Structural Subsystem of CubSat

Capestone 2.0 Term 222
Cluster 1 – Group 4
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Introduction

Background

The aviation industry has been experiencing significant growth, resulting in an increased number of aircraft and air traffic. This has created a need for sophisticated and reliable communication and power subsystems between aircraft and Access Control Center (ACC). Therefore, convectional satellites were heavier, extremely expensive and took more time of developing, so there is a model of satellite which is built smaller, economical, and easy to develop which is CubeSat.

Project statement

The project is to design and implement a CubeSat prototype that not only acts as a second line of communication between ACC and ground radar but also has a protective structural sub-system and deployable solar panels fulfilling the specific requirements of design standards.

Deliverable

A prototype of a full structural CubeSat with deployable solar panels and antennas to satisfy the power and software requirements.

Constraints

- Withstanding the space junk
- Time limited within 3 months
- 10cm x 10cm x 11.35cm size
- 2 kg weight of Whole CubeSat

Specifications

The Specifications	Parameters
Weight of Frame Structure	Max. of 500 grams / 1 unit.
The size of CubeSat	Max. 10x10x10cm
Total Mass of Solar Panel	< 100 grams
Total Mass of Antenna	< 100 grams
Temperature	-20 ºC to 80 ºC
Power Supply	> 0.85 W

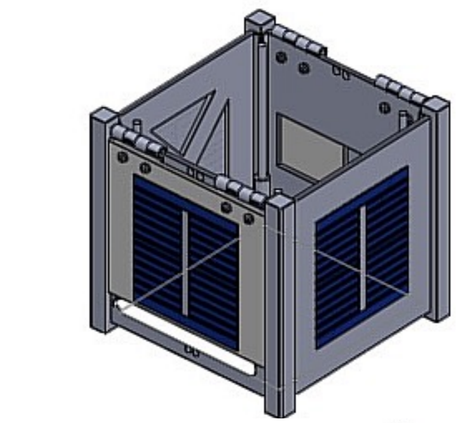
Overall Design

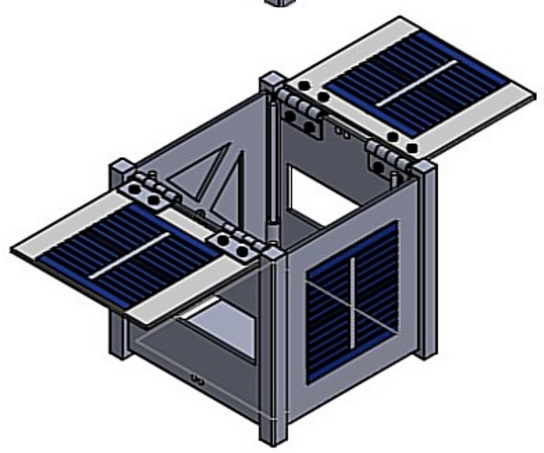
Advantages:

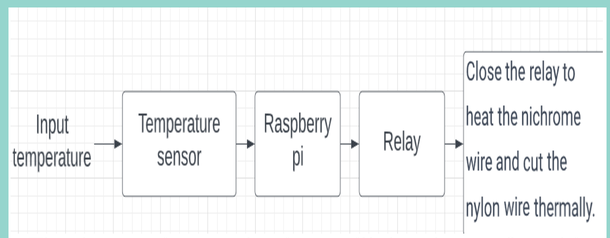
- Light weight.
- Corresion Resistance.
- Availability.
- Strength.
- -Thermal Properties.
- Machinability

Selected Material:

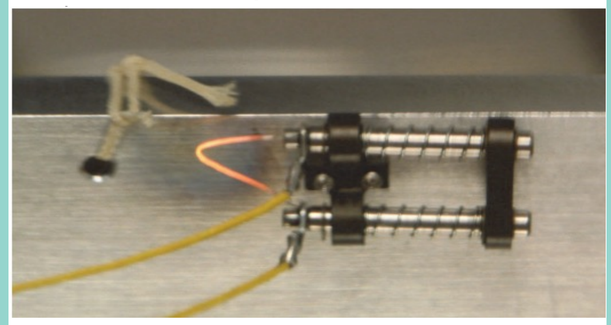
Material Name	AA6061–T6
Density g/cm3	2.70
Modulus GPa	70
Poisson's Ratio	0.33
Thermal Conductivity W/mK	180







The burn wire mechanism will be done after this process. The temperature sensor will provide feedback to the Raspberry Pi controller to determine when to close the relay which will be at



The Nichrome wire will be heated to 300°C using a 1.5A current, which will cut a nylon rope. The successful cutting of the rope will release the springs, allowing for the deployment of the solar panels. And after that the Raspberry Pi has already a command that if 8 seconds passed then open the relay.

Validation & Analysis

Volume and Mass Validation

The design is 10^3 cm^3 which met the specifications.

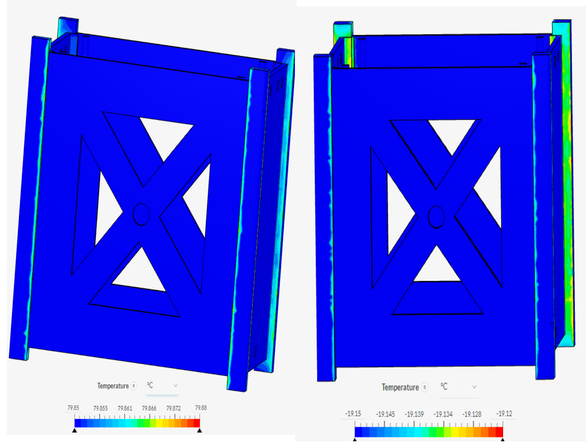
Knowing the density of Aluminum 6061 is 2.70 g/cm^3

Type	Volume (MM^3)	Mass (g)
Base	15714	42.43
Rod	2896	7.82
X face	25341	68.42
Y face	33164	89.54
Column	22414	60.52
Cover	15714	42.43
Total:	**115241**	**311.15**

Mass of Solar Panel mechanisms is 90 grams.
Mass of Antenna is 15 grams.

Thermal Validation

In this simulation the following parameters were used
Elevation: 400 km
Solar radiation: 1367 W/m2
Albedo: 413.3 W/m2
Infrared: 236 W/m2
Fixed temperature value: -20 oC, 80 ºC



Power Validation

$$\text{POWER}, P = V * I = 0.110 * 3 = 0.33W$$

Every two solar panels are connected in series, so Voltage will be 6V and current 110mA.

Thus, the total power will deliver is around 1.32 W.

Conclusion

Based on the design, the CubeSat structure was successfully designed, and the specifications were met with a total mass of 416.5 and a size of 10^3 m^3 satisfying the requirements of power and software.. The Vibration and Shock tests are needed to operate the CubeSat. Also, this project is with coordination with power and software group.