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Project Low Horizon - Horizon Detection through the use of Infrared Sensors

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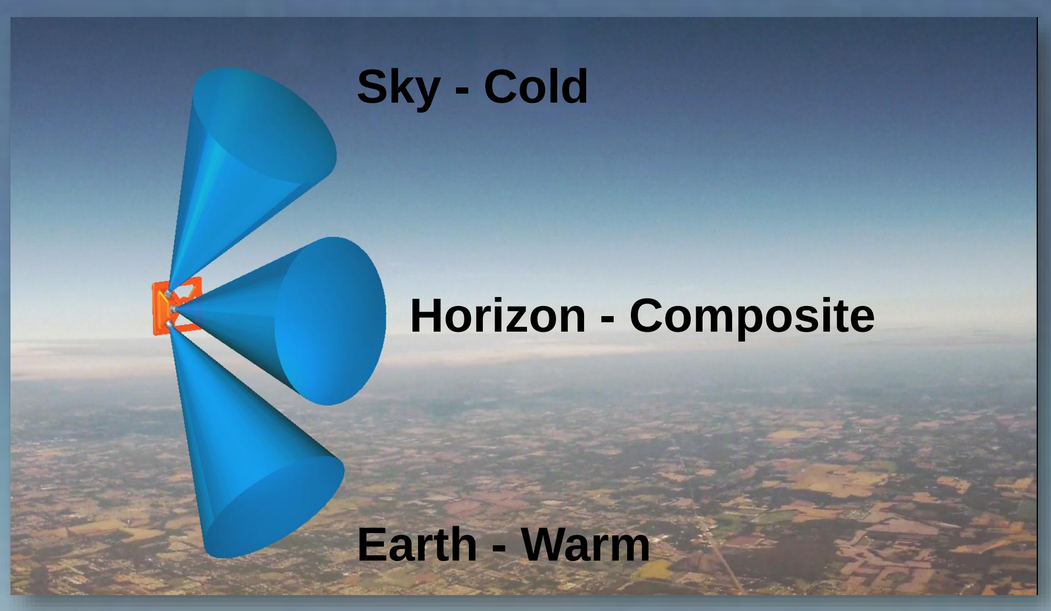
Overview

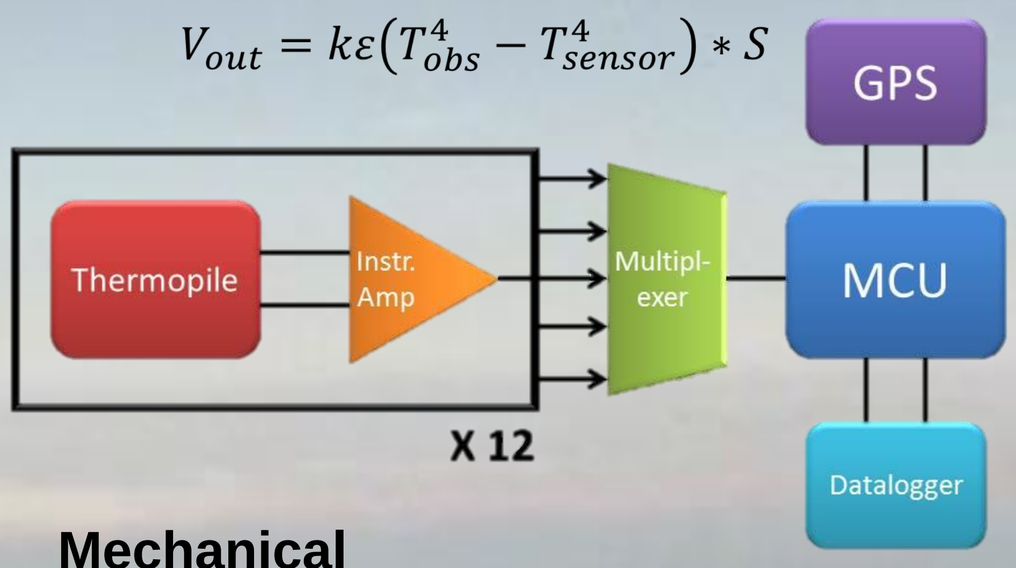
The mission of Project Low Horizon was to build a horizon sensing payload using Thermopile sensor arrays. By detecting the earth's horizon, the nadir vector of a payload can be calculated and used for attitude determination. The payload was flown on a high altitude weather balloon to 66,000ft on October 7, 2015 by members of the UAH Space Hardware Club after only 9 days of total construction.



How Thermopiles Work:

The voltage from the Thermopile follows the Stefan-Boltzmann Law of black body radiation below with a conversion between power and voltage based on the sensor's responsivity value:

$$V_{out} = k\varepsilon\left(T_{obs}^4 - T_{sensor}^4\right) * S$$

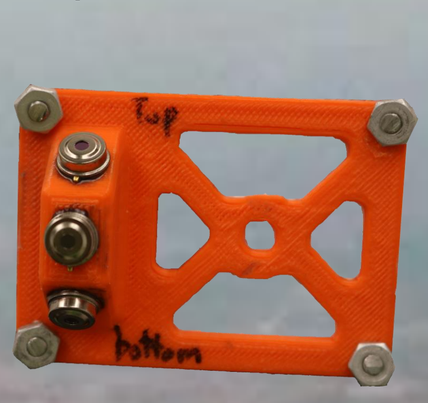


Electrical Design:

- Signal Collection
  - Instrumentation Amplifier
    - Low Pass Filter
    - 200x Gain
    - 1.27V offset for negative common mode voltage from sensor
  - Two External Multiplexers
  - ADC on Microcontroller Unit
- Time Synchronization with GPS @ 1Hz Refresh Rate
- LED in the FOV of Camera for time synchronization with GPS
- Separate AHRS unit for attitude comparison

Mechanical

- 11x9x6in Styrofoam box enclosure for electronics
- 4 Sensor arrays mounted on box 90° apart
- 3 Thermopile sensors per array
- 3D printed mounts for positioning sensors

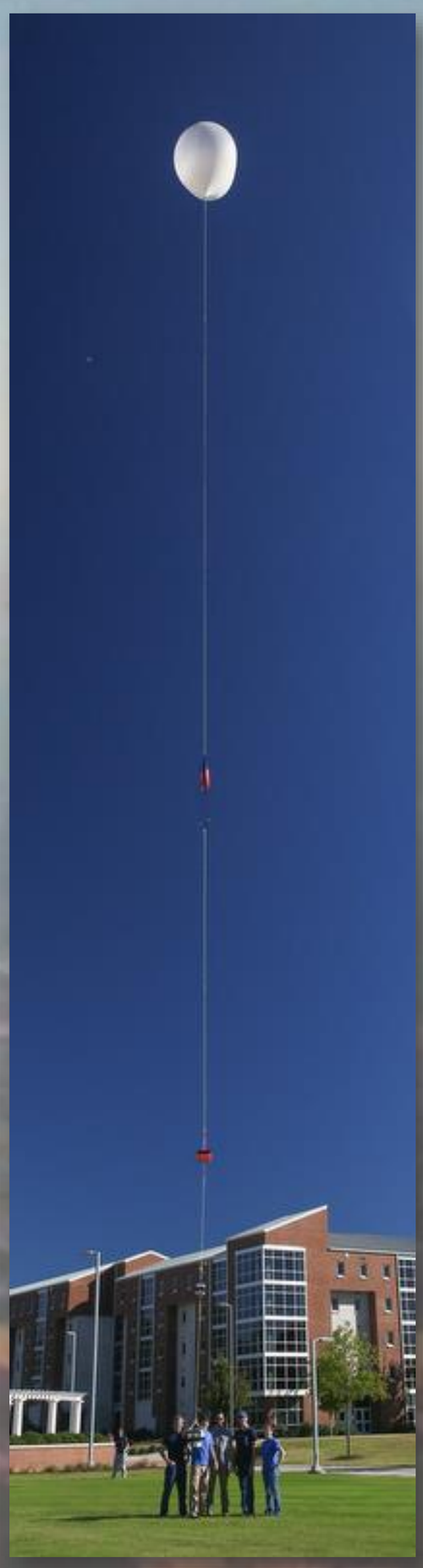


Post Flight

- Payload successfully recovered near Section, AL.
- Sensors and code worked nominally
- Data was too noisy to use due to MUX

Future Work

- Select different MUX
- Further high altitude balloon flights
- Add higher resolution IR sensors for comparison
- Develop into a reliable Attitude Determination System for use on CubeSats



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