Mile-High-MyRio

High Altitude Ballistic Descent, Landing, and Recovery

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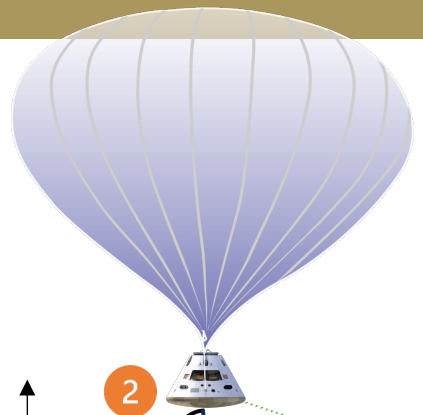


2. We rely on a High-Altitude Weather Balloon to bring our capsule to altitude – here we separate from the balloon

The position and velocity of the capsule is GPS tracked

3. During its descent, the capsule is currently set to record the following data:
- Video
- Pressure
- Temperature
- Position
- IMU

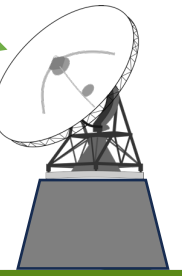
~120.000 [ft]

4-5. When altitude thresholds are met, an incendiary charge-released drogue and main chute the capsule reduces velocity near-landing

The capsule will actively downlink information through radio-communication

1. We launch balloon meeting weather and visibility targets. We notify ATC of launch and begin pursuit.

6. Payload recovered safely



Mission Goal

- **Send payload containing NI MyRio microcontroller to ~ 120,000ft and return it safely to surface of Earth.**
  - Ascent method: High altitude latex helium balloon w/ attached payload
  - Descent method: Ballistic descent
  - Landing Method: Drogue parachute deceleration and main parachute landing

- **Minimum Success Criteria:**
  - Payload detaches from balloon
  - Payload lands with electronics in functioning condition
  - Payload is recovered

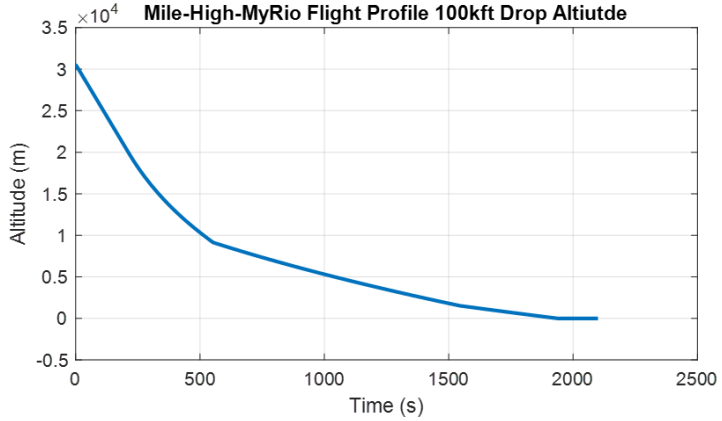
- **Icing on the Cake:**
  - Capture clear video footage of entire flight
  - Record data from various sensors for entire mission duration
  - Successfully demonstrate capsule return capabilities
  - Demonstrate MyRio operational ability in novel environment

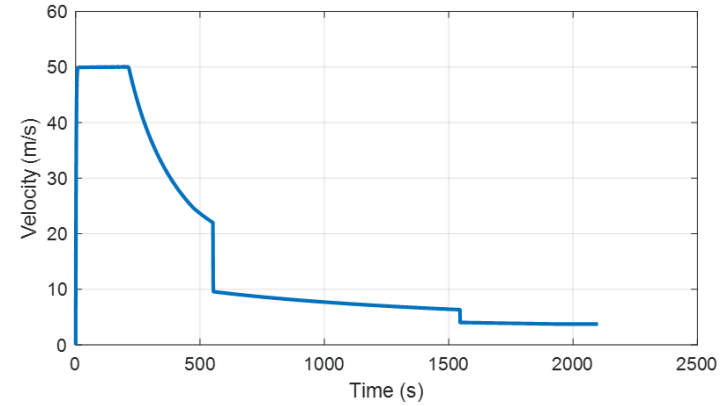
Preliminary Capsule Design

- **Capsule Properties:** The capsule is currently designed approximately with a diameter of 13 [inch] and a size of 1100 [g]
  - We aim to maintain the mass of the capsule below 4 [lbs], if we exceed this threshold, we must adhere to stricter FAA regulations and paperwork
  - The MyRio shall operate the sensors and actuators within the capsule, with exception however the video hardware shall operate on a separate architecture

- **Capsule Design Concept**
  - Trilateral carbon fiber frame: carbon fiber rods and 3d printed joints
  - Safety Cell: weather sealed enclosure for electronics with impact protection
  - Dual Batteries: one battery for flight critical hardware and another for cameras and lights
  - Drogue Assist Main Deployment: drogue deployment will be used to pull main parachute out of capsule when commanded

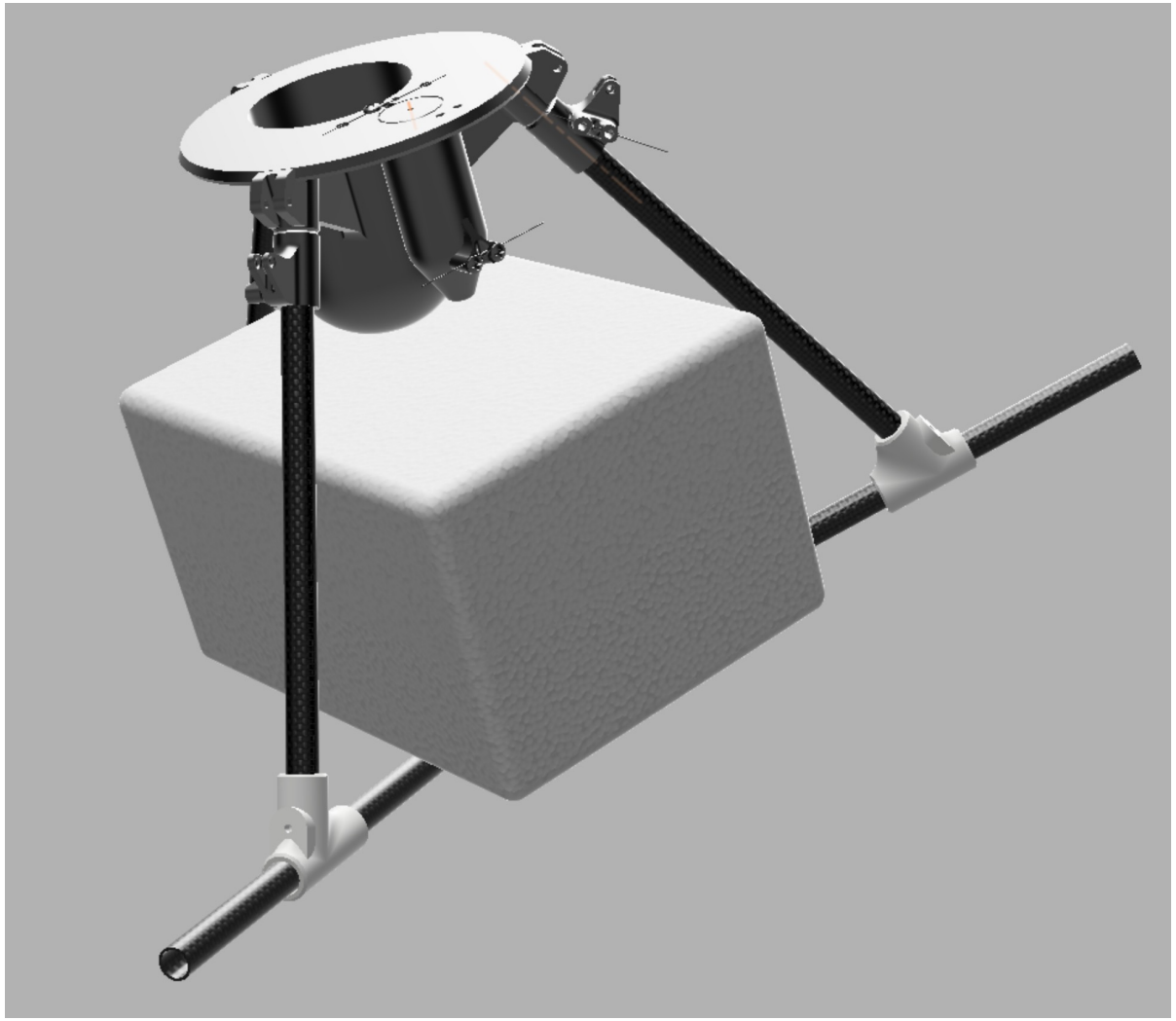
- **Initial Simulation Validation**
  - Initial simulation results show a maximum speed <150 [mph] and a touch down speed of ~8 [mph] indicating project feasibility.





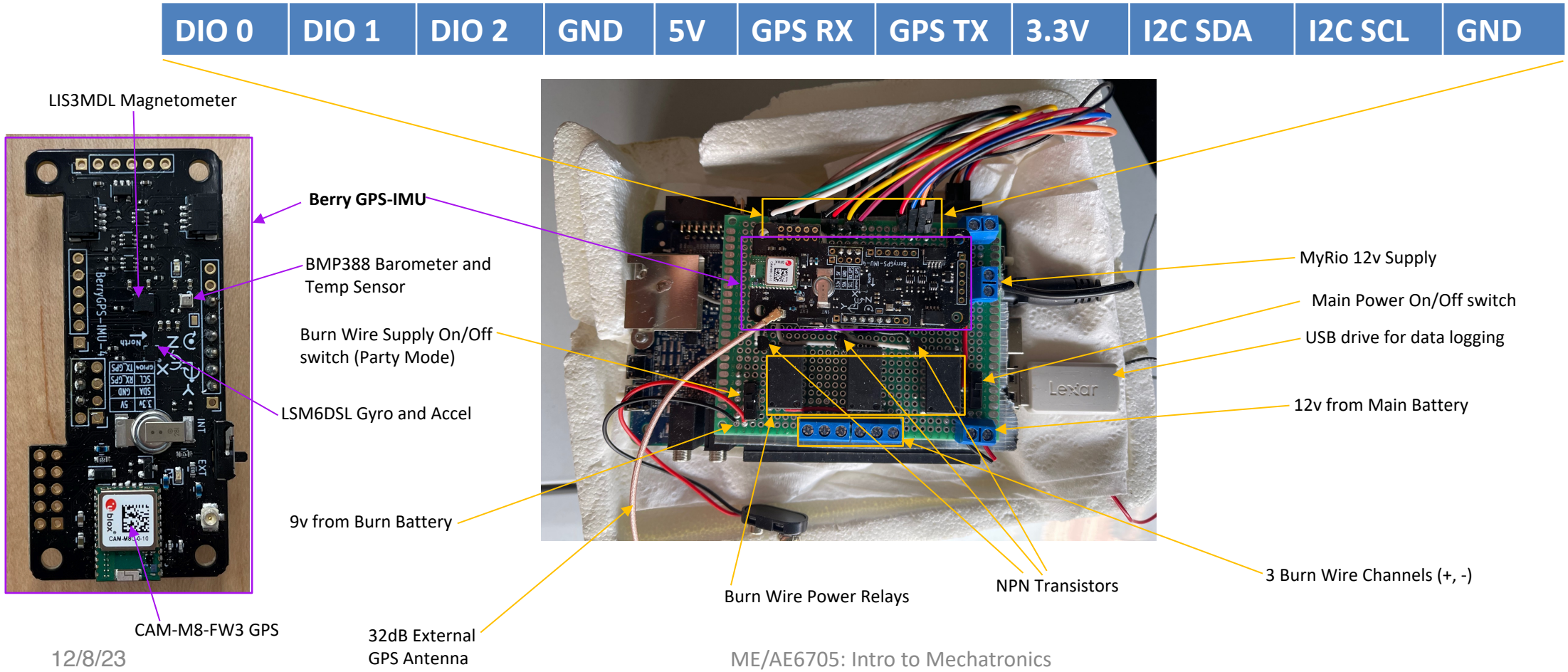
Design:

- **Trilateral Carbon Frame w/ Safety Cell**
- **Independent Drogue Deploy & Drogue Assisted Main Deploy**
- **Zero Pyrotechnics**
- **Demonstration of non-pyrotechnic parachute deployment concept**
- **Electronics Housed within Styrofoam safety cell for temperature control**



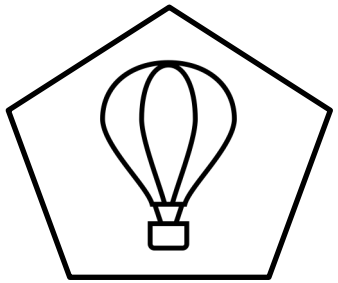
Hardware Implementation

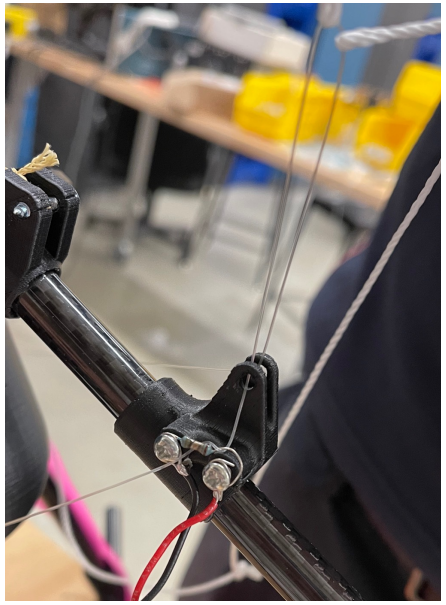
- **Custom proto board was made to route power and signal to all appropriate components**



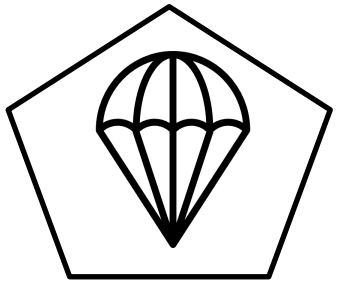
Release Mechanisms

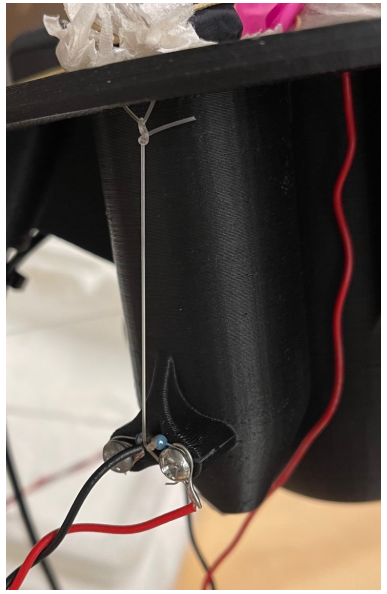
Balloon Release



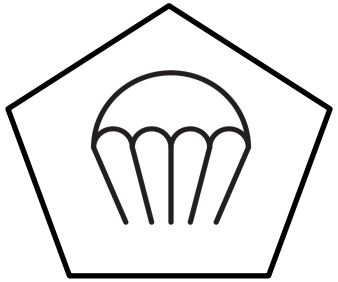


Drogue Release



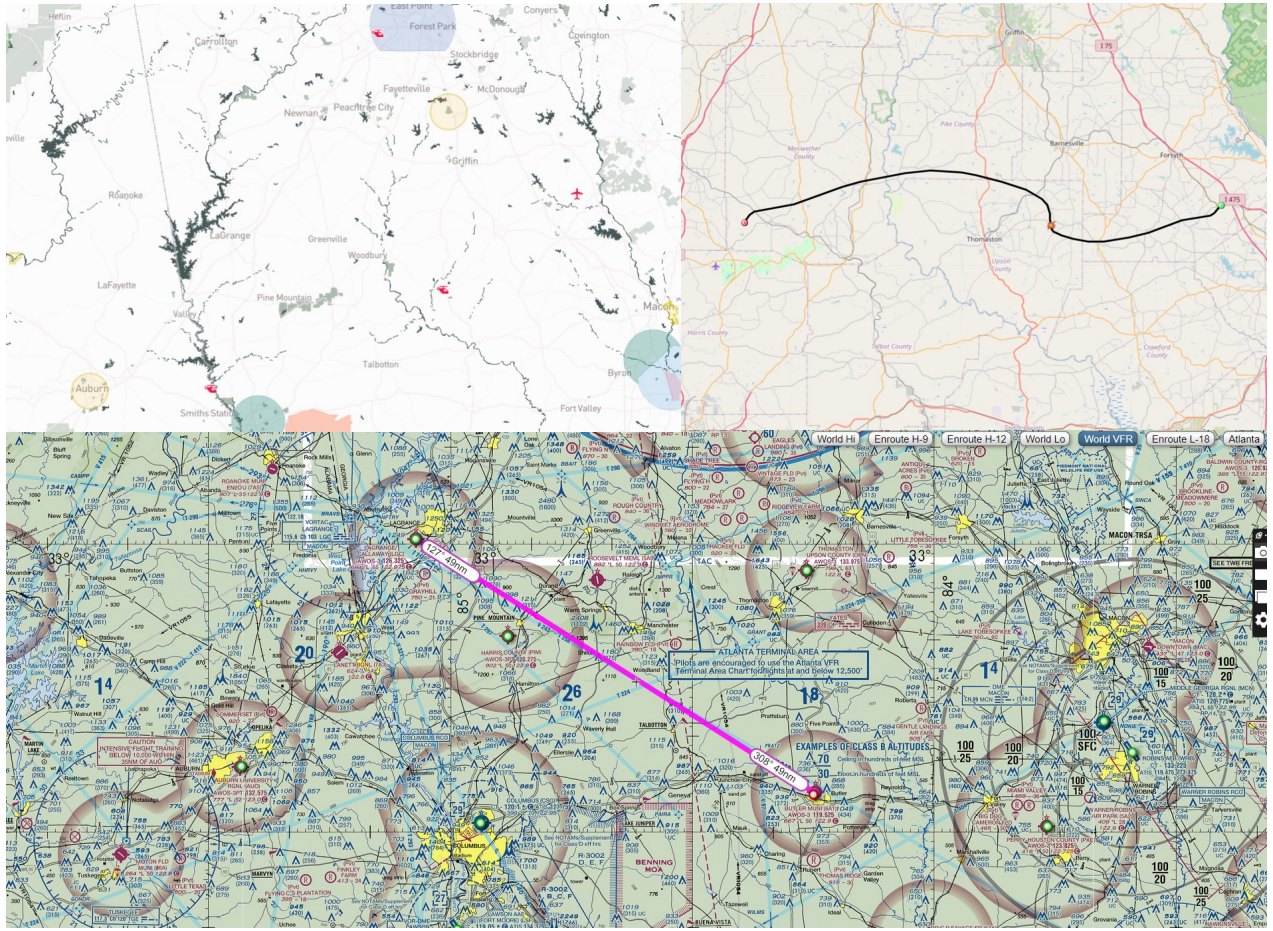


Main Release

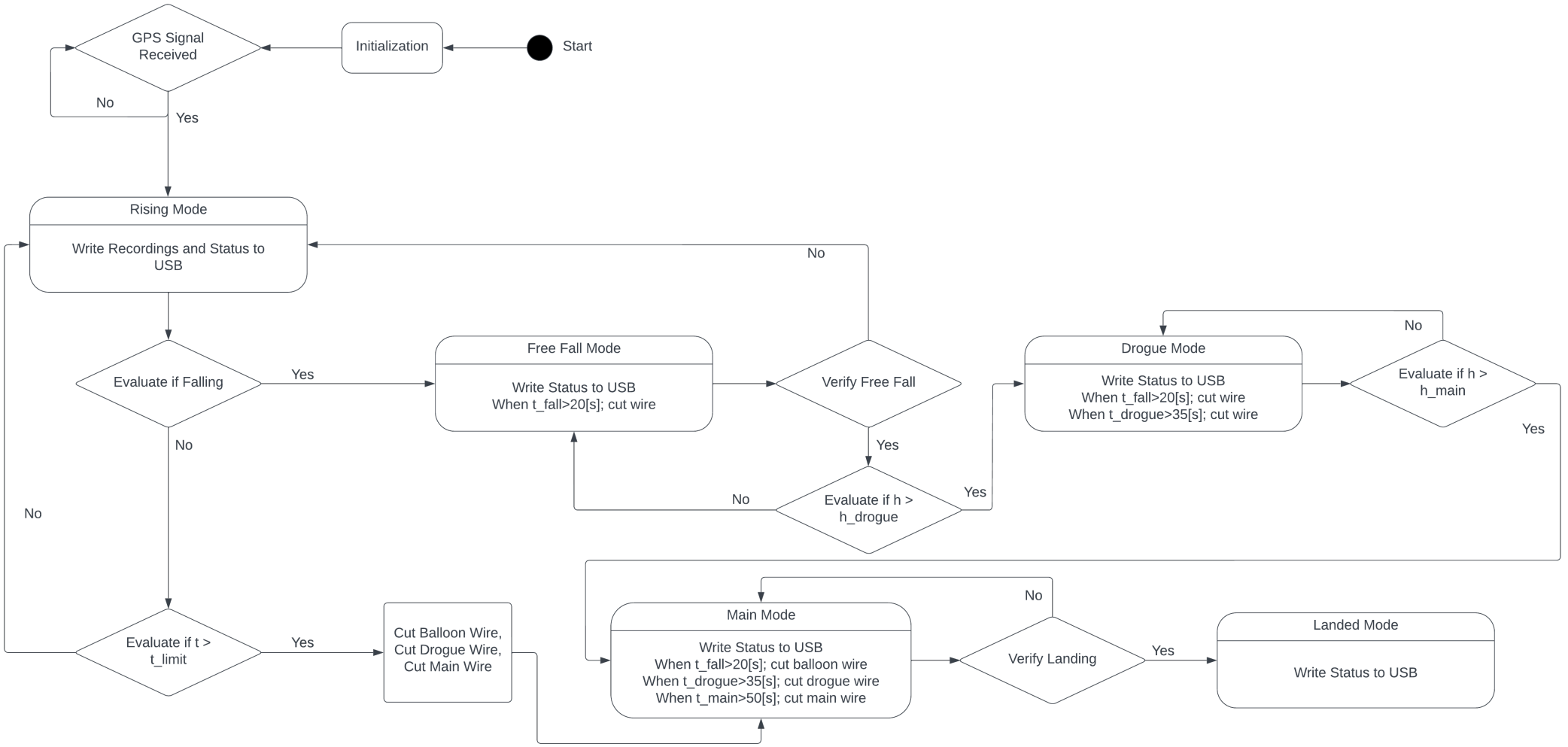


Logistical Planning

- **We planned our mission in accordance with the FAA legislation, and requested our NoFlyZone.**
- **We adhered to our weight limit, with a total weight of approximately 3 [lbs].**
- **NOTAM: ZTL12/189**



Operation:

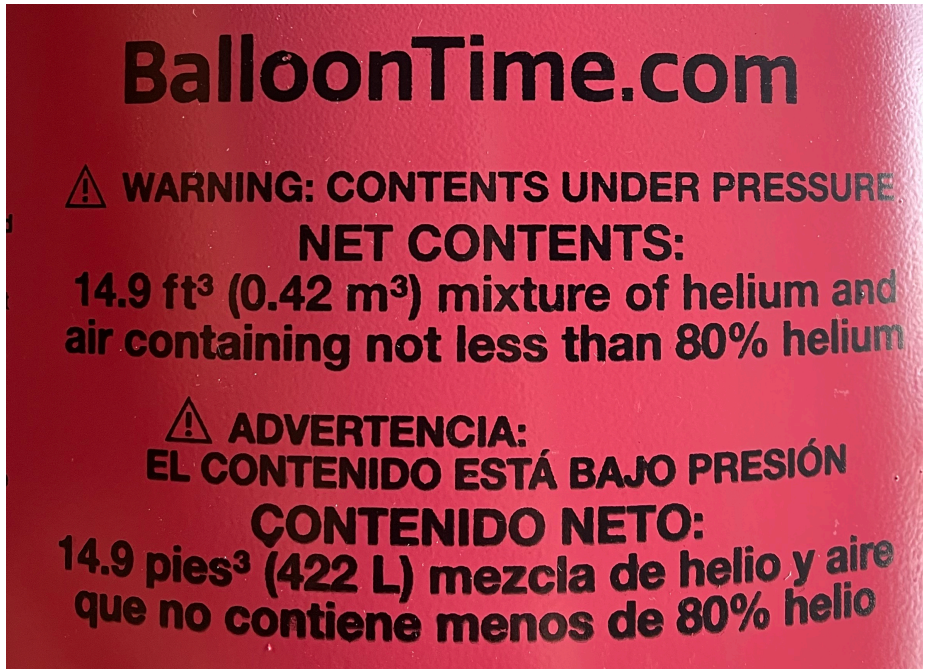

Start
Initialization
GPS Signal Received
No
Yes
Rising Mode
Write Recordings and Status to USB
Evaluate if Falling
Yes
No
Free Fall Mode
Write Status to USB
When t_fall>20[s]; cut wire
Verify Free Fall
No
Yes
Evaluate if h > h_drogue
No
Yes
Drogue Mode
Write Status to USB
When t_fall>20[s]; cut wire
When t_drogue>35[s]; cut wire
No
Evaluate if h > h_main
Yes
No
Evaluate if t > t_limit
Yes
Cut Balloon Wire,
Cut Drogue Wire,
Cut Main Wire
Main Mode
Write Status to USB
When t_fall>20[s]; cut balloon wire
When t_drogue>35[s]; cut drogue wire
When t_main>50[s]; cut main wire
No
Verify Landing
Yes
Landed Mode
Write Status to USB

LabView Implementation:

Helium Balloon

Due to sanctions implemented because of Russia's invasion of Ukraine, there is a nationwide shortage of helium – specifically high density helium. (Russia is largest producer)

Fortunately, we managed to find a source that supposedly guaranteed at least 80% purity.



Helium Failure

- **Sadly, it was not 80% helium and even with the margin of safety we had built in, we did not have enough lift.**

We calculated the helium % to have been < 55%