Critical Design Review

GoGreenSAT

The University of Northern Colorado

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Feb. 23 2009
Mission Overview

- The goal of GoGreen SAT is to observe the most effective materials and conditions in which a payload can generate energy to be used and stored.
- GoGreen SAT will determine the maximum energy output of different onboard systems throughout the flight.
- The three energy systems are:
  - **Pendulum**: Capturing the swinging motion of the flight line
  - **Solar Power**: Capturing energy from the sun
  - **Peltier Cooler**: Using the differences in temperature inside and outside the box to produce energy
### Mission Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Method</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>The payload must not exceed a weight of 1.5 kg.</td>
<td>Design, Test</td>
<td>Green</td>
</tr>
<tr>
<td>The flight line should go through the payload's center of gravity.</td>
<td>Design, Analysis</td>
<td>Green</td>
</tr>
<tr>
<td>The payload must be able to survive an impact of at least 16m/s.</td>
<td>Design, Test, Analysis</td>
<td>Green</td>
</tr>
<tr>
<td>Components in payload must be able to survive a temperature of -80°C.</td>
<td>Design, Test</td>
<td>Yellow</td>
</tr>
<tr>
<td>Payload must not &quot;cut&quot; through the flight line.</td>
<td>Design, Test</td>
<td>Yellow</td>
</tr>
<tr>
<td>Payload must survive the &quot;shaking&quot; of balloon burst.</td>
<td>Design, Test</td>
<td>Yellow</td>
</tr>
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</table>

- **Green**: Compliant
- **Yellow**: Partially Compliant
- **Red**: Not Compliant
Fundamental Block Diagram

- Solar Panel
- Solar Panel
- Peltier Cooler
- Magnetic Coils
- Energy Systems
- Logomatic
- SD Card
- 7V Battery
- Barometer
- Determining Altitude

Data Flow: Green
Power Flow: Red
Before the launch of the balloon, the payload will be activated via an external switch to provide power to the *Logmatic* recording software. During the ascent, the software will gather current readings from the solar panels, the Peltier cooler, and the pendulum system. The solar cells will gather light energy from the sun depending on the payload’s orientation (an increase in altitude is expected to produce an increase in energy output). The Peltier cooler will produce a current as the outside of the payload is cooled by decreasing atmospheric temperatures, and the inside of the payload maintains a reasonably warmer climate. The pendulum system is expected to produce a current as the turbulence of the payload causes the pendulum to swing the attached magnet over a series of six copper coils.
Structural Drawings

Copper Coils on Board

Side View of Box, Solar Panels on Top

Pendulum
Structural Drawings

- Battery
- Logomatic
- Hobo, Barometer
- Copper Plate
- Copper Coil
- Pendulum
- Hot Hands
- Peltier Cooler

Views:
- Top View of Box
- Side View of Box
- Back View of Box
## Parts List

<table>
<thead>
<tr>
<th>Parts</th>
<th>Company</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar Panels</td>
<td>Flex Solar Cells, OEM Components</td>
<td>RC 7.2-75</td>
</tr>
<tr>
<td>Peltier Cooler</td>
<td>Frozen CPU</td>
<td>437W</td>
</tr>
<tr>
<td>Magnet</td>
<td>K&amp;J Magnetics, Inc.</td>
<td>DX0X0-N52</td>
</tr>
<tr>
<td>Low Current Sensor</td>
<td>Sparkfun Electronics</td>
<td>ACS712</td>
</tr>
<tr>
<td>SD Card</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Logomatic</td>
<td>Sparkfun Electronics</td>
<td>V1.0</td>
</tr>
<tr>
<td>Ball Bearings</td>
<td>McMaster-Carr</td>
<td>57155K356</td>
</tr>
<tr>
<td>Copper Sheet</td>
<td>Whimsie</td>
<td>21-gauge</td>
</tr>
<tr>
<td>Foam Core Board</td>
<td>Hobby Lobby</td>
<td>1/2&quot;</td>
</tr>
</tbody>
</table>
Subsystem Overview

- Power for the payload will come from a 7V battery.
- Data from the flight will be stored in a SD card.
- The payload will have two states, non-active and active. A switch will be installed on the outside of the box to activate the payload.
- Peltier Cooler—there must be a temperature difference between the two plates.
- The inner components (Hobo, battery, logomatic, and SD card) should not get below negative 20°C.
- Pendulum—Must swing in only one dimension.
Management

- Program Manager-Jessica
- Project Members-Max, Brent, Ryan, Zach
- Faculty- Dr. Bob Walch

- Meetings, Tue. 6:00 p.m. and Thus. 7:00 p.m. and scheduled as needed

- Budget-$800-$900
Test Plans

- **Cold Test-** Dry Ice/Liquid Nitrogen, Styrofoam cooler, four thermo probes, four multimeters, timer
- **Impact Test-** high place to drop box from
- **Shake Test-** Line/string
- **Time Test-** Timer
Conclusion

- Issues/Concerns:
  - The magnet used in the pendulum system will interfere with other components in the box.
  - The current produced by the pendulum system will be too little to measure at times.
  - The temperature difference between the two plates of the peltier cooler will “flip-flop” during the descent, which will pull energy instead of produce it. This problem could solved with a diode.
  - The box will continue to swing in one direction for extended amounts of time, causing the pendulum not to move much.

This data from this payload should allow the efficiency of each system to be analyzed during the different sections of the flight.