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SYNOPSIS FOR STUDENT PROJECT PROPOSAL FOR THE 46th SERIES OF STUDENT PROJECT PROGRAMME

1. **PROJECT REFERENCE NUMBER :** 46S_BE_1729

2. **TITLE OF THE PROJECT :** Mapping of Air Pollutants using Helium-filled Airship with Internet of Things (IoT)

3. **NAME OF THE COLLEGE & DEPARTMENT :** Dayananda Sagar College Of Engineering - Department Of Aeronautical Engineering

4. **NAME OF THE STUDENTS & GUIDE(S) :**

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5. **KEYWORDS :** Lighter-Than-Air systems ; Airships ; Air Quality ; Internet of Things.

6. INTRODUCTION / BACKGROUND :

Ever since the 19th century, carbon emission has been increasing. The increase in the machine has mainly increased the emission of pollutants like Carbon Monoxide, Sulphur oxides, and Nitrogen oxides. Moving forward into the zero carbon emission era by 2030, the need for monitoring these pollutants is as important as reducing emissions. The effects of these high levels of air pollution can cause a variety of health issues. Major cities like Delhi is mostly covered with extensive amount of smog, that is coming from stubble burning of garbage, power plants, factories and vehicles. All these pollutions need to be monitored and recorder for the government authorities to review. The designed airship will be capable of monitoring air pollutants across wide areas while giving notable endurance time which enables us to get less stoppage time for recording data.

Currently, pollution is monitored mainly through ground stations, sampling in labs and satellites which have their own disadvantages in terms of time and range. To bridge the gap between the advantages of ground-based stations and satellites. We are introducing an airship with the ability to measure the pollutants and update the ground station server in real-time using an Internet of Things (IoT) device. The advantages of this airship over other UAV vehicles are that lift is produced at the cost of helium's buoyancy and the least effort has to be spent on lifting the payload. To measure the pollutants in the air, Carbon monoxide sensor, Optical dust sensors and SO_X sensors are equipped with an IoT device.

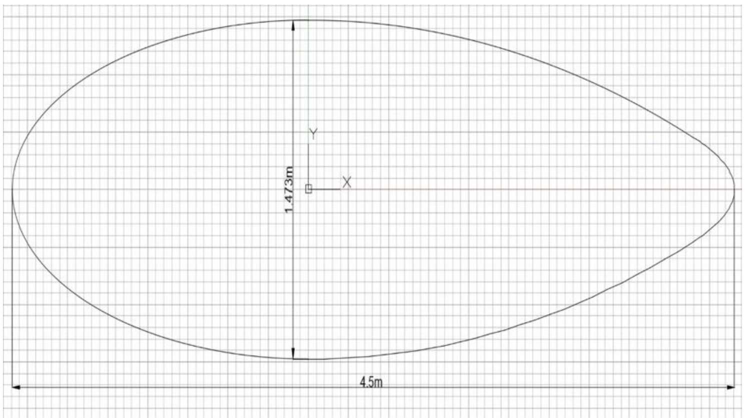
7. OBJECTIVES :

- To evaluate the common air pollutants and their impact on ecosystems and ournatural environment.
- To estimate the payload of the airship.
- To select the sensors, IoT device and the required connection.
- To estimate the aerodynamic and structural properties of the airship.
- To design a 3D model of the airship and to carry out static analysis.
- To fabricate the airship.
- To test and implement the sensors, IoT and propulsion system.
- To Map the air quality data over the area and comparing with

National Air QualityIndex.

8) METHODOLOGY :

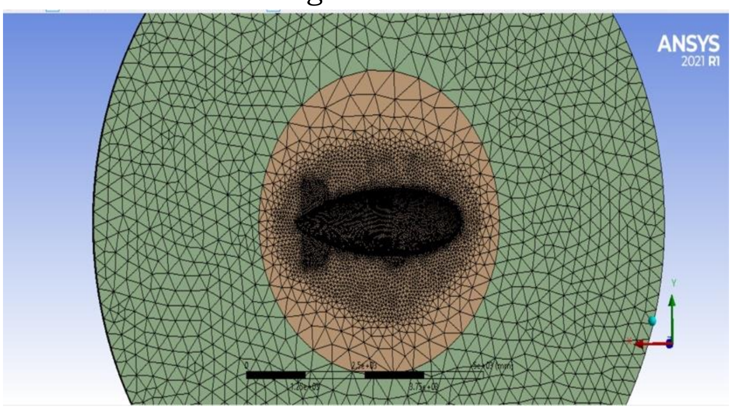
Following the GNVR shape nomenclature, ideal length for the airship was 4.5m found by iteration method. The remaining dimensions were calculated once the max diameter of the envelope was found. The figure below shows the 2D model of the GNVR shape.

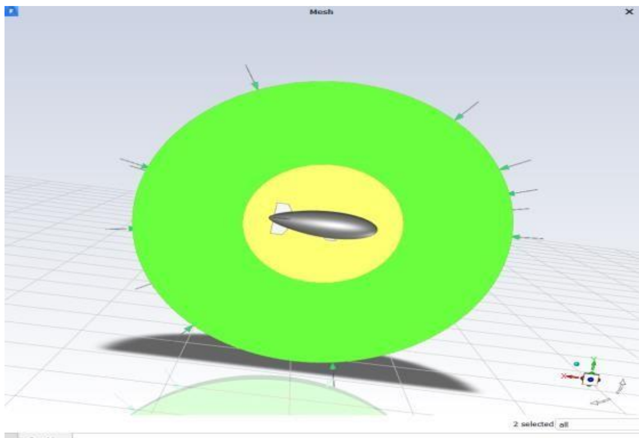


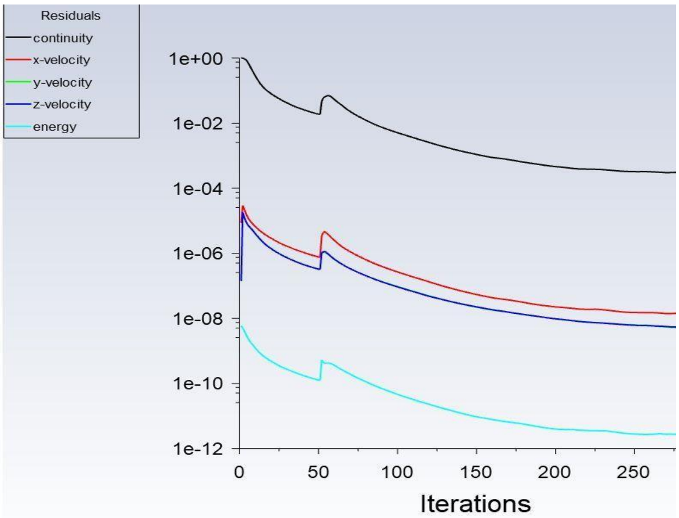
Weight breakdown was obtained as follows using which the net lift was calculated:

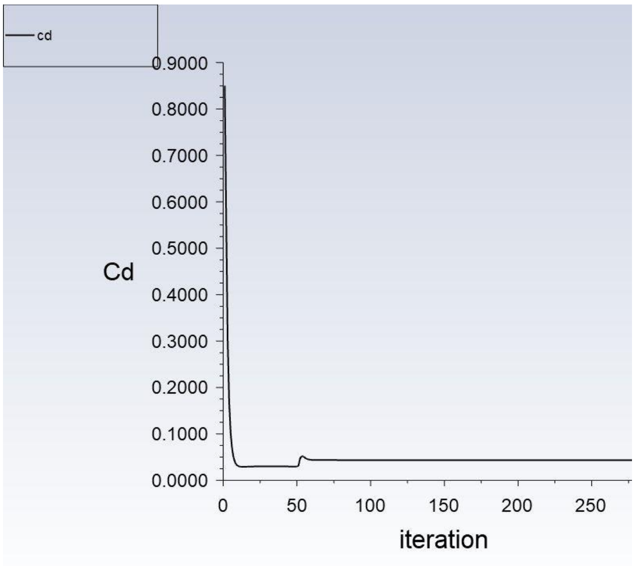
Item	Weight(g)
Envelope	3935
Motor	45
Gondola	100
Receiver	20
Battery Pack	265
Propulsion	30
Wires	25
Breadboard	95
Fin Weight	90
Payload	200
Total Mass	4733g

For the verification of drag calculation, a simple flow analysis was carried out in ANSYS Fluent and the drag coefficient was found and compared with the theoretical drag.





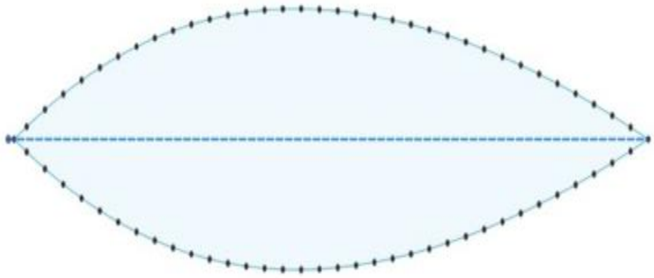


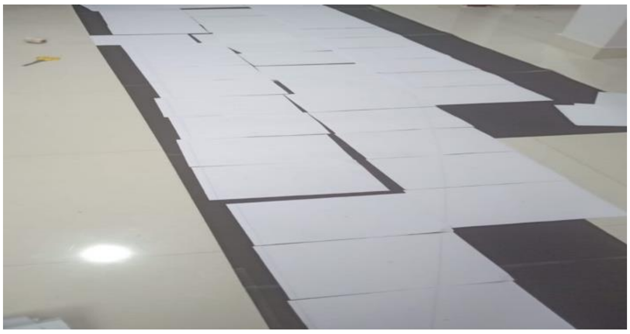


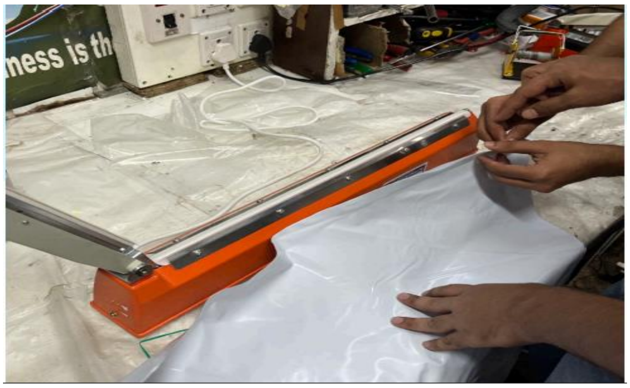
Residuals for velocity=4 m/s

Drag Coefficient vs Iterations

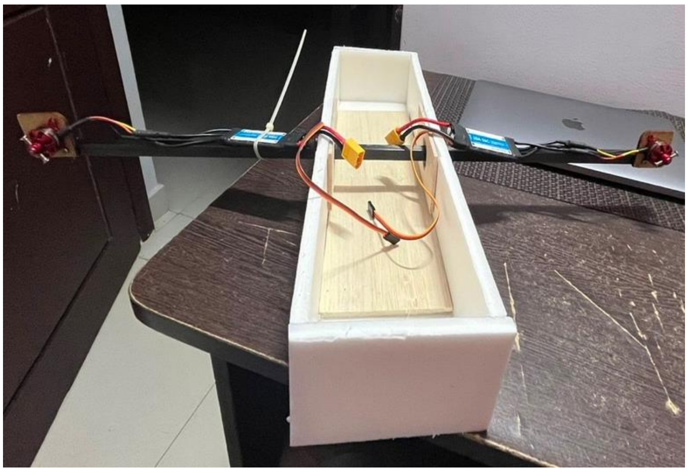
Using a fourth order polynomial fit, co-ordinates were generated and the cross-sectional shape of the envelope was obtained. We decided to manufacture the envelope in four petals for ease and accuracy in fabrication, as well as to minimize the wastage of the fabric. The envelope material (PVC Fabric 200gsm) was cut into pieces as per the template and heat sealed along its ends.

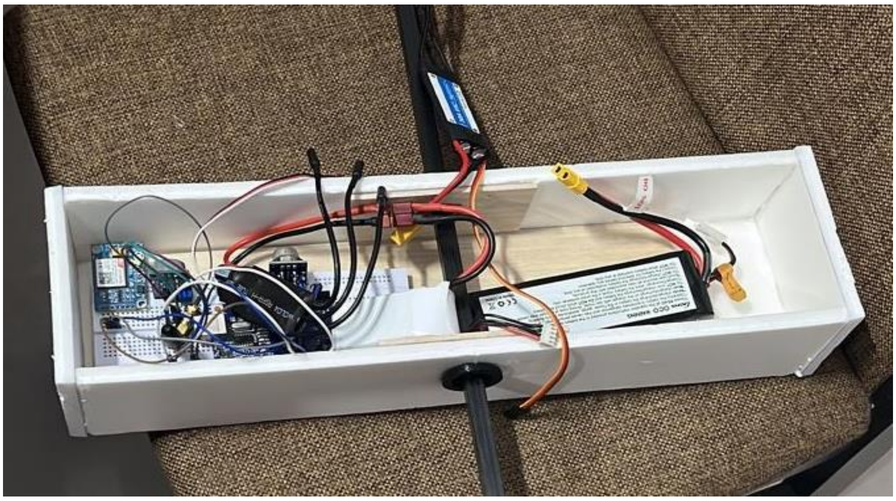






For the gondola, upon analyzing the cost, density and the strength of the various materials it is best to procced with Balsa wood and Depron though acrylic sheet is a better option but making cuts and holes is a difficult task and it is better to cut down the weight since the gondola is going to hold onlythe IoT device, battery and avionics.





The gondola was fabricated according to designed dimensions as shown in the figure above. The sensors were tested individually for working and integrated. The sensors along with the motors were mounted to complete the gondola assembly.

The leak tests were done on the airship and leak prone areas were patched to make it leak proof. The fins made of depron material were cut and attached onto the airship. The testing of the airship will be done once the assembly of the airship is complete.

9) RESULTS AND CONCLUSIONS : (ABOUT 20 LINES WITH SPECIFIC REFERENCE TO WORK CARRIED OUT)

Detailed literature survey was done for the airship size & shape determination. GNV Rao (GNVR) envelope shape is chosen as it being the most efficient shape available The initial design estimate was done for the airship of our requirements. After several iterations, the ideal length for the airship was found to be 4.5m. Brief analytical verification was done for the theoretical values obtained. The performance and stability characteristics of airship was determined accordingly. Arduino Uno is chosen for the IoT device which is powered through a lithium-ion battery. The sensors required for monitoring the air pollutant concentration would be gathered and first tested at ground level. This is followed by fabrication of the airship with the best available material. The airship was tested for leakages and were patched in leak prone areas. The sensors were tested along with the IoT is integrated with the airship. IoT shall be used to get the real time values from the sensors. Initial testing with the airship will be done at an altitude of 20 meters & radius 30 meters. Furthermore, real time testing would be done in specific areas of the Bengaluru city.

10) SCOPE FOR FUTURE WORK :

The following works to be completed in the upcoming weeks are listed below:

- Fabrication of airship : complete assembly of airship and testing the functioning
- Testing of airship : filling of helium gas into the airship and conducting indoor testing. This will be followed by outdoor testing of the airship to obtain real time air quality data over an area.