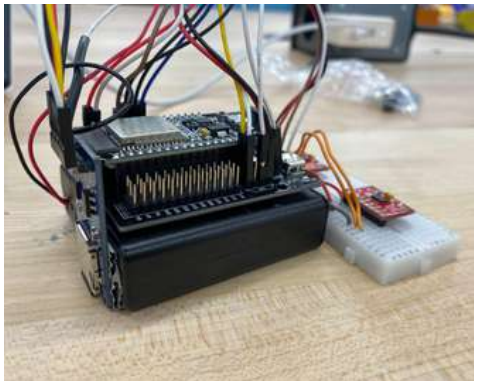
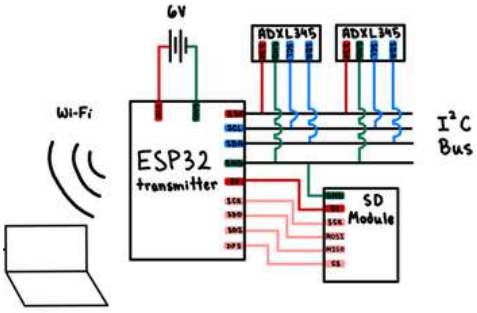
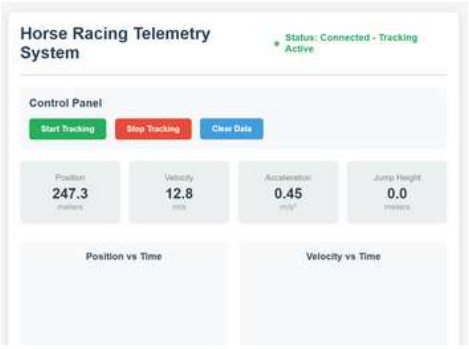
Horse Racing Real-Time Tracking Collar







What?

- Designed and built a wearable horse racing telemetry system using **ESP32 microcontrollers** and **accelerometers**
- Created real-time motion tracking collar that measures position, velocity, and acceleration during races
- Developed **Python-based GUI** for live data visualization and **analysis**

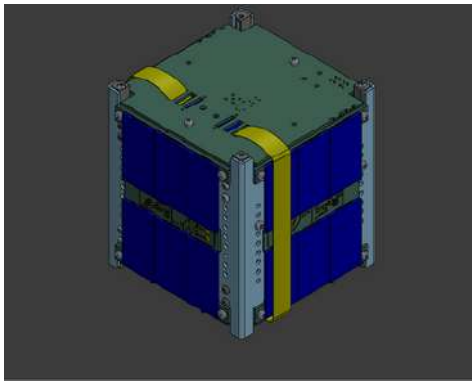
How?

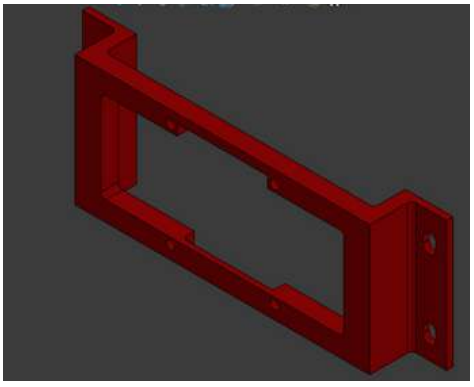
- Used **SolidWorks** and **FDM 3D printing** to design and manufacture hardware casing
- Implemented **Kalman filtering** algorithms to minimize sensor noise and enhance data reliability
- Implemented P2P **WIFI** communication protocols for wireless data transmission

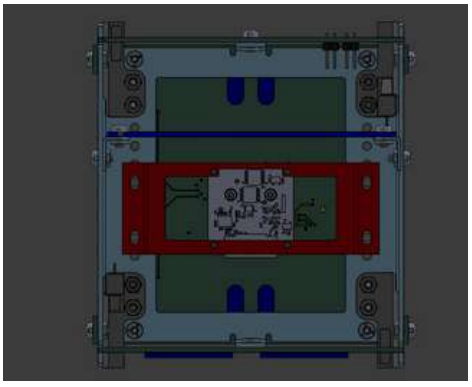
Results

- Successfully enabled real-time data logging with live data streaming
- Achieved reliable wireless transmission with filtered sensor data for accurate motion tracking
- **Presented** project to panel of judges and received recognition for innovative design and implementation

CubeSAT Camera Bracket







What?

- Designed a critical camera bracket that would fit within the 1U **aerospace** satellite
- Camera bracket would be need to be optimized to be used within all satellites within satellite constellation mission

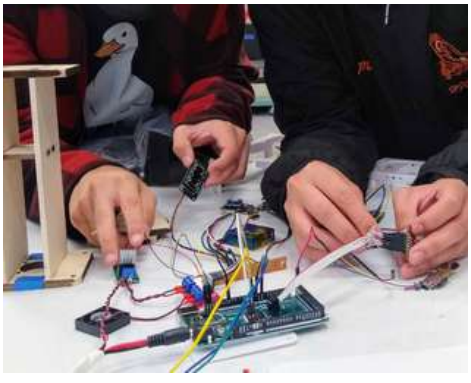
How?

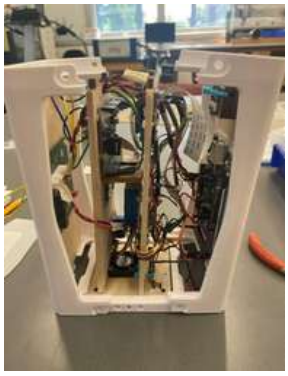
- Used **SolidWorks** to design components and produced prototypes using **SLA 3D printing**
- Conducted **FEA** to test structural integrity of brackets
- Applied **GD&T** on all drawings to prepare for manufacturing

Results

- Prepared drawings which were sent to manufacturing
- Component was implemented into satellite and is going through testing
- Conducted **TVAC**, **shock**, and **vibration** testing after part arrived to verify and simulate conditions for environment

NASA TechRise High Altitude Balloon





What?

- Created an instrumentation payload which used sensors and image data to research the effect of greenhouse gases on climate change
- **Cooperated** with classmates to brainstorm ideas

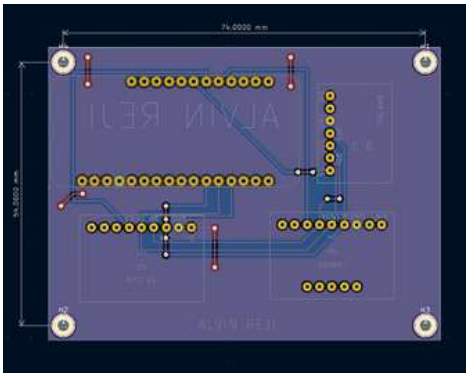
How?

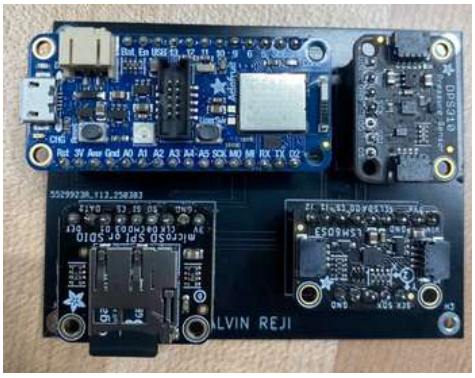
- Used **OnShape** and **AutoCAD** to design casing for **microcontrollers**
- Created BOM to choose materials capable to withstand weather conditions
- Utilized **laser cutter** and **CNC router** to manufacture wooden frames
- **Soldered** electrical components

Results

- Captured data throughout different layers of the atmosphere
- Data concerning ozone, carbon emissions, nitrogen, and humidity were **presented** to the scientific community

Avionics Flight Computer



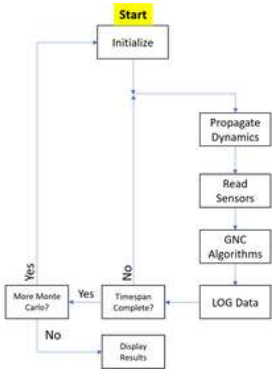


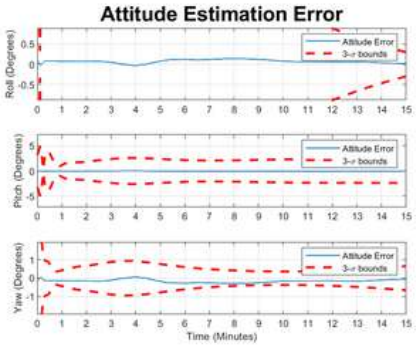
What?
- Created a flight computer to be used onboard a test rocket
- Designed a circuit board to ensure efficiency of sensor communication
- Created algorithms to detect stages of mission operation

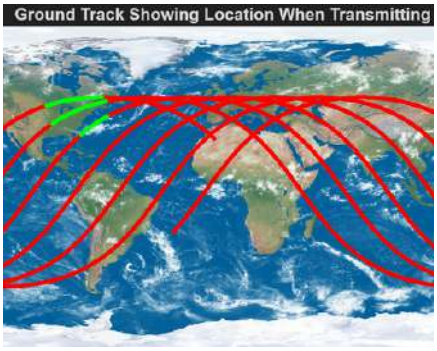
How?
- Used **KiCad** and **Altium** to create circuit diagrams that reduced noise interference and manufacturing costs
- Programmed **microcontrollers** in **C++** and created a real-time flight **data acquisition** system

Results
- Developed a state machine-based flight computer that tracks rocket flight phases using barometric pressure and accelerometer data
- Test rocket was launched and data collection was successful

Guidance, Navigation, and Control Satellite Simulation





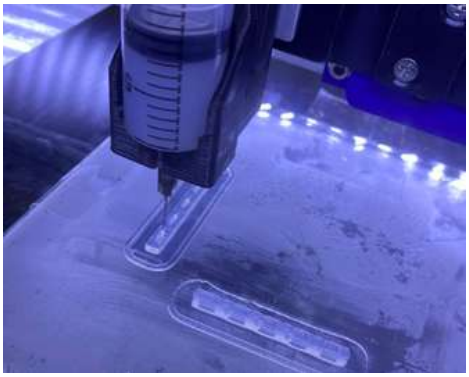


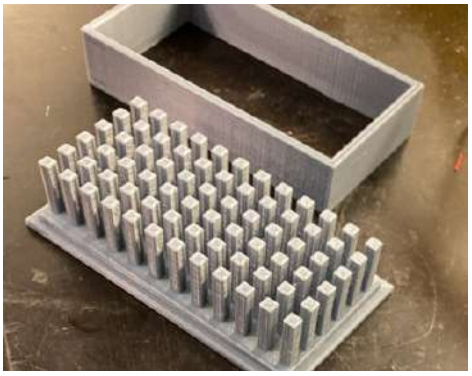
What?
- Developed attitude determination and control algorithms for a nanosatellite using **MATLAB/Simulink**
- Implemented sensor fusion combining magnetometer, sun sensor, and gyroscope data for **spacecraft** orientation
- Created mission **simulation** software to validate pointing accuracy and control performance

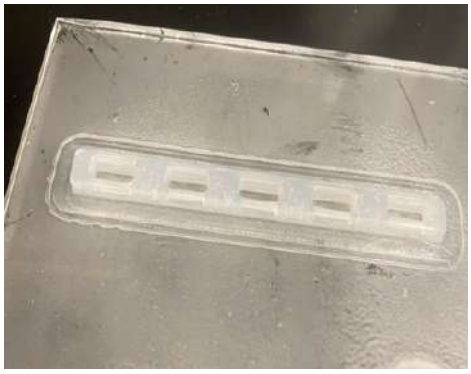
How?
- Applied **Extended Kalman Filter (MEKF)** for attitude estimation with 3-sigma error bounds tracking
- Integrated ADCS hardware models (reaction wheels, magnetorquers) with **custom control algorithms**
- Built power-aware control system that tracks solar panel efficiency and battery state during mission operations

Results
- Verified pointing accuracy requirement for polarimeter field-of-view in mission mode
- Demonstrated robust attitude control across 40+ **Monte Carlo** runs with randomized initial conditions
- Validated 8+ hour continuous operation with positive power margin and wheel desaturation capability

Microstructure Adhesive Properties Research







What?
- Studied effects of order and disorder on **adhesive** properties of **microstructures** using **PDMS** materials
- Operated large-volume **3D printer** with **FDM** and **DIW** resin printing capabilities

How?
- Designed **CAD** models and **molds** for PDMS pouring to fabricate test specimens with controlled microstructures
- Created foam prints with varying properties for adhesion testing

Results
- Contributed to understanding of how structural order/disorder affects adhesive performance in soft materials
- Presented findings at Northeastern RISE conference