



Fall 2019 Final Design Review



Development Team

Crystal Eskander(Lead)

- IMU, KerberosSDR Interface

Jerry Liu

- KerberosSDR Interface, Triangulation

Lillian Liu

- Emitters, Triangulation

Lekha Adari

- Emitters, IMU





Project Description

- Goal: To plan against potential GPS loss, such as jamming or in locations without GPS, by acting as an alternative location tracking system
- GPS uses satellites; Bermuda is a proof of concept that location can be found using radio emitters.

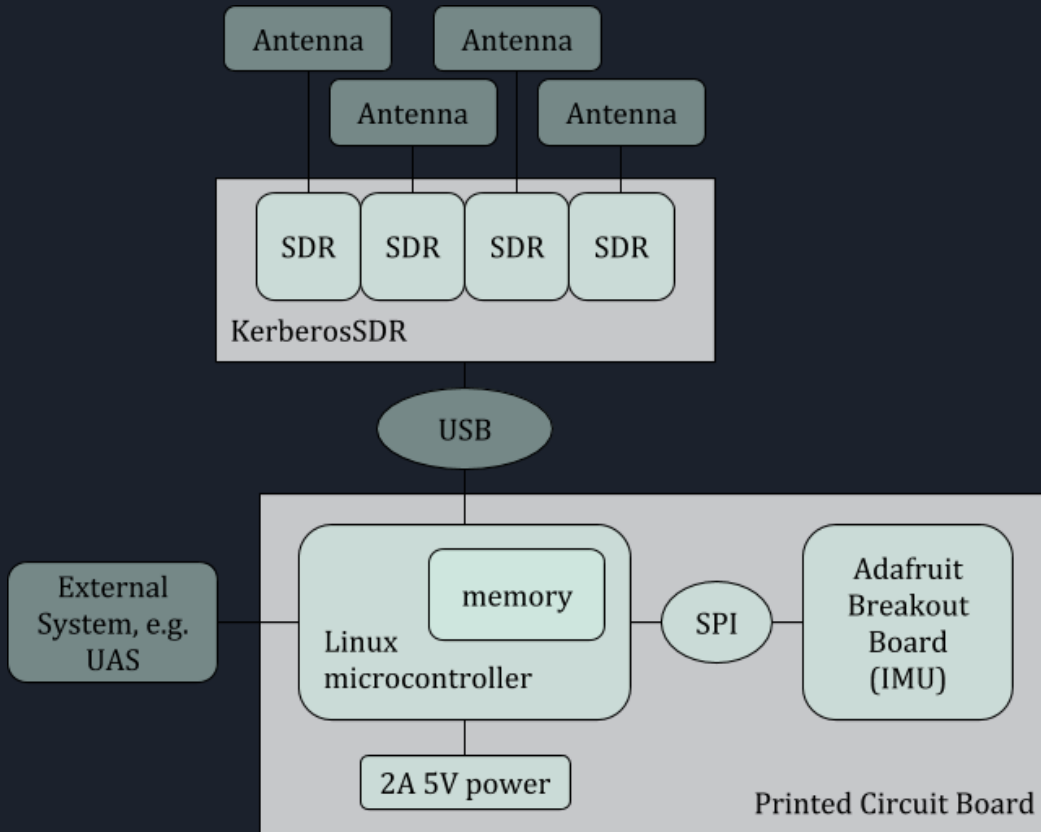


System Architecture

- KerberosSDR
- Microcontroller (Raspberry Pi 3 B+)
- Adafruit Breakout Board
- RadioFruit Emitters
- AeroVironment drone



Block Diagram





IMU (Inertial Measurement Unit)

- know Bermuda's absolute starting location
- + know acceleration or velocity
- + know direction
- = can estimate location

Not very accurate due to:

- wind
- drift (error accumulation)



Bermuda's Triangulation

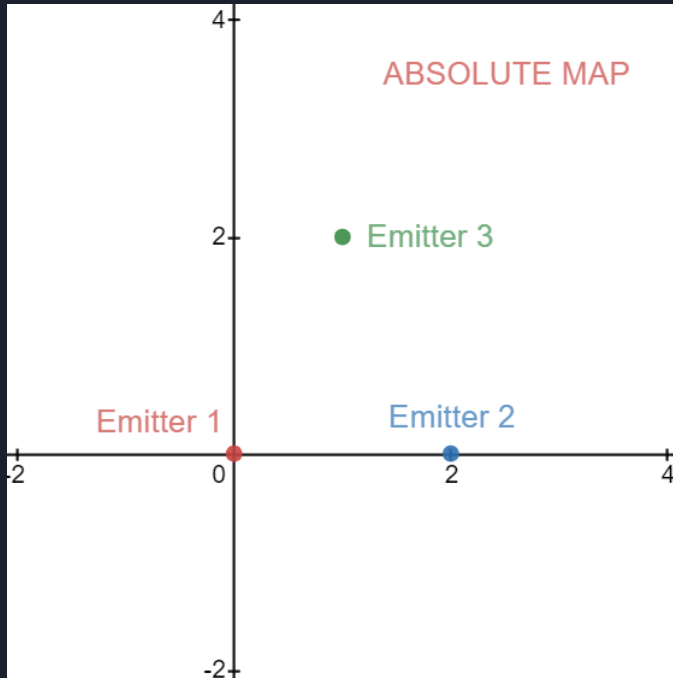
Requires:

- Radio emitters
- Radio emitters' absolute location and frequency range
- Bermuda's estimated location from IMU



Bermuda's Triangulation

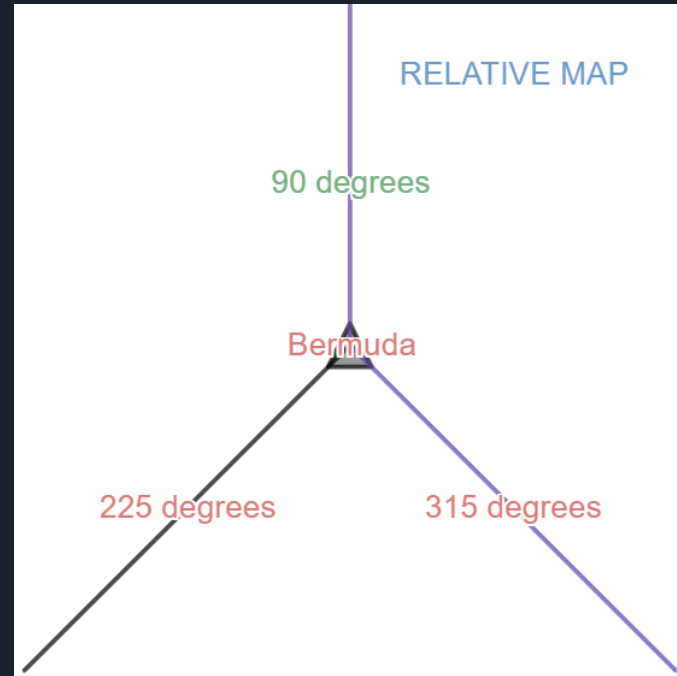
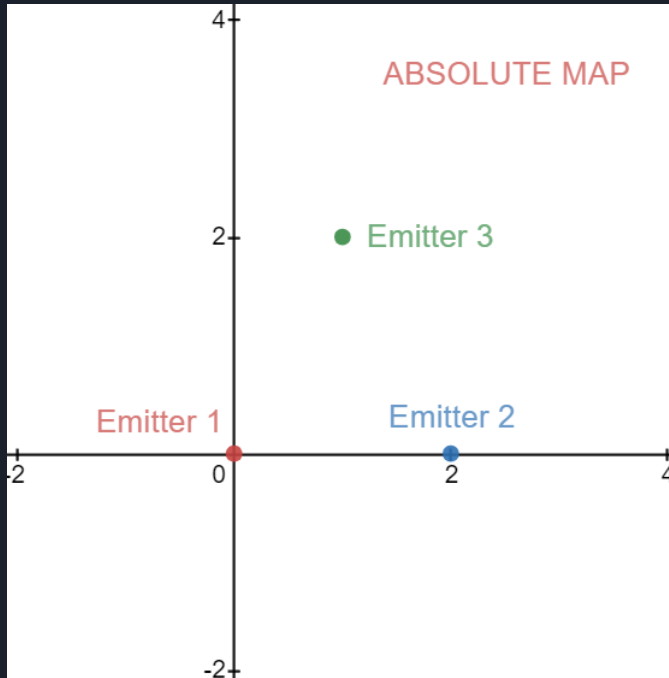
1. Determine nearest emitters. Plot them.





Bermuda's Triangulation

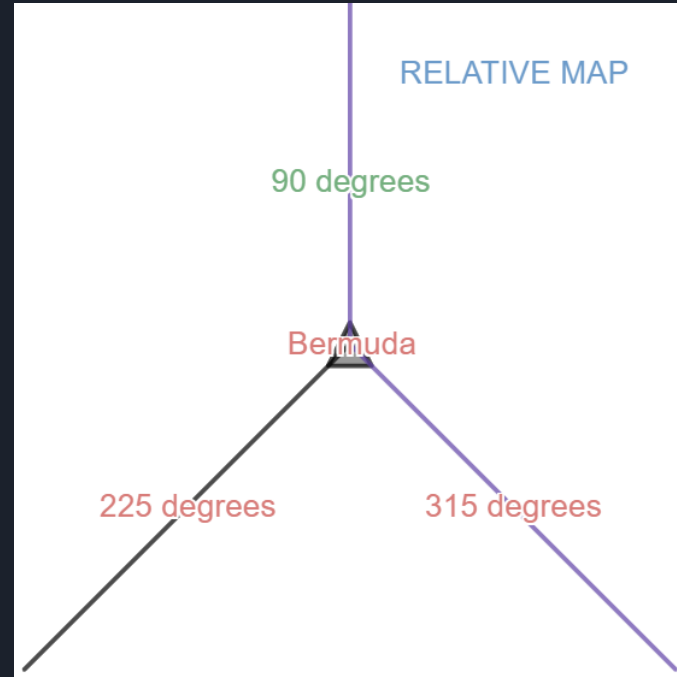
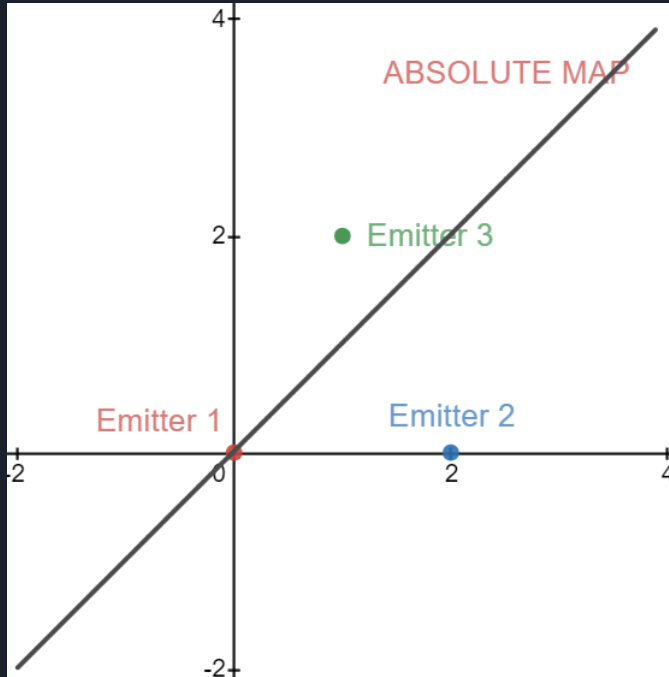
2. Get direction to each emitter from the KerberosSDR.





Bermuda's Triangulation

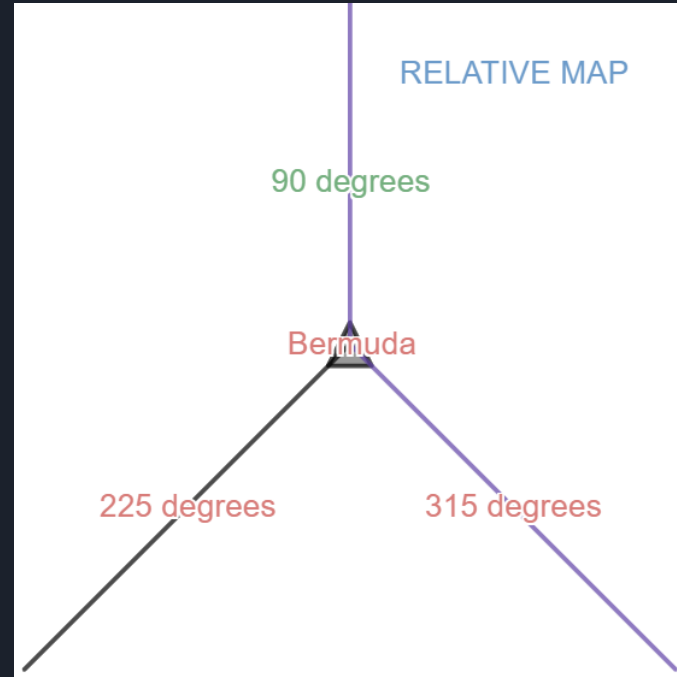
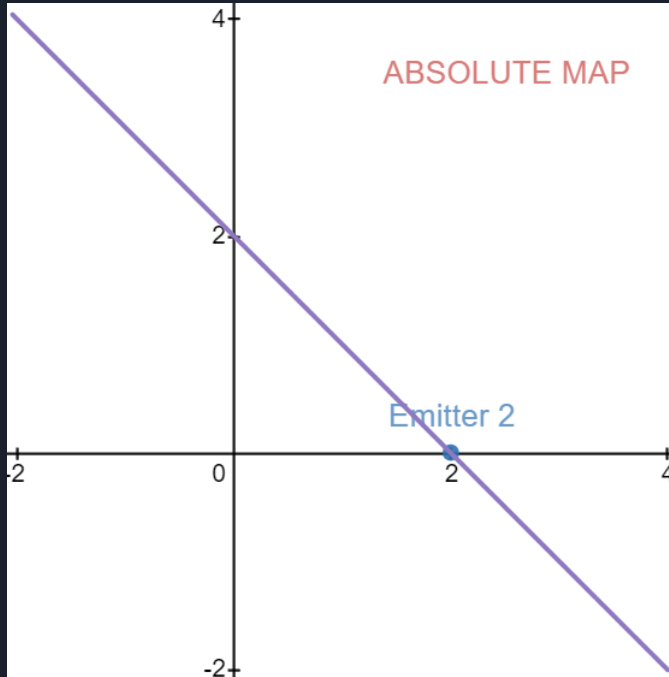
3. Combine a point and a slope to get a line: $y - y_1 = m(x - x_1)$





Bermuda's Triangulation

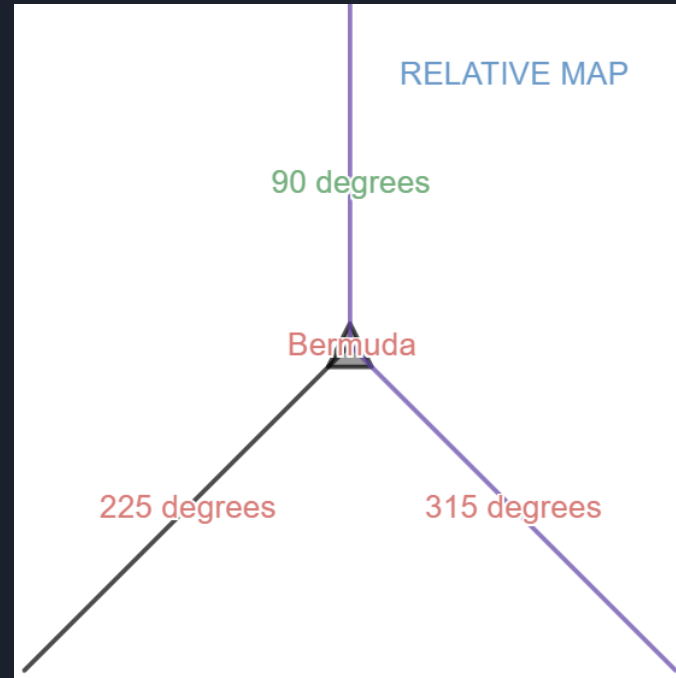
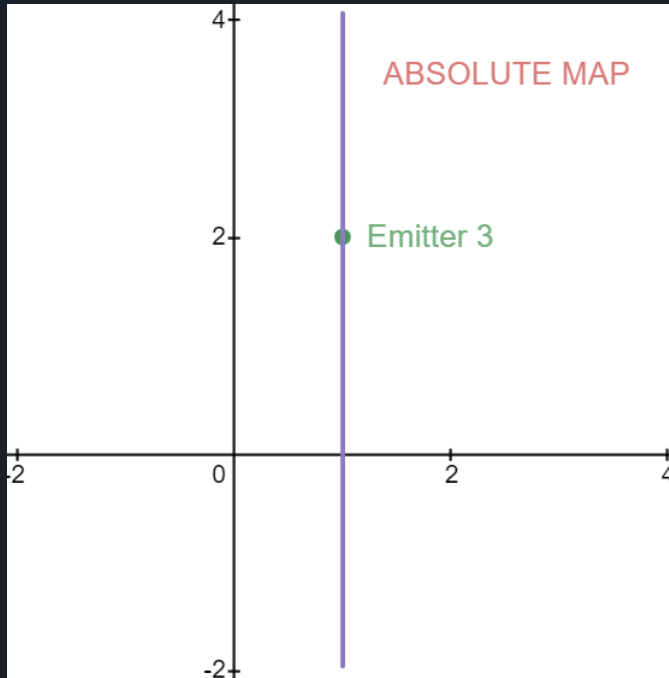
3. Combine a point and a slope to get a line: $y - y_1 = m(x - x_1)$





Bermuda's Triangulation

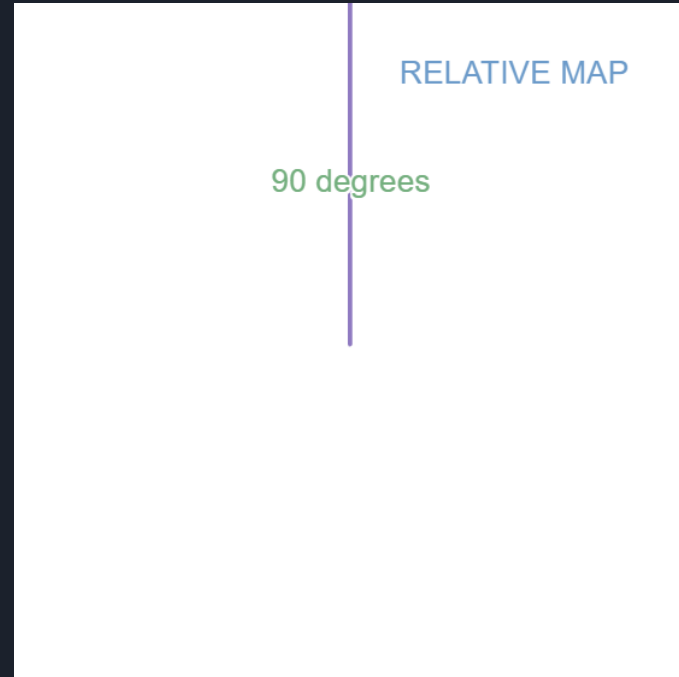
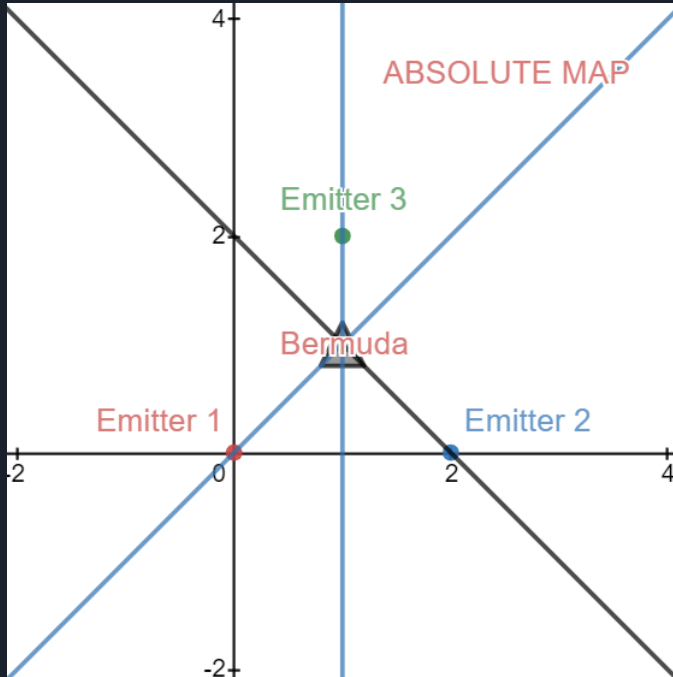
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Bermuda's Triangulation

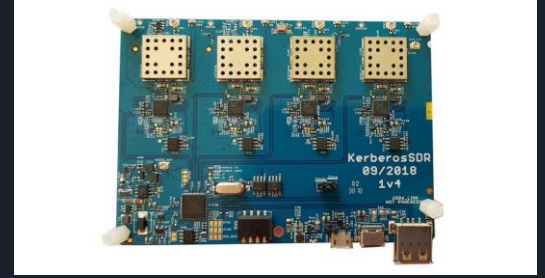
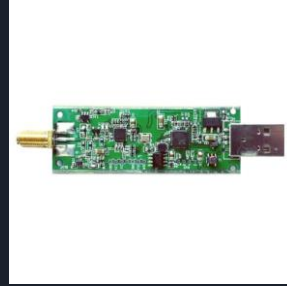
4. The intersection is the absolute location of the Bermuda.





Current Progress

Experimentation with Hardware



Testing and Understanding Existing Software



Future Goals

End of Fall 2019 Goals:

- KerberosSDR able to detect emitters

Winter 2019 Goals:

- Triangulation and location finished



Applications

- Defense
- Warehouse Navigation
- Space Exploration
- Surgery



THANK YOU!!

- Yogananda Isukapalli, Capstone Instructor
- Aditya Wadaskar, TA
- Kyle Douglas, TA
- Phil Tokumar, AeroVironment Project Advisor
- AeroVironment Inc, Project Sponsor





Questions?