evaluated in terms of cost, power density, torque-to-inertia ratio, stator current for constant field and field weakening conditions, thermal capability, parameter sensitivity effects and other control considerations, such as braking, cogging torque, ripple torque and rotor-position transducer selection, in this process.

6. Lee, B.J., Choi, G.J., Lee, S.H., Jeong, Y.M., Park, Y., and Cho, D.U, detailed the working principles of Li-ion batteries and validated the cause of explosion by overload testing caused by the high energy storage density. Based on these experiences, we undertook a research to develop scanning methods for fire and safety measures.

7. Li, T., Liu, J., Zhang, W., Ni, Y., Wang, W., and Li, Z proposed that UAV-Human supports the research and application of various data intensive learning models for UAV-based human behaviour understanding in 2021. A GT-I3D network is also suggested for distorted fisheye video action detection.

8. Liu, R.L., Zhang, Z.J., Jiao, Y.F., Yang, C.H., and Zhang, W.J., 2019, studied the impact of an opposed-piston gasoline engine on UAV's and flight performance was studied using a simulation test and theoretical derivation; this led to the development of variation rules for propeller thrust characteristics as well as maneuverability, the flight envelope, and the duration of flight.

9. MacNeill.R, D. Verstraete, and A. Gong, 2017, described in their study a strategy for optimising propellers for unmanned aerial vehicles. This means that propeller optimization may now be done as part of the powertrain of the air vehicle in question, whether it's an internal combustion engine or an electric motor. This technique guarantees a perfect solution that considers propeller efficiency as well as propeller weight.

10. Mohammadnia, A.; Ziapour BM; Ghaebi H; and Khooban MH in 2021, have discovered a method using a laser-based wireless power transfer

(WPT) that can be used to extend the operating time of drones, which is a first for this field of study. While flying at a considerable distance, drones may be charged wirelessly using this method. In order to write the analytical code, one must use the Engineering Equation Solver (EES). According to previous studies, the conclusions regarding the system's fundamental components are consistent. Commercial photovoltaic (PV) materials were put to the test in this investigation.

11. Muthusamy, S.K., Sangeetha, S.T.,Al Busaidi, A.S., Al Moqbali, K.S., Al Balushi, M., and Al Mawali, S.A.,2021, have explained different ways to be safe in the event one loses data, in addition to the procedures to use the pulley.

12. Na. H.Y, J.H. Lee, Y.S. Hong, S.R. Oh, I.H. Suh, and W.K. Kim. B.J. Yi, H.Y. Na, J.H. Lee, Y.S. Hong, S.R. Oh, I.H. Suh, and W.K. Kim stated that the term "configuration control" refers to the research of managing the form of arobot configuration utilising kinematic redundancies. Traditionally, however, study on this problem has been restricted to serial manipulators that are kinematically redundant.

13. P. Jagadeeswaran Automatic stated that fruit plucking drones must be developed to reduce personnel shortages and save time. In order for drones to be automated, fruits must be detected and sorted accurately.

14. Riananda, D.P., Nugraha, G., Putra, H.M., Baidhowi, M.L., and Syah, R.A., 2020, have shown how we manage the workflow for regulating the pulley mechanical system using mechanical sensors to develop a smart pulley system.

15. Ritchie.M, M. Fioranelli, H. Griffiths, and B. Torvik, felt that the danger presented by micro unmanned aerial vehicle platforms was examined in this paper, as well as the rotor blade reflections that rader systems are interested in. In order to show the predicted changes in frequency, azimuth angle, and polarisation, EM simulations of individual rotor baldes were employed.

16. Shin, Y.T., and Teh, Y.K., focused on the challenges of designing power electronics, particularly the most power-hungry electronic modules on a drone, such as the electronic speed controller (ESC). Power loss and flight time estimate models for the 3-phase motor driver are calculated and compared using state-of-the-art silicon-based Insulated Gate Bipolar Transistor (Si-IGBT) and wide-bandgap semiconductor duals, i.e. silicon carbide (SiC) and Gallium Nitride (GaN) power transistors.

17. Tkáč, M., and Mésáro, P., 2019, said that drones are useful in improving communication between construction participants and improving site safety; they can also be used to take topographic measurements of huge regions; and they can save time and money by applying aerial photogrammetry techniques.

18. Toleos Jr, L.R., Luna, N.J.A.B.D., Manuel, M.C.E., Chua, J.M.R., Sangalang, E.M.A., and So, P.C., 2020, concluded that this study was able to determine the feasibility of using Fused Deposition Modeling to manufacture propellers for Unmanned Aerial Vehicles by determining.

19. Toyama, S., and Nishizawa, U., 2019, stated that for military and national defence needs, the autonomous underwater vehicle (AUV) has progressed in Europe and America's technical development. However, they are mostly interested in sections of water that are less than 200 metres deep. The appropriate functioning of an AUV aiming at the ocean's deepest depths has yet to be achieved.

20. Van de Straete. H.J, P. Degezelle, J. De Schutter, R.J. Belmans, established a criteria that may be used to exclude any motors that are unable to drive the prescribed load, independent of the reducer's transmission ratio. It's meaningless to include such motors in a cost analysis in the future. As a consequence, this criteria will shorten the time it takes to choose a drive.

21. Vergouw,B.,Nagel,H.,Bondt,G. and Custers, 2016, stated that there must be some kind of connection between the drone and its operator in order to complete a flight. If you're using a camera or sensor, you'll also need to communicate with them. A frequency spectrum is required for this

communication to take place, ensuring worker safety.

22. Xue, X., 2019, has stated that At least four brushless or brushed motors, an ESC, batteries, sensors, and a flight controller work together to power the drone's flying mechanism. The ESC (Electric Speed Control) subsystem regulates the speed of electric motors. They are employed in the most advanced drone models because of their ability to function at the highest levels.

23. Yallappa. D, M. Veerangouda, D. Maski, V. Palled, M. Bheemanna, Using this method, pesticides may be sprayed on rice fields, orchard crops, and crops in hilly locations 34 without the need for human intervention. It helps with coverage, chemical efficacy, and makes the spraying procedure simpler and quicker.

24. Yoon, M has stated that ON duration (PPM) mode may be used with a low frequency PWM signal, whereas duty-ratio mode can be used with a higher frequency PWM signal (usually from 50 Hz to several hundred) (many kHz).

25. Zareei.M.H, D.A. Carnegie, A. Kapur, and D. McKinnon, 2014, stated that the constant buzzing of DC motors is rhythmically and timbrally altered to emphasise the aural aesthetics of some of the most popular electromechanical components in our daily electronics.

Accordingly, this study provides a comprehensive review of drone literature and provides an in-depth look at the current state of drone research. Drones, or unmanned aerial vehicles that can be managed in real time, are the focus of this study, which aims to provide a complete assessment of drone research literature. Real-time control systems ensure that activities be accomplished within a defined time frame since their answers are more predictable. For drones that are expected to execute more complex jobs in the future, this system characteristic is critical.

CHAPTER 3

AIM AND SCOPE OF PRESENT INVESTIGATION

3.1 AIM

The aim of this work is to construct a drone to help farmers chop off their produce from trees at high altitudes in order to avoid accidents.

3.2 OBJECTIVE

The objective of the present study is to:

- Minimize the consumption of time when compared to other technologies
- Use this cutting mechanism to increase the efficiency and decrease human risks.
- Help farmers in multiplying production thereby increasing their harvest.

CHAPTER 4

MATERIALS AND METHOD

The main components used namely drone, propellers, brushless motors, connecting rods, electronic speed controller, batteries etc. Table 4.1 displays the complete classification of material parts that has been used in this investigation.

4.1 LIST OF MATERIALS

Table 4.1 Classification of components

SI.NO	COMPONENT NAME	SPECIFICATION/MATERIAL
1	FRAME	CARBON, ALUMINUM, PLASTIC
2	PROPALLERS	23.88 PITCH & CARBON FIBRE MATERIAL
3	BRUSHLESS MOTORS	180 KV(HOB)X6 12’ SERIES(44.4 VOLT) 1 PARALLEL
4	FLIGHT CONTROLLER(FC)	INTEGRATED WITH SENSORS
5	REMOTE CONTROLLER(RC)	2.4GHz 1.5 KM LINE OF HEAD
6	ECTRONIC SPEED CONTROLLER	7.4V-22.4V
7	BATTERY AND MOTOR WIRES	8Awg-15Awg
8	CAMERA	800 TVL CMOS 1.4 CAMERA
9	BATTERY	16000 mah LiPo battery

4.1.1 Drone

Insect and fungal infestations, soil variation, and irrigation issues can all be seen from a drone's viewpoint. Multispectral pictures display a spectrum perspective of the visible and infrared spectrums. It helps the farmer distinguish between healthy

and unhealthy plants, which aren't always obvious to the naked eye. As a consequence, crop growth and production can be measured from a variety of angles. At any time of day or night, agricultural drones can examine crops, allowing for the early discovery of problems.

4.1.2 Different Types of Copters

Because multicopters (also known as multirotors) often employ fixed-pitch propellers, vehicle motion is controlled by altering the relative speeds of the motors. Aerial photography and land surveys are becoming more popular using radio operated multicopters. Drone Racing, which involves the use of multicopters for racing and freestyle competition, has recently become a hot topic.

The number of motors employed is used to classify them; for example, a threemotored multicopter is referred to as a tricopter.

There are many types of multirotor. Some of them are listed below.

- Bicopter
- Tricopter (Y3, T3)
- Quadcopter (X4, Y4, V-Tail, A-Tail)
- Pentacopter
- Hexacopter (Y6)
- Octocopter (X8)

Flying performance is influenced by the number and location of the propellers.
As an example, the more motors in your vehicle, the more power and lift capacity you'll have, which will allow you to transport more stuff. In the event of a motor failure, having more motors implies having more redundancy. However, there is a decline in power efficiency, as well as an increase in the cost of obtaining new gear and maintaining it.

4.1.3 Quadcopter

Fig.4.1: Quadcopter

X4 quadcopters, as shown in Fig 4.1, have four motors mounted on a symmetric frame, with each arm typically 90 degrees apart. Two motors revolve CW (clockwise) while the other two rotate CCW (counterclockwise) to maintain balance (opposite force). This is the most popular multirotor design and the simplest mechanical structure. It's often used in drone racing as a "small quad." The two major configurations are X and +. The X configuration is more common since the propellers are hidden from view (for FPV and aerial filming). It's easy to use and flies like an aeroplane in the plus (+) mode. This method makes determining the orientation much easier. Cameras may be placed far front in the frame to avoid propellers from obscuring the vision. There's often a controversy regarding whether X or H is preferable to make, particularly in the micro quad community counterclockwise).

4.2 FRAME

Most of the drone frames are made from carbon fiber composition. Almost all the UAV’s structures are made of carbon fiber composition owing to its strength and less weight. In recent times, structures are made from aluminum and titanium in addition to carbon fiber composition. Fig. 4.2 represents the frame of the machine.

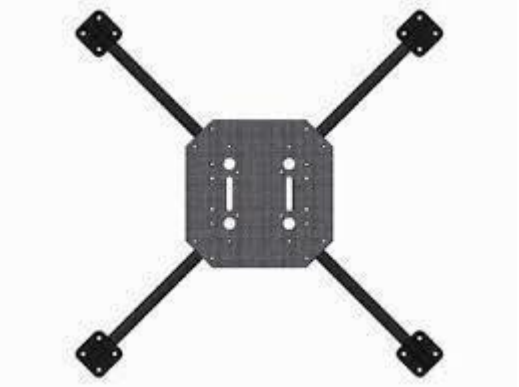


Fig.4.2: Frame

4.3 PROPELLERS

Fig.4.3: Propellers

The blades of UAV propellers are built of a range of materials, including carbon fibre and plastic. As a result of the carbon fibers' stiffness, which reduces vibration, as well as their smaller weight and greater strength than plastic, the blades' reduced inertia allows for faster changes in speed. Fig.4.3 represents the propellers that were used in this investigation.

- Rotational motion is converted to linear motion by use of mechanical devices known as propellers.
- The pressure difference between the top and bottom surfaces of the propellers of a drone's rotor creates lift for the aircraft.
- Air is accelerated in one direction, which creates lift, which is the

antigravitational force.

- The propellers of multirotor drones, such as Hexacopter, Octocopter, and Quadcopter propellers, are stacked in pairs and spun clockwise or anticlockwise to ensure balance.
- These propellers allow the drone to vary its yaw and roll, as well as hover, ascend, and plummet.
- In order to modify the propeller's speed, an Electronic Speed Controller changes the voltage provided to the propeller's motor (ESC).
- Drone propellers may have two, three, or four blades.
- Due to the bigger surface area moving through the air, propellers with more blades provide more lift each revolution but are less efficient because of the increased drag.
- Those with shorter battery lives will benefit from propellers with fewer blades.

Materials used for propellers

- Carbon fiber
- Plastic

Purpose of using carbon Fiber

- Carbon fibre propellers have a higher rigidity than metal propellers, which reduces vibration and improves the drone's flying performance while also making it quieter.
- Also lighter than plastic, carbon fiber is a better choice for aerospace applications, making it possible to save weight.

4.4 BRUSHLESS DC MOTOR

Fig.4.4: Brushless DC Motor

- Brushless motor, like a brushed motor, works by reversing the windings inside the motor.
- As observed in Fig 4.4, there are no brushes required since it's an inside-out brushed motor.
- There are no brushes required since it's an inside-out brushed motor.
- Brushless DC motors have permanent magnets on the rotor and electromagnets on the stator. In order to enable the rotor to revolve in all directions, an electronic speed controller (ESC) controls the charge applied to the stator's electromagnets.

Advantages

- Brushless DC motors have a longer lifetime than brushed DC motors since they don't have brushes. They also need less maintenance.

- With an average efficiency of 85-90 percent compared to 75-80 percent for the brushed DC motors, brushless DC motors are somewhat more energy efficient.

4.4.1 BLDC motor for the outrunner

- An out runner brushless DC motor is similar to a gimbal motor, but instead of rotating the motor's outer casing around a fixed centre, it spins the motors outside casing around a fixed centre.

- Because these motors have a larger number of poles, they spin at a slower rate than other kinds of motors.

- However, because of the greater number of poles and external spin, it produces more torque than many other brushless motors, making it attractive in applications that need more torque in a smaller compact.

- Model applications, such as model aircraft and such, are the most popular use for these motors outside of industrial and commercial applications.

4.5 FLIGHT CONTROLLER

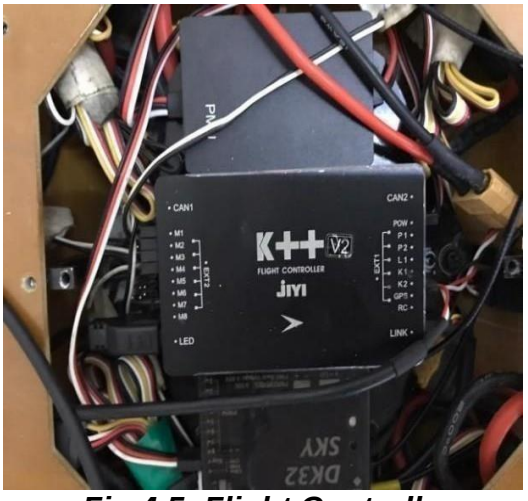


Fig.4.5: Flight Controller

- An FC is a small circuit board, as shown in Fig 4.5 that can perform a wide range of tasks. Its primary function is to regulate the speed of each motor in response to input.
- In response to the pilot's request, the flight controller determines which motors need to be turned on in order to propel the multirotor forward.
- The drone's brain is the flight controller.
- Sensors on the board detect the movement of the drone and the user's commands.
- This information is used to alter the drone's motor speed, enabling it to go in the direction it was programmed to.

4.5.1 Type of Flight Controller in Drone:

- K++, K++pro
- K++V2
- K3, K3Apro
- Topxgun TIA

4.6 TRANSMITTER

Fig.4.6: Transmitter

- Radio waves are used by the Transmitter, as shown in Fig 4.6, an electrical device, to transmit commands to the Radio Receiver, which is connected to the remote control drone.

- To put it another way, it's a piece of equipment that converts the pilot's commands into multirotor movement.

4.6.1 Basic commands in Transmitter

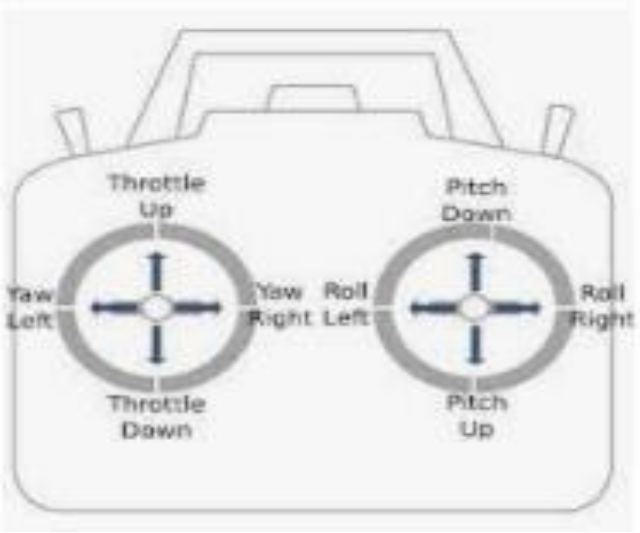


Fig.4.7: Basic Commands in Transmitter

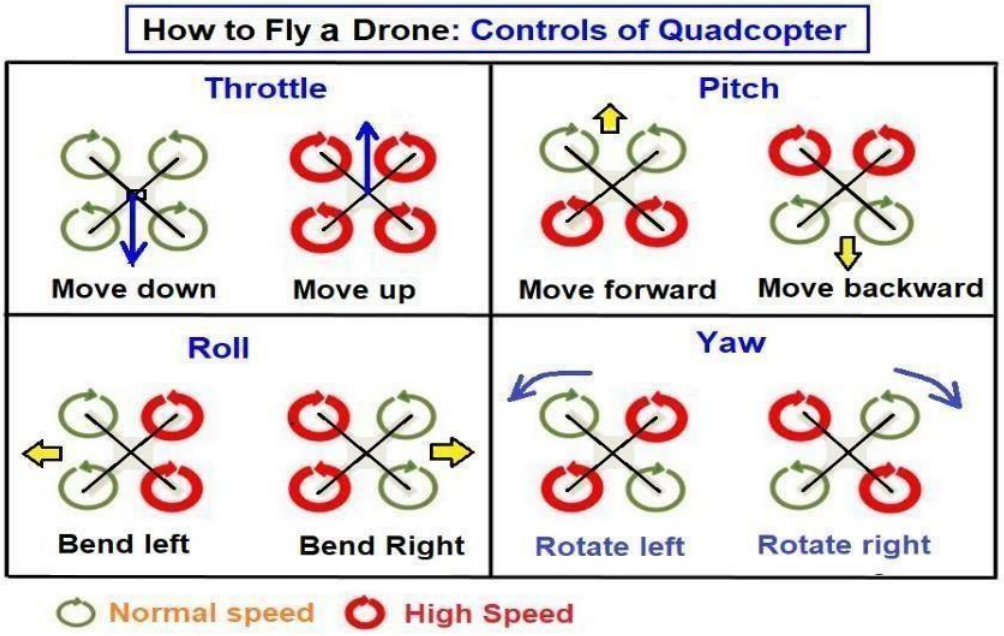
CH 1 - Roll CH 2 - Pitch CH 3 - Throttle CH 4 - Yaw

Channels are used by an FPV Drone Radio Transmitter to convey orders. Each channel represents a separate action transmitted to the aircraft. The basic commands in a controller are represented in Fig 4.7.

Roll. The "rolling" of your drone is accomplished by moving it to the left or right in the air.

1. **Pitch**. By tilting your drone, you may move it forward or backward.
2. **Yaw**. Rotate your drone in either a clockwise or counterclockwise direction to create airborne patterns and circles.
3. **Throttle**. Push the left stick forward to increase. Pull the left stick backward to decrease. This changes the drone's altitude, or height.

4.6.2 Basic Movements and Stick Modes



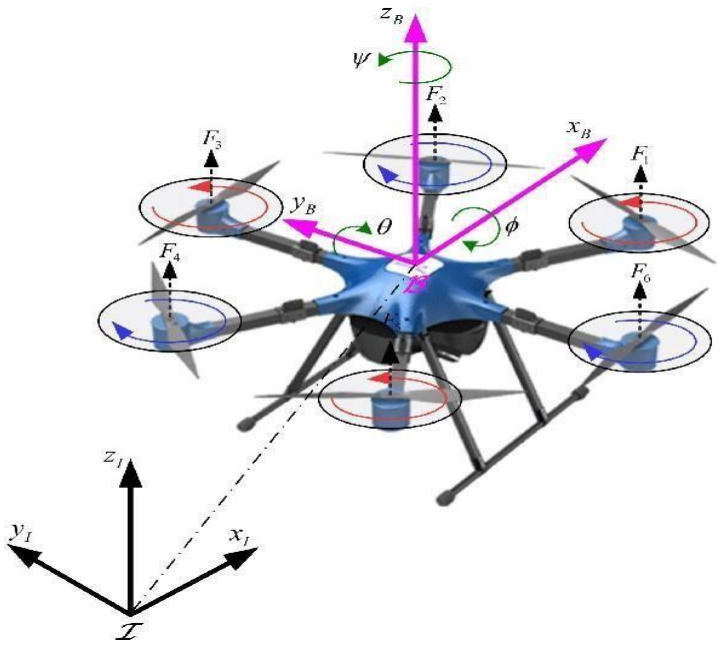


Fig.4.8: Basic movements and stick mode

Fig.4.8 shows the different ways to control the Quadcopter via a remote control. The basic movements and directions are shown accordingly. In order to do an action, the steps that are mentioned must be used appropriately to control the Quadcopter.

4.7 RECEIVER

- Radio signals from the drone controller are received by a built-in antenna in the drone receiver, as shown in Fig 4.9.
- However, the drone controller's signals aren't the only ones that the receiver receives. Alternating current pulses are generated as a result of this process.
- Flight controllers receive this data and utilize it to control and fly the drone in line with the original radio signals.

Fig.4.9: Receiver

4.8 ELECTRONIC SPEED CONTROLLER (ESC)

Fig.4.10: Electronic speed controller

The electrical circuits that regulate the speed of DC motors are known as electronic speed controllers (ESC). It also has options for dynamic braking and reversing. Fig 4.10 represents the ESC.

Electronic Speed Control's Purpose:

- A speed reference signal is used by an ESC, or electronic speed control, to adjust the speed of a switching network of field-effect transistors.
- The switching frequency or duty cycle of the transistors may be modified to vary the motor speed.
- Different types of speed controls are required for BLDC motors since the speed of the motor may be changed by altering the voltage on the armature.
- This kind of motor requires a variety of operating rules, such as adjusting the timing of pulses for current supplied to the various motor windings to modify the motor speed.

4.8.1 Components used in ESC

1. Solder pads for the three phases of the BLDC motor
2. LIPO connections that are negative (-)
3. LIPO Connection that is Positive (+)
4. A servo signal or a PWM signal input
5. PWM Signal GND Reference

6. Solder a jumper to change the rotational orientation (CW/CCW).
7. A solder jumper is used to change the type of PWM input signal.
8. Turn on the LEDs ESC's applications
    - Vehicles that run on electricity
    - Bicycles with electric motors
    - Electric planes
    - Cars
    - Helicopters
    - Airplanes
    - Boats
    - Quadcopters
    - Firmware for the ESC

4.8.2 Types of ESC

- Brushed ESC
- Brushless ESC

Above mentioned types, we use Brushless ESC because

- When it comes to Electronic Speed Controls, brushless ESC is the most recent technological breakthrough.
- It's also a little more expensive. It is connected to a brushless motor, which provides better power and performance than brushed motors.
- It may also be used for a longer length of time.

4.8.3 ESC design mainly includes the following features

- The topology utilized for controlling the motor
- Compromise among efficiency & cost
- The kind of battery used on the drone
- Necessary performance
- EMC (electromagnetic compatibility) and resistance to interference.

4.9 BATTERY

Fig.4.11: Battery

- Commonly nickel based and lithium based batteries are known, where Fig 4.11 represents the latter.
- Lithium based batteries are mostly used due to best performance.
- Lithium batteries has two most commonly used batteries are:

1. Lithium ion battery (e.g. Mobile batteries etc.)
2. Lithium polymer battery (e.g. Quadcopter, helicopter etc.)

4.9.1 Purpose of using Li-Po Battery

- Li-po batteries are used in drones due to best performance as compared to li-ion battery.
- Li-po battery has less weight
- Li-po battery has High discharging capacity
- Li-po battery can be given required shape

Two Types of Li-Po battery in Drone:

- 6 cell battery and 12 cell battery
- Each Cell has minimum of 3.7 volt and maximum of 4.2V capacity
- 6 cell battery contains 22.3 volt
- 12 cell battery contains 44.4V
- 6 cell battery 16000MAh and 12 cell battery 22000MAh

The following are the seven primary factors that reduce the life of a LiPo battery:

1. Heat
2. Leaving a fully charged lipo for a few days
3. Excessive discharge (voltage & current)
4. Excessive billing (voltage & current)
5. Improper balance
6. Inadequate storage voltage (more on that shortly)
7. Physical damage (dropping, overtightening straps, pulling cells apart, over using/over stretching velcro, etc.)

4.10 GLOBAL POSITIONING SYSTEM (GPS)

Fig.4.12: Global positioning system

- The GPS module, as shown in Fig 4.12, transmits navigational information to the Controller (longitude, latitude, and elevation).
- In the event of a connection loss, this module helps the controller recognize the path taken and safely return to its starting point.

4.10.1 Landing Rods

- Small drones do not need landing gear. Larger drones, on the other hand, need landing gear to minimize damage when landing.
- The landing gear required varies depending on the drone's capabilities.

4.10.2 Power Distribution Board (PDB)

PDB’s essentially distribute the power from the battery to the ESC. Additionally, it also minimizes the additional load stress on Flight Controllers and filters electrical noises usually better than most. Fig 4.13 represents the PDB.

Fig.4.13: Power Distribution Board

4.10.3 Power Management Unit

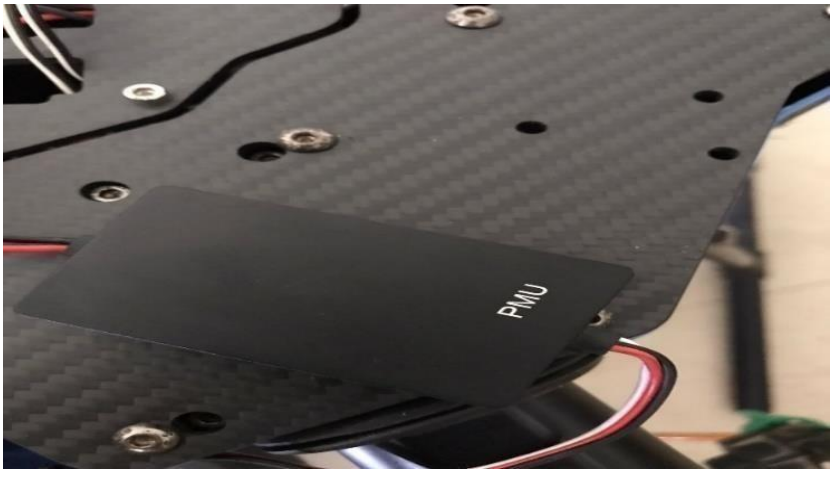


Fig.4.14: Power Management Unit

Digital systems' power management is handled by the Power Management Unit (PMU), a microprocessor, as shown in Fig.4.14. Input/output functions, clocks for measuring periods of time, analogue to digital converters for monitoring the voltages of the computer's main battery or power source are all included in this microchip, which contains many of the same components as a standard computer. Only the PMU, which is powered by a backup battery, stays active even when the computer is completely shutdown.

The PMU is in charge of coordinating several functions in portable computers, including:

- Keeping an eye on power connections and battery levels
- Recharging batteries as needed
- Managing the flow of power to other integrated circuits
- Turning off non-essential system components when they are not in use.
- Managing sleep and energy levels (On and Off)
- Managing the built-in keypads and touchpads of portable computers
- Keeping the real-time clock in check (RTC)

4.11 CUTTING MECHANISM AND BLADE SELECTION

Fig.4.15: Cutting Mechanism and Blade Selection

Blade Selection Guide

Operation	Type of Blade	Blade Feature
Cutting Wood	Standard blades Rip-cut blades Crosscut blade Framing blade	Made out of steel 20 – 40 Teeth 40 – 80 Teeth 24 Teeth
Plywood	Fine plywood blade	100 -160 Teeth
Metal Cutting	Non-Ferrous Metals Carbide-tipped steel blades	Aluminum, brass, copper 60-100 Teeth RPM: 3000-6000
Metal Cutting	Ferrous Metals 1. Carbide-tipped steel blades 2. Abrasive Discs	Cast iron, steel, pipes and channels 30- 80 Teeth RPM: 1800-3500
Masonry (Concrete, Tiles) Diamond Blade	Continuous Rim Blades Turbo Rim Blades Segmented Blades	No teeth- Clean Finish Serrated. Cuts brick & concrete Most aggressive, for fast cutting.

4.12 CIRCULAR SAW BLADE

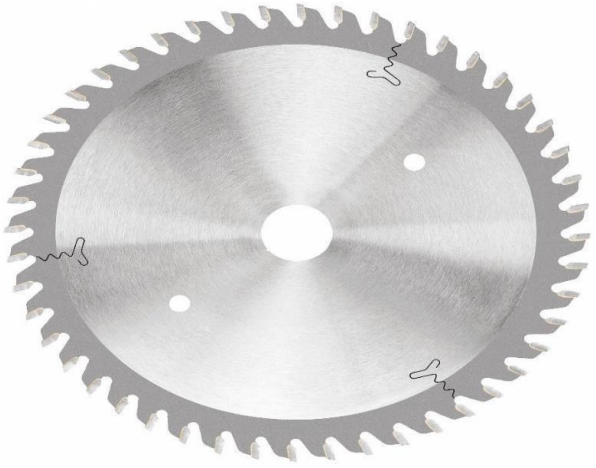


Fig.4.16: Circular saw blade

A circular saw is an extremely important instrument that can be found in practically any workshop. For a circular saw to work well, the parts that go into it must be of high quality, just as with any other power instrument. A circular blade looks similar to that in Fig. 4.16.

4.12.1 Circular Saw Basics – Hook angle and kerf

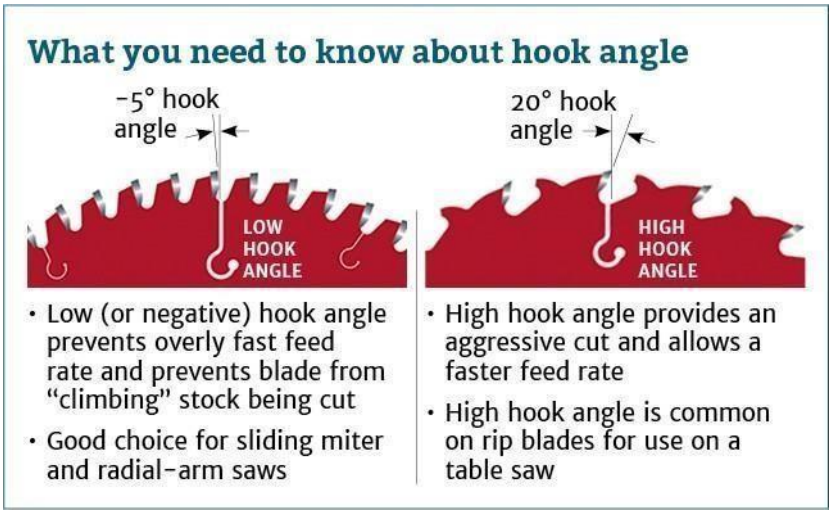


Fig.4.17: Circular saw basics

When purchasing a circular saw blade, there are two more factors to consider. First, there's the concept of a hook angle. Saw blades are available at a variety of hook angles, ranging from roughly 20 degrees to -5 degrees, as displayed in Fig 4.17. To cut through soft fabrics, the blade's hook angle should be as wide as possible. Because of this, if you want to cut through a lot of softwood quickly, utilize blades with a greater hook angle. On the other hand, blades with a lower hook angle offer more precise cuts, but they do it at a much slower speed.

Another essential topic is the kerf number of a blade. This is merely a fancy way of describing the thickness of a blade. Thicker blades (i.e., those with a greater kerf value) are better at cutting through tougher materials and are also more durable. Blades with a low kerf number (also known as thin blades) are better for making smaller, more accurate cuts, but they are less durable and less effective for cutting through larger amounts of material.

4.12.2 Types of circular saw blades

Depending on its intended application, circular blades come in a range of forms and sizes. Cutting metal and masonry requires diamond blades, but a typical set of carpentry saw blades may be used to cut wood.

4.12.3 Standard circular saw blades

In addition to a wide range of sub-varieties for a variety of woodcutting applications, they are great at cutting wood. Blades are available in a wide range of sizes and forms.

4.12.4 Rip-cut blades

Fig.4.18: Rip cut blades

The number of teeth on these blades varies widely; some have as little as 16 and others as much as 40, as displayed in Fig.4.18. Because there are fewer teeth, you can cut more aggressively and produce bigger slices.

4.12.5 Framing Blades

Fig.4.19: Framing Blades

"Framing blades" are a kind of rip-cut blade that is closely connected to rip-cut blades. It is common for these blades to have merely 24 teeth, yet they are engineered to deliver powerful and quick cuts. When speed and volume are more important than precision, rip-cut and frame blades shine. It can be seen in Fig.4.19.

4.12.6 Crosscut blades

Fig.4.20: Crosscut Blades

The number of teeth on these blades is greater. The tooth count on these blades is typically between 60 and 80, as shown in Fig.4.20. The more teeth you have, the more accurate and clean your cuts will be while cutting through wood.

4.12.7 Plywood blades

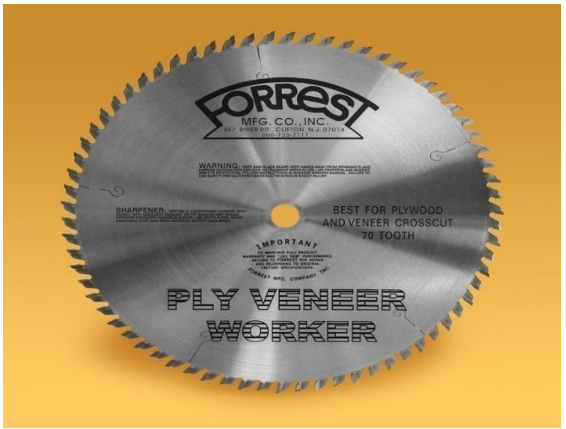


Fig.4.21: Plywood Blades

The largest number of teeth seen on a commercial saw blade may be found on these blades. The blades often contain more than 100 teeth, as displayed in Fig.4.21. With these blades, the objective is to get the most precise cut possible while causing the least amount of damage or ripping to the wood as feasible.

4.12.8 Abrasive blades

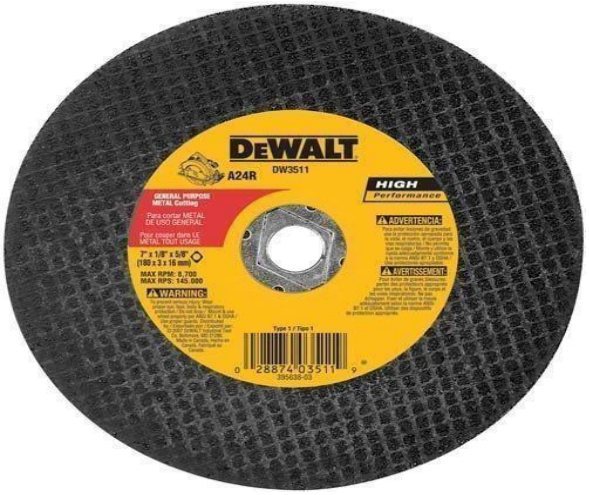


Fig.4.22: Abrasive Blades

Saw blades with abrasive blades, often known as discs, are a distinct kind of saw. Unlike standard circular saw blades, they do not "cut." Abrasive discs, as shown in Fig.4.22, on the other hand, function in a similar way as grinders. Abrasive discs are typically made of a variety of abrasive materials. Silicon carbide and aluminum oxides are two of the most frequent materials used to manufacture abrasive circular saw blades. Disc abrasives are excellent for slicing through dense materials such as steel. They may also be used for masonry work, albeit a diamond blade is a better option.

4.12.9 Diamond Blades

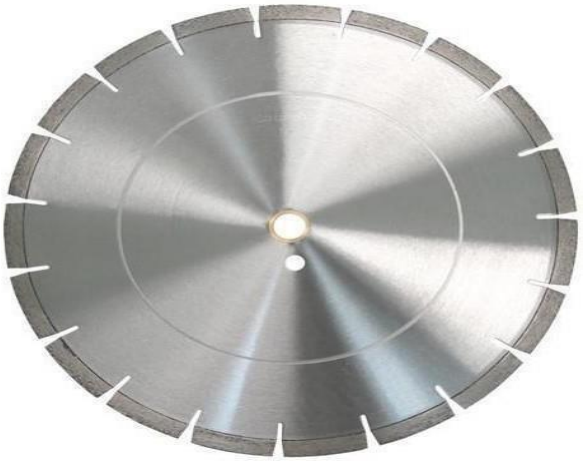


Fig.4.23: Diamond Blades

These blades are made of steel and have a sprinkling of faux diamonds, which can be seen in Fig.4.23. For the most part, diamond circular saw blades are used in masonry work. Using these blades, you can cut through a wide range of hard materials, including concrete and brick.

4.12.10 Continuous rim blades

Fig.4.24: Continuous rim Blades

As witnessed in Fig.4.24, the biggest difference between these blades and conventional circular saw blades is that they do not have teeth. These blades are made particularly for cutting through materials like tile. As a result, they're not well adapted to cutting through wood; normal circular saw blades are preferable for the task.

4.12.11 Turbo rim blades

Fig.4.25: Turbo rim blades

Unlike continuous rim blades, which have teeth, turbo rim blades lack them, as shown in Fig.4.25. They have a lot more cutting power out of the box since they are serrated. To cut through tough materials like concrete or brick, turbo rim blades are the saw blades of choice.

4.12.12 Segmented blades

Fig.4.26: Segmented Blades

Diamond edges are ringed around the edges of segmented blades, as shown in Fig.4.26. Turbo rim blades and continuous rim blades have a gullet that separates one edge from the other. Segmented blades may produce a lot of cutting force because to their gullets, but with less precision and surface polish. With a segmented blade, you'll have no problem slicing through tough materials like oak or concrete or brick quickly and safely.

4.13 WET VS DRY CUTTING

Fig.4.27: Wet Vs Dry Cutting

There are certain diamond circular saw blades that can be used for wet cutting, while others can only be used for dry cutting. Depending on the circular saw one has and the project one works on, we can know which one to use. Fig.4.27 distinguishes between Wet and Dry Cutting.

4.14 DRY CUTTING

If you have a small circular saw or a cordless circular saw, dry cutting blades may be your only option. For intermittent cutting, dry cutting is advised. If you're working on a home repair project with limited room, a dry cutting blade is a terrific option.

4.15 WET CUTTING BLADES

When cutting wet, water is used to cool the blade and remove dirt from the cutting surface. For tile cutting, wet cutting is preferred since it is faster and cleaner. Additionally, wet cutting extends the life of the instrument. Wet cutting is not supported by all electric circular saws due to the danger of electric shock.

4.16 BLADE SIZE

It is possible to buy circular saw blades in a wide variety of sizes. This is important to keep in mind since certain saws only accept specific blade sizes. It is only possible to use a smaller circular saw blade (such as a 7-inch blade) with an even smaller circular saw (such as a handled model). Also, for devices with a bigger cutting capacity, such as a table saw, you may use larger blades (such as 12-inch blades). Blades having a smaller diameter cut more deeply than blades with a larger diameter, as is obvious.

4.17 CAD DIAGRAM

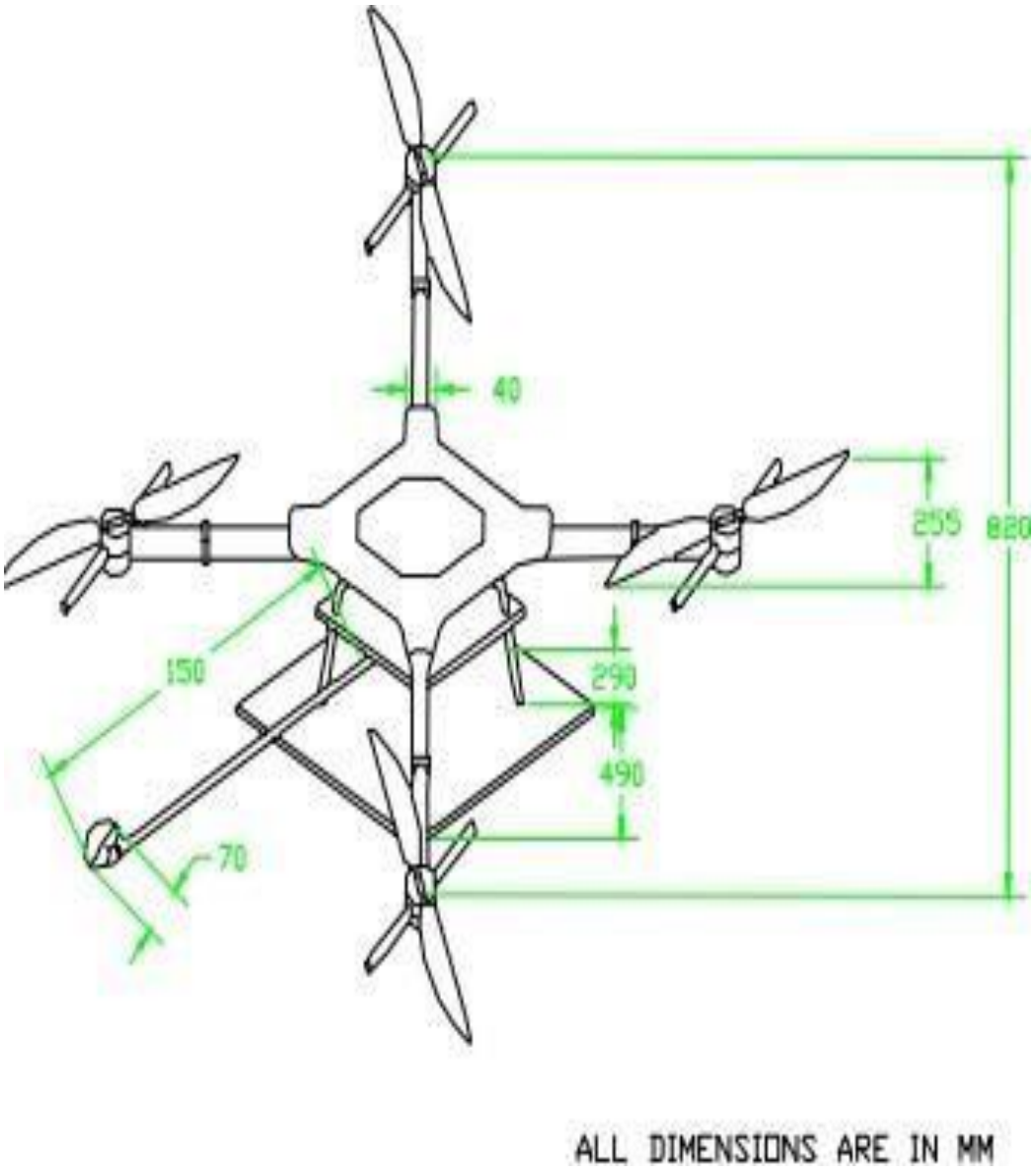


Fig.4.28: ISO Model of Drone

The Fig .28 represents the ISO Model of the said Drone that was realized using a modelling software. The dimensions are as given in the image, wherein they were geometrically retrieved.

4.18 MOTOR & PROPELLERS

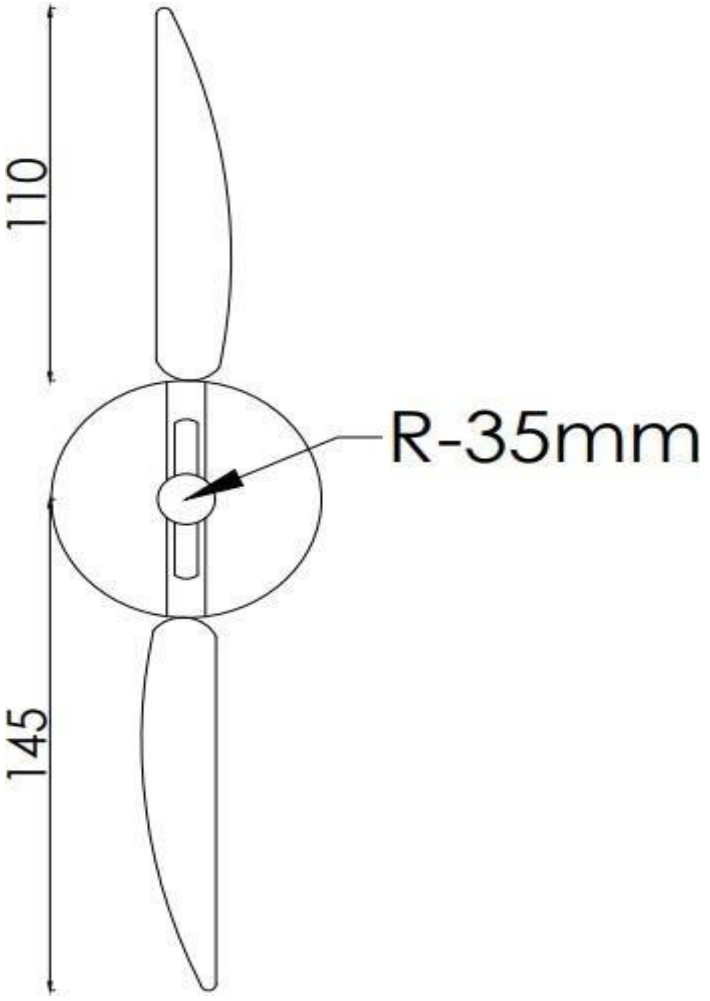


Fig.4.29: Motor & Propellers

The motor runs at a speed of 180 KV and as this motor is connected in series with the propellers they run at the same speed as that of motor. Fig.4.29 geometrically represents the dimensions of the said part.

4.19 ELEVATION DIAGRAM

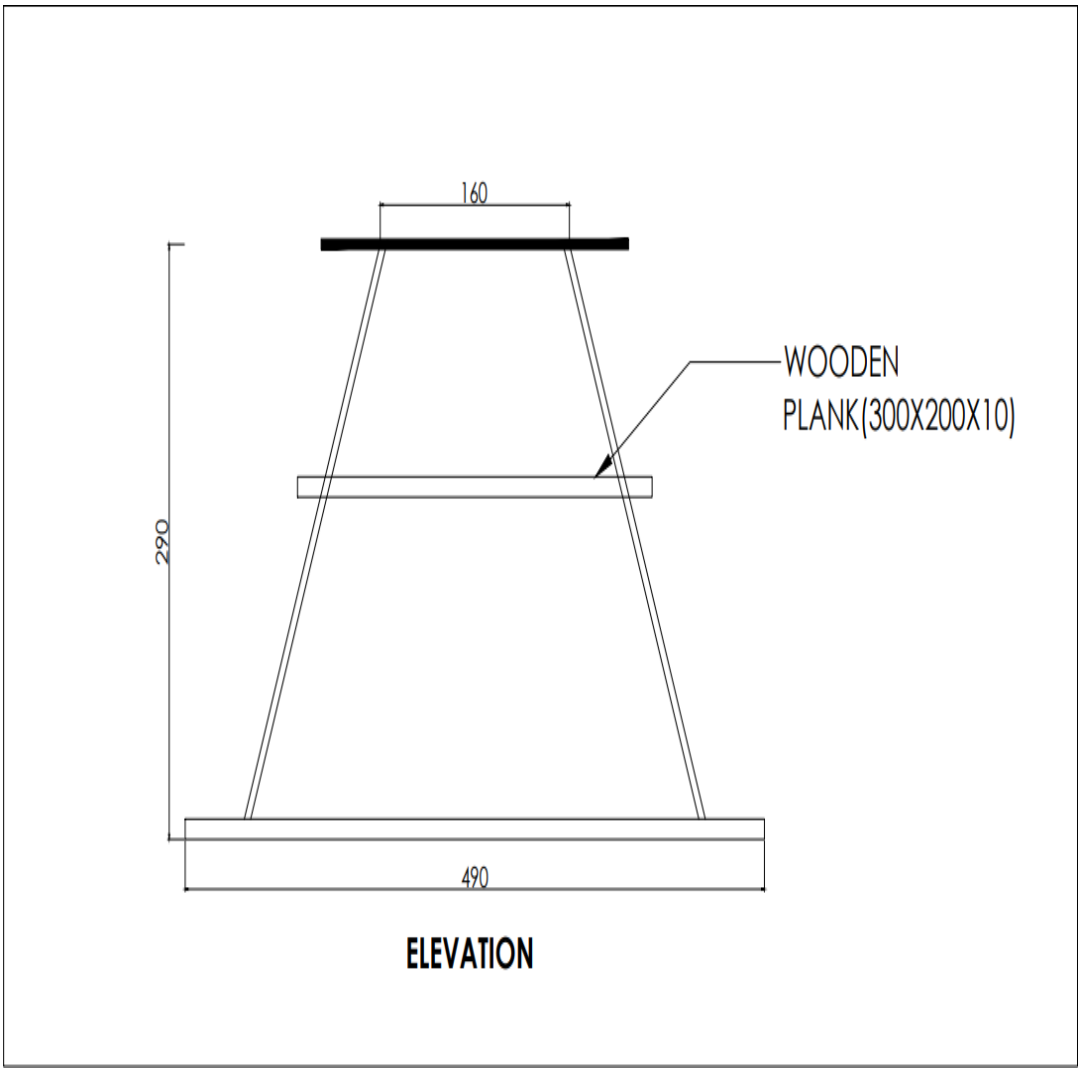


Fig.4.30: Elevation diagram

Fig.4.30 represents the Elevation Diagram, which helps us to identify the elevation of the drone from the surface when it is stationary and to simply hold the drone in one place.

4.20 TRANSMITTER

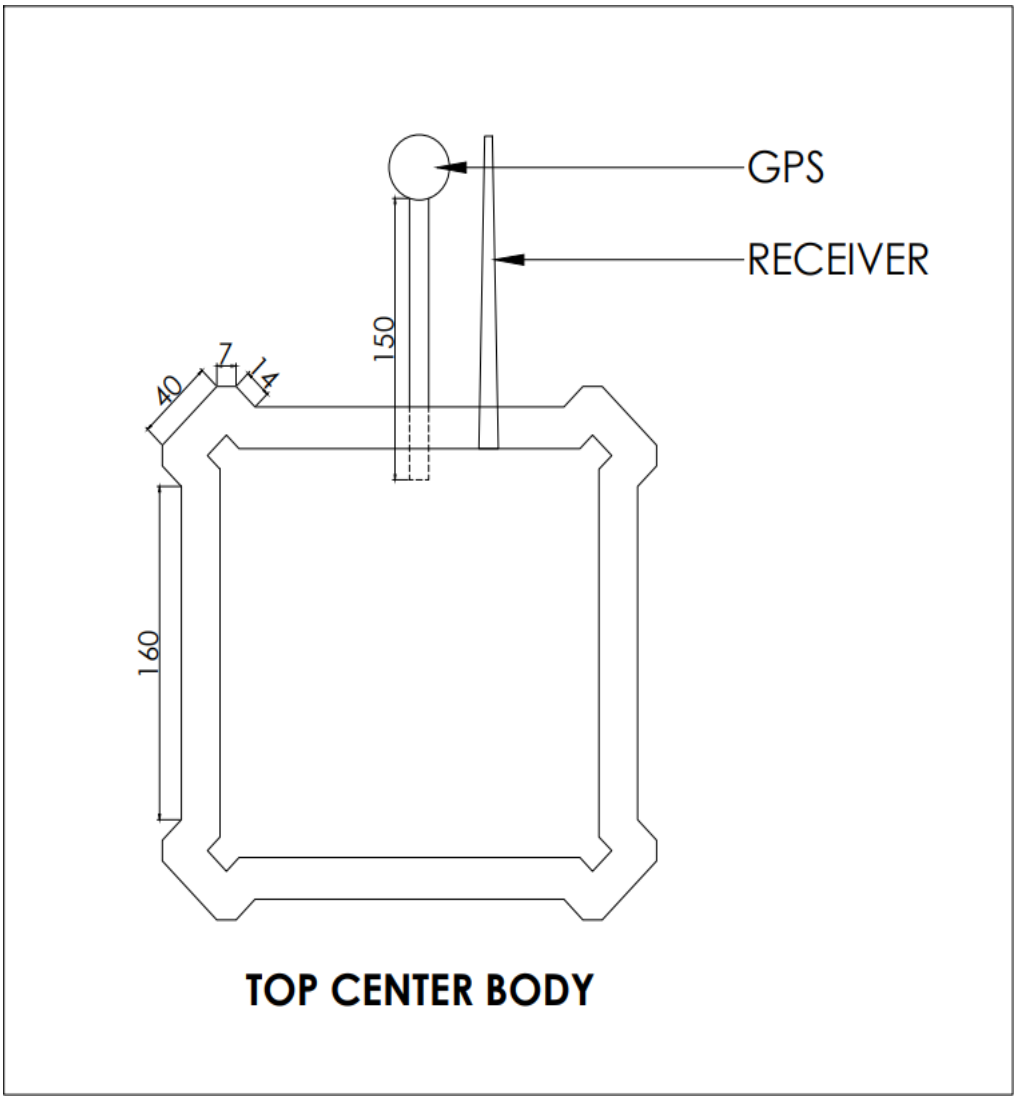


Fig.4.31: Transmitter diagram

A transmitter is an electronic device that transmits signals and commands wirelessly via a set frequency of radio over to the receiver, which is remotely connected to the drone. A diagram of the transmitter has been shown in Fig.4.31.

4.21 CALCULATIONS

$L_1+D_1+m_1g+m_1G_1V_1 = L_2+D_2+m_2g+m_2G_2V_2$

In terms of V is the equation

$270+70+(90*9.81)+90(V_1)(6.67x10^{-11)}= 820+490+(750*9.81)+(750*6.67x10^{-11})V_2$

$1102.9\ V_1 = 8667.5\ V_2$

$\mathbf{V_1/V_2 = 7.85}$

7.85 is the standard elevation of drone with respect to Gravitational Constant

Hence, the equilibrium is maintained by the propeller to maintain the weight of the drone along with the speed at which the blade rotates

L_1 = Length of the Blade

D_1 = Diameter of the Blade

m_1 = Mass of the Blade

L_2 = Length of Drone Axis

D_2 = Diameter of Drone Body

m_2 = Mass of Drone

CHAPTER - 5

RESULTS

Fig.5.1: Fully constructed and operational UAV Drone

As shown in Fig.5.1, the fully operational and constructed drone is ready for use. Prior to earlier calculations, it was flown and tested to meet the objectives of the investigation. Furthermore, the configurations and the capacity of the drone was checked before it went airborne.

CHAPTER - 6

CONCLUSION

We would like to conclude the project by re-caping the things we did with our project first we made a drone which compact in size that can be able to travel through the fields without any commotion in the field or any damage to the plant and we have connected a rod which is of 1 meter length for the extension of the cutting mechanism. The main purpose of using the 1 meter rod is to place the drone in certain distance without causing any damage to the propellers. Firstly we have constructed a frame which suitable for our idea. Then we attached hobby wing 180kv kde motors to the frame. And we connected 380kv kde motor to the connecting rod to mount the circular saw blade. After mounting the circular saw blade we have to check the connections given properly connected. As the drone can travel at a radius 1 km and at an altitude of 30 m sufficient enough to cut the fruits which are in high altitudes. We can attach a camera to the drone which helps in identifying the fruit which we wanted to cut. This drone can help our farmers and reduces human harm. As the drone can reach high altitude where farmers can't climb and it also reduces the time and also reduces the risk factors involved in the cutting process. These type of drone can be used under any conditions and it's possible to make it work. And this the drone which help our farmers and also reduces the accidents occurring in cutting high altitude fruits.

With this we would like to conclude the above project.

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