Team 007: Skyfall

Conceptual Design Review

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Mission Overview

- **Hypothesis:** Thermoelectric technology could utilize the temperature differential between the inside and outside of the BalloonSat as an additional energy source.

- **Mission objective:** Our mission is to test energy harvesting capabilities with a thermoelectric generator in near-space to discover if it can feasibly provide an efficient, reliable source of supplemental power for missions with heating components.
Mission Overview

- **Why:** The generator can “recover” some of the energy from the heater by converting it back into a useful form.
  - Batteries suffer dramatic performance decreases in cold conditions and can fail or run out. With thermoelectrics, extreme temperatures become an advantage, providing a reliable solid state power supply with a long working life.

- **Origin:** Current space missions, such as the Curiosity Rover, generate power with a radioisotope thermoelectric generator, a nuclear version of the technology we plan to test.
Design: How

- **Setup:** We intend to mount two generators on a conductive surface in holes in the insulation as close as possible to the heater.
  - The temperature difference between the inside and out will create a voltage and current from the generator.
  - By connecting the generators to an ammeter and voltmeter on the second Arduino, we can record data throughout the flight.
  - We will determine the generator’s power output to measure effectiveness of harvesting thermal energy and converting it back to electricity.
Design: How

20 x 20 x 10 cm

Design: FBD

- 4.9V Batteries
- LED Indicator
- SD Memory Card
- Arduino 1
  - Internal temp probe
  - Accelerometer
  - Humidity sensor
  - SD Memory Card
- External temp probe
- LED Indicator
- Arduino 2
  - Voltmeter
  - Ammeter
  - Thermoelectric generators
  - SD Memory Card
Design: FBD

- LED Indicator
- Switch
- Heater System
- 3 9V Batteries
- LED Indicator
- Switch
- Camera
- Battery
- SD Card
**Management**

- **Organization Chart:**

<table>
<thead>
<tr>
<th>Task</th>
<th>Group Members</th>
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<tbody>
<tr>
<td>Project Management</td>
<td>Christine and Colton</td>
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<tr>
<td>Systems</td>
<td>Rachel and Kennedy</td>
</tr>
<tr>
<td>Structures</td>
<td>Colton, Rachel and Kevin</td>
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<tr>
<td>Thermal and Power</td>
<td>Christine, Kevin and Ryan</td>
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<tr>
<td>C&amp;DH and Software</td>
<td>Kennedy and Ryan</td>
</tr>
<tr>
<td>Captain</td>
<td>Jean-Luc Picard</td>
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</table>
Management

- **Schedule:** Weekly meetings Sunday night and Monday afternoon, totalling 5-6 hours a week. Our team plans to work continuously throughout the semester to avoid a rush at the end.

- **Cost:**
  - $15- voltmeter+ammeter, $25- 2 thermoelectric generator, $10 thermal adhesive
  - Total: minimum $50 beyond required sensors
Conclusions

- Conclusion: With applications to future BalloonSats and other near-space craft, our mission presents a test of a potential solution to power issues in extremely cold environments where heaters are required. Based on current NASA technology, thermoelectric generators present an innovative and elegant method of energy harvesting.
007
SKYFALL
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