Spacecraft Thermal Management Systems

CubeSat Variable Emissivity Radiator Design Project

UCI Samueli School of Engineering

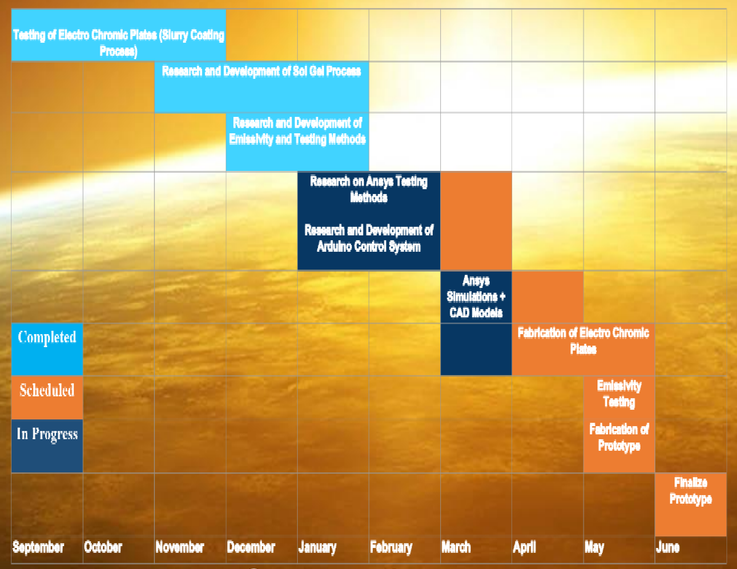
Introduction: A satellite's thermal management system controls the amount of heat absorbed or rejected through radiation in space environment. There are thermal cycles as the satellite orbits around the Earth's shadow creating various thermal loads that must be controlled and dissipated.

Goal: To develop an electrochromically controlled film that can variably absorb or reflect radiation for a Cube-Sat at low-Earth Orbit.

Objectives:

1. Create a low cost electro chromic plates.
2. Test and compare low cost film to competitive plates.
3. Develop a control system to have adaptable thermal performances.

Timeline



Contact Information

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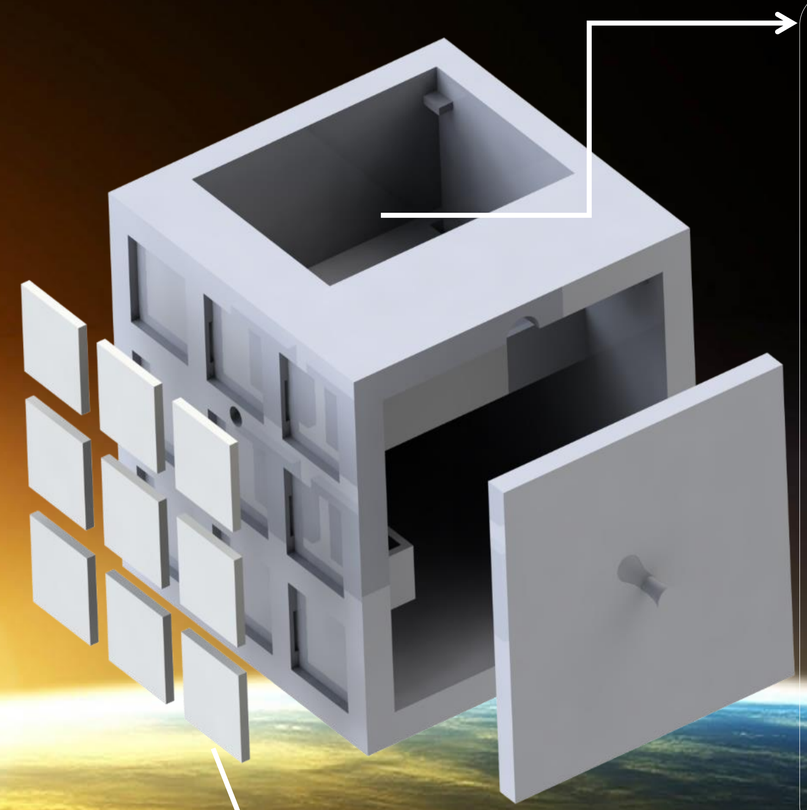
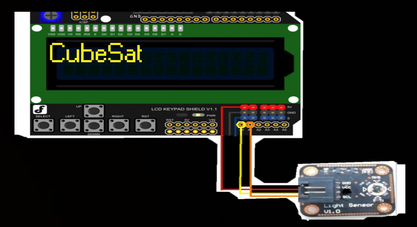




Light Intensity Sensor:
Wide range & High resolution
(1 – 65535 lux)
Human eye responsive

The controls system will compose of three main components:

- UNO R3 Atmega328P Development Board W/ Battery Attachment (Arduino)
- LCD Keypad Shield
- Digital Light Sensor Module

Testing

Emissivity Analysis

Testing Apparatus:

- Kept in an enclosure to provide undistributed natural convection surroundings.
- Rugged imaging infrared thermometer to measure temperature of plates.

Ansys

- Design the C2 vacuum chamber to simulate radiation and conduction thermal loads on our CubeSat.
- Derive the view factor results to correlate our data used in the emissivity testing.

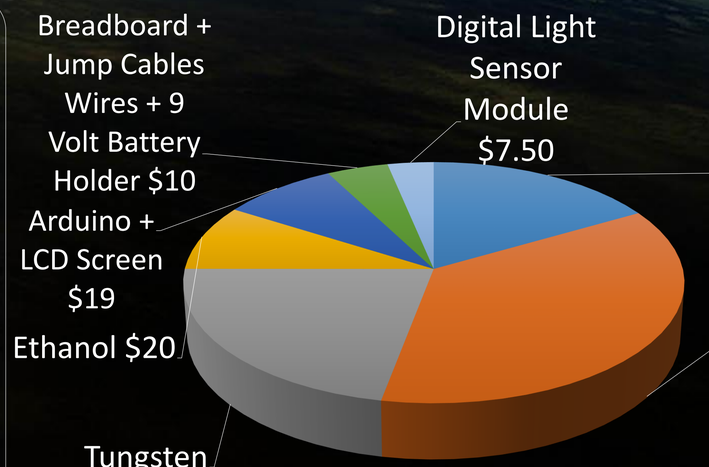
Light-weight electro chromic plates that can change emissivity with the application of current.

The electro chromic film features five layers of electro chromic materials.

Layer One - Indium Tin Oxide (**Conductive Layer)**
Layer Two - Titanium Oxide **(Anode)**
Layer Three - Lithium Perchlorate **(electrolyte)**
Layer Four - Tungsten Oxide **(Cathode)**
Layer Five - Indium Tin Oxide **(Conductive Layer)**

High Emissivity, Absorptive

Low Emissivity, Reflective



Total Cost: $226.19