MEC4910

DRONE DESIGN FOR SANITIZATION PURPOSES

Mechanical Final Year:

Rifaa Javed 18MEB450

Mohammad Ghufran 18MEB502

Aas Mohammad 18MEB538

Under the Supervision of:

Mr. Ateeb Ahmed Khan

Assistant Professor, MED

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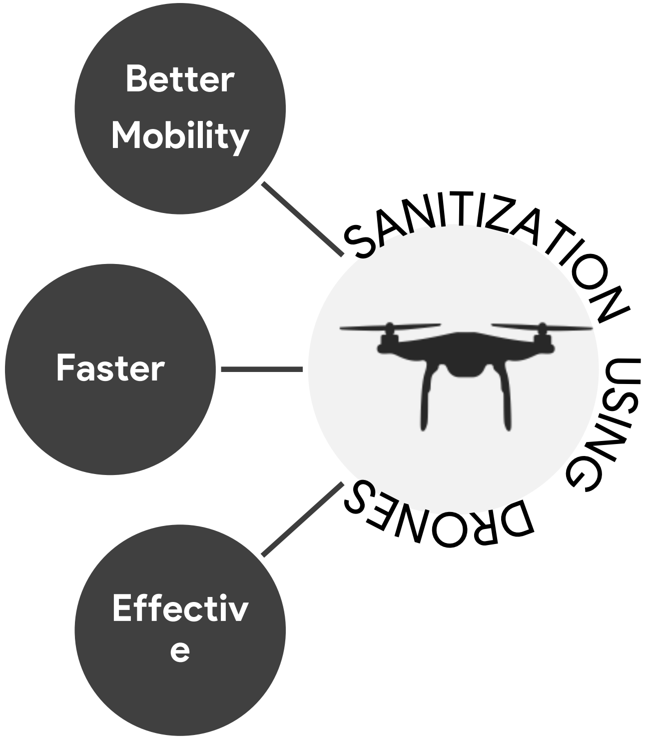
INTRODUCTION:

Coronavirus outbreak has had a major impact on health, economy, and daily life for people around the world. Delay in the availability of vaccines and cyclic raise in the number of victims pose a challenge to the huge population to return to their routine.



The current solution proposed by public health care officials is to frequently sanitize one's self and surroundings. In this aspect, disinfecting large halls, malls, shops, playgrounds, parks, streets, etc. is a challenging task. This requires a lot of manpower and time being wasted on this repetitive task. Sanitizing using the hand pump technique is a too slow and tedious process.

According to WHO's report, longer contact with surface sanitizer can bring serious health risks like Eye and skin irritation, liver damage, Respiratory conditions, Central nervous system effects, Cardiac reaction, etc. Drones can be effectively used to perform the sanitization process in a large area. The present work aims to create a drone for sanitizing a large hall.

PROBLEM STATEMENT:

The team needs to design and develop a 3D Printed Quadcopter equipped with sanitizer in its reservoir and a spray system to dispense the liquid. The Quadcopter should be able to be operated effectively for indoor as well as outdoor sanitization processes, namely Large Halls.

DRONE DESIGN:

PROBLEM STATEMENT

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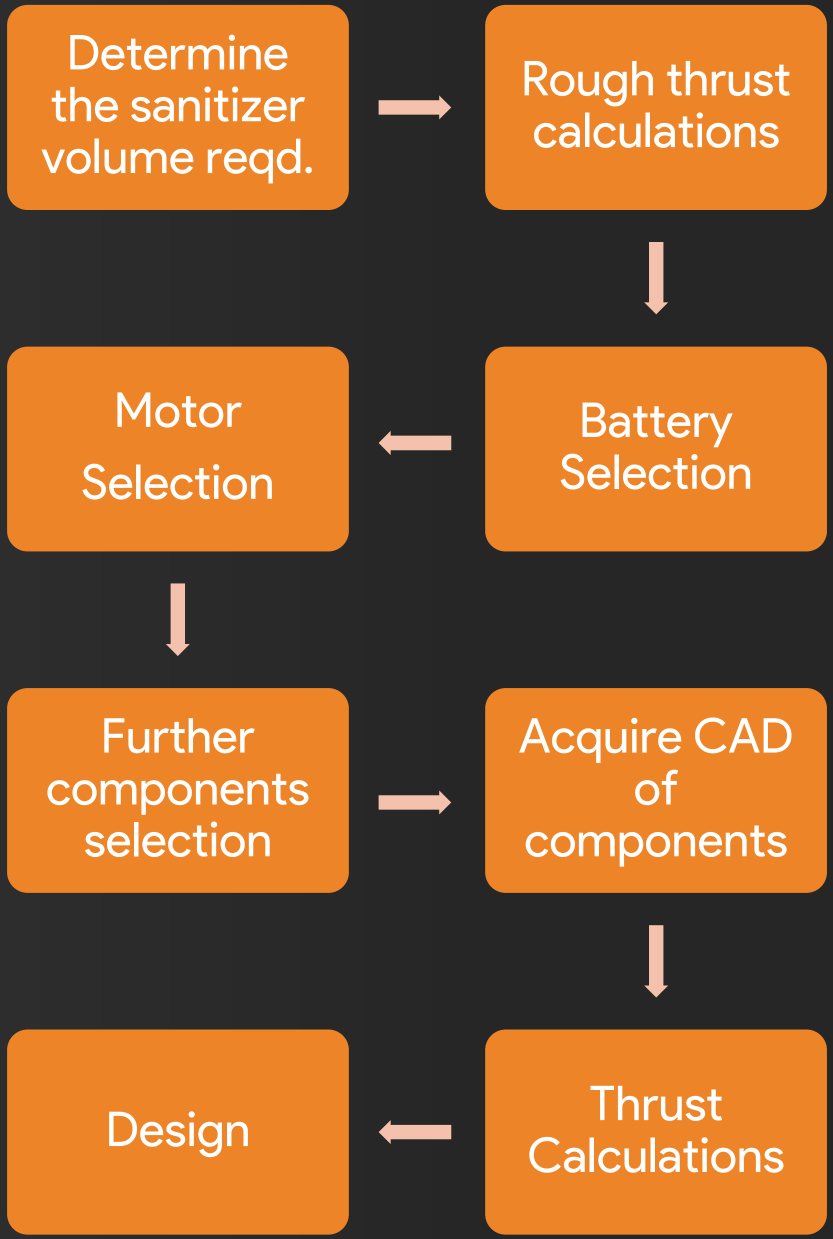

PROPOSED

ACTION PLAN

Current Status:

100% Achieved

DRONE DESIGN:

DESIGN CRITERIA & CONSIDERATIONS

Mechanical Final Year:

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DESIGN CRITERIA:

Flight Time ~ 10 minutes
(at 80% discharge)

Overall Weight < 2 kg

Thrust Ratio > 3:1

ACHIEVED:

(As per simulations)

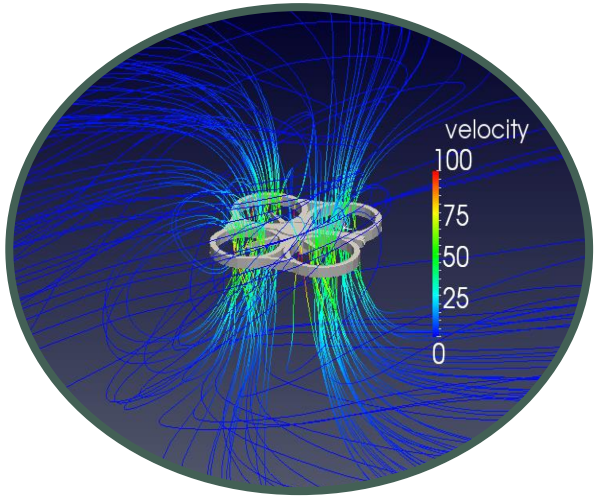
Flight Time = 8.2 minutes
(at 80% discharge)

Overall Weight = 1.70 kg (inflated)

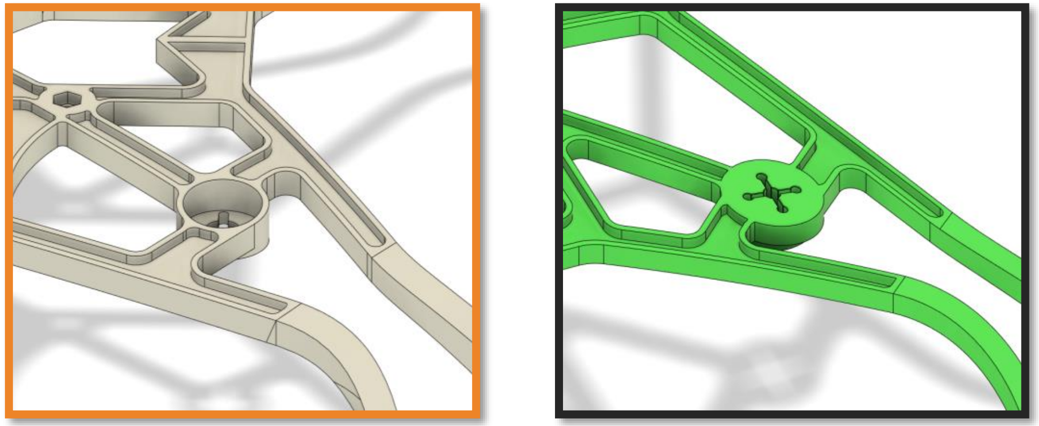
Thrust Ratio ~ 4:1

DESIGN CONSIDERATIONS:

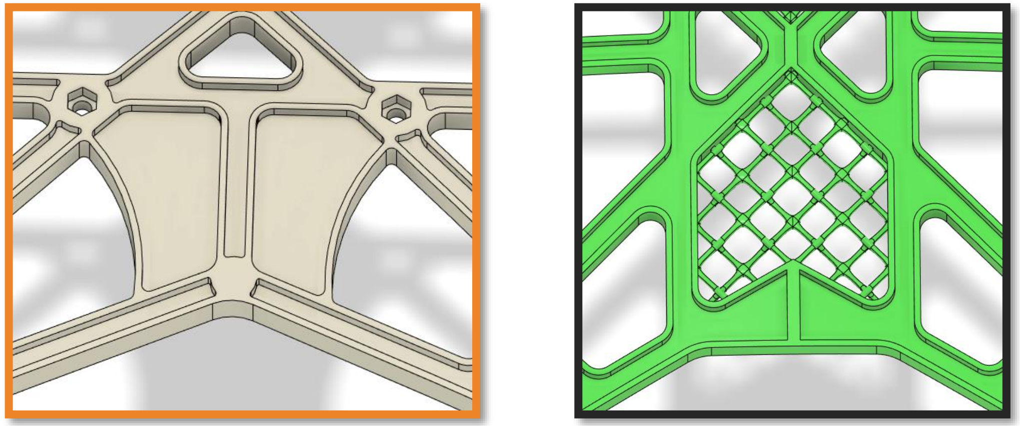
- Frame
  - Protection for Propeller
  - Landing Gear
  - Proper Airflow
  - Light-weight



DESIGN ITERATIONS:



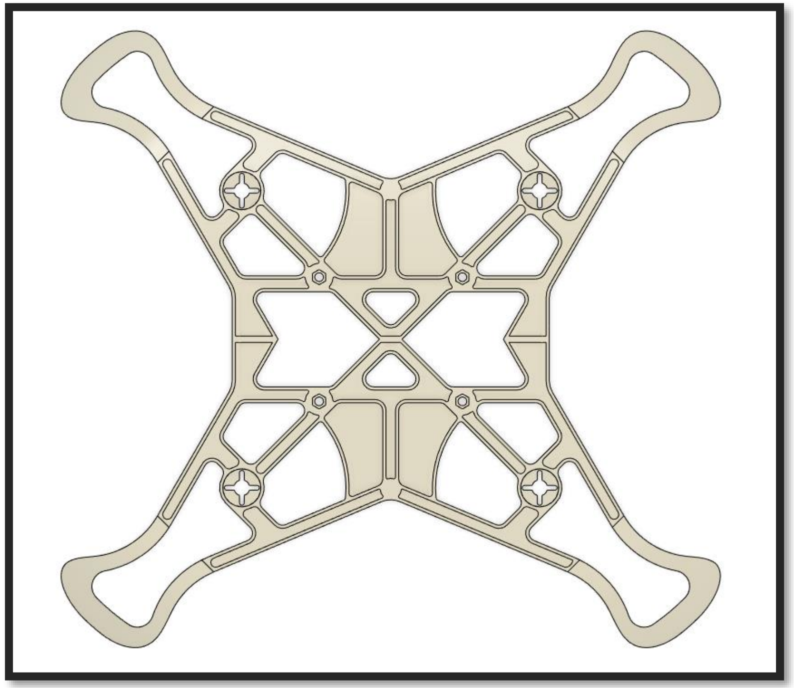
Motor Mounts have been changed for better fit.

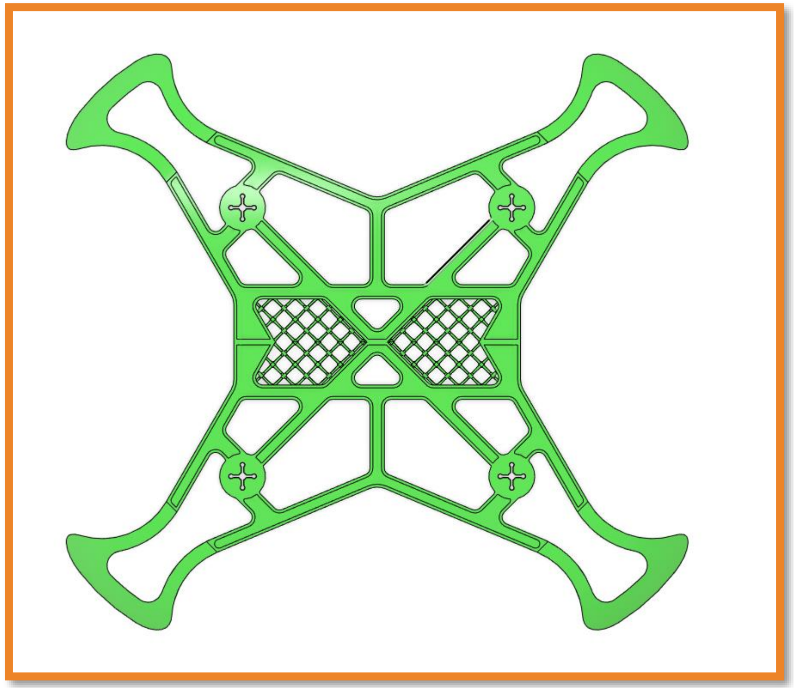


Plates have been replaced by grills for light weighting.

Initially, the design was scaled down from a full size agricultural drone to a 265 mm frame size due to resource limitations.

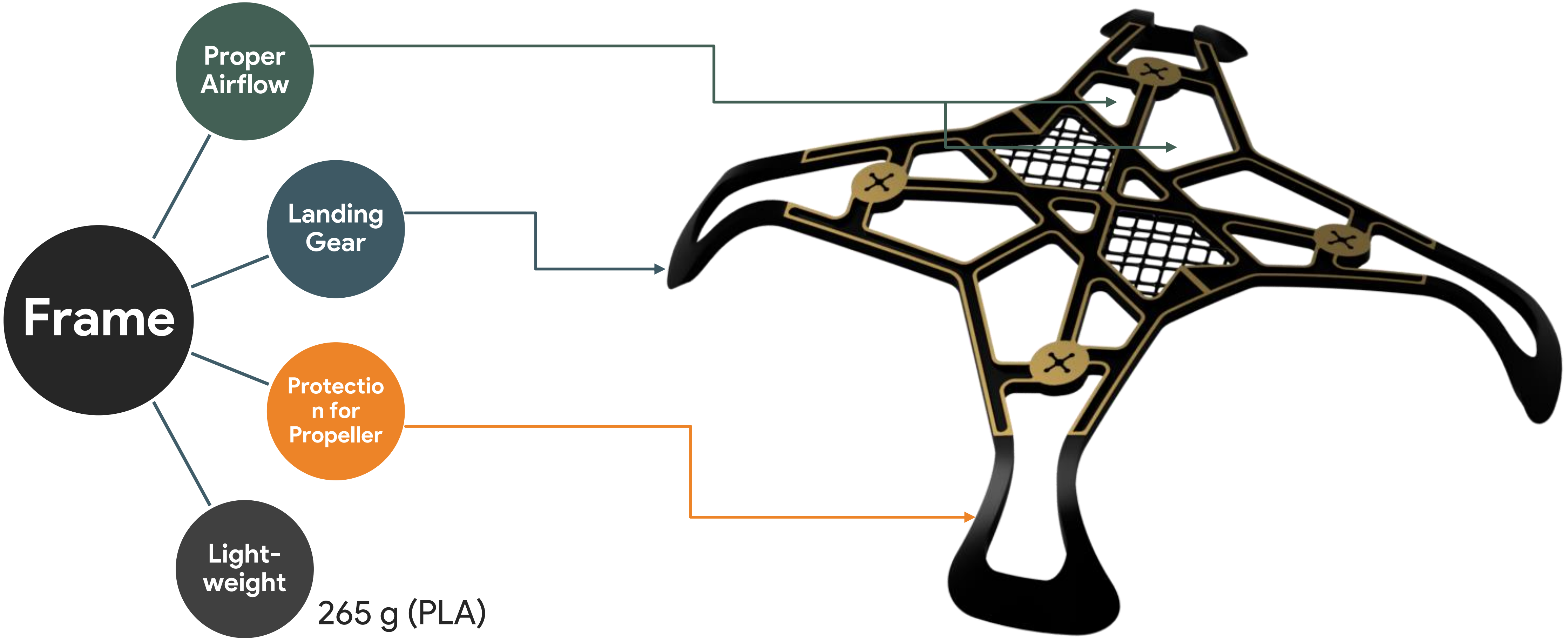
DESIGN ITERATIONS:



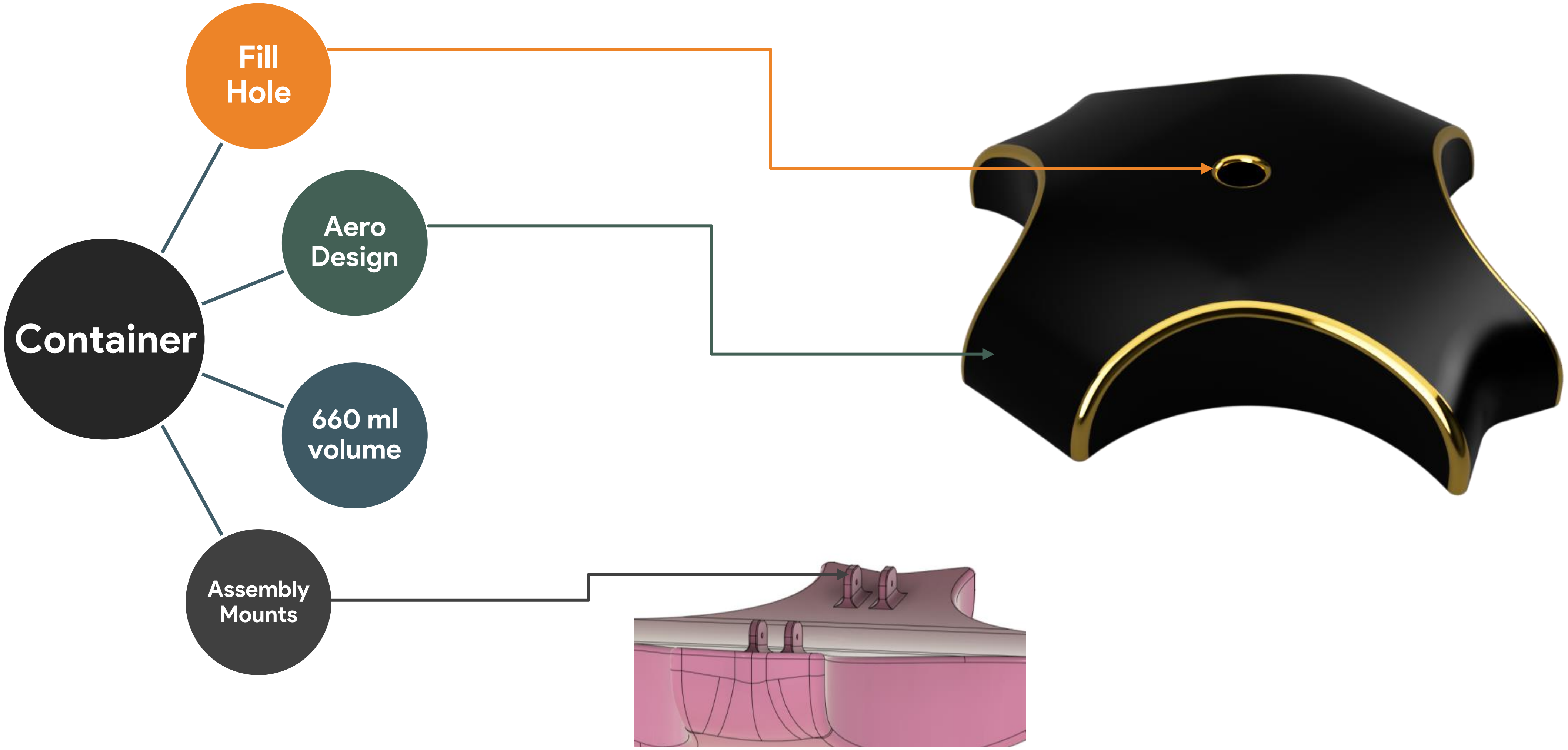


The final design is lighter (30%), aesthetically better, and of similar strength as the old design.

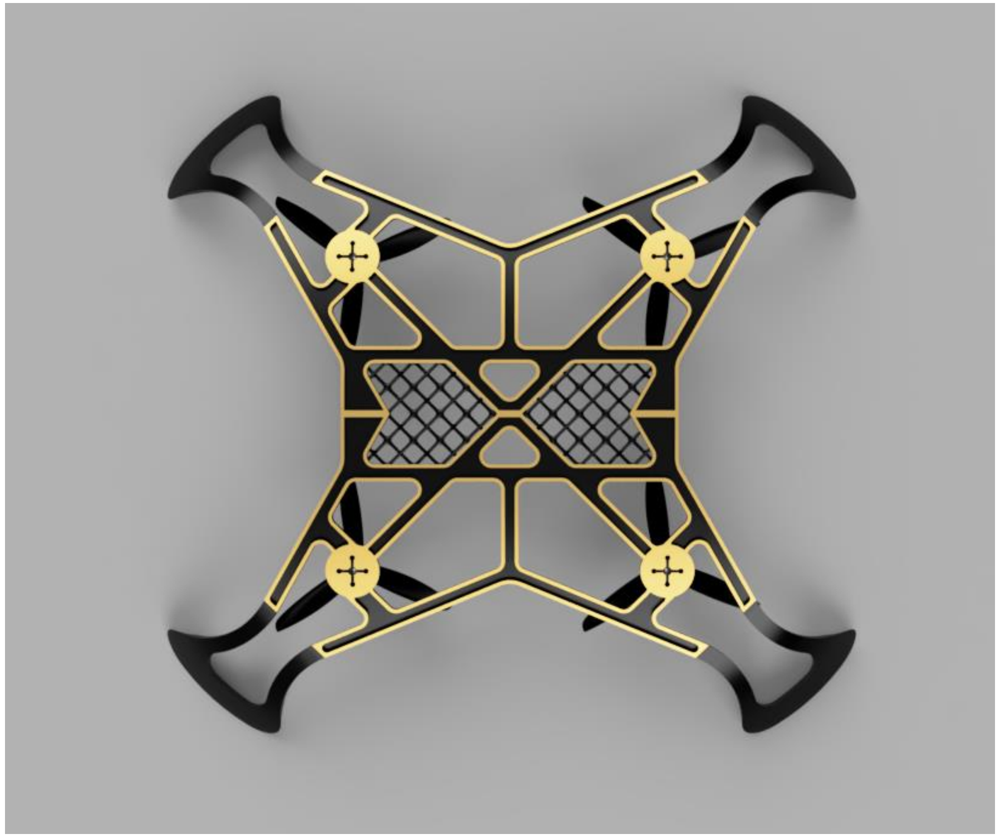
FINAL DESIGN:



CONTAINER DESIGN:



RENDERED DESIGN:



RENDERED DESIGN:

DRONE DESIGN: MOTION STUDY

Mechanical Final Year:

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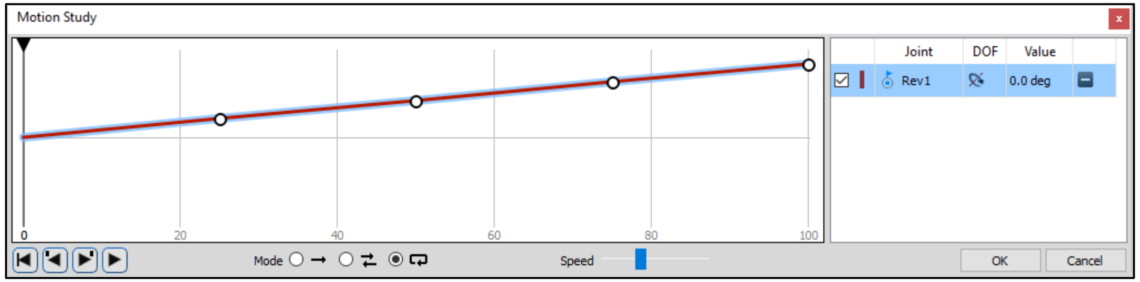
MOTION STUDY:



DRONE DESIGN:

MATERIAL SELECTION & PROPERTIES

Mechanical Final Year:

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Aas Mohammad

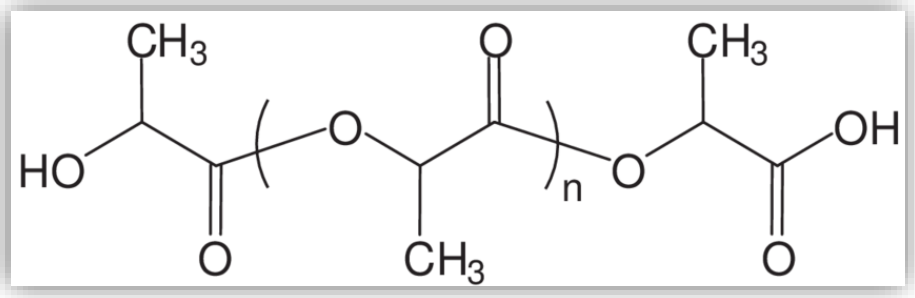
MATERIAL SELECTION:

- Nylon, ABS (Acrylonitrile Butadiene Styrene) & PLA (Polylactic Acid) were considered.
- Nylon left out as the available printer doesn't support.
- ABS & PLA compared on various parameters on a 5 point scale.
- PLA scored highest.

Material	Strength	Durability	Stiffness	Printability	Heat Resistance	Cost	Total
ABS	2	3	3	2	2	3	15
PLA	3	2	3	4	1	4	17

Material Properties (PLA):

Solid density	1.252 g/cm3
Elongation at break	7 %
Young's modulus	1280 MPa
Shear modulus	1287 MPa
Poisson's ratio	0.36
Yield strength	70 MPa
Flexural strength	106 MPa
Rockwell hardness	HR 88
Ultimate tensile strength	73 MPa



DRONE DESIGN:

STRESS ANALYSIS REPORT

Mechanical Final Year:

Rifaa Javed

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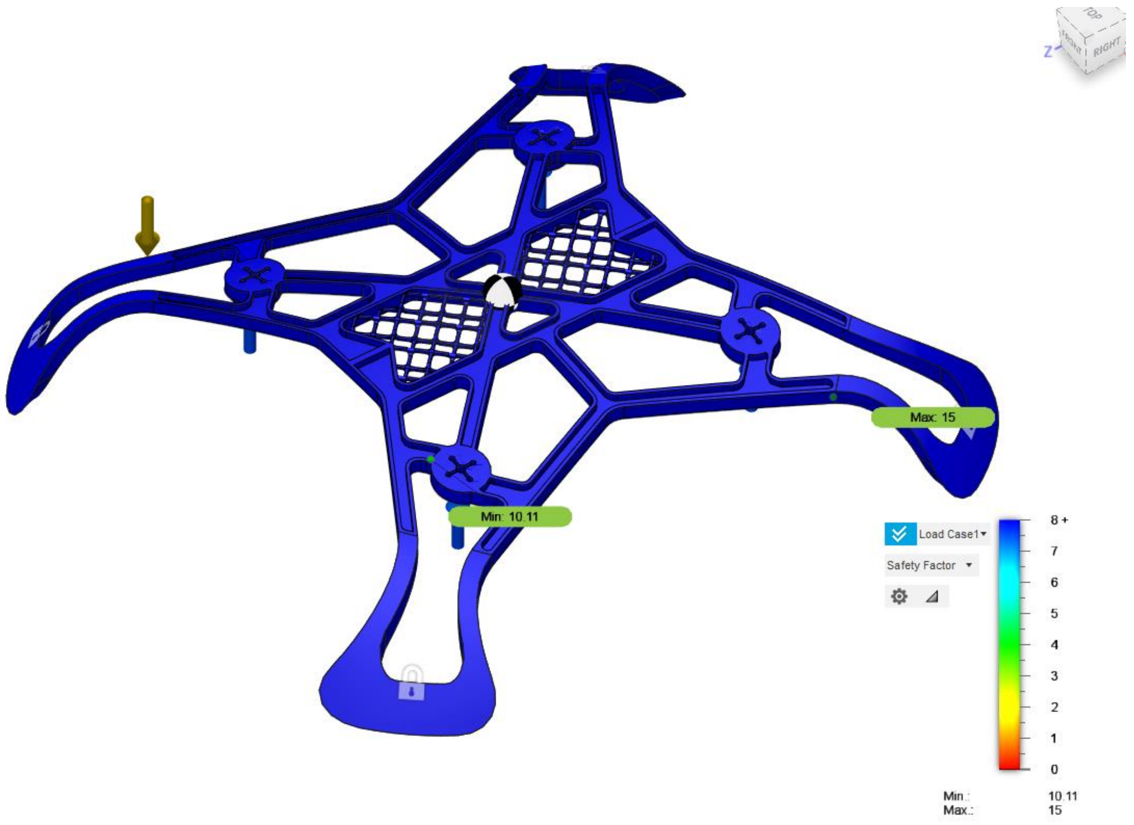
STRESS ANALYSIS:

Material: Polylactic Acid (PLA)
Mesh Refinement: Medium

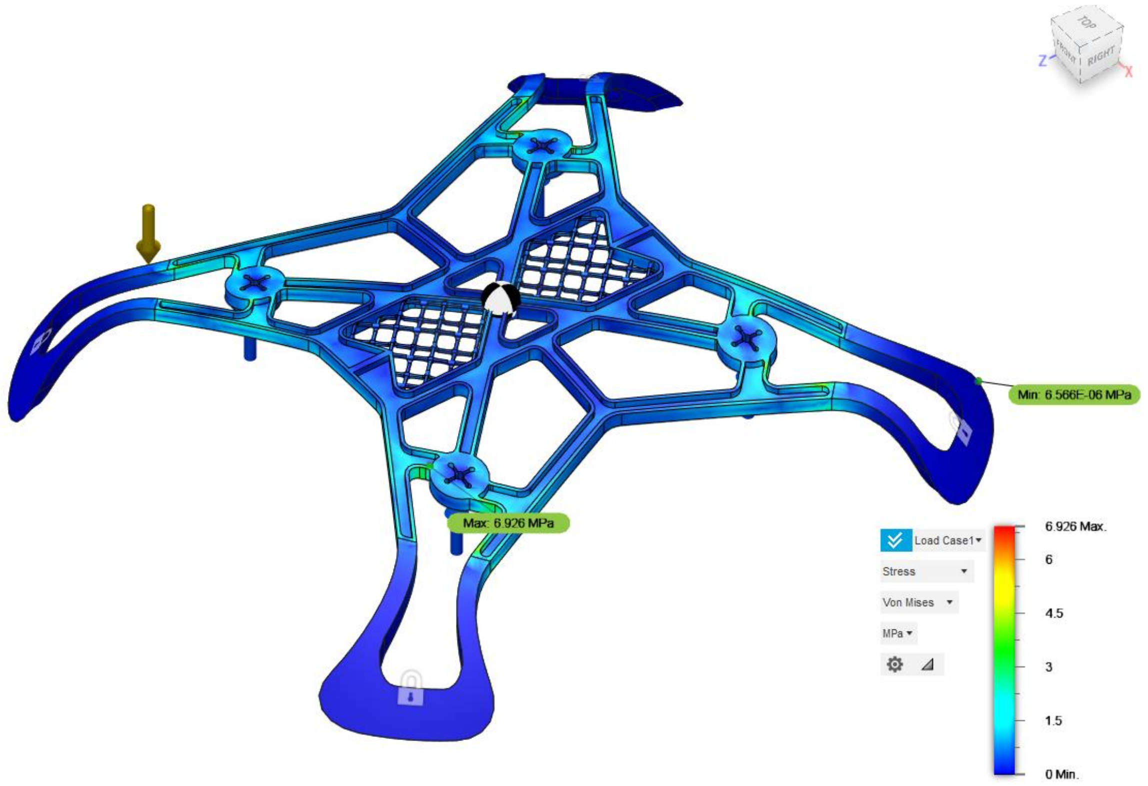
Considering the entire weight of the drone (components included), and the max thrust from the motors:

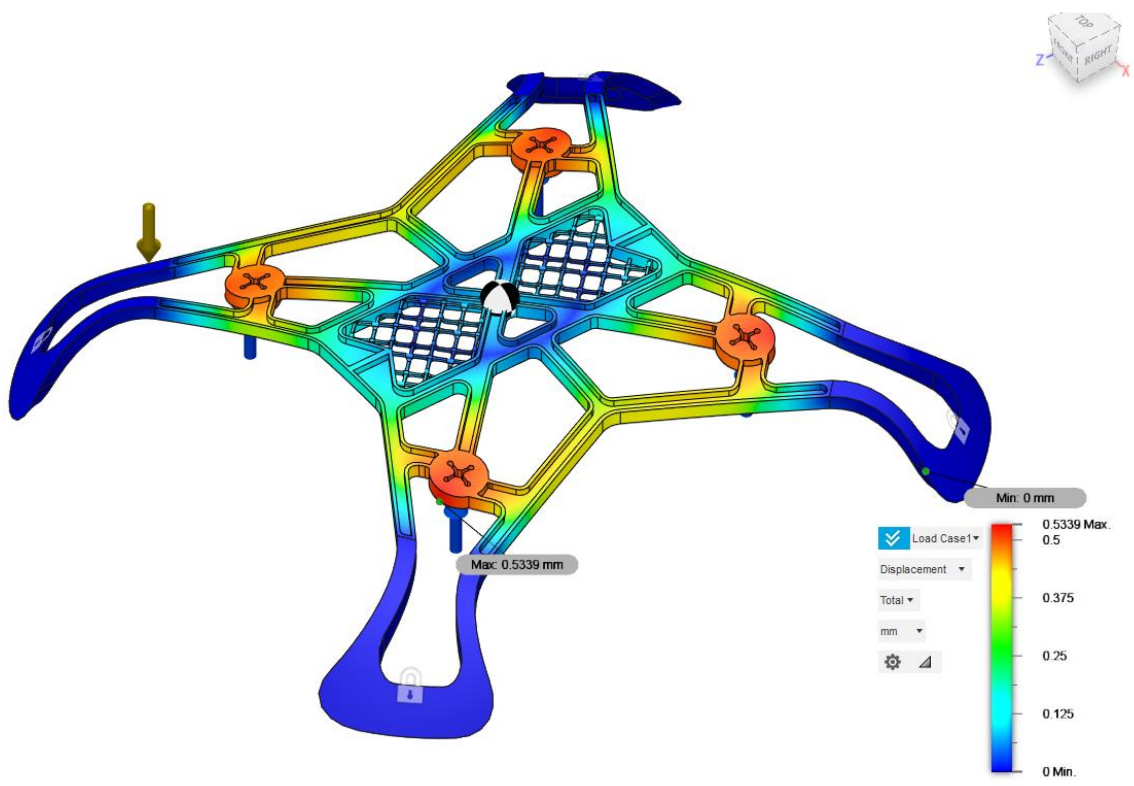


Factor of Safety: Min 10.11

Equivalent Strain: Max 0.0085

STRESS ANALYSIS:





Von Mises Stress: Max 6.926 MPa
Rankine Stress: Max 9.326 MPa

Max Displacement: 0.534 mm

DRONE DESIGN:

3D PRINTING PREVIEW

Mechanical Final Year:

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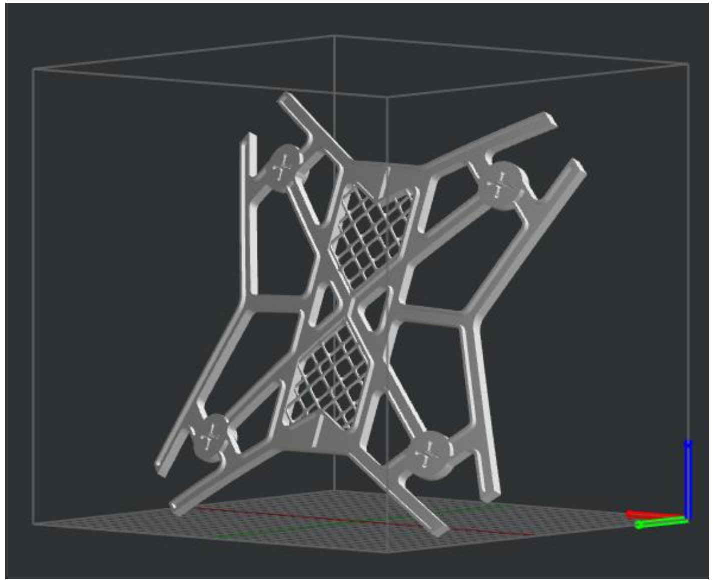
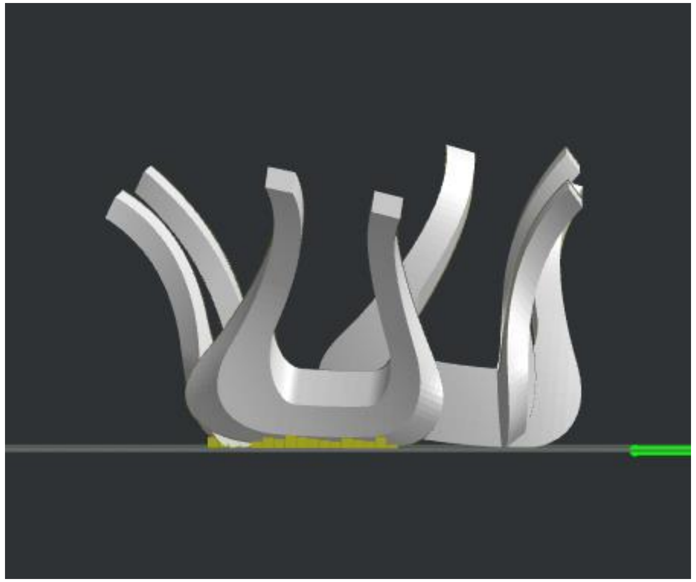
3D PRINTING PREVIEW:

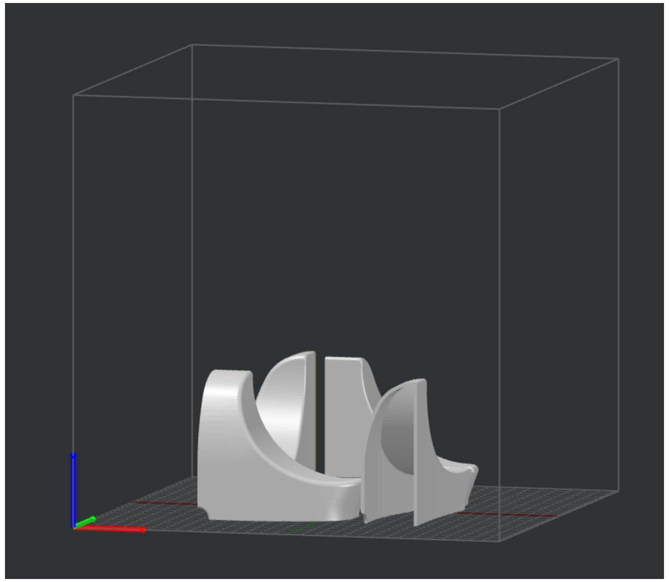
Printer:	Raise3D Pro2
Software:	Ideamaker
Material:	Polylactic Acid (PLA)
Mesh Refinement:	Medium
Infill Density:	15%



Central Plate: 24 hours (104.8 g)



Fins: 9 hours (52.6 g)



Container (in parts):
7.5 hours each (55 g)

DRONE DESIGN: COMPONENTS SELECTION

Mechanical Final Year:

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SELECTION CRITERIA:

Batteries

- Lightweight
- Max Flight Time
- More Voltage; More Motor RPMs
- Higher Discharge Rate

Motors

- Thrust to Weight Ratio
- KV Ratings
- Motor Size

Electronic Speed Control

- Current Rating
- Input Voltage Rating
- Weight & Size

Power Distribution Board

- Integrated or Standalone
- Compatibility
- Voltage Regulation
- No of Connectors

Flight Controller

- Compatibility
- Type of Flying Application
- Processor

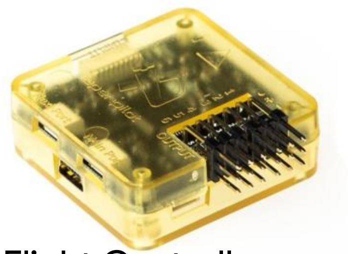
Controller & Receiver

- No of Channels
- Receiver Frequency
- Firmware

COMPONENTS:

Motor

ECO II Series
2207 1700KV
Brushless Motor

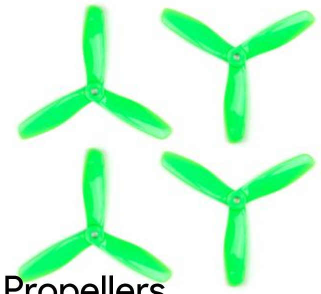


Flight Controller

OpenPilot
CC3D EVO
Flight Controller
with Side Pins

Battery

Orange
3300mAh 4S
25C/50C Lithium
Polymer Battery
Pack



Propellers

Orange HD
Propellers 5045
(5X4.5) Tri Blade
Bullnose
Polycarbonate

COMPONENTS:

ESC

EMAX Formula Series 45A ESC

Tx & Rx Module

FlySky CT6B 2.4GHz 6CH Transmitter with FS-R6B Receiver

PDB

CC3D Mini Power Distribution Board

Pump

Kamoer 6V 0.35A 36ml/min Silicone Tube Liquid Pump

DRONE DESIGN:

BILL OF MATERIALS

Mechanical Final Year:

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BILL OF MATERIALS:

S. No.	Item	Description	Cost (₹)	Quantity	Amount (₹)
1.	Motor	Eco II Series 2207 1700KV	1439	4	5756
2.	Propeller	Orange 5045 Tri Blade	249	1	249
3.	Battery	Orange 3300 mAh 4S	2599	1	2599
4.	Flight Controller	OpenPilot CC3D Evo Side Pin	1599	1	1599
5.	Electronic Speed Control	EMAX Formula Series 45A	1350	4	5400
6.	Power Distribution Board	CC3D Mini Power Distribution Board	119	1	119
7.	Controller & Receiver	FlySky CT6B 2.4GHz 6CH & FS-R6B	2690	1	2690
8.	Pump	Kamoer 6V 0.35A 36 ml/min	399	1	399
9.	Nozzle	-	-	1	-
				Grand Total (₹)	18,811

Note: The component list has already been forwarded to our Supervisor and procurement is in motion.

DRONE DESIGN:

FUTURE COURSE OF ACTION

Mechanical Final Year:

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FUTURE COURSE OF ACTION:

CFD Analysis

- Calculate Aero Drag
- Check the Airflow to the components
- Simulate different flying conditions

Fabrication of the frame

- 3D Printing the components
- Finishing Operations (if reqd.)
- Painting

Assembly

- Programming the components
- Installation

Testing

- Flight testing
- Spray testing

Target: If the components are procured by mid of January 2022, we intend to wrap the project by mid of **February 2022**.

DRONE DESIGN:

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THANK YOU.

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