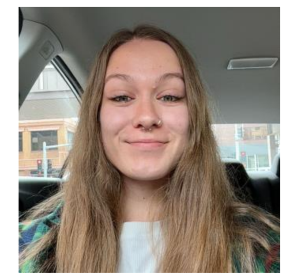
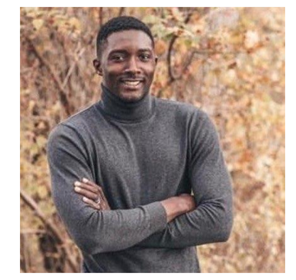
Raytheon Humanitarian Relief UAS

Project Team: Sonja Elstad, James McGalliard, Andrew Nab, Haley Wambach
Mentor: Karifa Diawara



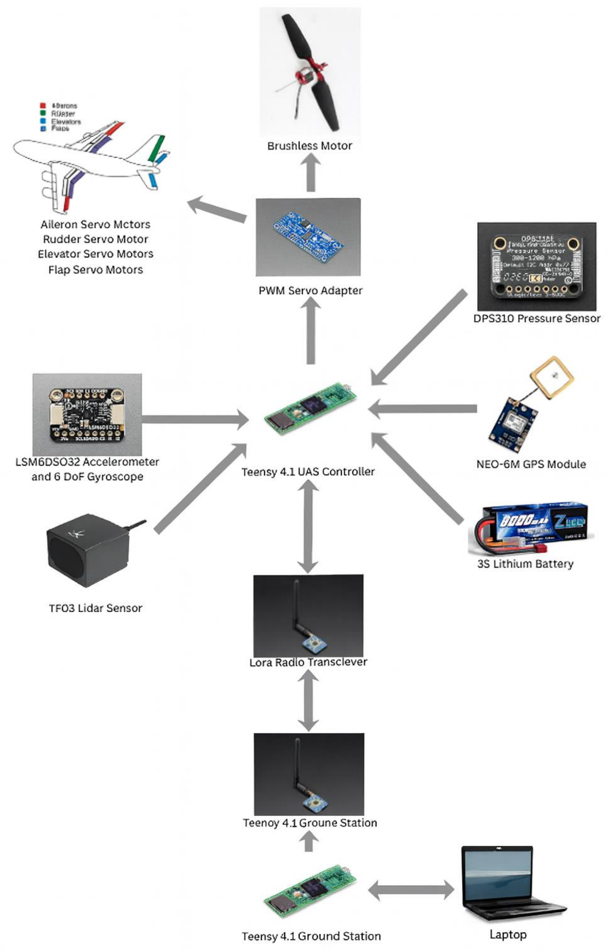




Introduction

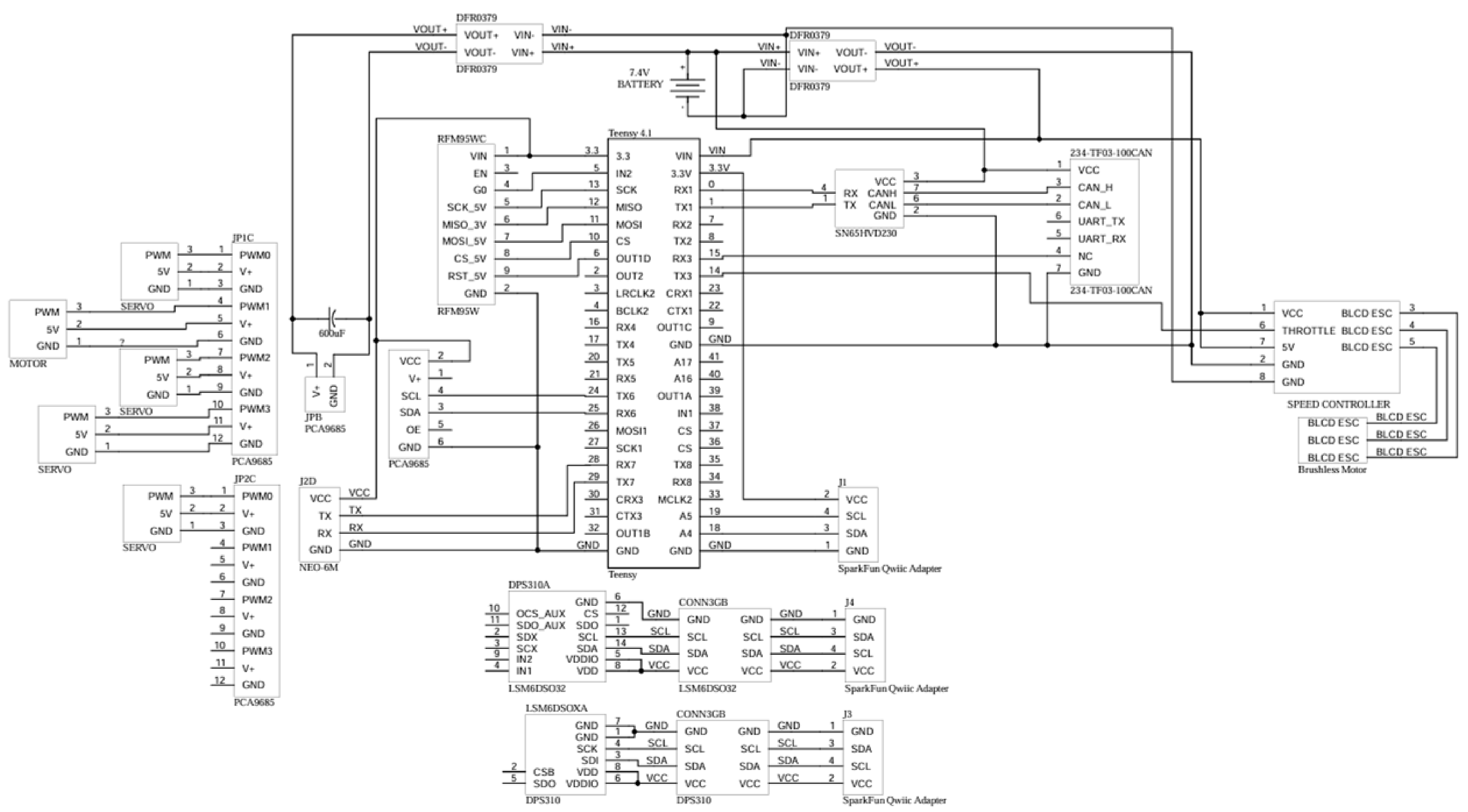
Natural and man-made disasters often leave people stranded without access to critical resources, especially in developing regions. To address this need, this project develops a cost-effective UAS (Unmanned Aircraft System) guidance system built from commercial off-the-shelf (COTS) components. This approach provides an affordable solution for delivering humanitarian aid in resource-constrained environments.

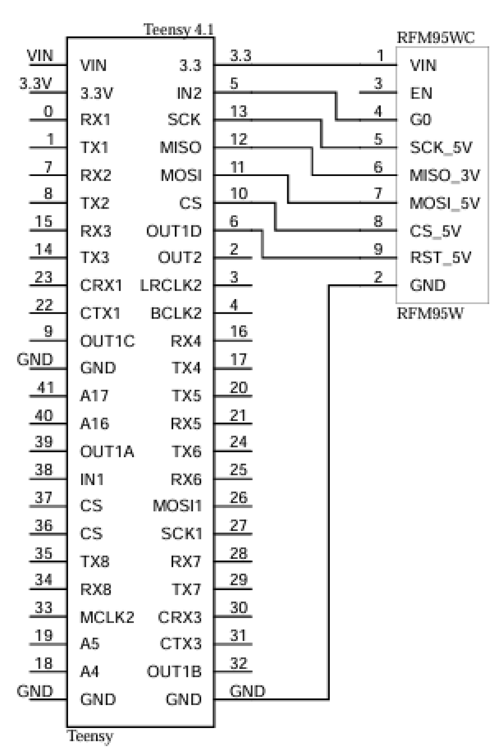
Theory

The theory behind this UAS system is to combine low-cost communication and sensing technologies to enable fully autonomous flight for disaster-relief applications. Using LoRa radio modules to connect the UAS with the ground station, the design integrates a Teensy 4.1 microcontroller, NEO-6M GPS, Benewake TF03 LiDAR, DPS310 altimeter, and LSM6DSO32 gyroscope to execute an autonomous navigation algorithm. With these sensors and the communication link, the UAS can travel to a designated drop-off location, release an aid package, and return to its launch point.



Schematics

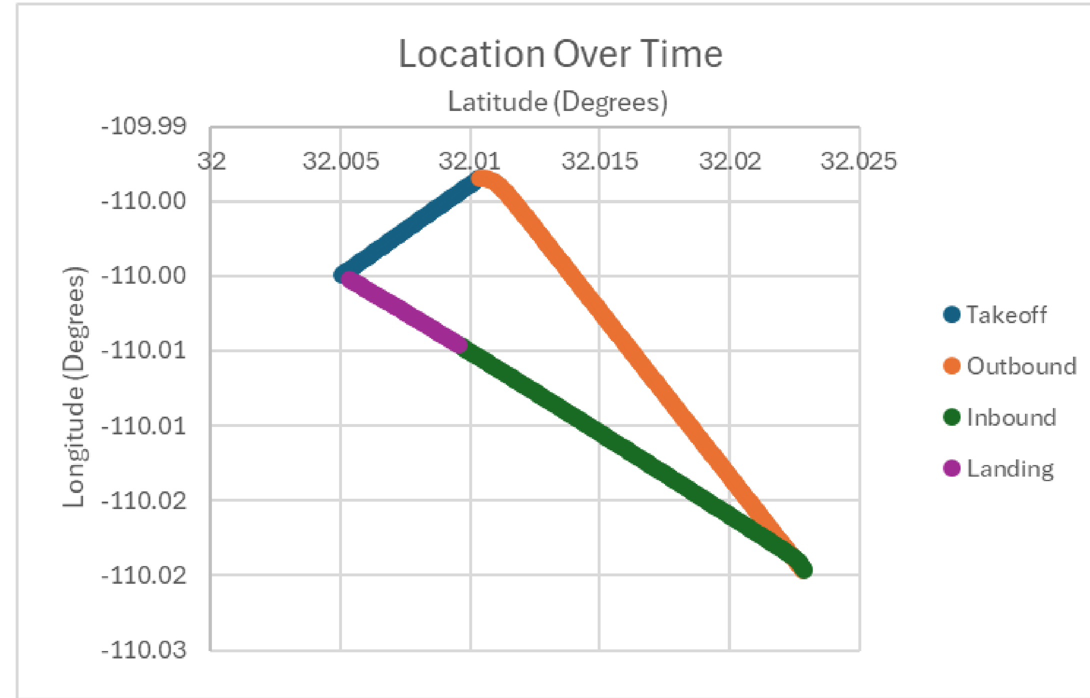


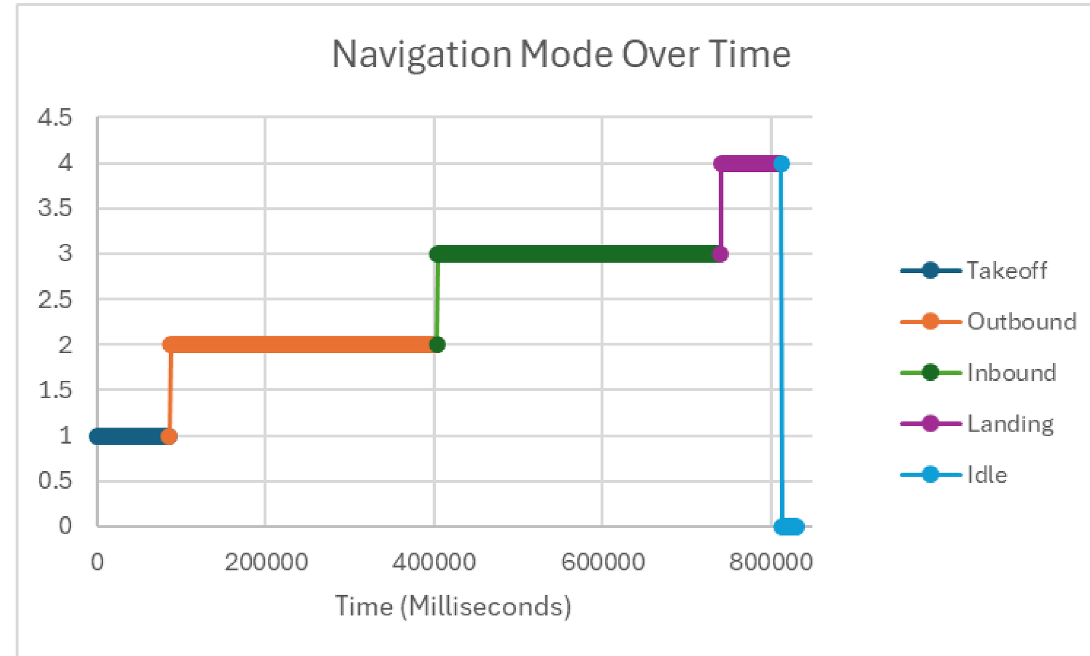


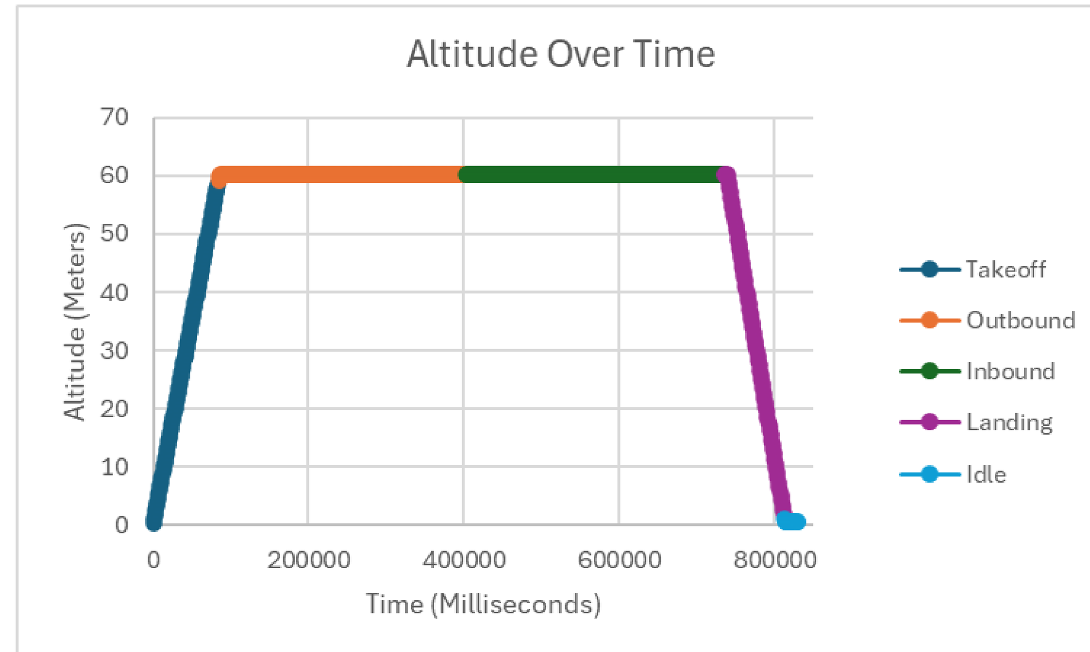
Results

Before full system integration, each sensor and control surface was rigorously tested to ensure reliability. Once functionality was verified, integration between the modules was completed. Communication testing confirmed that telemetry and commands could be successfully sent between the ground station and the UAS. After achieving this milestone, algorithms were designed to represent flight modes, as shown in the "Navigation Mode Over Time" graph. Hardware integration was then completed and validated through testing of control surfaces within the UAS. After the algorithms' ability to alter the throttle and control surfaces was confirmed (ailerons, flaps, rudder, elevator), a simulated flight was performed. The three graphs display one complete flight cycle.

- **Location Over Time (top):** Shows directional arrows marked at 40,000 ms intervals to showcase flight progress over time.
- **Navigation Mode Over Time (middle):** Represents the navigation modes of the UAS along the flight path. Mode 1 is Initial Take Off, Mode 2 is Outbound Delivery, Mode 3 is Inbound Return, Mode 4 is Landing, and Mode 0 is Idle.
- **Altitude Over Time (bottom):** Shows the altitude of the UAS, including takeoff, steady cruise, and landing.







Conclusion

The team successfully developed a UAS capable of extended-range autonomous flight through unknown terrain. Using low-cost COTS components paired with custom autonomous flight software, the entire system was completed for under $800. This demonstrates that effective and reliable autonomous UAS solutions can be achieved without relying on high-cost commercial platforms.