



Ballistic Acquisition Telemetry and Trajectory System using an Arduino

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Overview:

1. **Goal:**

Report telemetry from a self-contained device to a fixed ground station.

2. **Components:**

- Ground Station:

Arduino -> Antenna/Receiver (Comms) -> Data processing.

- Air Unit:

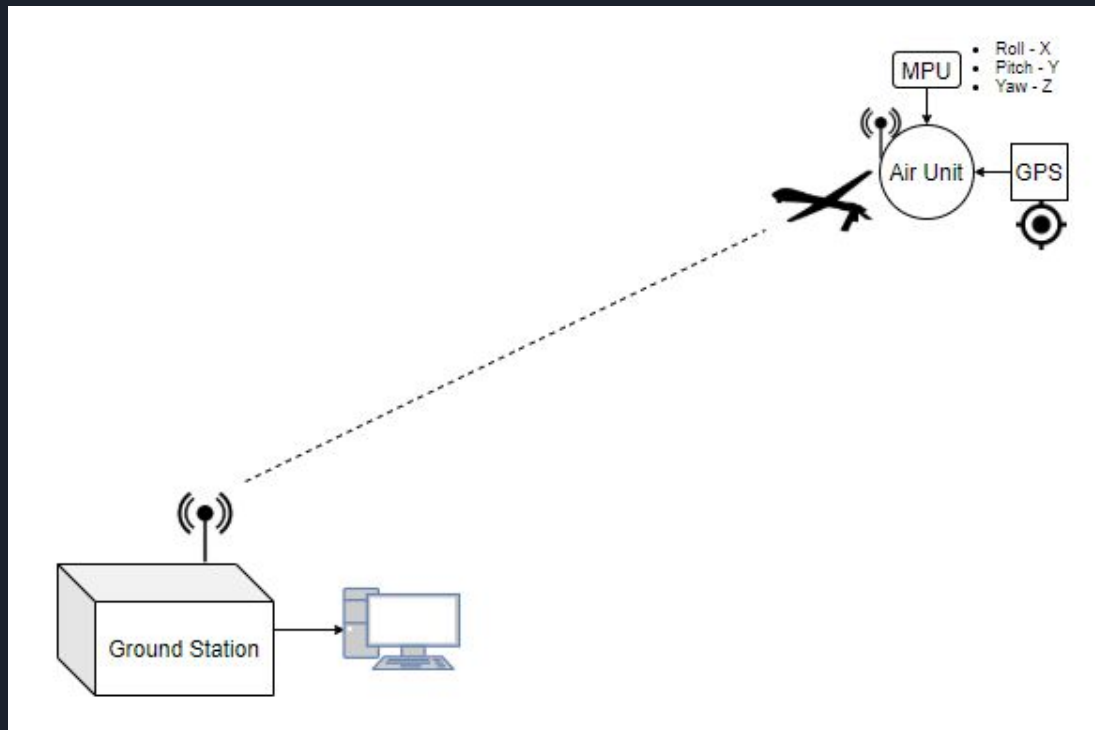
Teensy -> IMU (initial measurement unit) - MPU -> Antenna/Transmitter (Comms).

3. **Results:**

Data is output to the serial monitor according to the same scheme it's sent to the radio transmitter. Eg.

< A.x, A.y, A.z | G.x, G.y, G.z | M.x, M.y, Mz | AD.x, AD.y, AD.z >

Overview:





Planning:

Software Component -> Teensy & (IMU-MPU, GPS) Code
-> Uno & PC Code

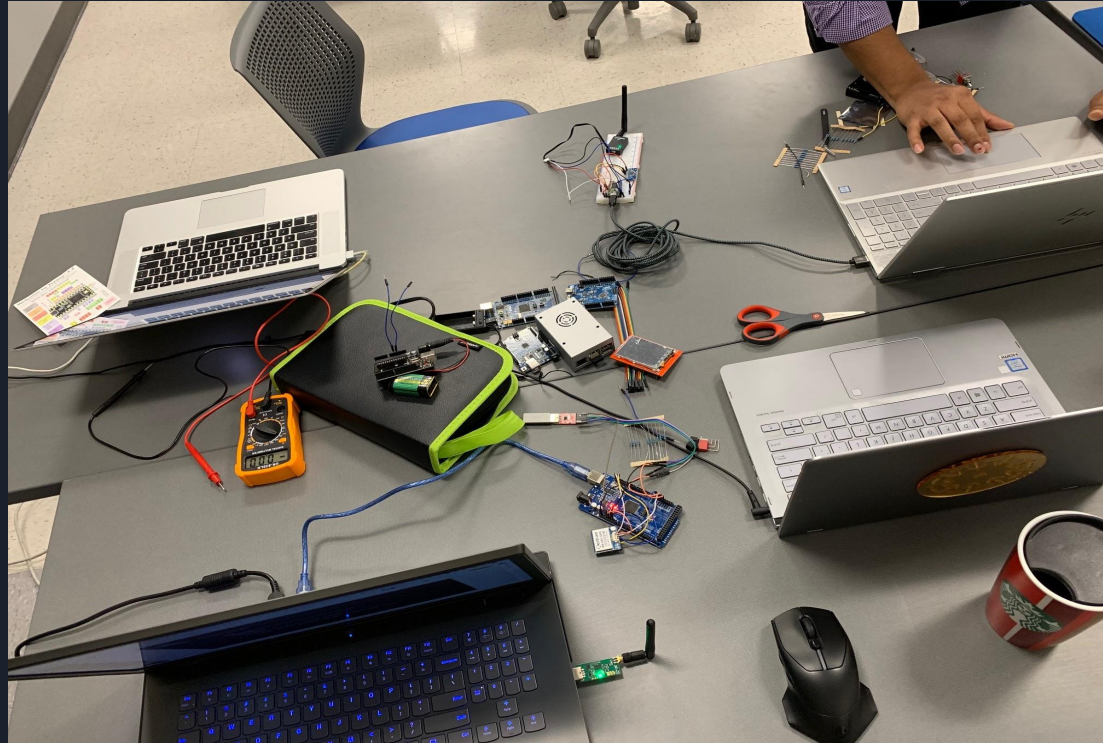
Antenna -> Communication RX/TX Connections and Configurations

Data Processing & Filtering

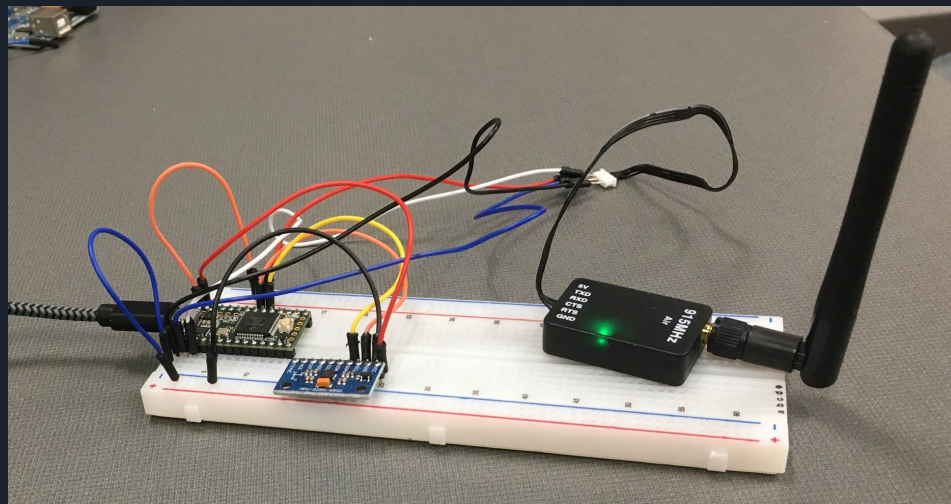
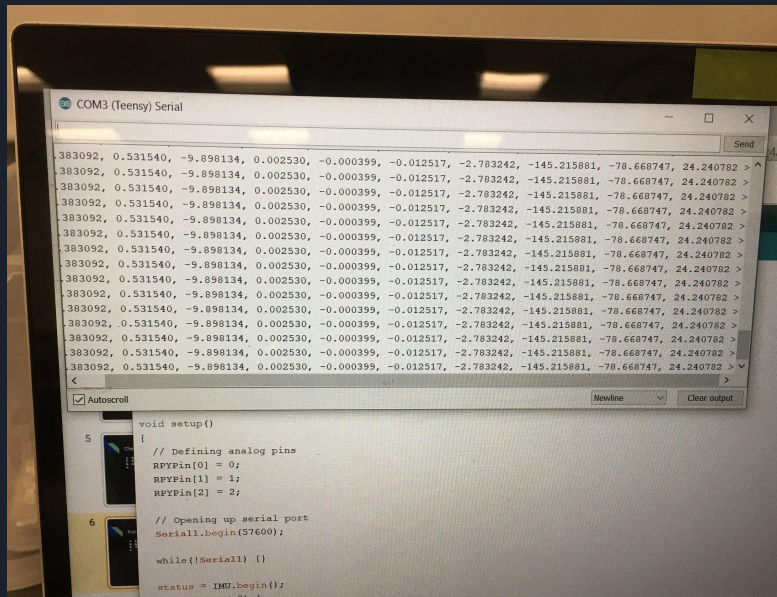
Hardware Component -> Uno - Physical Ground Ops.
-> Teensy - Physical Air Unit.

Design & Containers -> 3D CAD SOLIDWORKS

Planning:



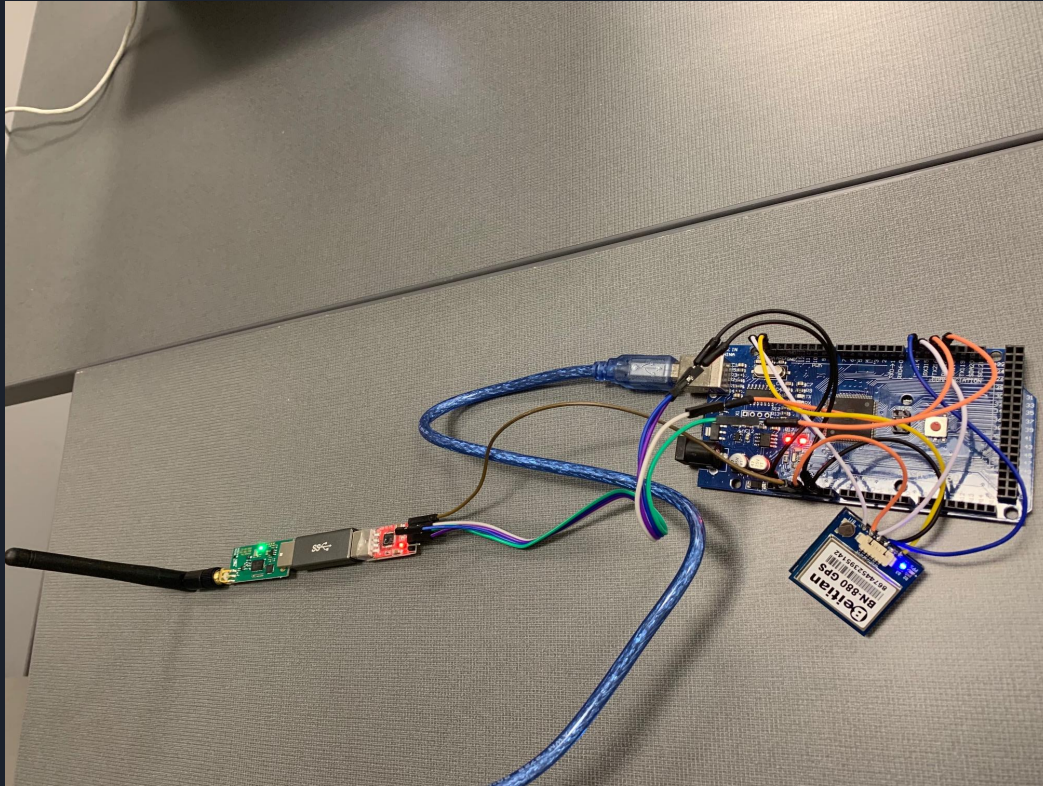
Progress (Air Unit):



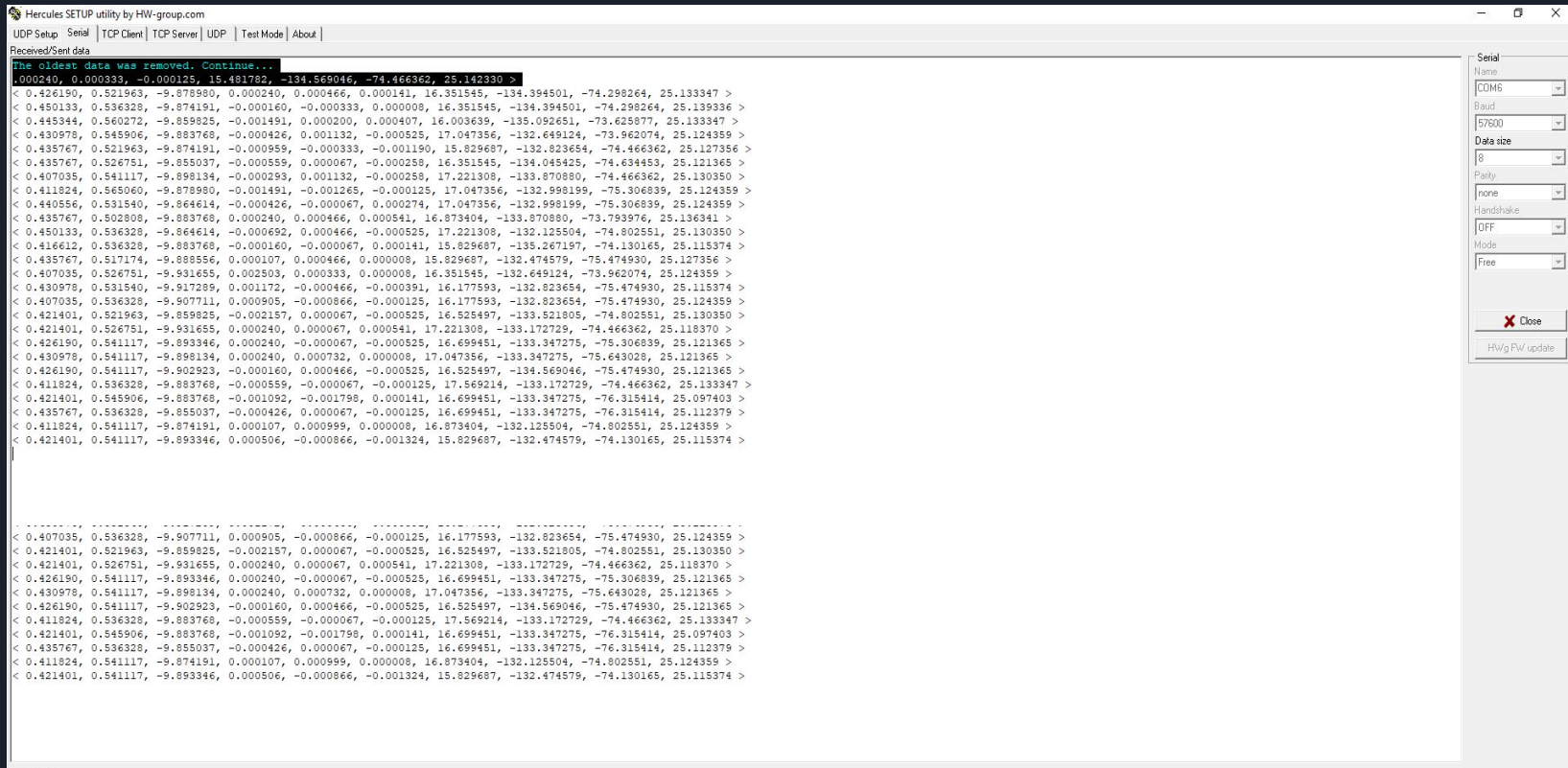
Air Unit (Drone):



Progress (Ground Station):



Data Readings:



The screenshot displays the Hercules SETUP utility window, titled "Hercules SETUP utility by HW-group.com". The window has a menu bar with "UDP Setup", "Serial", "TCP Client", "TCP Server", "UDP", "Test Mode", and "About". The "Serial" tab is selected, and the "Received/Sent data" section is active. The main text area shows a list of data readings, with the oldest data removed. The readings are organized into columns, with the first column containing a sequence of numbers (e.g., 0.000240, 0.000333, -0.000125, 15.481782, -134.569046, -74.466362, 25.142330) and the second column containing a sequence of numbers (e.g., 0.426190, 0.521963, -9.878980, 0.000240, 0.000466, 0.000141, 16.351545, -134.394501, -74.298264, 25.133347). The readings are separated by a greater-than sign (>). The right sidebar contains a "Serial" section with a "Name" dropdown set to "COM6", a "Baud" dropdown set to "57600", a "Data size" dropdown set to "8", a "Parity" dropdown set to "none", a "Handshake" dropdown set to "OFF", and a "Mode" dropdown set to "Free". At the bottom of the sidebar, there is a "Close" button and a "HW/g Pw/ update" button.

Hercules SETUP utility by HW-group.com

UDP Setup | Serial | TCP Client | TCP Server | UDP | Test Mode | About

Received/Sent data

The oldest data was removed. Continue...

0.000240, 0.000333, -0.000125, 15.481782, -134.569046, -74.466362, 25.142330 >

< 0.426190, 0.521963, -9.878980, 0.000240, 0.000466, 0.000141, 16.351545, -134.394501, -74.298264, 25.133347 >

< 0.450133, 0.536328, -9.874191, -0.000160, -0.000333, 0.000008, 16.351545, -134.394501, -74.298264, 25.139336 >

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< 0.411824, 0.565060, -9.878980, -0.001491, -0.001265, -0.000125, 17.047356, -132.998199, -75.306839, 25.124359 >

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Serial

Name: COM6

Baud: 57600

Data size: 8

Parity: none

Handshake: OFF

Mode: Free

Close

HW/g Pw/ update



Questions:

- How should each axis of data be mapped?
- What communication protocol is each component of the project using?
- How will the data be collected from the Arduino?
- How does the Beitan GPS work? How do we print data from it to the serial monitor repeatedly?
- How does the `Serial*.available()` function work?
- How many devices can the Mega handle?
- At what baud rate is the data optimally received at from each device?
- What have we learned so far?
- If we were to receive data from the computer, how would it be graphed?



Challenges:

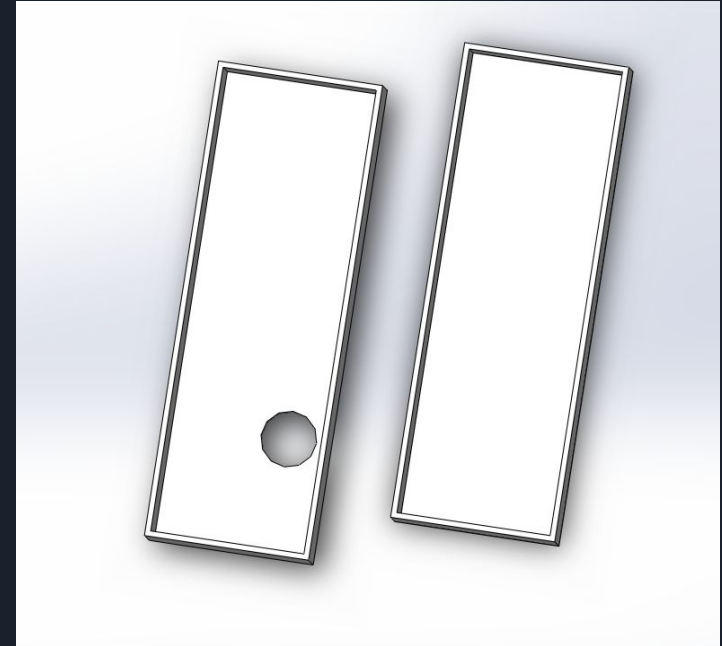
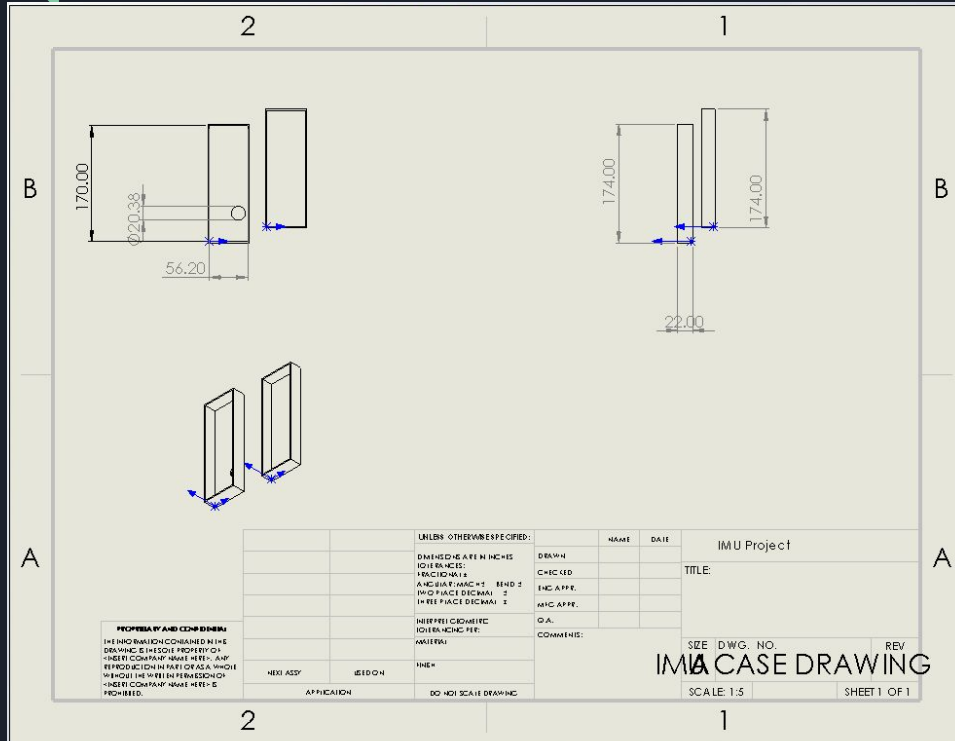
- Team Coordination.
 - Worked on better communication.
- Arduino Malfunction (UNO R3).
 - Replaced it with a Mega 2560.
- USB to TTL Problems (USB Slave).
 - Attempted to replace the radio telemetry unit with 3DR Radio 915MHZ with serial connections on both ends.
- Dealing with Arduino Libraries when reading from both MPU & GPS.
 - Need to merge the two code bases and deploy on Mega.



Future Work:

1. Building a container for both Air and Ground Units using Solidworks.
2. Setting up the Air Unit on a drone and run tests.
3. Connect multiple sensors, potentially a camera.
4. Continue answering the questions on slide 9.

IMU Case-Ground





References & Reproducibility:

GitHub:

<https://github.com/SMikaelian/BATTS>

Book Reference:

https://learning.oreilly.com/library/view/arduino-cookbook-3rd/9781491903513/ch01.html#getting_started