University of Minnesota – Twin Cities Modifications to the Montana State University Telemetry System for Stratospheric Eclipse Ballooning

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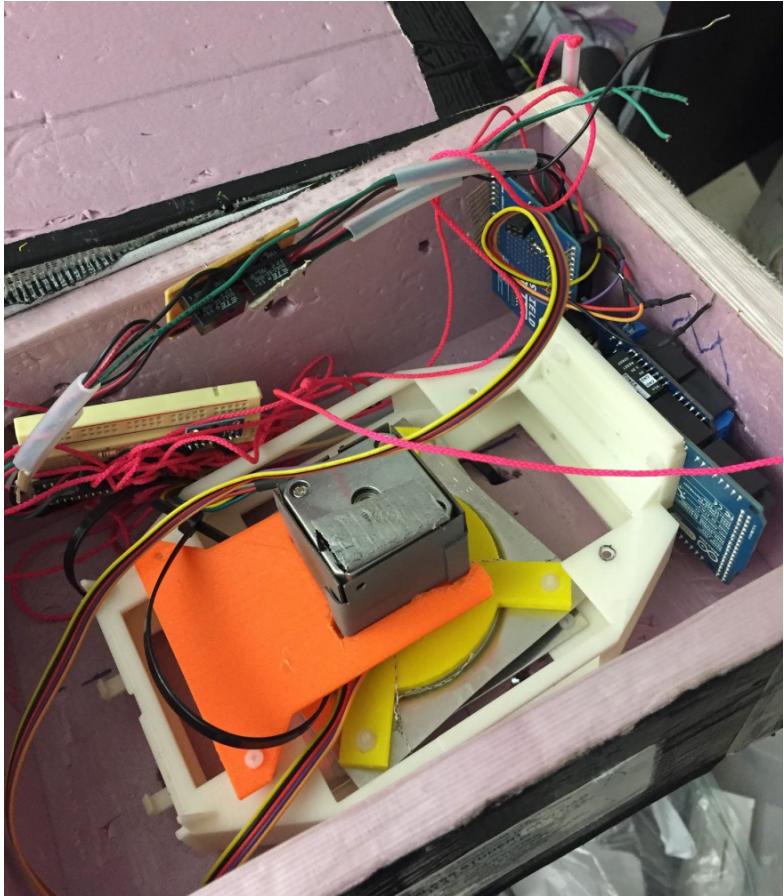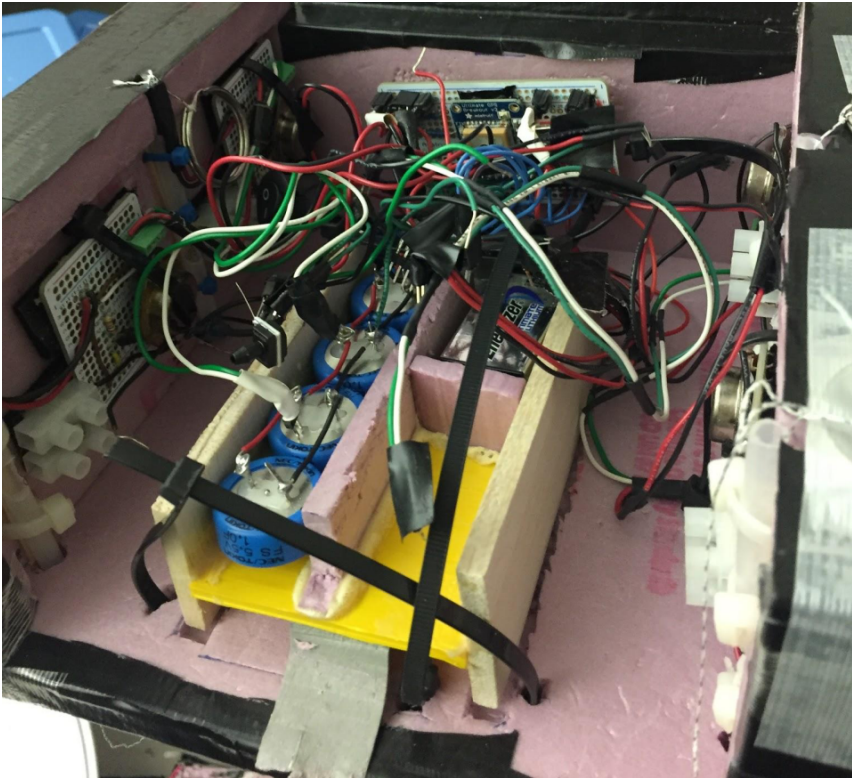
Introduction

- Joined Montana State University as a "leadership" team in January 2016.

- We decided to make changes to system to add functionality and improve reliability.

- "Minnesota Tracking System" improves GPS update time of system, relays commands, and improves usability.

New Hardware for UMN System
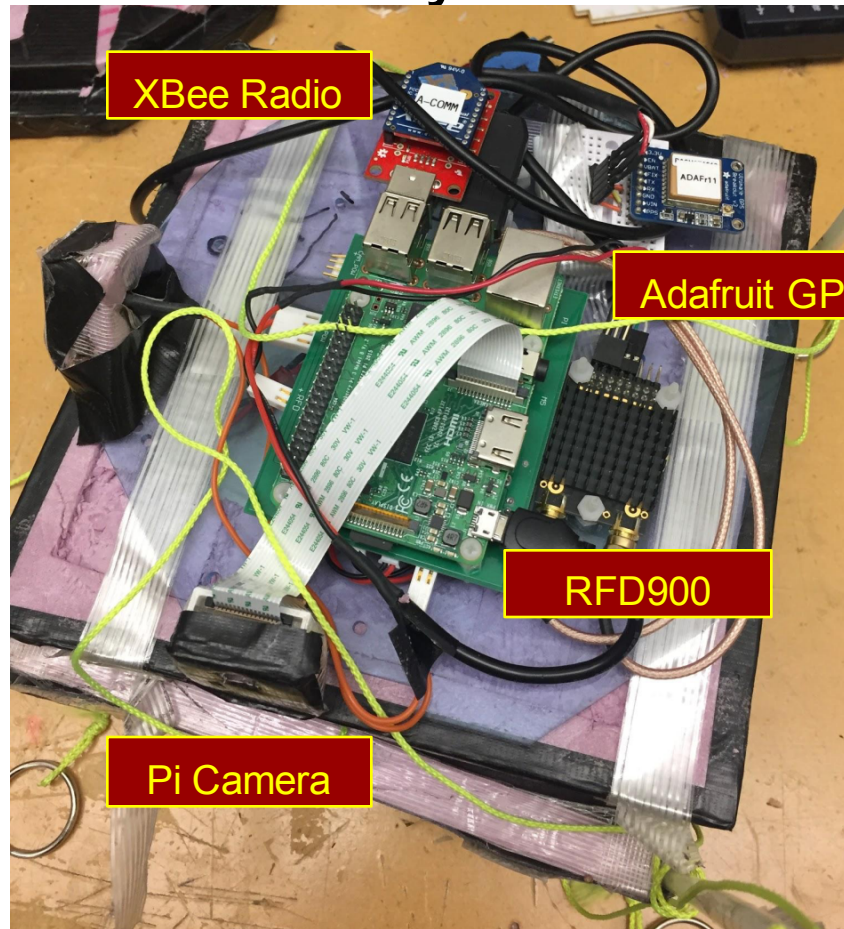
Other Payloads with UMN System

Ground Station Hardware

- Original system left mostly intact.

- Updated radio firmware to allow for "downrange" ground stations

- Downrange stations let us be closer to the balloon at the peak of flight.

- Omnidirectional antenna picks up balloon up to 60 km.

New Software

- Began modifications to MSU system in summer 2016

- Team wanted uplink and downlink for tracking, etc

- Still image connection was used due to lots of downtime of radio link.

Tracking Updates

- Simultaneous tracking of multiple sources

  - Iridium

  - APRS

  - Direct through RFD

- Data Logging

- Automatic Device Detection

- New Servo Mapping

RFD Controls

- RFD connection sends GPS packets and XBee messages from other payloads.

- Ground station software is multithreaded to support these activities.

Other Tab Updates

Flight Software

- Flight software was restructured

- Multithreaded to remaining responsive

    - Relay XBee/RFD

    - Take photos

    - Retrieve GPS updates

    - Beacon

- Highly error tolerant

- Can trigger cutdown independent of Iridium

UMN Experiences

- Approximately 20 test flights

- ~~Becoming more familiar~~ with the flight units, and the best ways to use them

- Down Range Ground Stations (Gustavus)

- Coordinating launch site accordingly, to fly over ground station

- Getting Video Stream to internet, and what that told us about network needs in Nebraska

- Reliability of Systems

- Plan to fly three telemetry stacks

Trip Preparation

- Lake Landing (August 13th)

- Rebuild damaged units and test by August 18th.

- Familiarity with systems allowed us to be prepared

Nebraska

Future Work

- System is still useful after eclipse.

- We have more control over our balloons than ever.

- Working on implementing "light" version of ground station.

- Would use car mounted antenna and drive under balloon in flight.

- Allows for data to be sent live in flight

Questions?

GPS Decision

- Tested Adafruit Ultimate GPS Breakout, UBlox NEO6MV2, and Trimble Copernicus II.

- Adafruit was selected after testing.

- However, newer Adafruit GPS modules have firmware restricting their use above 18,000 meters.