

TEAM 091

CubeSat Solar Activity Monitoring

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Introduction

Problem Statement

- CubeSat is a small, low-cost satellite units used for space research and monitoring.
- Solar flares and CMEs release high-energy radiation that can disrupt satellites, power grids, and communication systems.
- These space weather events also increase health risks for astronauts, pilots, and high-altitude populations.
- Earth's magnetic field and ozone layer provide limited protection during extreme solar activity.
- Current monitoring systems are costly, delayed, or difficult to use.
- A real-time, low-cost, and accessible alert system is needed to protect critical sectors from space weather threats.

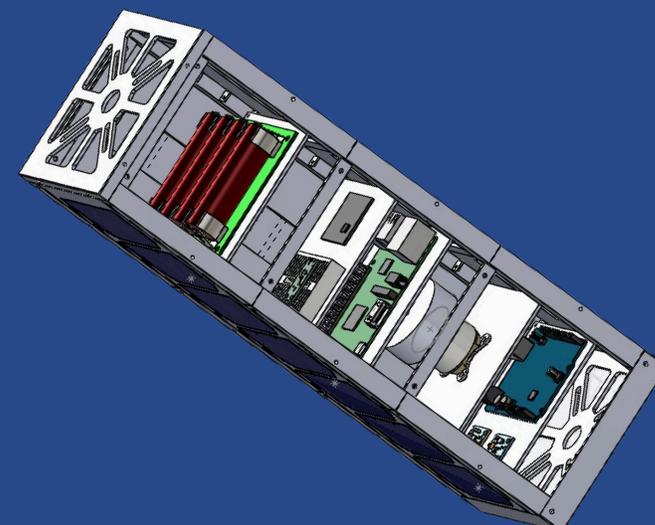
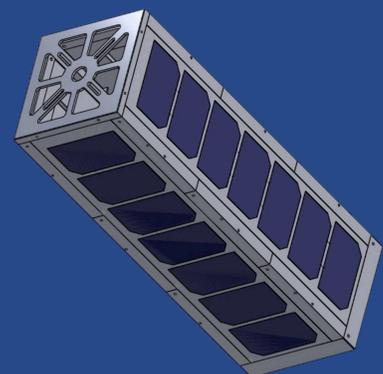
Constraints

The aim is to Develop a CubeSat to monitor space weather and deliver real-time solar activity alerts, helping industries reduce economic losses and protect human safety while considering the following.

- Development time limited to 4 months
- The total project budget should not exceed 7000 SR
- Compliance with the International Space Law and Space Qualifications
- The CubeSat total weight should be 5KG or less

Multy-layer Isolation System

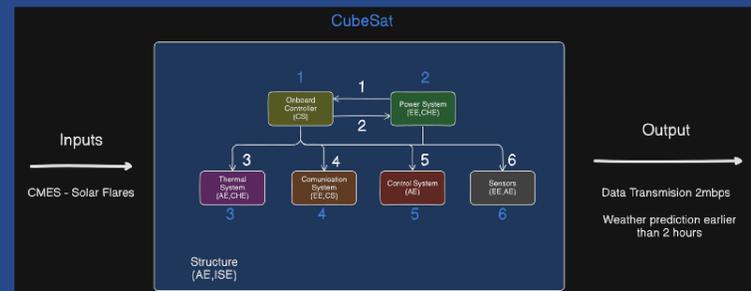
- Sheliding
- Radiation-heat isolation
- Vibration isolation
- Electrical isolation



Concept

Specifications

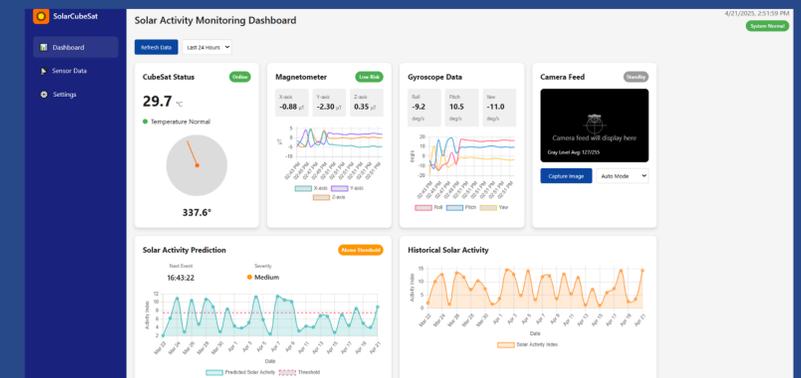
- Operating temperature range: 0°C to 50°C
- CubeSat size: 3U (10×10×30 cm)
- Battery capacity: 30 Wh (Lithium-ion)
- Mission altitude: 600–800 km
- Data transmission rate: 2 Mbps
- Solar panel output: 15 Wh
- Early warning alerts displayed on dashboard 1 hour before solar events



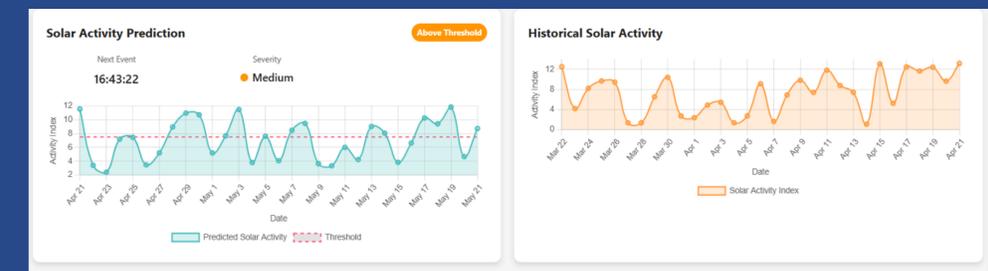
Multidisciplinary Prototype Summary

Final Prototype

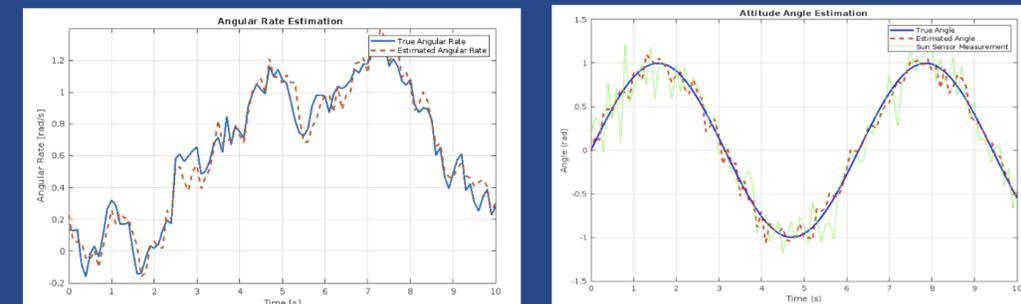
Validation and Verification



Solar Activity Dashboard



Prediction Model



Control System Simulation

Result - Optimal solution found

Objective value: 2.00000000
 Solver time: 0.00000000
 Total iterations: 2.00
 Time (seconds): 0.01
 Time (milliseconds): 0.01

Option for printing level changed from normal to all:
 Total time (CPU seconds): 0.02 (milliseconds): 0.02

Optimal CubeSat Distribution (10 Satellites, Inclination: 97°)

Optimal Number of CubeSats Needed at 700 km: 2
 ✓ Optimal Period: 10.42 minutes
 ✓ Effective Sunlight Duration per Orbit: 100.34 minutes
 ✓ Total Orbits per Day: 24.08
 ✓ Sunlight Exposure per CubeSat per Day: 24.42 hours
 ✓ Required Daily Sun Coverage: 24 hours
 ✓ Minimum CubeSats Required for Continuous Coverage: 2
 ✓ Minimum CubeSat: One After Another: Succession: 2
 ✓ Total Weight: 10.00 kg (out of 30000 kg)
 ✓ The calculated result confirms that the optimal number of CubeSats meets the minimum required for 24-hour solar monitoring.

Complete Mathematical Formulation