ASCEND StratoDevils High Altitude Ballooning

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Project Overview

ASCEND is a NASA-funded Arizona Space Grant program that gives undergraduate students hands-on experience in the full lifecycle of a space mission—designing, building, launching, operating, and analyzing a high-altitude balloon payload.

Students work in multidisciplinary teams—spanning engineering, science, and other fields—to design custom hardware and collaborate with researchers to collect and analyze atmospheric data. The payload includes onboard cameras to capture footage near the edge of space and sensors to monitor environmental conditions throughout the flight.

By combining systems engineering with scientific inquiry, ASCEND prepares students to tackle real-world challenges and produce meaningful data from the upper atmosphere.

System Overview

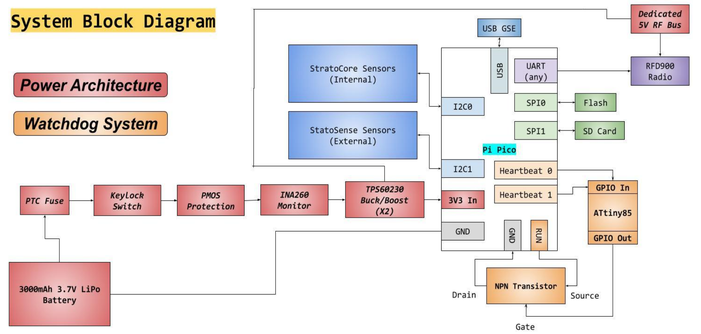
Flight Data Recorder (FDR): Manages all data collection and logging through two custom-designed PCBs: StratoCore (internal sensors and processing) and StratoSense (external sensors). These boards are connected via a Molex MicroFit 3.0 interface that shares power and communicates over SPI and I2C. The system is powered by a 3.7V 3000mAh LiPo battery, with 1.8V, 3.3V, and 5V rails provided by buck and boost regulators w/ a +5 hour operating time.

Sensor Array: Captures atmospheric and positional data including temperature, pressure, humidity, air quality (CO_2, VOCs), UV A/B/C radiation, and inertial motion. Redundant sensors and distributed integration across PCBs improve system resilience.

Power Management System: Provides regulated and protected power delivery. Includes a resettable PPTC fuse and PMOS-based reverse polarity protection, followed by an INA260 current monitor for real-time diagnostics.

Insta 360 Camera: Captures 5.7K 360° high-altitude video, documenting atmospheric conditions in real time.

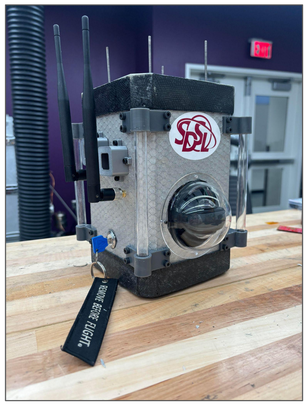
Structural Design: Enclosure constructed using green reflection carbon fiber (2x2 Twill 3k Weblock) and internal brackets printed from Tough 2000 SLA resin and PETG. Nylon standoffs and mounting points allow for secure sensor and board integration.



Mechanical Subsystem: THE UFO

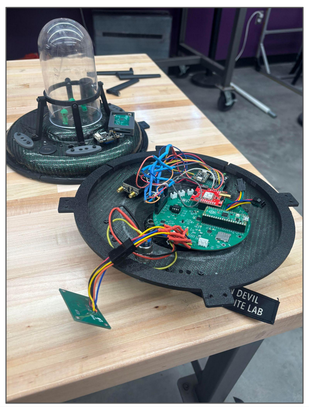
Previous Year:

1. Utilized a CubeSat-style architecture
2. Hybrid structure of fiberglass and carbon fiber materials
3. Flaws: excess weight, limited structural rigidity, and difficult internal accessibility



This Semester:

1. Streamlined the overall design to reduce complexity and improve accessibility
2. Pushed the boundaries of in-house fabrication techniques
3. Developed a fully custom “UFO” structure



New Materials:

Carbon Fiber
- Green Reflection Carbon Fiber Fabric 2x2 Twill 3k Weblock

External Components:
- Tough 2000 SLA Resin for sensor housing & mounting Brackets

Internal Components:
- Camera mount, rope brackets, Mounting rings

Finish:
- XCR Clear Coating Resin top coat for aesthetics

New Hand Lamination Process:

Mold setup
- Experimented with various molds
- Inverted mold Produced successful results

Lamination
- Layed six layers
- Durable and very rigid parts

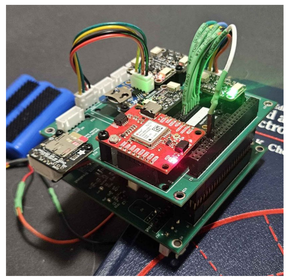
Vacuum baging
- Ensure precise parts

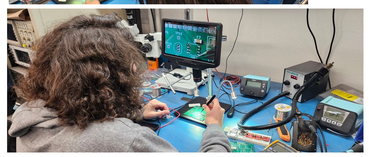
Parts took 12 hours to complete

Electrical Subsystem

Previous Semester:

The **PicoBoard** and **Le Breakout Board** made up the **Flight Data Recorder (FDR)**, which logged sensor data during flight. However, the setup suffered from messy external wiring, bulky power distribution across multiple boards, and increased complexity. Though the system functioned as needed, the design underscored the need for a more integrated and reliable solution.





StratoCore PCB:

Core FDR: Custom Internal PCB that is the electrical mothership of the system. Connects peripherals to the microcontroller, power system, and onboard storage devices.

Microcontroller: Raspberry Pi Pico - 3.3V Logic

Protection: Contains power protection and voltage regulation circuitry

Redundancy: Backup 3.3V & 5V regulator breakout boards

Diagnostics: Built-in troubleshooting capabilities with embedded test points covering power busses and essential GPIO connections

StratoSense PCB:

Innovative Approach: Custom External PCB containing all external payload sensors

Connectability: Uses Molex MicroFit 3.0 connector to route signals and power to and from outside the payload for external sensor readings.

Optimizations: Compact design (56.5mm x 36.0mm) for the integration of multiple sensors with minimal weight and surface area.

Together the PCBs Captures Data On:

-Temperature	-UVA/B/C
-Pressure	-GPS (location & velocity)
-Altitude	-Air Quality Index
-Relative Humidity	-Ozone (O3)
-CO2	-Volatile Organic Compounds