DESIGN AND FABRICATION OF DRONE FOR GRAIN TYPE PESTICIDES, SEED DISPERSAL

A project report submitted in partial fulfilment of the requirement for the award of the degree of

Bachelor of Technology
in
Mechanical Engineering

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ABSTRACT

Drones, also called Unmanned Aerial Vehicles (UAV), have witnessed a remarkable development in recent decades. In agriculture, they have changed farming practices by offering farmers substantial cost savings, increased operational efficiency, and better profitability. The goal of this project is to build, modify, and improve an existing agriculture quadcopter .The project used a Quadcopter material that included motors, electronic speed controllers, flight controller, batteries, a transmitter, a receiver and 3D printed frame. Individual Motor was tested with Arduino board and verified to work properly.

Agricultural pesticides and seeds dispersal is a very labour-intensive task with various problems faced in manual process. Human spraying may lead to inadequate or spraying of pesticides in certain parts of field, also it is not safe to handle pesticide as exposure can cause skin and breathing problems in human. So, flapper mechanism was developed that consists of horizontal blade rotates while the pesticide from storage tank flow through the vacuum will be sprayed to the required place in field.

This project aim is to design an agriculture drone with additive manufacturing process. various parts of drone like frame, flapper mechanism attached with storage tank is designed in the Autodesk FUSION software and then printed with the help of 3D printer(material -PLA), then they are assembled with addition to various components like servo motors etc. Overall, aim of the project is to develop a drone and spray the materials with the help of flapper mechanism.

Keywords : Agricultural pesticides, Unmanned Aerial Vehicles (UAV), Spray materials, Seeds dispersal , Autodesk FUSION software, 3D printed frame, Polylactic acid, Agriculture, Labour-intensive task**,** Inadequate spraying

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NOMENCLATURE

UAV	Unmanned aerial vehicles.
IOT	Internet of things
GPS	Global Positioning System
RPV	Remotely piloted vehicle
RGB	Red Blue Green
BLDC	Brushless DC Electric Motor
DC	Direct Current
Li-Po	Lithium Polymer
ESC	Electronic Speed Controller
RPM	Revolutions per minute
CNC	Computerized Numerical Control
CAD	Computer aided design
TPU	Tensor Processing Unit
STL	Standard Triangle language
PLA	Polylactic acid
BEC	Battery Eliminator circuit
APM	Ardupilot Mega
USB	Universal Serial Bus
LCD	Liqiud crystal display

CHAPTER 1

INTRODUCTION

Our nation's primary industry is agriculture, yet when it comes to adopting technologies for greater farm productivity, we still lag far behind other nations. The overall amount invested in the agriculture industry has expanded by 72 to 80% over the last 5 to 6 years. This investment's primary goal is to increase production by at least 70% by the year 2050. The most crucial component of smart farming and precision agriculture is remote sensing. The future of remote sensing in Precision Agriculture and smart framing is thought to be UAV-based IOT technologies. Because pesticides are the primary means of destroying pests, pesticides are a bigger problem for farmers than bugs. As a result, drones are employed to spray urea and pesticides to boost crop yield.

1.1 DRONE

The drone's technical definition. These three definitions are, in my opinion, the best for elucidating what a drone is.

- The majority of dictionaries define a drone as an unmanned aircraft or ship controlled remotely or by computers on board
- A drone is a flying robot that may be controlled remotely or can fly independently using software-driven flight plans in embedded systems in conjunction with onboard sensors and GPS
- Unmanned aerial vehicles (UAVs) or Drones are aircraft with no on-board crew or passengers. They can be automated 'drones' or remotely piloted vehicles (RPVs)."

1.2 TYPES OF DRONES

To design a drone first we have to calculate our payload, then with respect the load of payload motor, electronic speed controller, Propeller, Battery has to be selected. Battery has to be selected by knowing the voltage and current requirement of the components. Then the thrust requirement has to be calculated and the design of frame decided by determining the required arm number, arm length.

1.2.1 Quadcopter

The prefix Quadcopter implies (Quad= Four), It is a drone design where there are four arms.

We have witnessed a significant increase in the production and sales of quadcopters, remote-controlled aircraft, over the past few years. These unmanned aircraft are equipped with fixed pitch propellers that may be configured in either an X or + configuration, with an X configuration being preferred. They feature four arms.

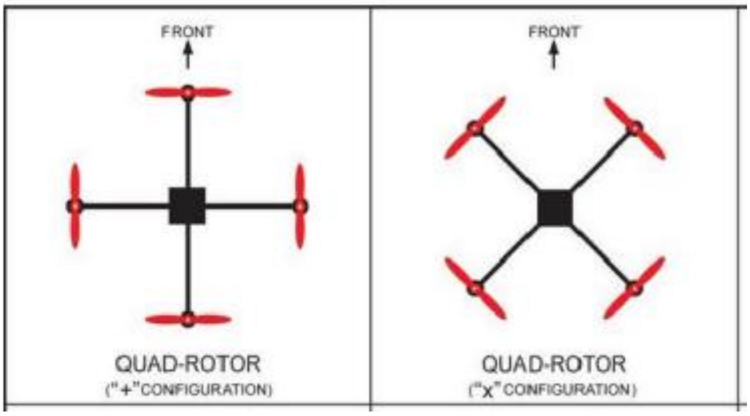


Figure 1.1 quadcopter

1.2.2 Hexacopter

The prefix Hexacopter implies (Hexa= Six), It is a drone design where there are Six arms.

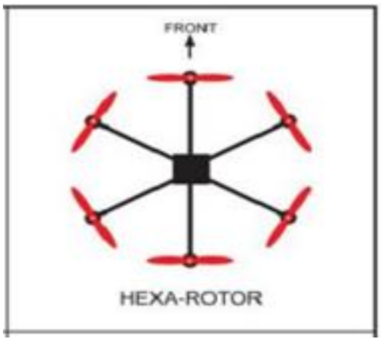


Figure 1.2 Hex copter

1.2.3 Octocopter

The prefix Octocopter implies (Octo= eight), It is a drone design where there are eight arms.

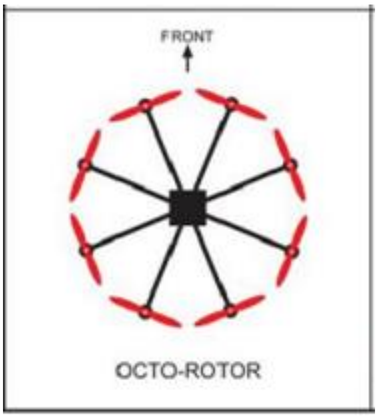


Figure 1.3 Octocopter

1.3 CLASSIFICATION OF DRONES

The maximum total weight of drones, including payload, should be categorised as follows.

- Micro drone: weighing more than 250 grammes but not more than 2 kilogrammes.
- Nano drone: less than or equal to 250 grammes
- Small drone: weighing more than 2 kilogrammes but not more than 25 kilogrammes.
- Medium drone: weighing more than 25 kilogrammes but not more than 150 kilogrammes.
- Big drone: weighing more than 150 kilogrammes.
- Male: Long Endurance, up to 30,000 Feet, Medium Altitude, Range Over 200 Kg
- Hale: High Altitude, Long Endurance, Range Over Indefinite, More Than 30,000 Feet.

Drone	Payload	Application
Sprayer Drone	Sprayers with Water pump	• Pesticide Spraying • Fire Prevention
Agriculture Drone	Sprayers, Seed Spreaders, Water Tanks, Imaging sensors	• Agriculture spraying, • Precision Spreading • Crop Monitoring • Soil health Monitoring
Surveillance Drone	Multispectral Sensor	• Industrial Area, • Public Gatherings • Coastal Inspections • Search and Rescue • Industrial Inspections
Delivery Drones	Parcels, Packages, Medicine Boxes	• Logistics • Transportation of Emergency Supplies
Mapping Drones	RGB sensor	• Land Surveying • Marine • Wildlife conservations • Constructions
Nano drones	Optical Cameras Tracking systems	• Photogrammetry • Military Inspections • Law Enforcement • Surveying

Table 1.1 Drone w.r.t payloads and applications

1.4 DRONE ARCHITECTURE

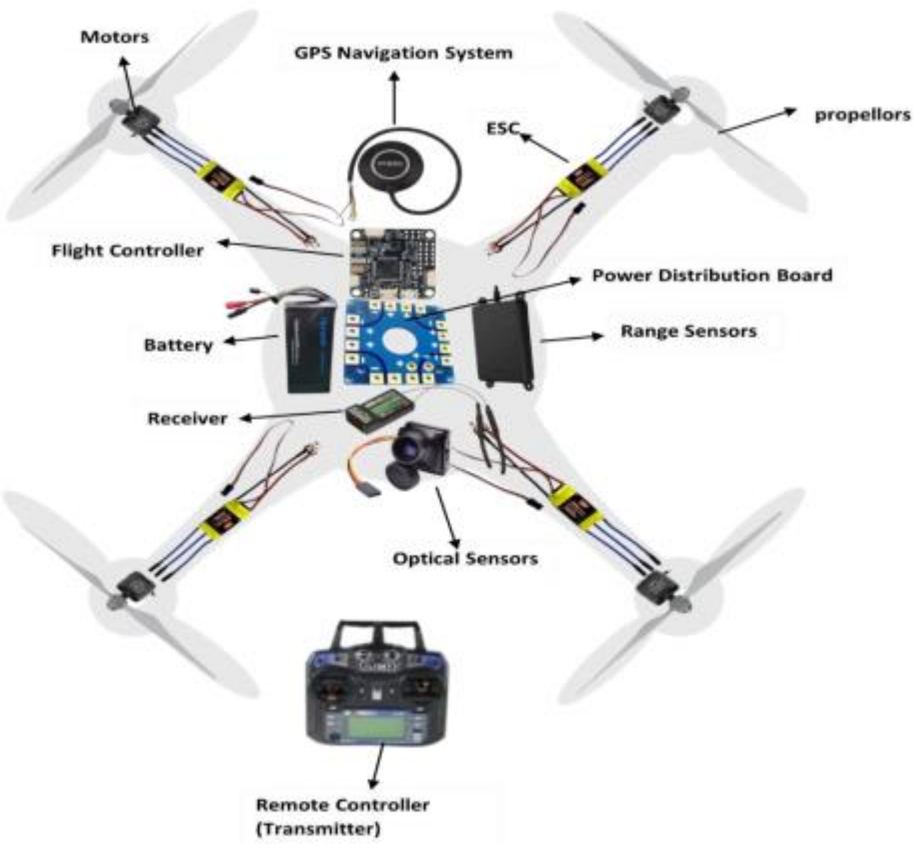


Figure 1.4 Drone & receiver

1.5 DRONE COMPONENTS

A) Frame

The drone's frame is crucial for sustaining all of the components. It is important to take the weight of the frame into account because a heavy frame would make it harder to lift the drone. We made the decision to construct the drone with a lightweight hardwood frame after carefully weighing all the factors

Figure 1.5   Frame

B) BLDC Motor

Brushless DC motors are also referred to as synchronous DC motors or commutated motors. These motors are driven by batteries through an inverter or electronic speed controller, which creates an AC current to drive each phase of the motor. The controller provides pulses of current to the motor winding which control the torque and speed of the motor. The rating of BLDC motors depends on the payload estimation. For our application, we are using the 1400 KV rating of motor which gives us approximately 1000gms thrust with 1145 propeller.

Figure 1.6 BLDC Motor

C) LiPo Battery

BLDC motors required high current for working. This high current flow capacity depends on the discharge rate of battery., Therefore here we used LiPo battery as this battery has high discharging current rating. For our application as per the motor rating we are using 2200mAh battery

Figure 1.7 Battery

D) Electronic speed controller

An Electronic Speed Controller is electronic circuit which is used to control the speed of BLDC motors, its direction I and also act as dynamic brake. For our application we are using 30A rating ESC. We decided this as per motors, battery and propeller specification.

Figure 1.8 Electronic Speed Controller

E) Propeller

As per the frame size and motor rating, the size of propeller is selected. Thus, we are selecting the propellers of size 11" and weight 25 gms each.

Figure 1.9 Propeller

F) Flight Controller

Flight controller helps to drive the drone by taking stability, speed, acceleration, gyro in consideration. We choose the KK 2.1.5 controller for this. The fundamental benefit of these KK is that calibration is simpler. It has firmware built in.

Figure 1.10 Flight Controller

G) Radio Controller

First, the receiver and flight controller should calibrate the transmitter. After calibration, the transmitter and drone will connect, and the drone will operate in accordance with the transmitter.

Figure 1.11 Radio Controller

1.6 FACTORS TAKEN INTO CONSIDERATION FOR DESIGINING DRONE :

1.6.1 Payload

The Amount of weight a drone or unmanned aerial vehicle (UAV) can carry is known as the payload.Typiccally,it comprises everything added to the drone in addition to the weight of the drone. Such as extra camera,sensors,or packages ,delivery and dank(agriculture tank)

1.6.2 Flight Time

Flight time is considered to be most important feature of a drone which has many different variables affects the flight time or duration of drone in the air.

1.6.3 Manoeuvrability

It is the quality of a drone being easy to move and direct. Manoeuvrability of drone is mostly relay on few different aspects of drone like weight, configuration or type of the drone which should be considered while designing a drone.

1.6.4 Frame Configuration

The configuration of drone in simple terms is the airframe design/type of the drone having number of arms or rotors configured to the air frame which will explain the type of the drone to be design to the requirement.

1.7 BASIC CALCULATIONS TAKEN FOR DESIGNING DRONE

1.7.1 Thrust to weight Ratio

The drone won't take off or respond properly to your control if all of its motors' thrust is less. Even in situations where there is a minor breeze, your drone motors must remain steady and fully operational. A drone with a high thrust to weight ratio will be more agile and accelerate more quickly, but it will also be more difficult to manage.

For instance, if your drone weighs 1 kilogramme overall, the motors' combined thrust at 100% throttle should be 2 kg, or 500 g each motor (for quadcopters). It is usually preferable to have more available push than is required.

If you want to take calm, steady aerial pictures with your drone, you'll need to keep the thrust to Weight ratio around 3:1 or 4:1.

The ratio for racing drones will be 5:1

1.7.2 Motor Type to Propeller Size Ratio

Typically, a four-digit number is used to categorise brushless motors. For instance, the first two digits of a motor with a name like 2205 indicate the stator's diameter (in mm). Stator height is indicated by the final two digits (in mm).In essence, a larger, taller motor can generate more torque.

greater power at higher RPM with a taller stator.

greater torque at lower RPM with a wider stator.

1.7.3 Drone Frame Configuration

Here are few calculations referring to drone frame configuration based on number of rotors installed on to the Airframe. According to the above calculations and the weight, flight time, manoeuvrability of the drone. The airframe and number of rotors are estimated.

1.7.4 Maximum Take-Off

Maximum take-off weight of the drone is calculations includes overall weight the drone (airframe, avionics, propellers, motors, battery, GPS, Etc) plus payload to the maximum thrust of the motors at 50% throttle gives you the maximum take-off weight of the drone**.**

Frame size	Propeller size	Motor Size	KV Rating
150 mm or smaller	3 inch or smaller	1306 or smaller	3000 KV or higher
180 mm	4 inch	1806	2600 KV
210 mm	5 inch	2204-2206	2300 KV-2600 KV
250 mm	6 inch	2204-2208	2000 KV-2300 KV
350 mm	7 inch	2208	1600 KV
450mm	8/9/10 inch	2212 or larger	1000 KV or lower

Table 1.2 Maximum take-off weight

1.8 DIFFERENT MANUACTURING PROCESS & MATERIALS FOR DRONE MAKING

Most common manufacturing processes used for producing a drone is :

- CNC MACHINING
- INJECTION MOULDING
- 3D PRINTING
- COMPRESSION MOULDING

1.8.1 C N C Machinig

The production equipment is moved by pre-programmed software and code in this computerised manufacturing process. A variety of sophisticated machines, including grinders, lathes, and turning mills, are controlled by machining and used to cut, shape, and produce various parts and prototypes.

1.8.2 Injection Modelling

In the process of injection moulding, a thermoplastic polymer is heated past its melting point, turning it from a solid to a fluid that has a relatively low viscosity. This melt is mechanically injected, or pressed, into a mould that is designed to hold the desired end product.

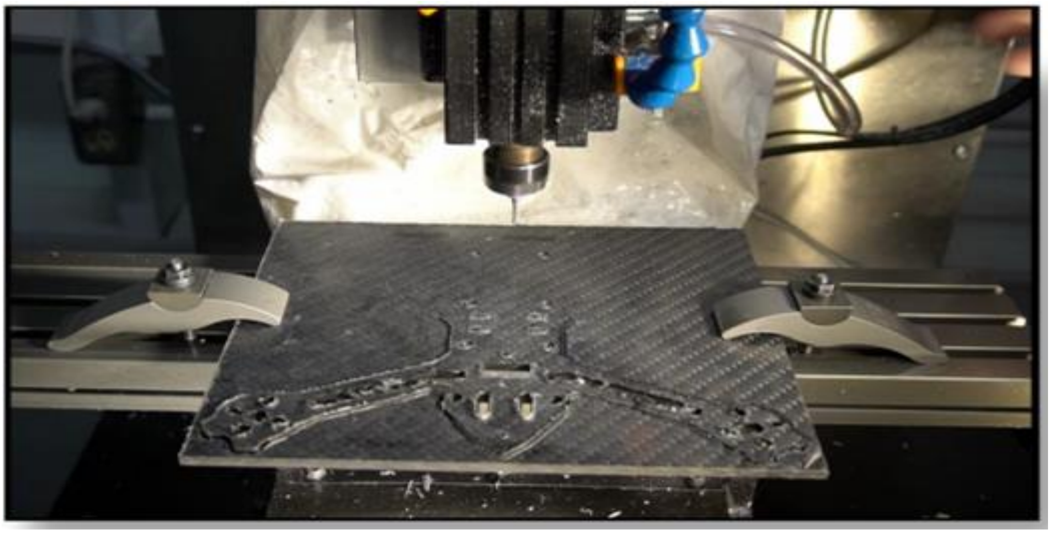


Figure 1.12 Injection Moulding

1.8.3 3D Printing

A 3D item is produced by the additive method of 3D printing, which involves building up layers of material. A final design is cut from a larger block of material in subtractive manufacturing techniques, which is the opposite of this. As a result, less material is wasted while using 3D printing.

Advantages of 3D printing

- Design Flexibility. More complicated designs may be created and printed using 3D printing than using conventional manufacturing techniques.
- Quick prototyping.
- Strong and lightweight parts; print-on-demand.
- Quick design and manufacturing.
- minimising waste and becoming economical.
- Accessibility.

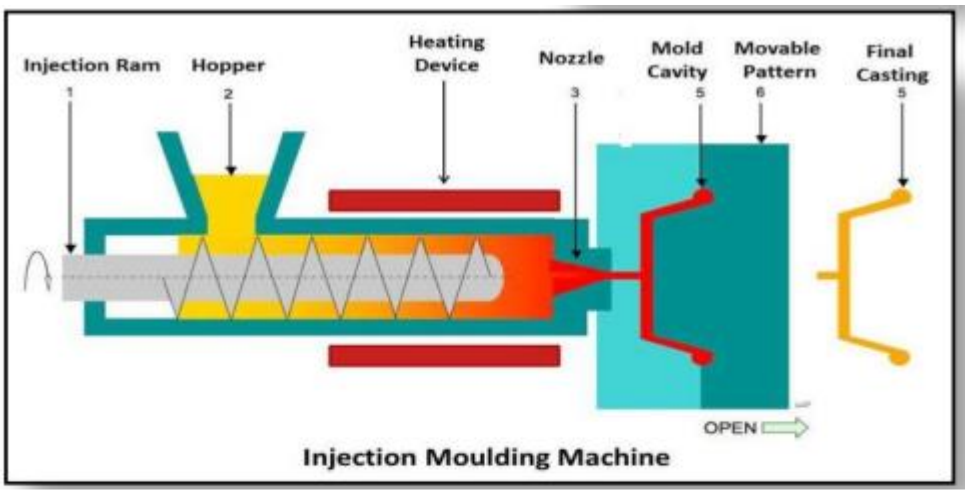


Figure 1.14 3D model printing

Figure 1.14 3D model printing

1.8.4 Compression Modelling

While selecting manufacturing process and materials to produce a drone. There are few things to be considered. By keeping the weight of the drone frame to the minimum the materials associated with the design and manufacturing of the drone, The material should have high weight to strength ratio and good machinability. In the moulding process known as compression molding, a feeding material is inserted into an exposed, heated mould chamber.

After that, a top plug is used to seal the mold, and heavy hydraulic presses are used to compress it.To ensure that the material contacts every part of the mould. In the heated mold, the charge cures.

1.9 MOST COMMON MATERIALS USED IN MANUFACTURING DRONE

- Aluminium/aluminium alloys
- Carbon fibre
- Glass fibre
- Polyamide-Nylon
- Composite metals
- PLA (Polylactic acid)
- ABS (Acrylonitrile Butadiene Styrene)
- PETG (polyethylene terephthalate glycol)

Figure 1.15 PLA wire

Figure 1.16 Aluminium Alloy

1.10 DRONE AS AN EMERGING TECHNOLOGY IN AGRI SECTOR

Agriculture drone equips farmer with cutting-edge technology as well as innovative workflows, making farming more efficient and faster than ever.

land Preparation and irrigation

Get clear and concise visual data on how to plan tillage for the best crop yield. Have multispectral images help you calculate indexes and plan for irrigation based on environmental changes.

Figure 1.17 examining the irrigation of soil

Crop / tree counting

Get a realistic view of the number of crops and trees in your agricultural setup. Have the UAV solutions generate and analyse high-definition images and videos of your entire farming area, instead of just a part of it.

Figure 1.18 crop counting

Crop Health Monitoring

Maximize crop yields through routine observation of crop colour, heat radiation, density and other early symptoms of infection or poor health. Identify optimal harvest pat terns by tracking crop growth rates and identifying produce maturity.

Figure 1.19 crop health monitoring

Damage Assessment

Shorten response time in the face of a natural or any other kind of disaster. Get access to high-definition visual data that can bring you a clear picture of the extent of damage and help you plan your next steps.

Figure 1.20 damage assessment checking

Yield Estimation

Meet your critical goal of improved crop yield estimation. Detect nuances of in-field variability that can help you strategize around the condition & health of your crops.

Figure 1.21 yield estimation

CHAPTER 2

LITERATURE SURVEY

According to the WHO (World Health Organization), more than 1 million pesticide cases are reported annually. More than one lakh people die every year, mostly in underdeveloped nations, as a result of human handling and pesticide spraying. In addition to cancer, hormone disruption, and issues with reproductive and foetal development, pesticide exposure has been linked to asthma, allergies, and hypersensitivity. The skin and eyes may become inflamed by other insecticides. More insecticides contain extremely harmful toxins. Other insecticides could include Engineering Sciences International Academic Research Journal The hormone and endocrine systems of the body are impacted by February. Even at relatively modest exposure levels, spraying can have negative health impacts. Pesticide exposure can have a variety of negative consequences on neurological health, including memory loss, loss of coordination, slowed reaction times to stimuli, decreased visual acuity, altered or irrational mood and behaviour, and diminished motor abilities.

Pesticide exposure can have a variety of negative consequences on neurological health, including memory loss, loss of coordination, slowed reaction times to stimuli, decreased visual acuity, altered or irrational mood and behaviour, and diminished motor abilities.

2.1 LITERATURE REVIEW

Prof B. Balaji et.al [1] had described a design of an unmanned aerial vehicles (UAVs) that can be used to establish a control loop for agricultural applications, where UAVs are in charge of spraying chemicals on crops and monitoring both agricultural fields and the environment. However, UAVs will play a significant part in the future advancement of precision agriculture. Significant labor, water, and chemical abuse savings (20% to 90%) are anticipated. Although there are restrictions on airspace, UAVs are used in agriculture since they are light and can fly over private and deserted areas at low altitudes.

Karan Kumar shaw et.al [2] has described a design for a drone-mounted spraying system for disinfection and agricultural applications. This method of applying pesticides to agricultural fields cuts down on the amount of labour, time, expense, and risk to the people doing the actual spraying.

Kurkute et.al [3] had worked on a basic, cost-effective quadcopter UAV and its spraying system. Both liquid and solid contents are sprayed using the universal sprayer technology. They have also compared several controllers required for agricultural applications in their research, and they have concluded that the quadcopter system with Atmega644PA is the most appropriate due to its effective implementation.

U.E Uche [4] had worked on a basic, cost-effective quadcopter UAV and its spraying system. Both liquid and solid contents have been sprayed using the universal sprayer technology.The quadcopter system with Atmega644PA is the most appropriate due to its effective implementation, according to their research, which also examined various controllers required for agricultural uses.

P.S. Mhetre [5] had developed a drone that was practical, affordable, and easy to use so that farmers could use it for pesticides. The drone's main benefit was that it allowed farmers to spray crop protection agents, insecticides, and fertilizers while being controlled by a single person from a secure place. The servo motor speed in the sprayer we have integrated allows us to adjust the amount of spray as well. Currently, the drone produced is simply used to spray crop protection products, but there are many potential uses for this concept in the future, such as crop surveillance to check on the health of the farm from a safe distance. Future improvements for drones are certainly possible.

CHAPTER 3

METHODOLOGY

3.1 DESIGN OF AGRICULTURE DRONE

The 3D computer-aided design (CAD), computer-aided engineering (CAE), and computer-aided manufacturing (CAM) software Autodesk Fusion 360 is extremely potent. With the use of a single tool, users may design, simulate, and produce goods with this cloud-based software.

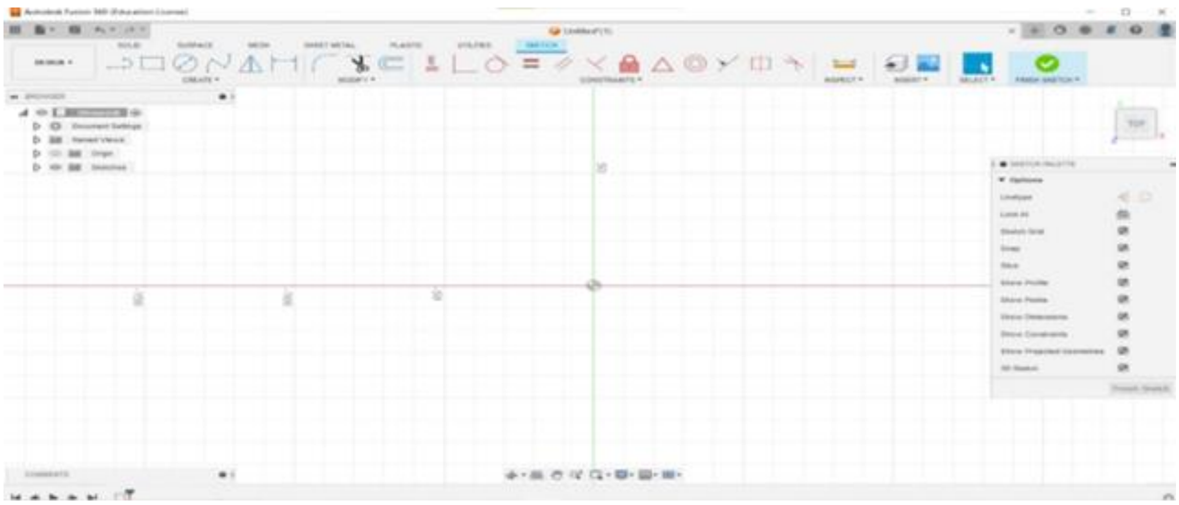


Figure 3.1 AUTO DESK Fusion 360 Interface

3.1.1 Designing of Agriculture Drone in Auto Desk Fusion 360

Various parts of the agriculture drone are designed using the FUSION 360 software. Different parts are first designed with the standard dimensions in the “create Sketch section”. After completion design of all the parts and the required sub-assemblies, it then using extrude command parts are extruded, the final assembly is done in the “assembly section” of the FUSION 360 software. During the assembly, proper mating is given. Various parts like Arm, Base plate, top cover, top plate, controller up & down parts, storage tank and seed dispersal system tool at bottom are designed in the create sketch section and all parts are assembled in the Assembly section and obtained the final assembly.

STEP – 1

Various parts of agriculture drone like Various parts like Arm, Base plate, top cover, top plate, controller up & down parts, storage tank and seed dispersal system tool etc, are designed in the part modelling section of the CATIA software . Various commands like Extrude, Assemble, line ,circle ,spline, trim, constrains, insert is used to draw 2D shapes with required dimensions and by using extrude command they are extruded accordingly to the required size.

The figures below are designs of the parts like Arm, Base plate, top cover, top plate, controller up & down parts, storage tank and seed dispersal system tool.

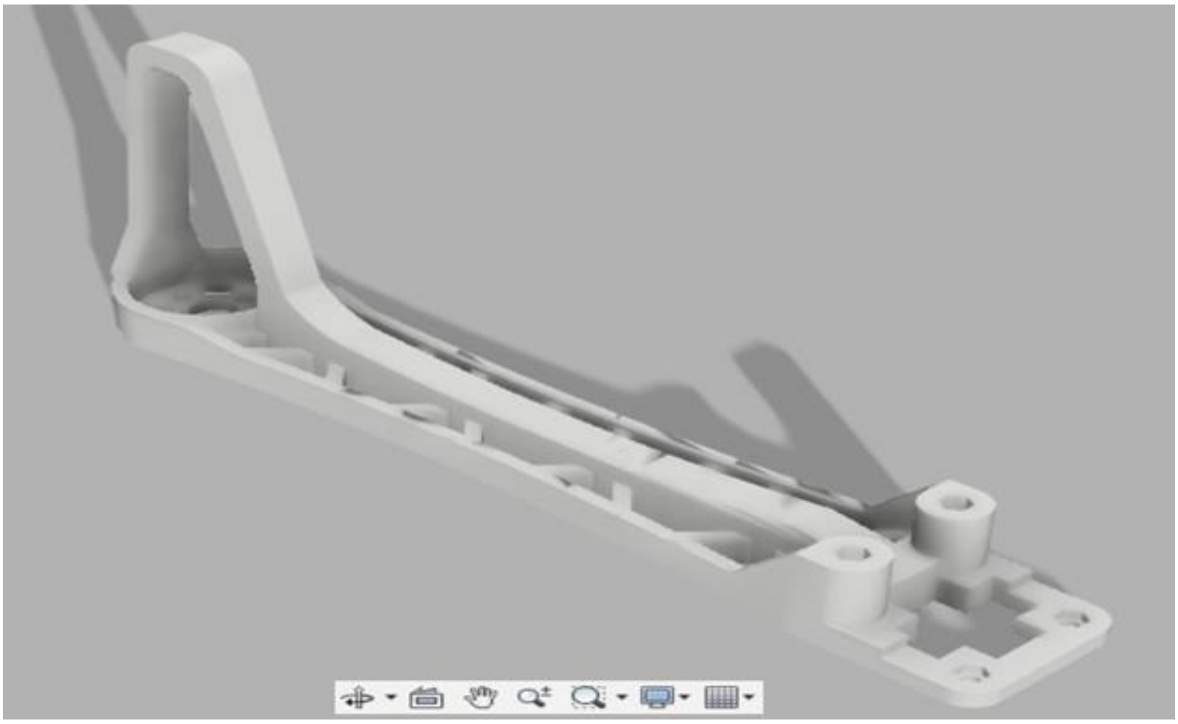


Figure 3.2 (a) Arm

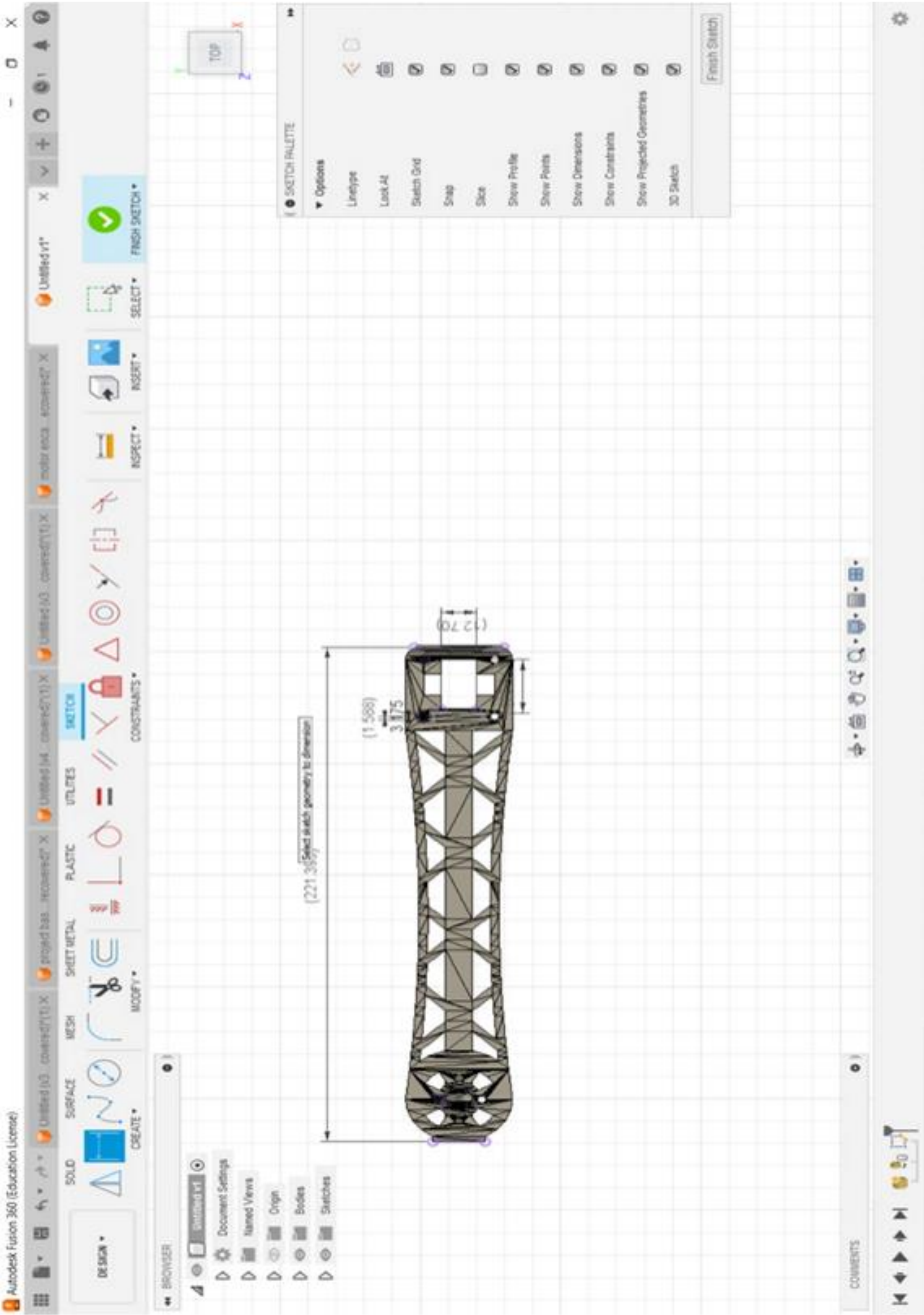


Figure 3.2 (b) Arm with dimensions

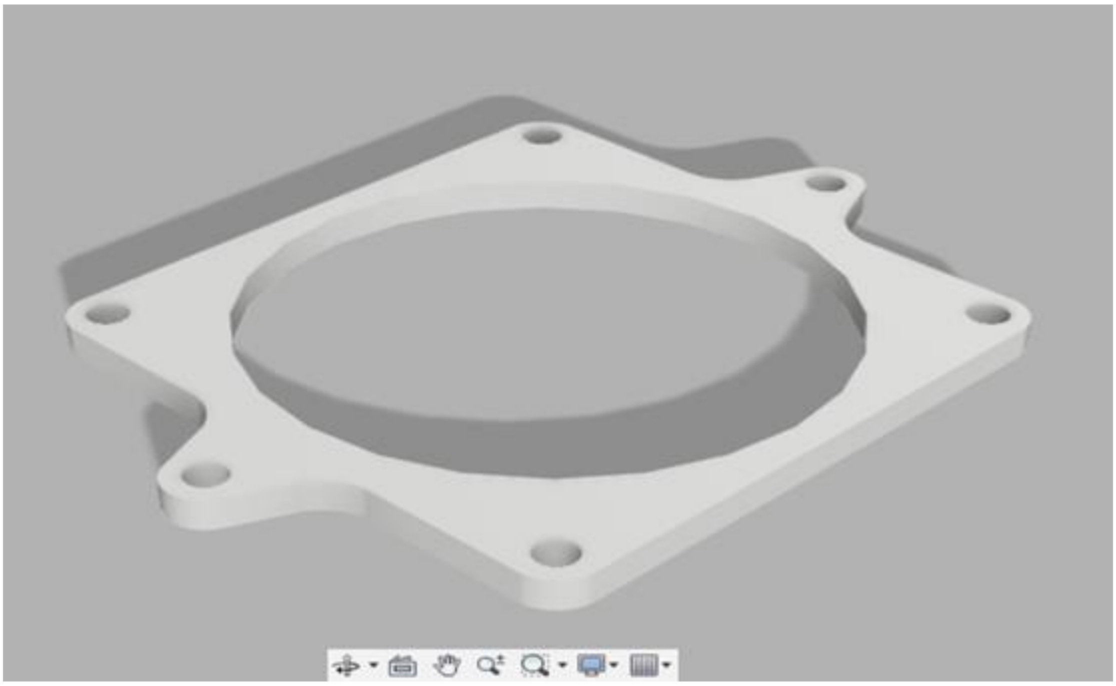


Figure 3.3 (a) Top part

Figure 3.3 (b) down part

Figure 3.3 Flight Controller supports

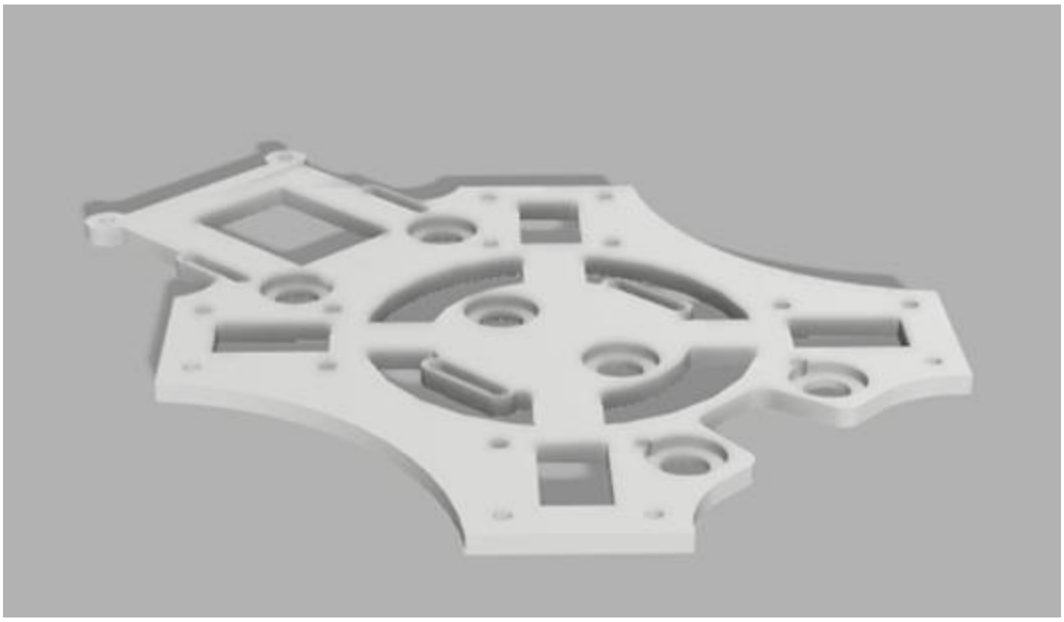


Figure 3.4 Base

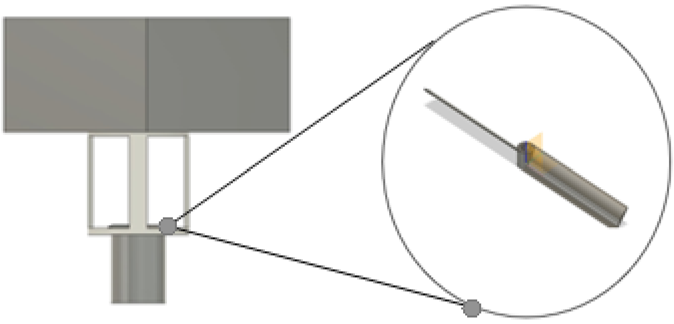


Figure 3.5 seed dispersal system with storage tank

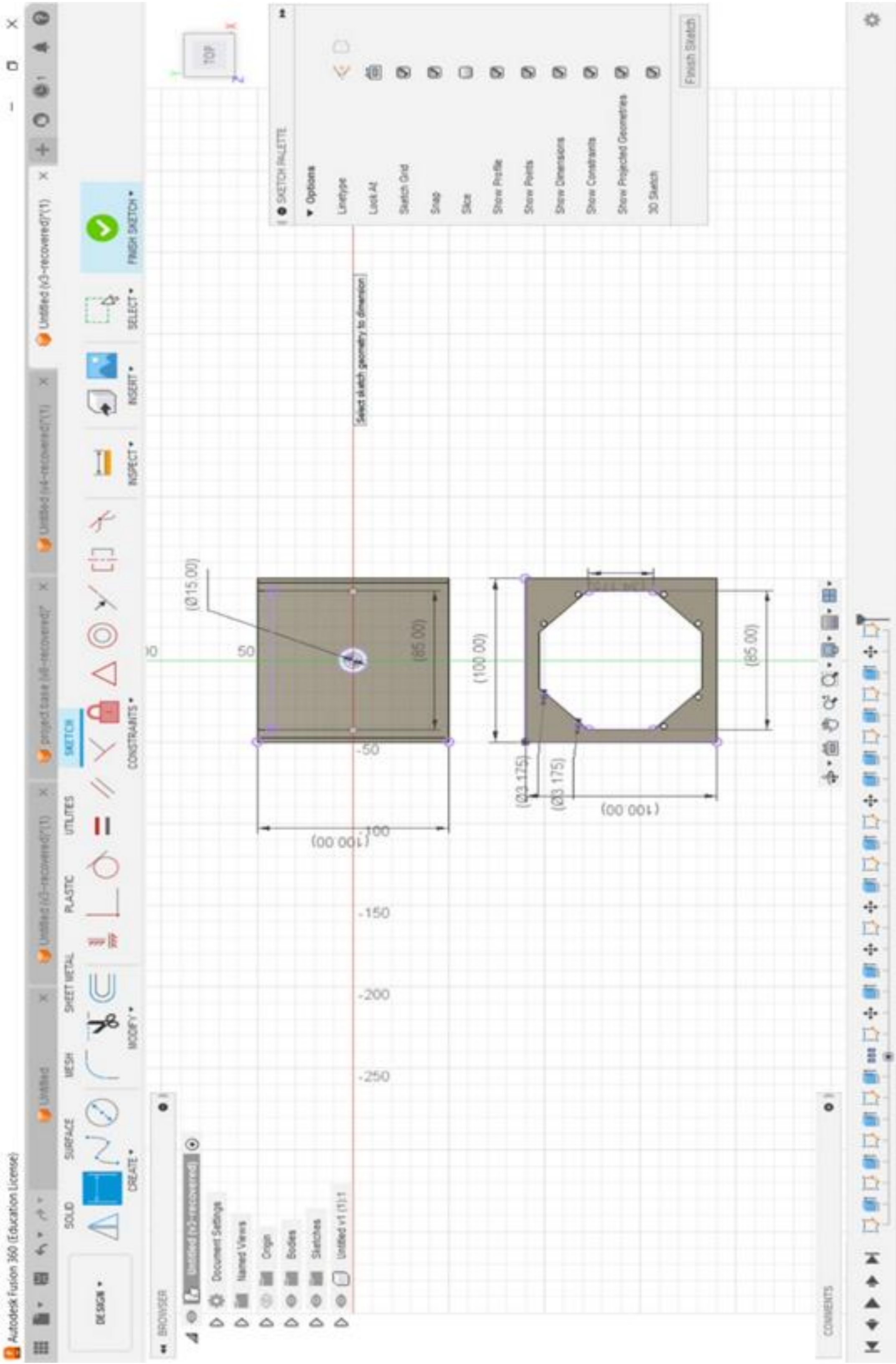


Figure 3.5 (a) seed dispersal system & storage tank dimensions

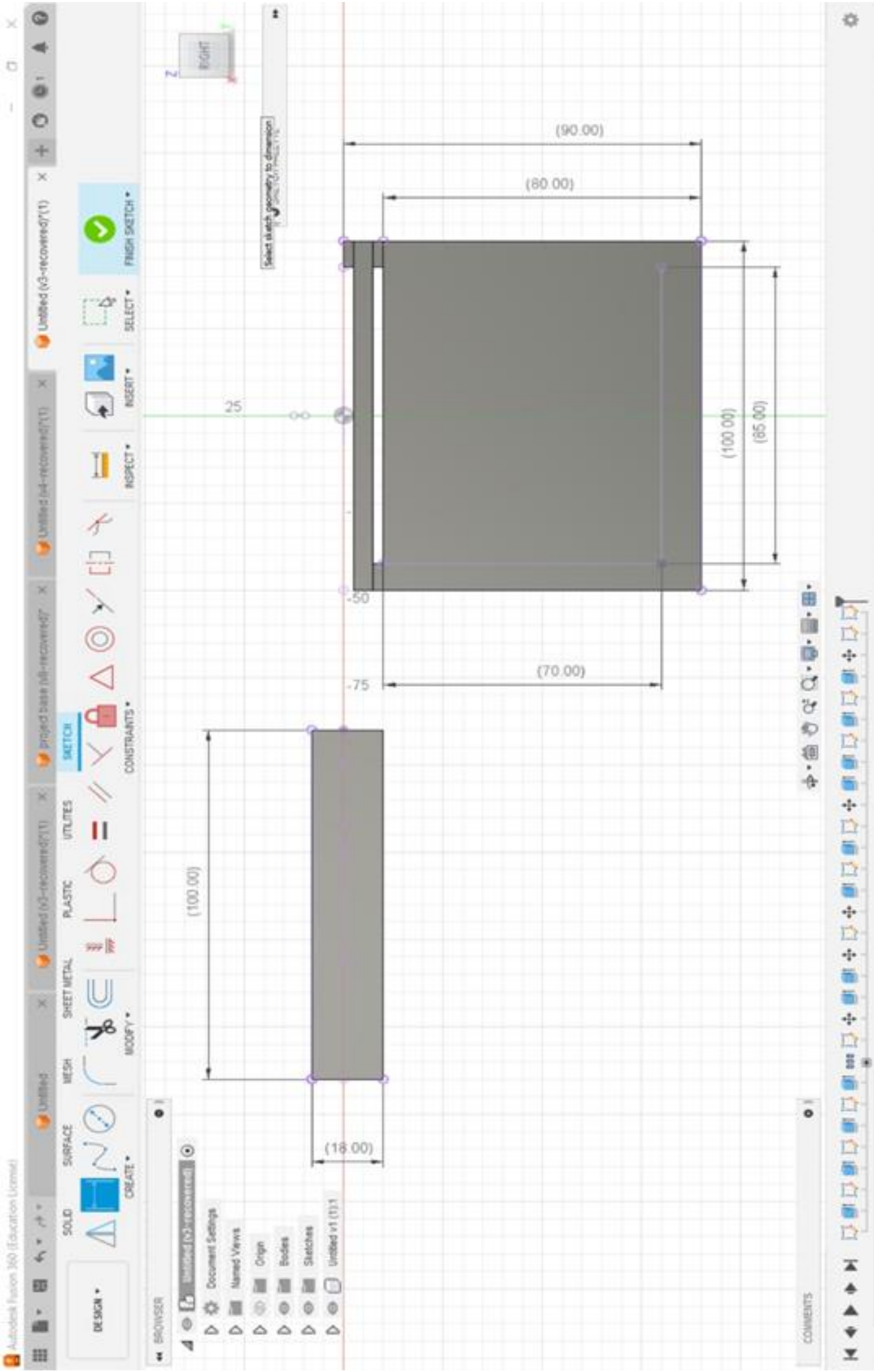


Figure 3.5 (b) Storage tank dimensions

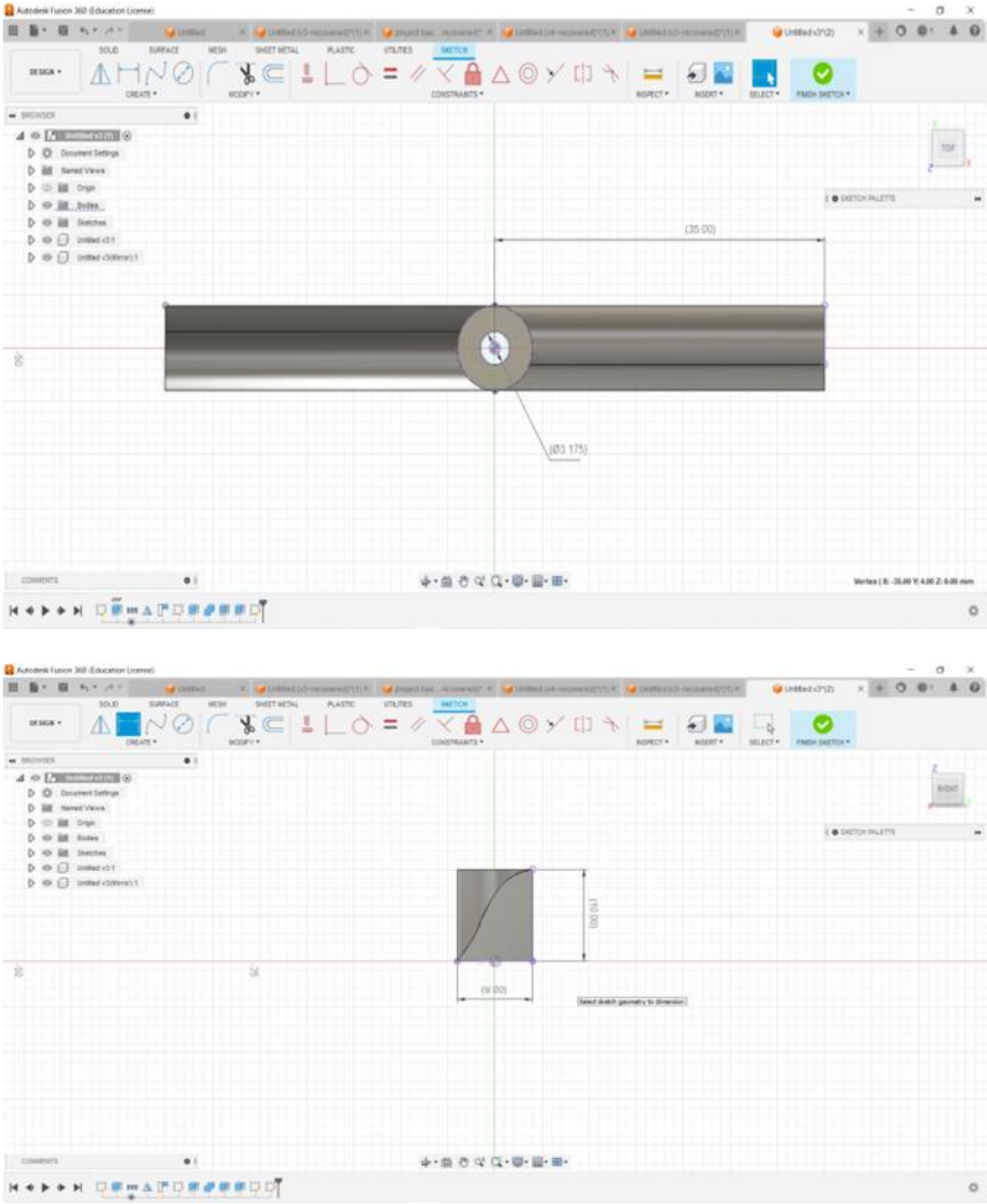


Figure 3.5 (c) Seed dispersal system dimensions

STEP – 2

Once the individual parts are designed in the sketch section, then some required sub-assemblies are made in the Assembly section of the FUSION 360 software. These sub-assemblies make the final assembly much easier.

STEP – 3

Finally, all the required individual parts and the sub-assemblies are inserted in the assembly section by using the "assemble command having joint & As-built joint ,Rigid group " sub commands are used properly for design of the final assembly.

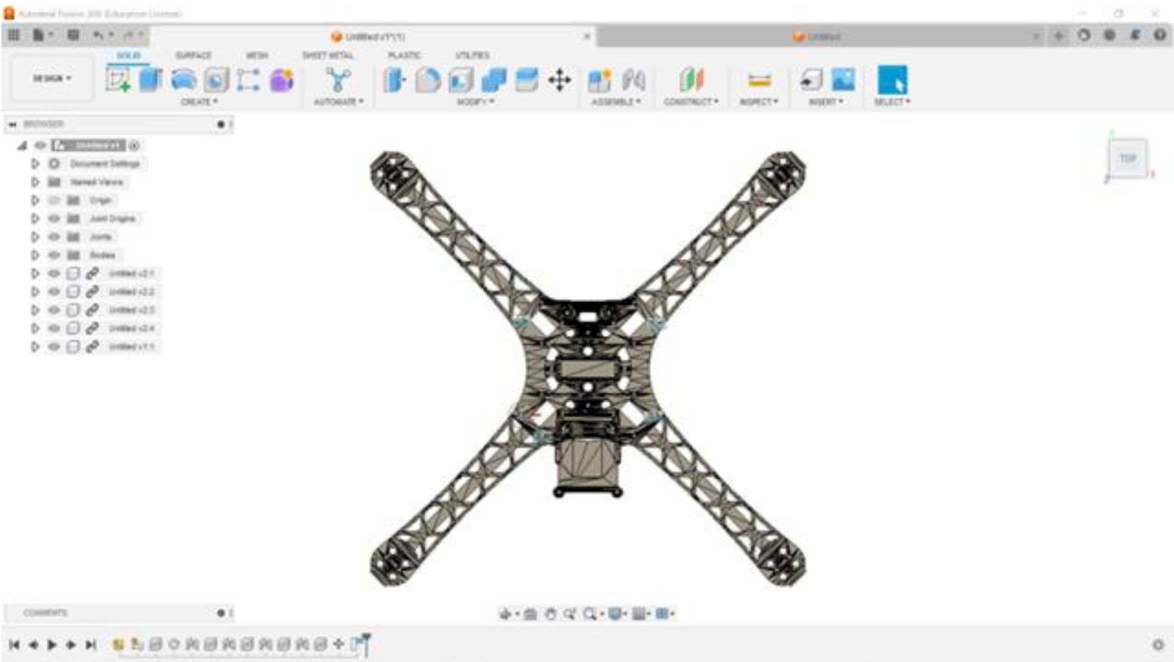


Figure 3.6 Top view of Drone

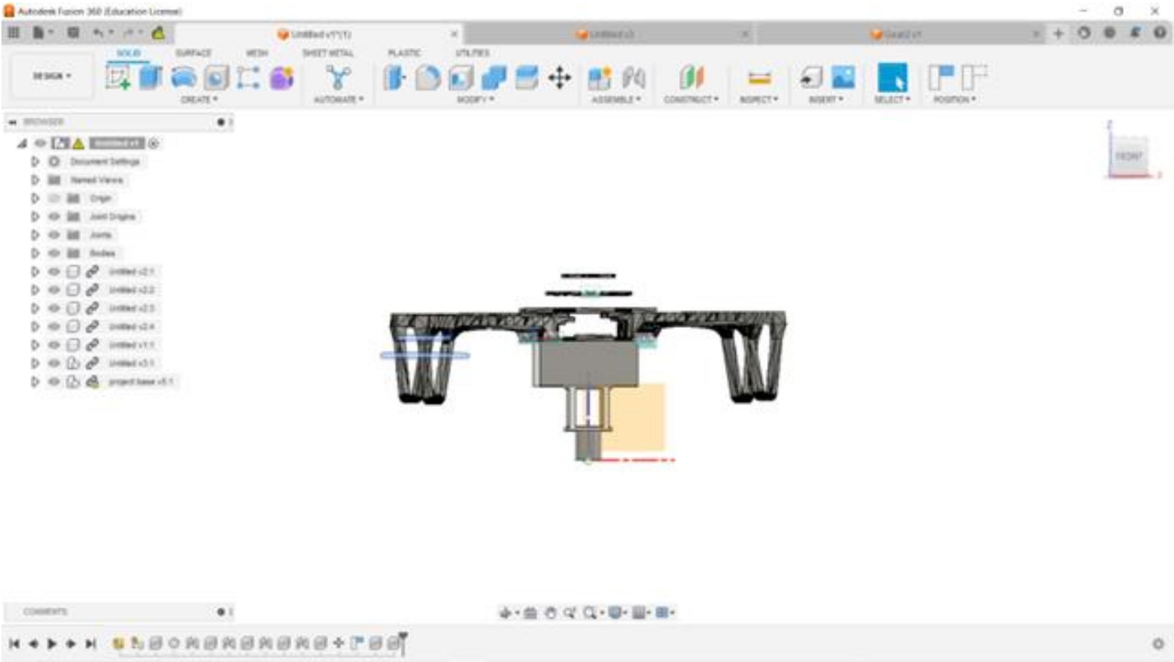


Figure 3.7 side view of Drone

Fig 3.8 3D design of drone

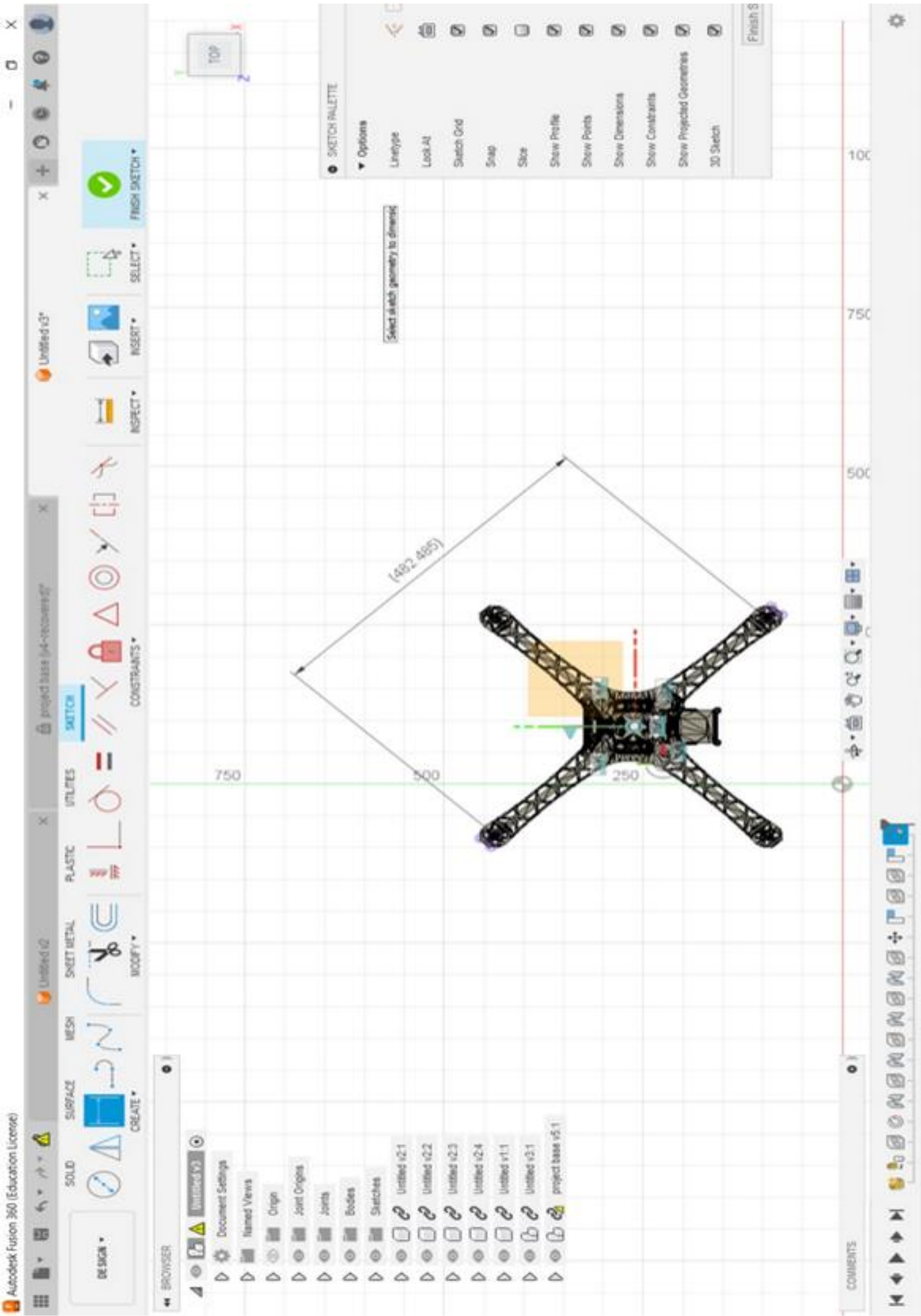


Figure 3.9 Frame Dimensions

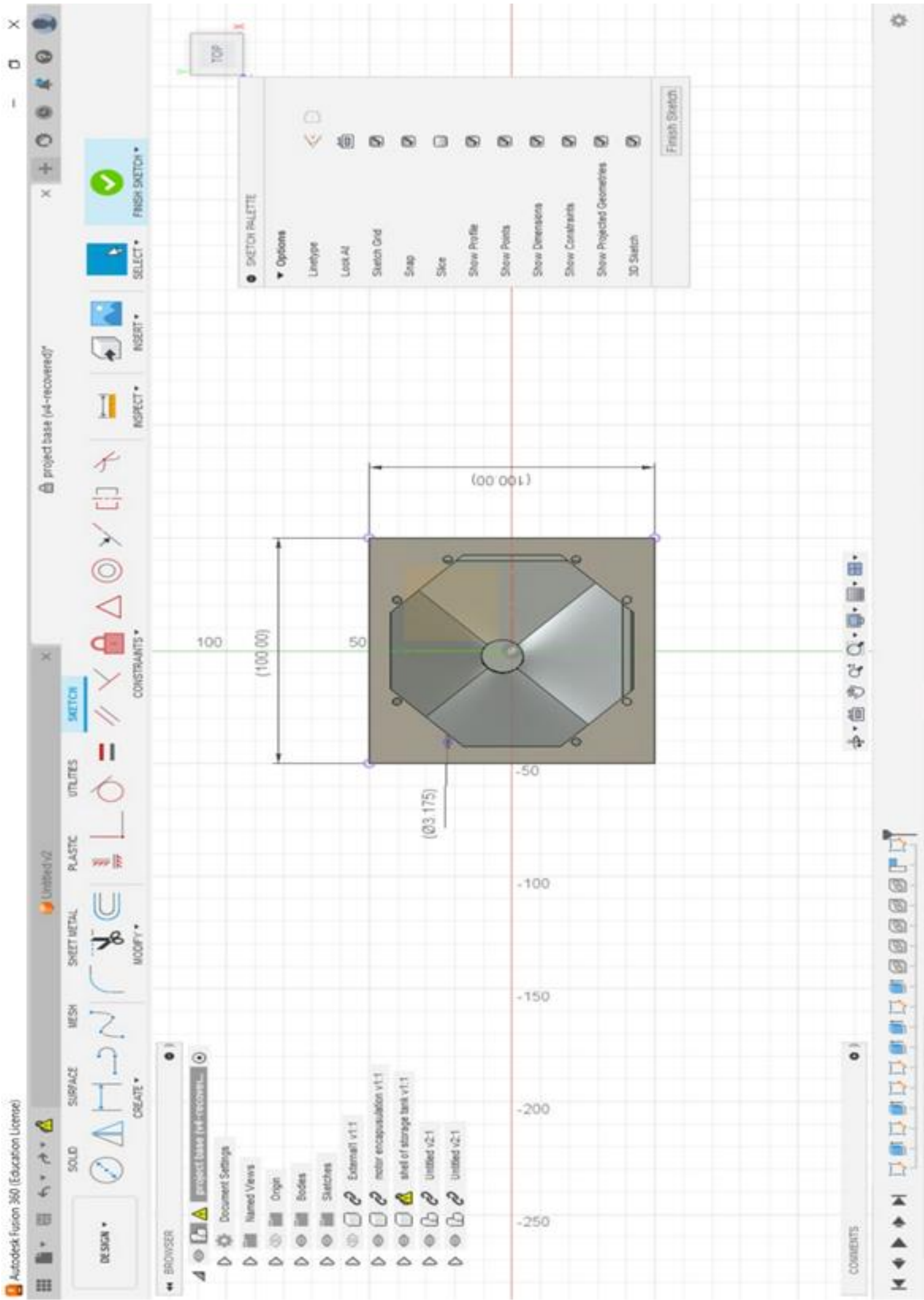


Figure 3.10 Storage tank dimensions (Top view

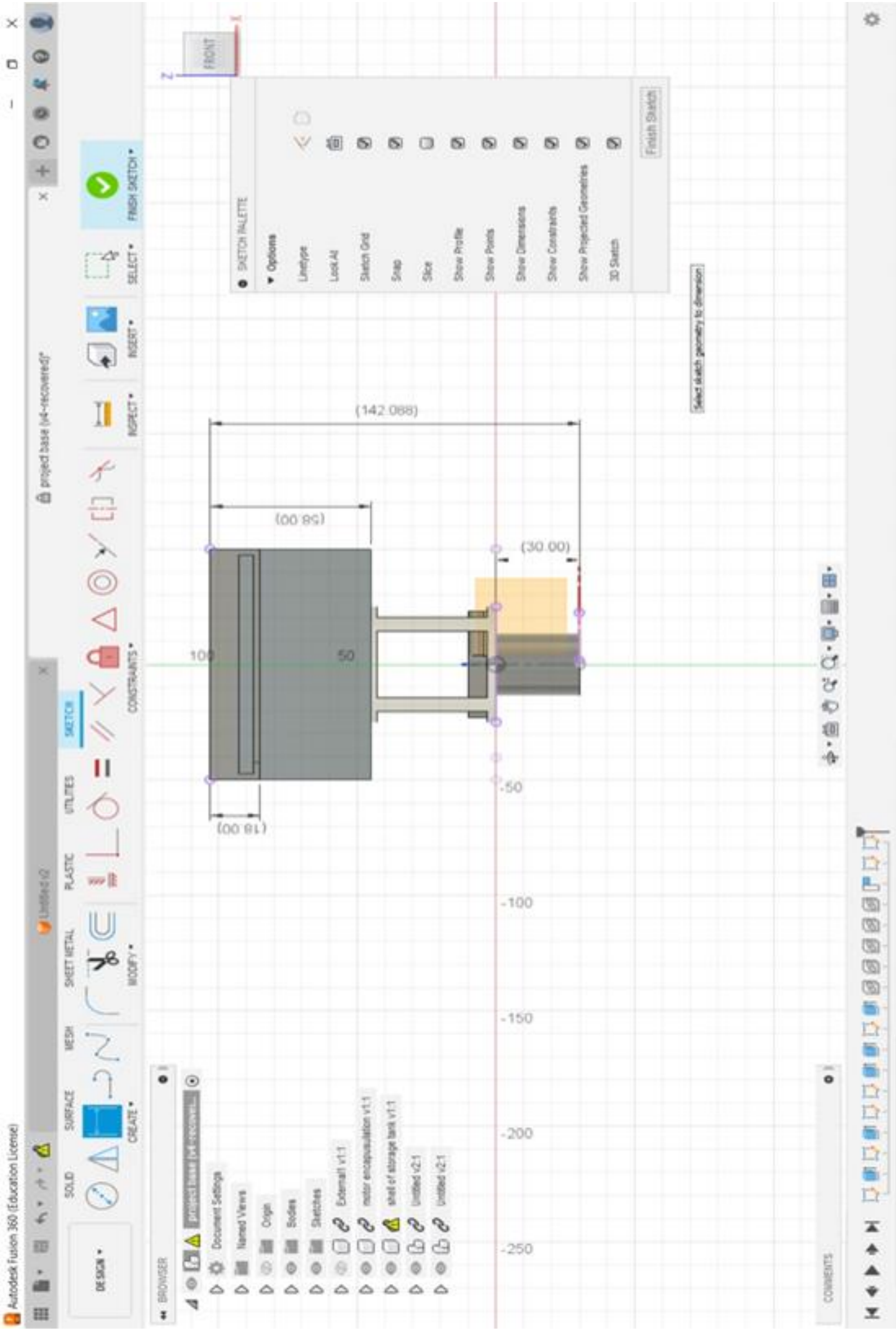


Figure 3.11 Storage tank with seed dispersal system dimensions

3.2 PARTS OF AGRICULTURE DRONE

3D PRINTER (CREALITY ENDER 3 V2)

The Ender 3 V3 has a build volume of 220 x 220 x 250 mm, which is suitable for printing a wide range of objects, from small toys to larger functional parts. It supports a variety of filament types, including PLA, ABS, PETG, and TPU, giving users the flexibility to choose the material that best suits their project.

One of the key improvements of the Ender 3 V3 is its more stable frame design, which helps to reduce vibration during printing and leads to more accurate and reliable prints. It also features a new and improved extruder that provides better filament feed and can print at higher speeds.

The below fig 3.12 creality ender 3 v2 3D PRINTER is used for printing the parts i.e. (fig 3.2,3.3,3.4,3.5) using the material PLA filament.

Figure 3.12 Creality Ender 3 V2

PLA FILAMENT

Polylactic acid, sometimes known as PLA plastic, is a vegetable-based plastic substance that frequently uses cornflour as a basic material. Fermented plant starch is typically used to create the monomer. The main natural raw material utilised in 3D printing is this substance, which is thermoplastic aliphatic polyester. A thermoplastic polymer made of renewable raw ingredients; PLA is entirely biodegradable. PLA is one of the most widely used materials for additive manufacturing for the production of filament among all 3D printing materials.

Figure 3.13 PLA filament

In comparison to ABS and nylon, PLA is a more user-friendly thermoplastic with greater strength and stiffness. PLA is one of the materials that 3D printers may successfully use the most since it has a low melting point and less distortion.

PRINTING OF PARTS

- In the first step, the files in the AutoCAD FUSION 360 are saved in the STL format which is the required format for the creality.
- In the next step, the file is opened in the creality and is transferred to the through SD card to the creality ender 3 v2 printer.
- Now the 3D printer will automatically prints the required parts with the required dimensions.
- The printer is given with some input instructions like fill density, fill pattern , print speed, left extruder temperature, platform temperature.

Finally, all the parts are printed in the creality ender 3 v2 printer using the PLA filament.

DURING PROCESS

The figure 3.14 shows the printing process of the Arm printing . All the parts are similar printed using the creality ender 3 v2 printer. The nozzle temperature 200^{o} C and Bed temperature of the printer is 60^{o} C and nozzle speed is 100 mm/sec . Once the printing is completed ,we need to let the platform cool for some time and then collect the part from the printer.

Figure 3.14 Layer by layer printing on creality ender printer

3.2.1 Pre-Process Images

- Arm
- Flight Controller support
- Base
- Storage Tank
- Seed dispersal system

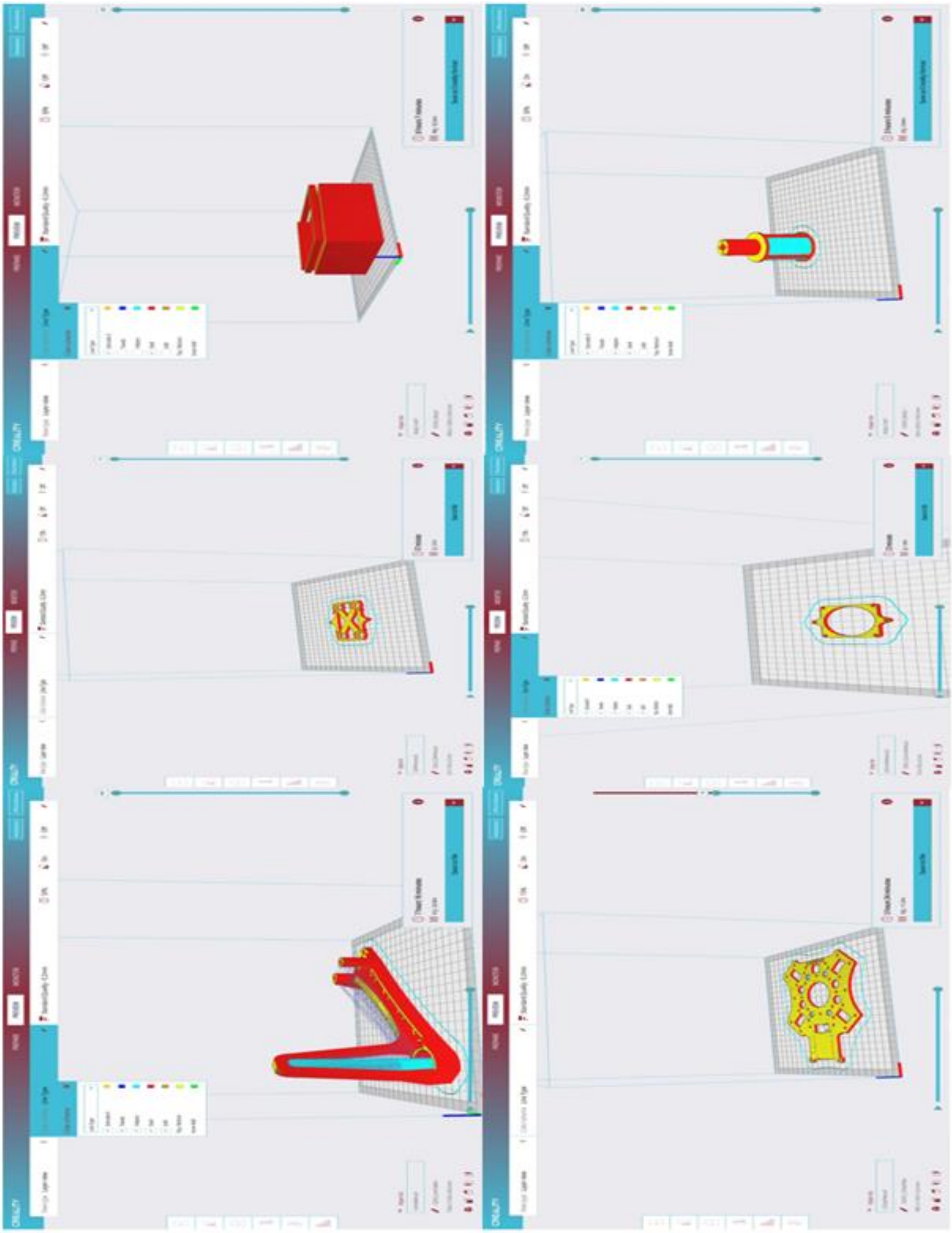


Figure 3.15 Pre-Process Images

3.2.2 Post-Process Images

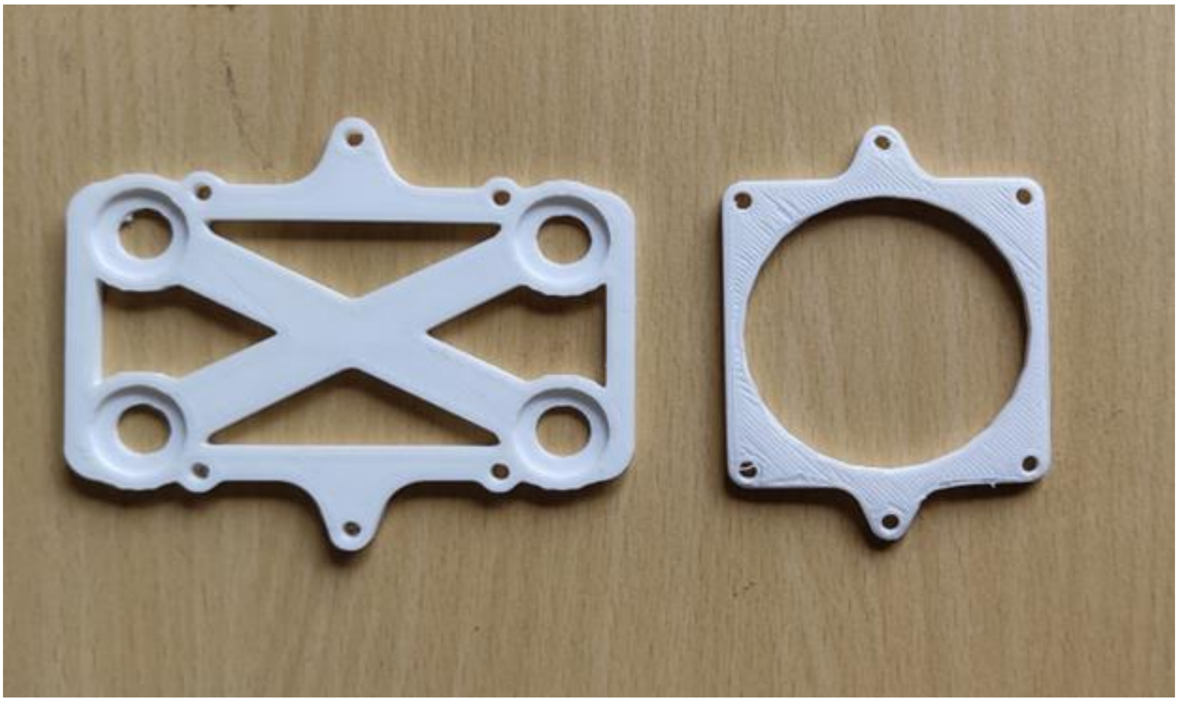


Figure 3.16 (a) Flight Controller Support

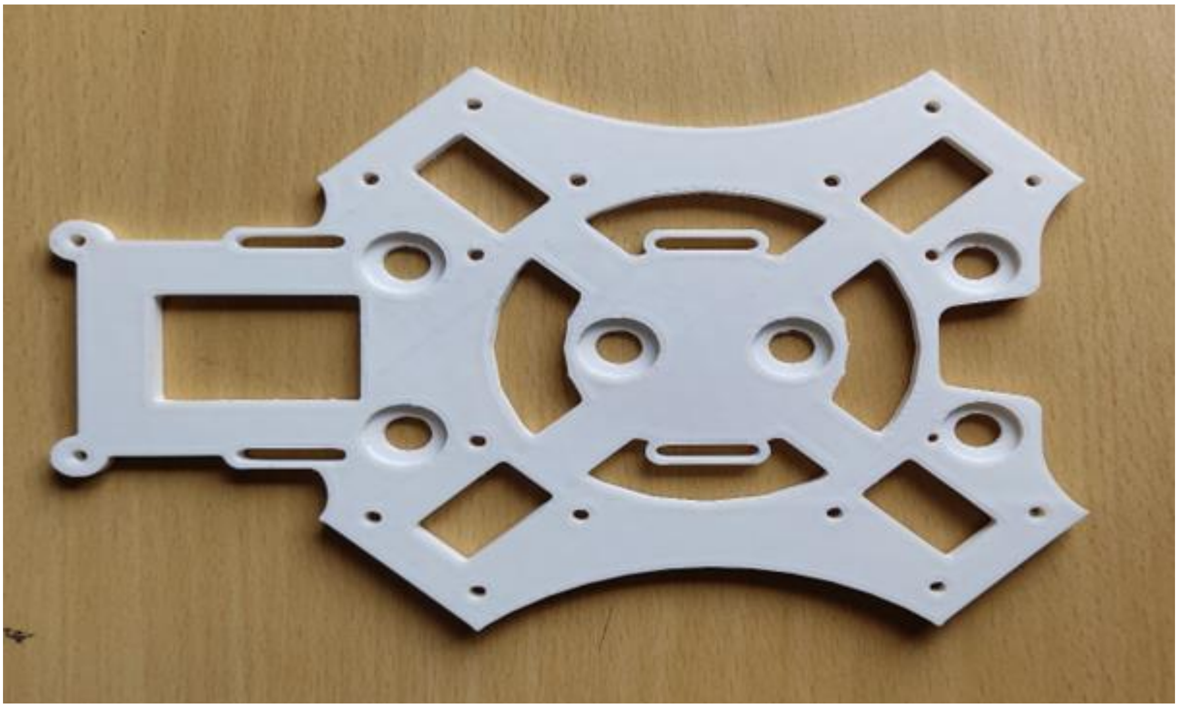


Figure 3.16 (b) Base

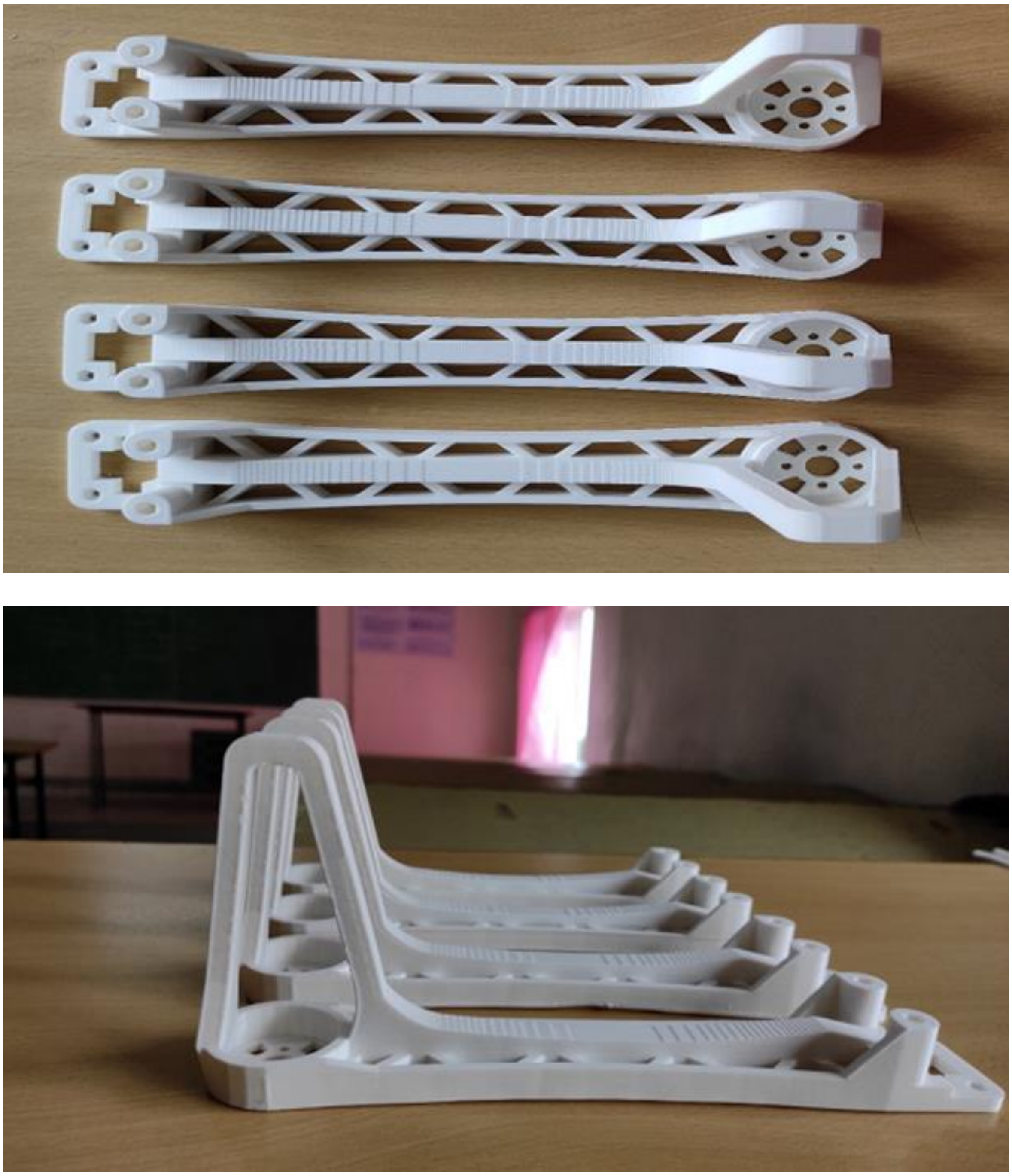


Figure 3.16 (c) Arm

Figure 3.16 (d) storage tank & flapper

Figure 3.16 Post Process Images

3.3 COMPONENTS USED

3.3.1 A2212 – 1000 KV BLDC Brushless Motor

The A2212 brushless outrunner motor in question was created especially to power quadcopters and multirotors. It has a 1000 kV motor. High performance, superpower, and stunning efficiency are all provided. These motors are ideal for medium-sized quadcopters with propellers between 8 and 10 inches in diameter. These motors can produce up to 800gms when used with our 30A ESC, high efficiency 10" propellers, and 3S LiPo battery. You can get 3.2 kg of thrust by using 4 of these motors on a quadcopter with our propellers! Use this to create strong, effective quadcopters.

Figure 3.17 A2212 1000KV BLDC Brushless Motor

SPECIFICATIONS

KV	: 1000
No load Current	: 10 V : 0.5 A.
Current Capacity	: 12A/60s
No Load Current @ 10V	: 0.5A
No. Of Cells	: 2-3 Li-Poly
Motor Dimensions	: 27.5 x 30mm
Shaft Diameter	: 934;3.17mm

Shaft diameter : 3.175 mm.

Minimum E S C Specification : 18A (30A suggestion)

Thrust of 3S with 1045 propeller be : 800gms approximate

Thrust of 3S with 0945 propeller be : 475gms approximate

Thrust of 3S with 0845 propeller be : 475gms approximate

WIRE DESCRIPTION

1.RED - Positive

2.BLACK - Negative

3.YELLOW -Neutral

3.3.2 30A BLDC ESC

In comparison to other ESCs on the market, the 30A BLDC ESC Electronic Speed Controller is designed exclusively for quadcopters and multirotors and offers faster and better motor speed control.

Motors with a current consumption of up to 30A can be driven by a 30A BLDC ESC electronic speed controller. 2S to 3S LiPo batteries are compatible. The flight controller and other onboard components are powered by an internal BEC that produces regulated 5V (with a maximum current draw of 2A). With a 2S-3S LiPo, it may be used to control our brushless motors (just make sure the motor doesn't drain more than 30A.

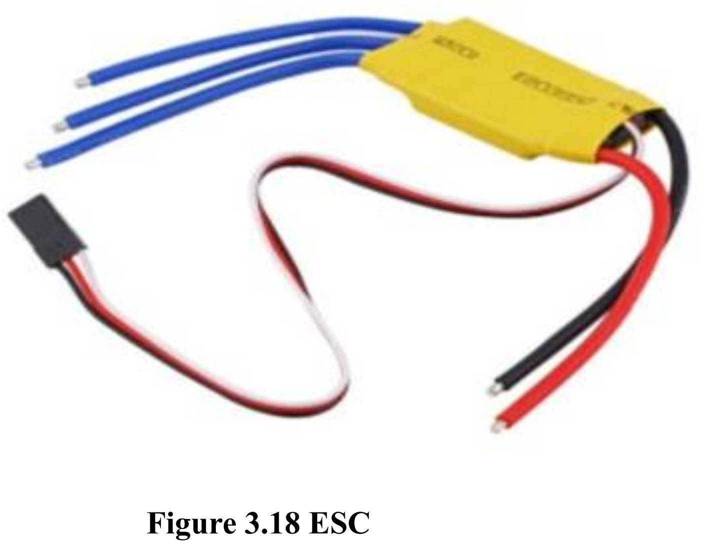


Figure 3.18 ESC

SPECIFICATIONS

MODEL: STANDARD 30A BLDC	ESC(ELECTRONIC SPEED CONTROLLER)
WEIGHT	: 23 grams
DIMENSIONS	: 45 x 24 x 9 MM(L x W x H)
COLOUR	: Yellow / Red(Depends on choice)
CURRENT (Amp)	: 30 Amp
BEC	: 3 A
Li-Poly	: 2-3 cells
Ni–Mh / Ni-CD	: 4-10 Ni - Mh
CONSTANT CURRENT	: 30A Max 40A < 10s
Li-Pol 2-3 CELL	: Ni-MH 4-10 CELL Auto Detect Break On/Off

Auto Low voltage BATTERY will Slow down at 3.0V/ cell Li-po, cut will be off at
2.9V/ Cell li-po.

Usage : Multirotor, Rc Aeroplanes, etc

3.3.3 Flight Controller

The 30A BLDC ESC Electronic Speed Controller delivers quicker and better motor speed control than other ESCs on the market and is specifically made for quadcopters and multirotors.

A 30A BLDC ESC electronic speed controller can drive motors with current usage up to 30A. Compatible LiPo batteries range from 2S to 3S. The internal BEC that powers the flight controller and other onboard components generates regulated 5V (with a maximum current draw of 2A). Our brushless motors can be managed by a 2S-3S LiPo (just make sure the motor doesn't draw more than 30A.

Figure 3.19 flight controller

SPECIFICATIONS

Model	: APM 2.8
Power supply	: LP2985-3.3.
Port	: MUX (UART0, UART2, mnnI2, and OSD are optional, OSD is the defaulted output).
Input Voltage (V)	: 12~16 VDC
Sensors	: 3-Axis Gyro meter, Accelerometer High-performance Barometer
Processor	:ATMEGA2560 and ATMEGA32U-2
Micro-SD Card Slot	: No
Dimensions (mm) LxWxH	:70 x 45 x 15
Weight (gm)	:82

FEATURES

Arduino compatible straight needle– 4 MB internal flash chip for automatic data logging.-AuBlox LEA-6H module with compass, optional off-board GPS.The Invernesses 6 DoF Accelerometer/Gyro MPU-6000 is one of the earliest open-source autopilot systems. -Barometric pressure sensor from Measurement

Specialties upgraded to MS5611-01BA03.-Atmel's ATMEGA32U-2 and ATMEGA2560 chips, used for processing and USB capabilities, respectively.

3.3.4 TRANSMITTER

The FlySky FS-i6 is an excellent 6-channel, low-cost 2.4 GHz transmitter and receiver that makes use of dependable and strong Automatic Frequency Hopping Digital System (AFHDS) spread spectrum technology. The programming on the FlySky FS-i6 is straightforward to use, and it has a good, high-quality look and feel. Additionally, a 6-channel FS-iA6 receiver is included. The FlySky FS-i6 is an excellent low-cost computer radio for both beginning and experienced pilots that can control quadcopters, multirotors, helicopters, and aeroplanes.

The ergonomic design of the ultra-slim casing fits your hands well, reducing hand fatigue, especially on lengthy trips. The FS-i6 has all the functionality you need and has a contemporary feel thanks to digital trims, a backlit LCD screen, and easy programming. The FS-i6 is simple to store and there is little risk of breaking it thanks to its low-profile antenna. The radio's comfort features also include adjustable length sticks and a loop for a neck strap. The FS-i6 comes equipped with two adjustable knobs, a 3-position switch, and several flap position options.

With the optional telemetry receivers and range of sensors, you may enhance the functionality of your models or simply keep track of what's happening. Normally, a transmitter with this capability would cost hundreds of dollars. Not the case with the FS-i6's accessibility.

Figure 3.20 transmitter

FEATURES

2.4GHz entry-level 6 channel radio with telemetry functionality-Throttle Hold, Dual Rate, Trims, Gear, Flap, Gyro Gain Adjustment, Flight Mode, and Hover Pitch Switches-Simple to use navigation and programming buttons-20 Model Memory; Supports Heli, Standard Wing, Elevon, and V-Tail; Eight Characters Trainer and charging ports are the model name.-A backlit LCD screen shows the transmitter and receiver voltage in real time.-4 Selectable Stick Modecomes with receiver; mode 2.

FS- i6 SPECIFICATIONS

count Channels	: 6 inputs
Model Type	: Glider /Heli / Airplane
RF Range	: 2.40-2.48 GHz
Bandwidth	: 500 KHz
Band	: 142 widths
RF Power	: Less Than 20 dBm
2.4ghz System	: AFHDS 2A and AFHDS
Code Type	: GFSK
Sensitivity	: 1024
Low Voltage Warning	: less than 4.2 V
DSC Port	: PS 2
Output	:PPM
Charging Port	: No
ANT length	: 26mm * 2 (dual antenna)
Weight	:392 grams
Power	: 6 V (1.5AA x 4 Not Included)
Display mode	: Transflective STN positive type, 128 * 64 dot matrix VA73 * 39 mm, white backlight.
Size	: 174 x 89 x 190 mm(L x W x H)
On-line update	: yes

Colour	: Black
Certificate	: CE0678,FCC
Model Memories	: 20
Channel Orders	: Aileron-CH1, Elevator-CH2, Throttle-CH3, Rudder-CH 4,Ch 5 & ch 6 open to assignment to other function operate.

3.3.5 PROPELLER

2 x 1045 Propellers in a set. One propeller that rotates clockwise and one that rotates anticlockwise are included in the kit, along with two propeller shaft adapters. The propeller can be used with motors of various shaft diameters thanks to the adapters.

With a rating of 800-2200 kV, this 1045 propeller can be utilised with brushless motors. This propeller delivers smooth flights and extended flight periods with a low kV motor (800–1400 kV), making it ideal for FPV and aerial photography. This propeller's high kV motor (more than 1200 kV) provides quick flights ideal for acrobatic performances.

Figure 3.21 Propeller

SPECIFICATIONS OF 10 X 4.5 PROPELLER

Diameter	: 10 inch (25.4 cm)
Pitch	: 4.5 inch (11.43 cm)

S.No	Components	Price
1	A2212 - 1000KV BLDC Brushless Motor	(364*5= 1820)
2	30A BLDC ESC - Brushless Motor Speed Controller	(385*4= 1536)
3	APM 2.8 Flight Controller with Built-in Compass	5799
4	PDB-XT60 with BEC 5V and 12V	730
5	Fly Sky FS-i6 6-Channel 2.4 Ghz Transmitter and FS-iA6 Receiver	4649
6	10x4.5 inch - 1045/1045R CW CCW Propeller	104
7	2200 mah 3s lipo battery	1900

Table 3.1 Cost of components

3.4 ASSEMBLY

Drone Assembly is a combat anomaly inhabited that can different parts are assembled together can make the drone (UAV) fly by using transmitter and flight controller.

THINGS WE SHOULD DO BEFORE ASSEMBLING DRONE

- To minimise weight and improve agility, drone frames are often composed of lightweight composite materials.
- The drone frame and access parts availability in market that make easy to replace the damaged parts of the drone.
- We should wear the safety gloves and mask while soldering the accessories of the drone.
- The components of drone like XT60, XT90 should be kept spare.
- The accessories like motor wires X60 AND XT90 connections should be shoulder before install the parts of drone

THE MAIN COMPONENTS OF DRONE ARE

- Frame
- Seed dispersal system
- Motor set.
- Control system
- Power system.
- Essential Tools


Figure 3.22 Components of Drone

ESSENTIALS
RC TRANSMITTER AND RECEIVER
MOTORS AND SPEED CONTROLLER
FLIGHT CONTROLLER
BATTERY AND CHAGER

Table 3.2 Basic Essentials of drone

STEPS FOR ASSEMBLY OF DRONE

1. INSTALL THE DRONE FRAME
2. INSTALL THE ESC's AND MOTORS TO FRAME
3. INSTALL THE BATTERY AND FLIGHT CONTROLLER
4. SETTING UP THE DRONE
5. INSTALL THE STORAGE TANK WITH SEEED DISPERSAL SYSTEM
6. PRE-CHECK THE FLIGHT DEBBUING
7. PREPARE FOR TAKE-OFF

1. INSTALL THE DRONE FRAME

Start by assembling of frame according to the drone measurments. Make sure that the frame is sturdy and lightweight.

Figure 3.23 initial frame set up

2. INSTALL THE ESC AND MOTOR TO FRAME

The motors should be mounted to the frame and connected to the ESCs. Make sure the ESCs are compatible with the motors and that the motors are securely fastened.

Figure 3.24 Attaching esc and motors' to frame

3. INSTALL THE BATTERY AND FLIGHT CONTROLLER

Connect the ESCs to the flight controller after mounting it to the frame. Make that the flight controller has the necessary functionality and is compatible with the ESCs.Connect the battery to the flight controller after mounting it on the frame. Make sure the battery has the necessary capacity and is compatible with the drone.Power to whole conections are supplied by power distribution board.

Figure 3.25 flight controller & battery

4. SETTING UP DRONE

Figure 3.26 Setting up drone

5. ATTACHING THE PROPELLER TO MOTORS

Figure 3.27 drone set-up

5. INSTALL THE STORAGE TANK WITH SEED DISPERSAL

Attaching the storage tank at bottom of drone along with seed dispersal system.

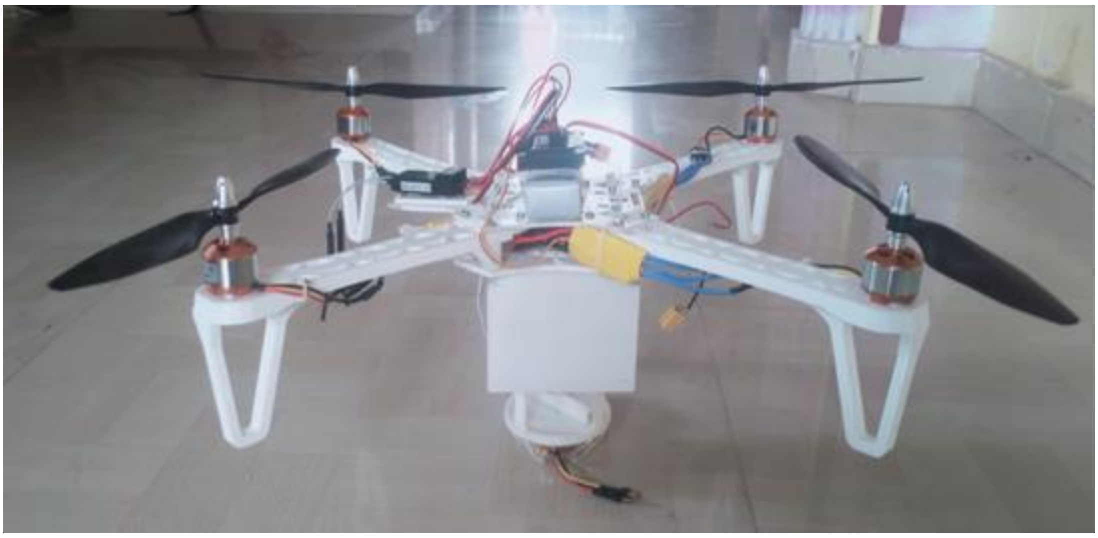


Figure 3.28 final drone set-up

6. PRE-CHECK THE FLIGHT DE-BUGGING

It's crucial to test and calibrate the drone after you've assembled all of the components to make sure it runs as intended. The drone should be checked for stability and flying time, and the flight controller and sensors should be calibrated. In order to manage the drone efficiently and safely, it is crucial to practise flying it. It is advised to fly the drone in an open region without any impediments and to steer clear of bad weather.

7. PREPARE FOR TAKE-OFF

Figure 3.29 Drone testing take-off

3.5 TESTING OF AGRICULTURE DRONE

- All the servos are connected to flight controller by ESC and to power source with the help of jumper wires.
- The signal to the ESC is given by flight controller received from the transmitter.
- Now with the help of libraries in flight controller, programming is done accordingly to operate the servos and is sent to to flight controller as input instructions.
- The working of seed dispersal system is started , once the drone started its moment and with the help of libraries in flight controller starts the mechanism by receiving the signals from transmitter.
- Indication of warning signals from the drone when the storage tank gets empty.

3.5.1 TESTING OF SEED DISPERSAL SYSTEM

Testing is done manually with storage tank placing at certain height Fixed and done some trail and error method to find out speed required for serve motor to seed dispersing.

- Height of storage tank from ground = 5'10" (1.7 M)
- Fertilizer quantity = 300 grams
- Fertilizer = Urea

- COMPONENTS
  - A) Servo motor
  - B) Arduino board
  - C) Battery
  - D) Usb cable & power banker (5w)
  - E) Storage tank

- CODE

// testing of serve motor under different speeds for better seed dispersal

```
#include <Servo.h>
Servo esc_signal;

void setup()
{
esc_signal.attach(12);  //Specify here the pin number on which the signal pin of ESC is connected.
esc_signal.write(30);  //ESC arm command. ESCs won't start unless input speed is less during initialization.
delay(3000);  //ESC initialization delay.
}

void loop()
{
esc_signal.write(50);  //Vary this between 40-130 to change the speed of motor. Higher value, higher speed.
delay(15);
}
```

// speed of motor for seed dispersal , consider for testing method are 50,60,70 and out of those three speeds with help of trial-and-error method .optimum outcome is finalised.

- FIELD TESTING

Trial and error method for optimum outcome

Figure 3.30 Urea in storage tank

Figure 3.31 Field testing

- Trail-1

Speed - 50

Quantity - 300 g

Outcome for Trail – 1

Distance covered ~1M inches (approx.)

Density of dispersal seed – good

Figure 3.32 outcome of trail 1

- Trail – 2

Speed - 60

Quantity – 300 g

Outcome for Trail – 2

Distance covered ~1.27M (approx.)

Density of dispersal seed – better

Figure 3.33 outcome of trail 2

- Trail 3

  Speed - 70

  Quantity - 300 g

Outcome for Trail – 3

Distance covered ~ 1.5 (approx.)

Density of dispersal seed – Too far

Figure 3.34 outcome of trail 3

- Final Outcome

Speed of servo motor with 60 value gives optimum outcome with dispersal of seed in close range With length of dispersal 1.27 M .So drone stops at every ~1.30M range for seed dispersal for around 2 seconds.

3.6 PRECAUTIONS

• Airspace: Unrestricted or Restricted Airspace, Obstructions near flight path identified

• Weather: Visibility >= 3 miles/500ft, wind <= 15mph.

• RPAS Airframe: No Structural defects

• RPAS Battery: Sufficient for Flight, not less than 80%.

• Controller/GCS Battery: Sufficient for Indented Flight

• GCS/Controller Power: ON

• RPAS Power: ON

• Compass Calibration for Current Location.

• Check all the motors and Controls

3.7 SOP FOR APPLICATION OF AGRICULTURE DRONE

• Verify that you won't be using a drone in an electronic station or an airport. A green zone requires no previous authorization for the use of an unmanned aircraft system.

• Check and mark proposed treated areas, boundaries, walls around the field for safe operations.

• Adopt proper pressure for optimized droplet spectrum(>100µm).

• Do pre-flight checks!

• Ensure appropriate flying height above target crop.

• When spraying pesticides that are toxic to crops and other nontarget organisms strictly abide by the product label requirements and take effective measures to avoid risks.

• Only central Insecticides Board and Registration Committee approved Pesticides/Insecticides shall be used.

CHAPTER 4
CONNECTIONS

4.1 WIRING

All the wiring is done initially between the Arduino Uno, Power Source and Motor where servo motor is fixed to an end of a rod to check the calculations are determined.

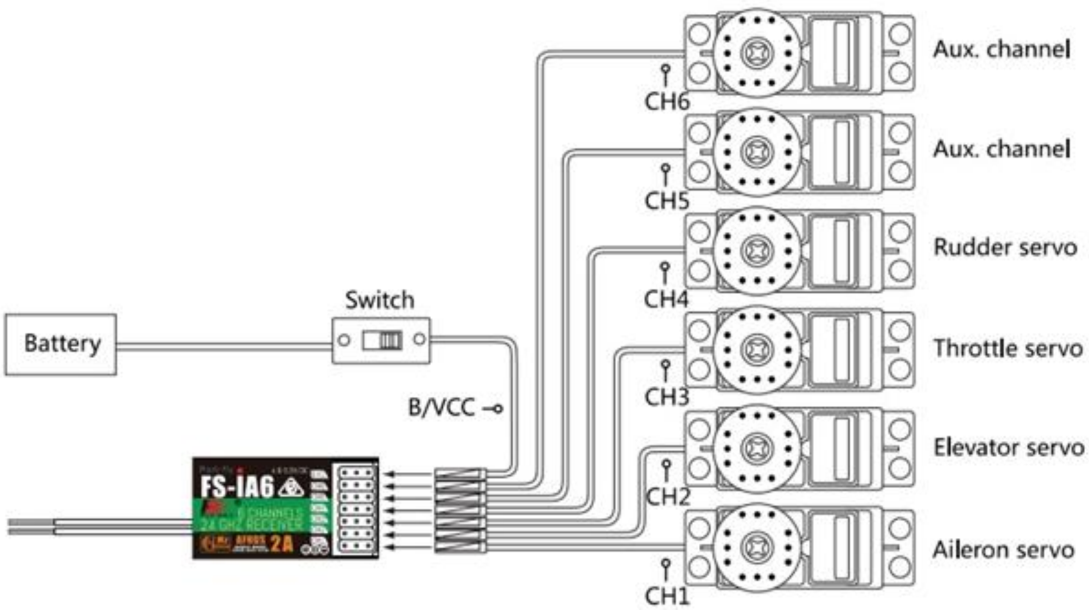


Figure 4.1 connection to flight controller

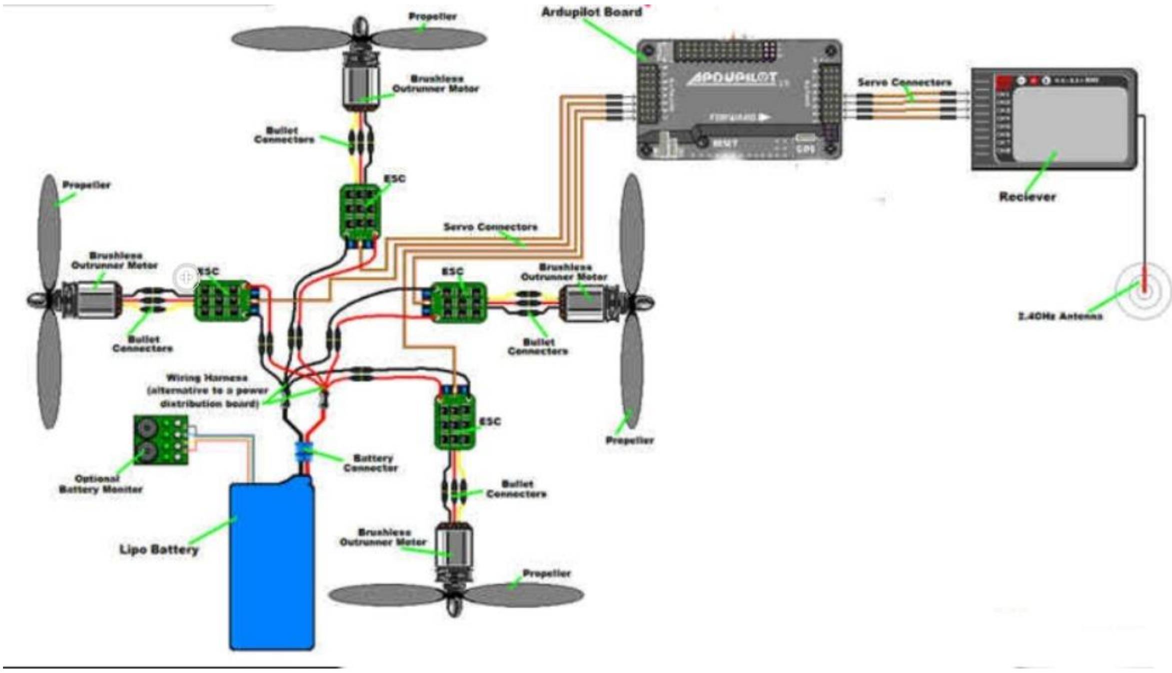


Figure 4.2 wiring between servo motors and flight controller to PDB

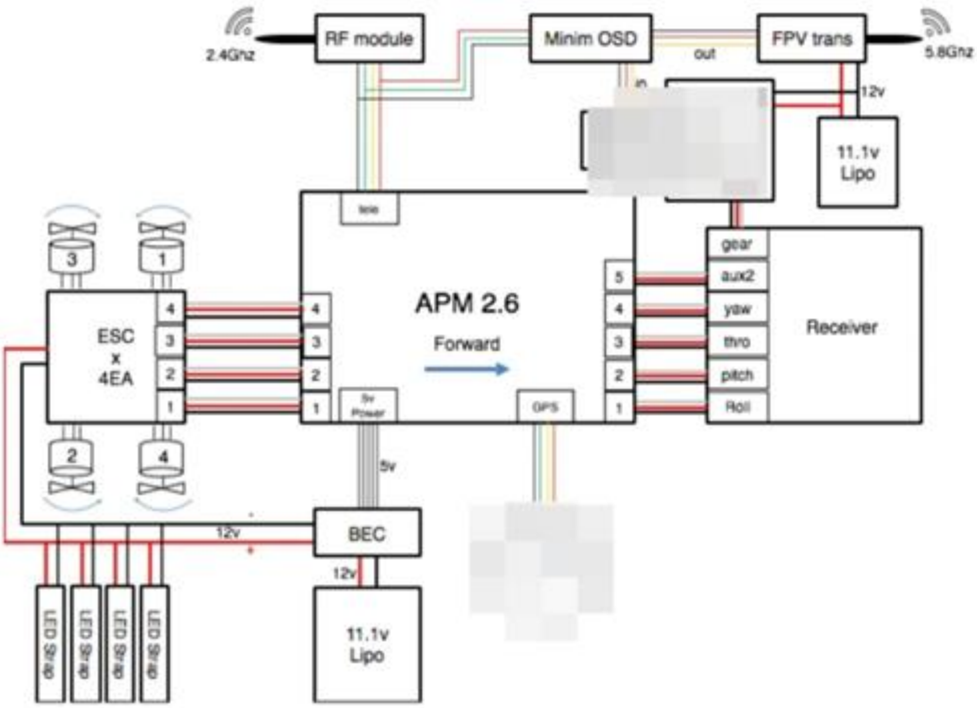
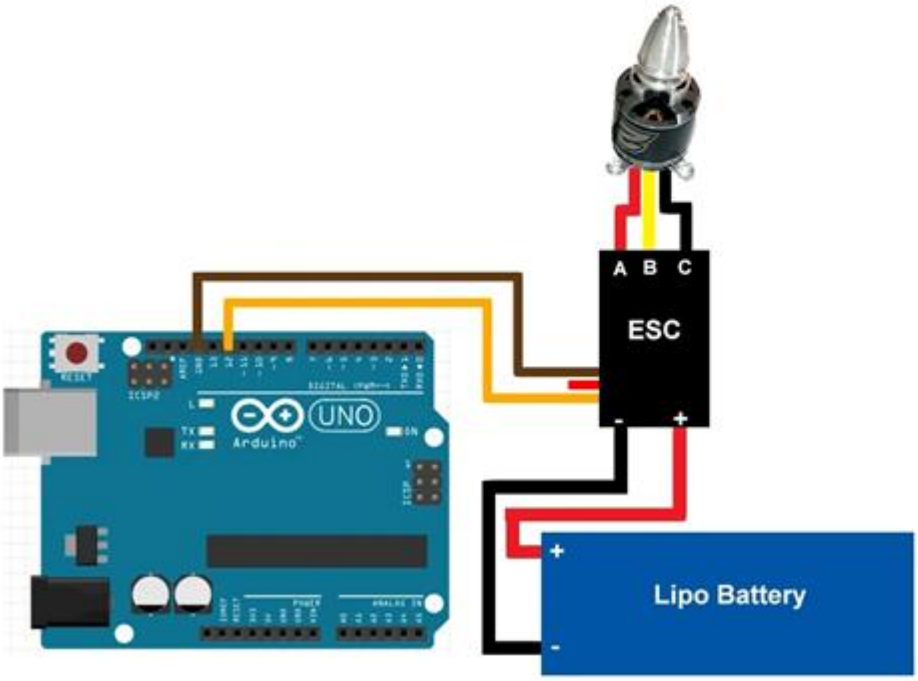


Figure 4.3 connection to ESC from battery, receiver



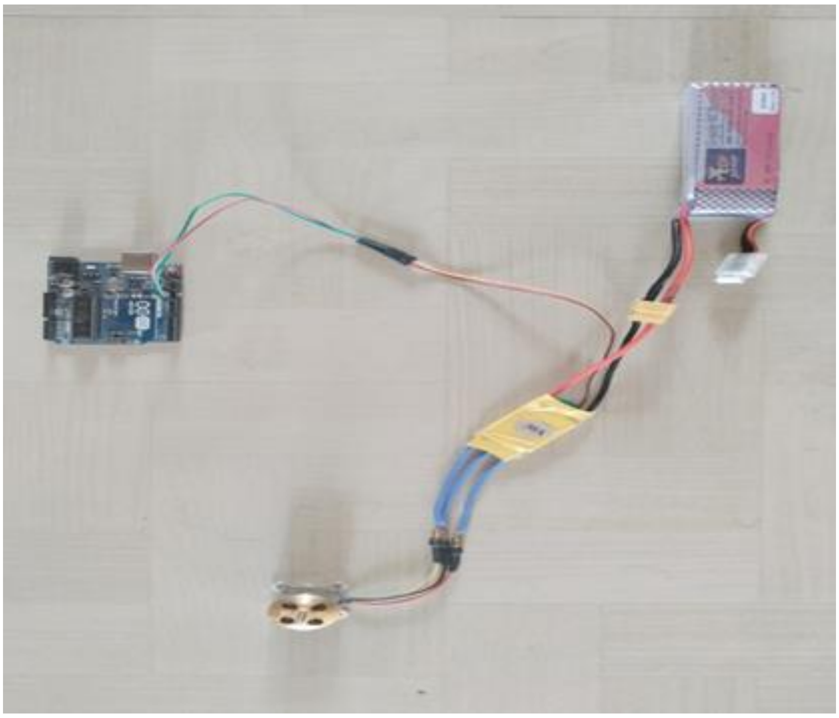


Figure .4 servo motor connections

CHAPTER 5

RESULTS AND DISCUSSIONS

5.1 CALCULATIONS

5.1.1 Calculations foe ESC

- **Max Amp Rating**

The majority of quadcopters use brushless motors, which are controlled by brushless ESCs.

The motor/prop combo must draw more current than the maximum amperage an ESC can take. To ensure that your ESC does not burn out, it is a good idea to add 20% to 50% extra Amps. For instance, since the motor's current rating is 22A, the 30A ESC you are considering should work just fine. This is an easy formula.

ESC = 1.2 – (1.5 x maximum ampere rating of motor)

So, we can select ESC between ranges (26A - 33A).

- **Voltage From Battery**

Make sure your ESCs can handle the voltage coming from the selected battery. If you recall, our motor only consumes a maximum of 15 amps, hence the wattage for 3S and 4S will be,

11.1 x 15 at a 3S battery is 166.5 Watt.

We only used 3S batteries because our motor and esc are not very efficient or capable of using 4S batteries. Since our motor's maximum current is 16 Amps, we can use an esc that draws 30A. based on logic or formulas.

ESC (A) =1.2- (1.5×max amp of motor) = 1.5×16 = 25.

we have selected the ESC of 30A.

5.1.2 Thrust calculations (Without seeding system) of drone

General required thrust is given by a formula mentioned below it is,

Thrust calculations of drone

lift force = Total weight of quadcopter (including payload& battery)*g(acceleration due to gravity

= 1500 * 9.81

= 14715 g-m/s^2

Thrust per motor = Lift force / number of motors

= 14715 / 4

= 3678.75 g-m/s^2

Here we got required thrust for each single motor should be 962 grams for each motor to lift.

Now we must calculate the actual amount of thrust of each motor by theoretical method.

Thrust offered by each motor

Here, we find that each motor needs to have a push of 962 grammes.

Now we need to figure out how much thrust each particular motor will actually create. Provided by each motor is thrust. We now need to determine how much push will actually be generated by each individual motor. I discovered that the following formula can be used to determine the motor's thrust.

$T= [(eta \times P)^2 \times 2 \times 22/7 \times r^2 \times \text{air density}]^{(1/3)}$

Were,

eta = prop hover efficiency let us take it as 0 .7-0.8

P = voltage ×current ×motor efficiency

R = radius of propeller in M

Air density $=1.22\ kg/m^3$

Voltage = 11.1 v

Current =12 A

Motor efficiency =80%=0.80 Eta=0.8

$T = [(0.7\times11.1\times12\times0.8)^2\times2\times3.14\times(0.100)^2\times1.22]^{0.33}$

$T = [(5563.9\times0.1723]^{0.33}$

T = 9.637 N

Therefore, Thrust calculated (For single motor)

T = 9.637 N

T = 9.637 X 0.101 Kg

T = 0.9733 Kg

T = 3893 grams

If we choose a motor with a lower efficiency once more, we will sacrifice some safety features; nevertheless, if they work at only 70% of their potential, we can still generate thrust.

T = 3.893 x 80/100

T = 3.11 kg

Therefore, the min-to-min amount of thrust produced by all the motors is 3.11 kg.

5.1.3 Battery Calculations

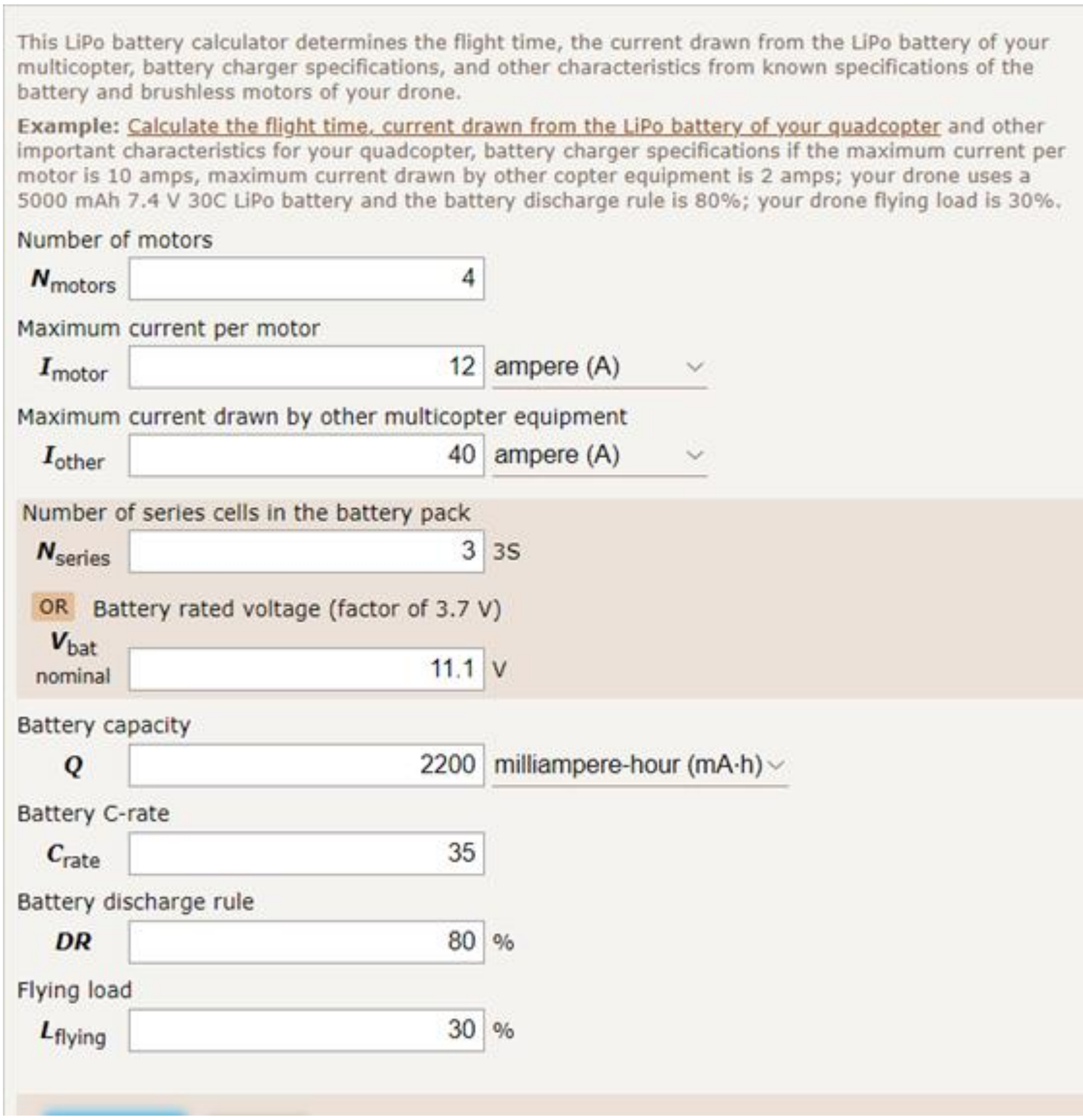
We must determine how much energy it consumes; thus, we have calculated the source that the battery needs.

Max source = discharge rate*capacity

Max source = 20×2200

Max source = 44000

Max source = 44 Amp


This LiPo battery calculator determines the flight time, the current drawn from the LiPo battery of your multicopter, battery charger specifications, and other characteristics from known specifications of the battery and brushless motors of your drone.
Example: Calculate the flight time, current drawn from the LiPo battery of your quadcopter and other important characteristics for your quadcopter, battery charger specifications if the maximum current per motor is 10 amps, maximum current drawn by other copter equipment is 2 amps; your drone uses a 5000 mAh 7.4 V 30C LiPo battery and the battery discharge rule is 80%; your drone flying load is 30%.
Number of motors
N motors 4
Maximum current per motor
I motor 12 ampere (A)
Maximum current drawn by other multicopter equipment
I other 40 ampere (A)
Number of series cells in the battery pack
N series 3 3S
OR Battery rated voltage (factor of 3.7 V)
V bat nominal 11.1 V
Battery capacity
Q 2200 milliampere-hour (mA·h)
Battery C-rate
C rate 35
Battery discharge rule
DR 80 %
Flying load
L flying 30 %

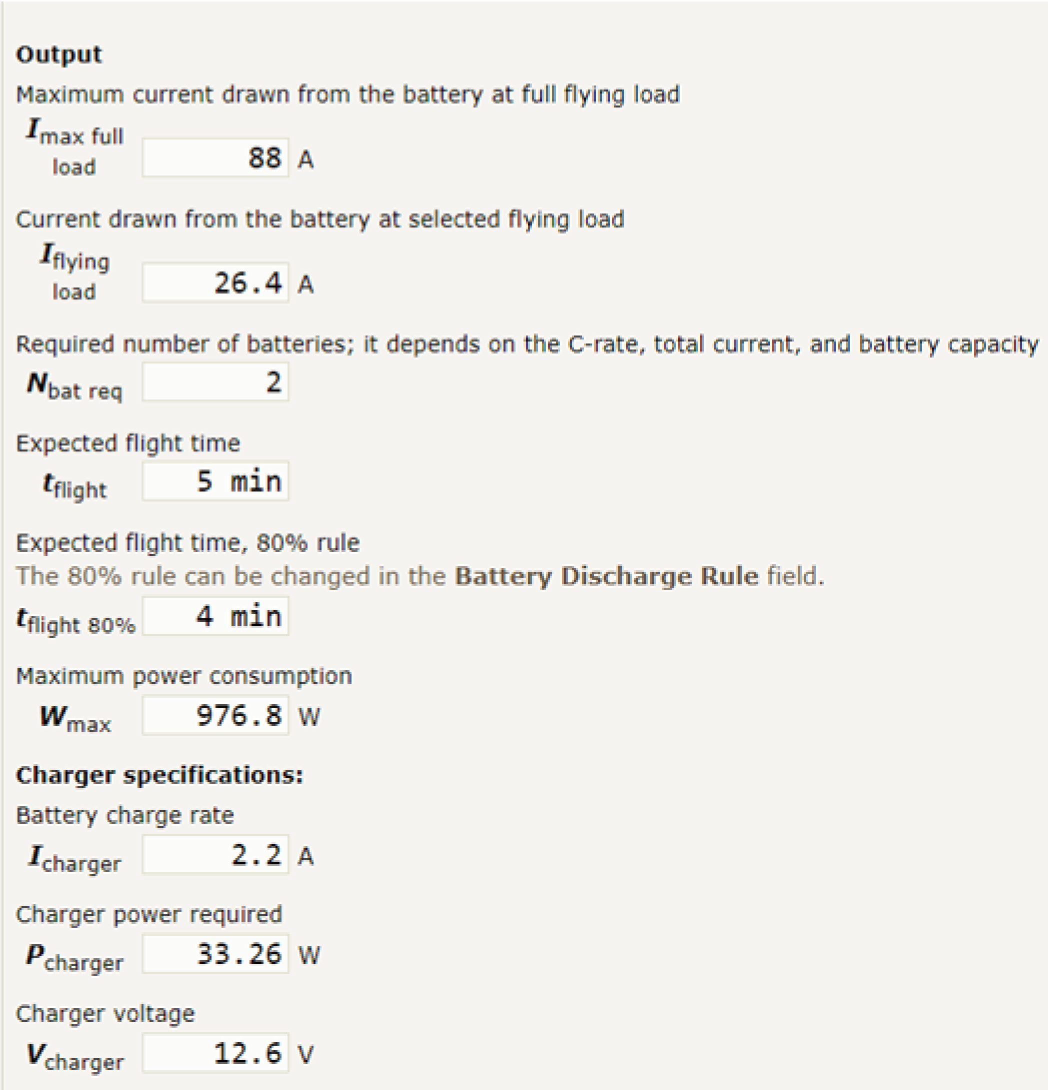


Figure 5.1 Battery Calculator

5.1.4 Propeller calculation for Thrust

Weight of the craft itself + Payload Capacity = Thrust * Hover Speed%.

if you decide to use a 3s Lipo battery as a power source. Your throttle is at 80% and your purpose is 10*4.7. The craft itself weighs 1700g, and we want to design a quadcopter that can carry 1000g.

$$1000+1700 = T\times75\%T = 2700/0.75\ T = 3600 \text{ grams}$$

This amount of push should be supplied by four motors; thus, we can determine the amount of individual thrust needed by using the formula T = 3600/4T = 900 grammes. Since the needed thrust is 900 grams, our calculations showed that each motor will produce or generate 943 grammes of thrust. The system will function safely or without any default settings. In the end, we decided to use four propellers, two of which are intended to turn in one direction (CW) and the others in the other (CCW).

5.2 OBSERVATION

ADVANTAGES

- Water conservation: ultra-low volume spraying technology can be used, using only 10% as much water as conventional spraying techniques.
- Affordable: The price is only a third of what conventional spraying would cost.
- Wide range of uses, including no dependence on crop height or terrain, remote control, low-altitude flight, and crop protection.
- Easy to use and maintenance: long life to use, low maintenance cost, easy to replace wearing parts.
- safety: shield farmers from the dangers of pesticides to avoid poisoning and heatstroke events.
- High efficacy: spraying rates of 50 to 100 acres per day, which is 30 times greater than the usual spraying rate.
- Protection of the environment: pesticides can be sprayed in a set position and orientation, reducing soil and water pollution.
- Pesticides can be saved by pressing chemical fog to all levels of the crop with a high degree of atomization, which can save more than 30% of pesticides.

DISADVANTAGE

• Flight Area and Duration

The use of drones in agriculture has significant drawbacks. The majority of agricultural drones only have a 20–60-minute flying time. For monitoring very big acreages, this might not be particularly successful. The radius that can be covered throughout each flying time is similarly limited by the flight range. Longer flight times and greater range monitoring drones are generally more expensive.

• Expensive drones with good features

Drones that are well-designed and have the qualities necessary for usage in agriculture are fairly pricey. This is particularly true for drones with adjustable wings that can cost up to $25,000 (Precision Hawk's Lancaster). The high cost of some agricultural drones includes hardware, software.

5.3 RESULTS

A 3D printed frame can provide a number of advantages for an agriculture drone, including improved durability, reduced weight, and potential cost savings. In addition to extending flight time, a lighter drone can cover more ground more effectively. A seed dispersal system for urea fertiliser that incorporates a storage tank can deliver accurate and controlled fertiliser application, resulting in better crop yields and more effective resource usage. The fertiliser may be applied evenly and strategically using the seed dispersal system, which lowers waste and increases fertilisation efficiency overall.

The weight of drone along with payload (storage tank) consists of ~1.5 kgs. Take-off of drone without payload after many unsuccessful attempts gives flight time of ~10 minutes ,which is average outcome of a quadcopter . On other side, Testing is done manually with storage tank placing at certain height Fixed and done some trial-and-error method to find out speed required for serve motor to seed dispersing. Speed of servo motor with 60 value gives optimum outcome with dispersal of seed in close range With length of dispersal 1.27 M .So drone stops at every ~1.30M range for seed dispersal for around 2 seconds. The attachments of both storage tank with drone eliminated the aurdino board connections as flight controller software operated by giving specific commands. This process resulted in decreasing of flight time as load on battery is more. Drone with payload results in unsuccesful attempt as there is mis- match in thrust of 1St motor, replacing with other motor and proper ESC calibration gives proper take-off drone. Duration of the flight time is ~6 minutes with urea dispersal of 500grams.with at an altitude hold of 2 Meters.

Overall, using a seed dispersion system for urea fertiliser and an agriculture drone with a 3D printed frame can assist farmers in a number of ways, including better efficiency, improved accuracy, and potential cost savings. The type of crop, the size of the field, and the circumstances surrounding the usage of the drone are just a few examples of the variables that will affect the specific outcomes.

CHAPTER 6
CONCLUSIONS AND FUTURE SCOPE

6.1 CONCLUSION

In this project we have designed a DRONE WITH PESTICIDES SPRAYER by Seed dispersal system which is an architecture built around unmanned aerial vehicles (UAVs) and a seeding system that may be used to construct a control loop for agricultural applications where a DRONE WITH PESTICIDES SPRAYER by Seed dispersal system is in charge of sowing seeds. By doing this, we can minimise human effort to some extent, if not much. This will enable faster completion of the seeding process in agricultural fields. This will increase efficiency and improve accuracy while lowering labour costs. Within the signal's range, this is entirely controlled by the radio transmitter and receiver. The DRONE BASED PESTICIDES SPRAYER's seed dispersal system won't operate properly if we go too far outside of the signal range.

This system may be further developed in a number of ways, including by substituting other equipment or systems for the seeding system. For example, if a cutter is placed, the crop will be cut, if a sprayer module is attached to a drone, the drone will be used to spray pesticides, and if expensive equipment is provided, the system will also perform scanning of plants, security purposes, and inspecting crop details with specific seeds, fertilizers, and pesticides according to soil conditions. The wireless sensor network built at ground level on the agricultural field provides feedback that is used to regulate the application process.

Drones will be used in almost every sector of the economy, but drone usage in the agricultural industry is booming. Our cutting-edge platform is a key to enabling world class practices for a safe, healthy and sustainable food supply chain.

6.2 FUTURE SCOPE

- The quadcopter's ability to hoist weight can be improved by increasing the number of motors, the size of the propellers, or the motor's revolutions per minute (rpm).
- Increasing the battery's capacity will extend the flight time.
- By enlarging the tank, one can improve the pesticide carrying capacity.

- By using additional nozzles that may be arranged in an array, a larger area can be covered.
- Spraying accuracy can be increased by controlling the spraying angle.
- Using image processing techniques, a drone can be used for surveillance to spot pest attacks on plants and fruit that is maturing.

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