Paintball Environment Tactical Engagement Recon System (P.E.T.E.R.S.)

Group Number: BCC-4

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Presentation Outline

- Introduction
- Problem Statement
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- Proposed Solution
- Fall Progress
- Work Schedule / Timeline
- Team Member Responsibility
- Budget
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Introduction

- In the game of paintball, there are a lot of distractions that prevent players from coordinating with teammates as efficiently as possible.
- Distractions Include
  - Determining Team Location
  - Paintball Availability
  - Air Pressure Availability
- This project aims to provide a solution for the most common and most frequent issues that players face on the field.

Introduction - Equipment Overview

Problem Statement

- Our research indicates that there is currently no single product available that addresses all of the most common distractions that a player faces while playing the game of paintball.

- We plan to utilize various sensors, a display, and a communication network to develop a single system which alleviates these distractions.

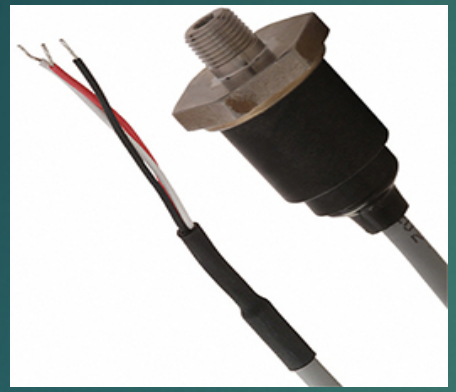
Background Research - Requirements

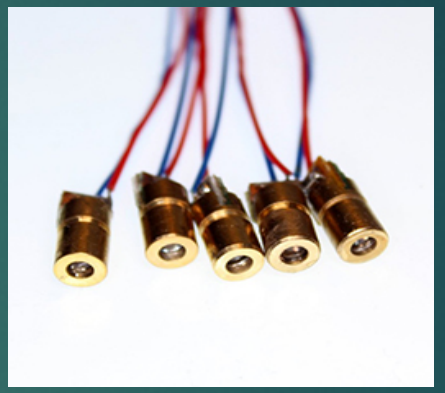
In order to design a system that addresses the previously mentioned problem statement, the following requirements were derived:

- The system shall:
  - Collect real-time data on user provisions (paint and pressure levels)
  - Track user location
  - Process data to be displayed to the user
  - Share user location with teammates
  - Display information on user provisions, user location, and teammate location

Background Research

Requirement - Collecting Data On User Provisions





Air Pressure Levels

- Existing Solution - Analog Gauge
- **Chosen Solution - Retrofit Pressure Sensor**
  - Honeywell MLH06KPSB10A
  - Operating Pressure: 0 – 6000 psi
  - Operating Supply Voltage: 5V

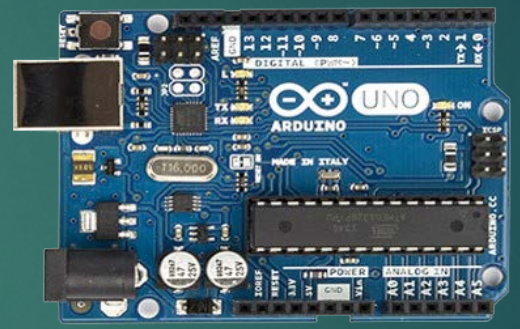
Paintball Levels

- Existing Solution – Visual Inspection, Clear Hopper
- Considered Solution - Counting Paintballs Expelled
  - User Defines Paintball Input
- **Chosen Solution - Break Beam Level Indicator**

Background Research

Requirement - Processing Data to be Displayed to User

Raspberry Pi 2



Arduino Uno

- Python Language - Balance of flexibility, performance, and portability
- Kivy – Community driven python GUI design tools that translate well to Android systems

python™

Background Research

Requirement - Sharing User Location with Teammates

Wi-Fi

Bluetooth

ZigBee

Ranking: (Best) 1 - Worst (4)	Architecture	Range Capability	Link Speed	Integration Complexity	Cost
WiFi	Central	2	1	1	**4**
Bluetooth	P2P	4	3	2	**9**
Zigbee	Mesh	3	4	3	**10**
CDMA/4G	Central	1	2	4	**7**

Background Research

Requirement - Display Information on User Provisions, User Location, and Teammate Location

Requirement - Track User Location

Recon Snow2 HUD

	Price	Viewing Angle	Resolution	Screen Size	Built-in Sensors	Support	Modularity	Connectivity	**Cost**
Google Glass	3	2	1	1	2	3	2	1	**15**
GlassUp	1	3	3	3	3	2	3	2	**20**
Recon Snow2	2	1	2	2	1	1	1	1	**11**

Background Research - Standards

- Standard ECMA-404 (*JSON Data Interchange Format)*
- Standard IEEE 802.11 – Wi-Fi
- Standard IEEE 802.15 - Bluetooth
- EPA regulation 40 CFR 273.13(a) (Waste management requirements for small quantity handlers of universal waste batteries)

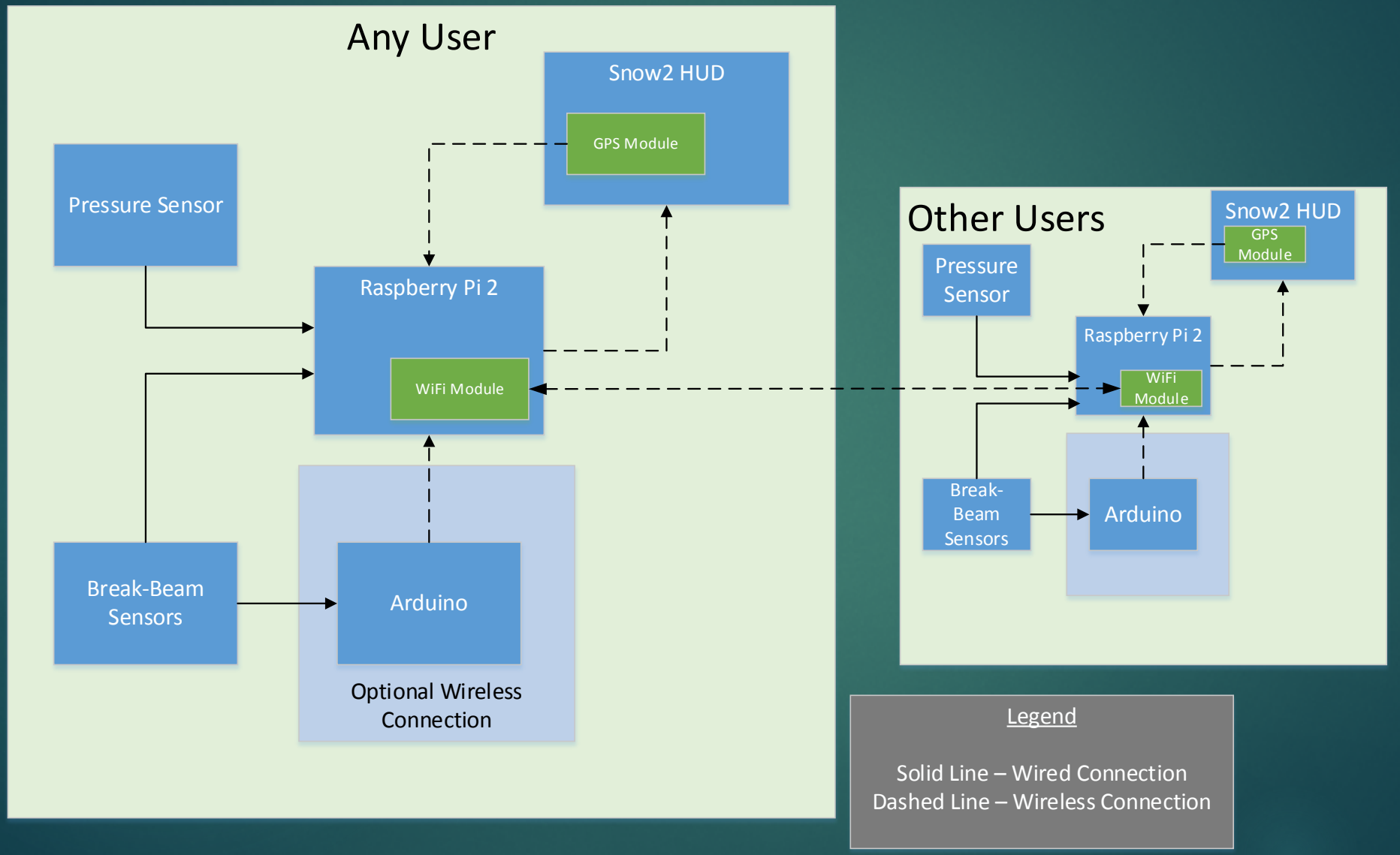
Proposed Solution

A system consisting of the following:

- Honeywell Pressure Sensor mounted to air tank regulator
  - Collects real time data on available pressure in tank
- Hopper with Break Beam System
  - Monitors available paint levels in hopper
- Raspberry Pi 2 with Wi-Fi/Bluetooth Dongles
  - Processes data
  - Share data between users
- Recon Snow2 Heads Up Display (HUD)
  - Displays Information to the user

Proposed Solution – GUI Preview

Proposed Solution – Block Diagram



Proposed Solution – Feasibility

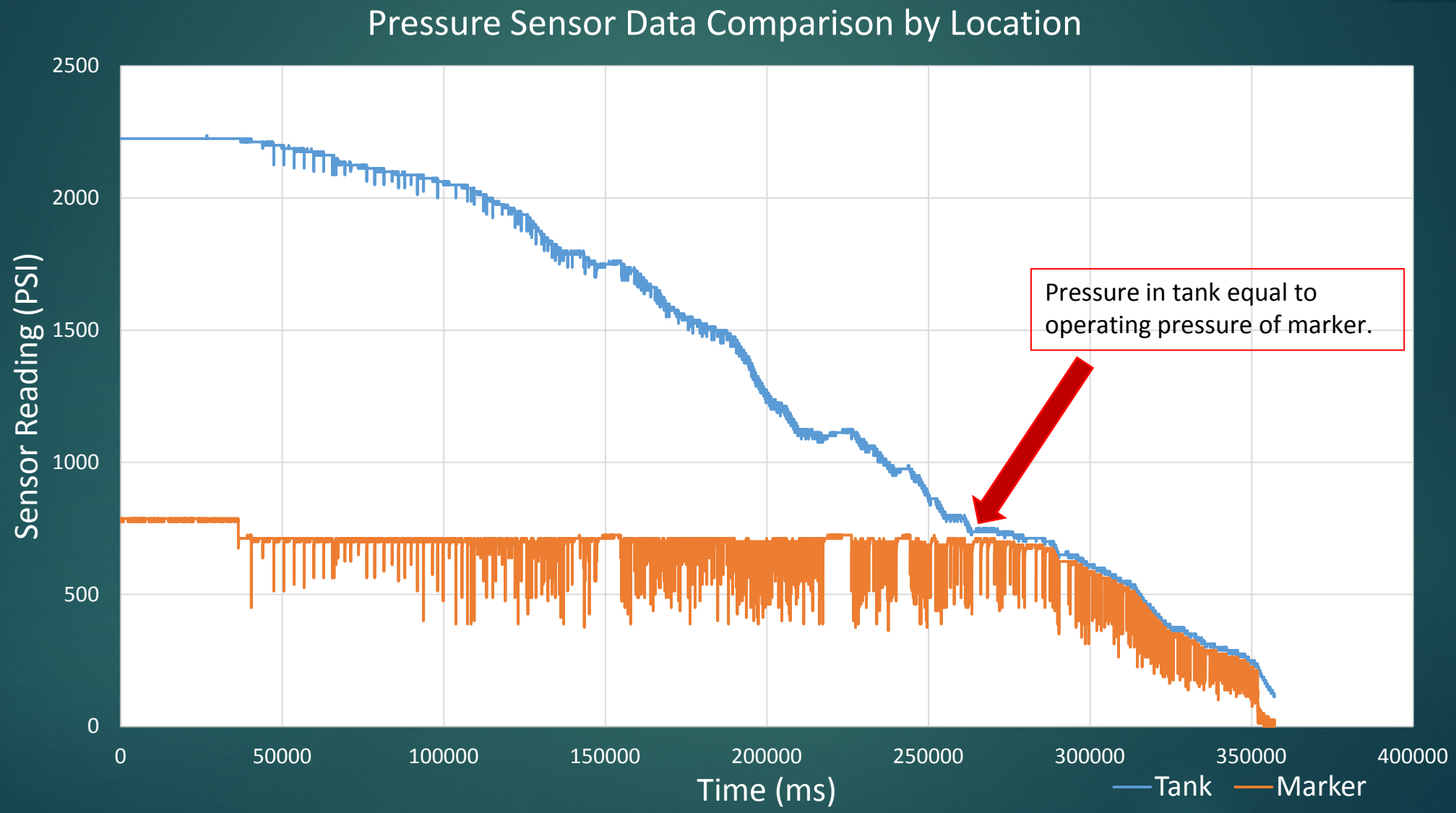
- Use of commercial-off-the-shelf products (C.O.T.S.) helps to satisfy our requirements
  - Pressure Sensor found that fits the requirements
  - Recon Snow2 has built-in GPS module, and many other features
  - Raspberry Pi 2 satisfies the processing requirement
- By compartmentalizing the project into smaller tasks, the overall project becomes more manageable

Fall Progress – Hardware

- All equipment purchased and acquired
- Honeywell Pressure sensor mounted and tested in 2 locations
- Gathered important data using Arduino
- Preliminary Break Beam Feasibility Test Completed

A – Pressure Sensor Mounted on Marker
B – Pressure Sensor Mounted on Tank

Fall Progress – Pressure Sensor Data

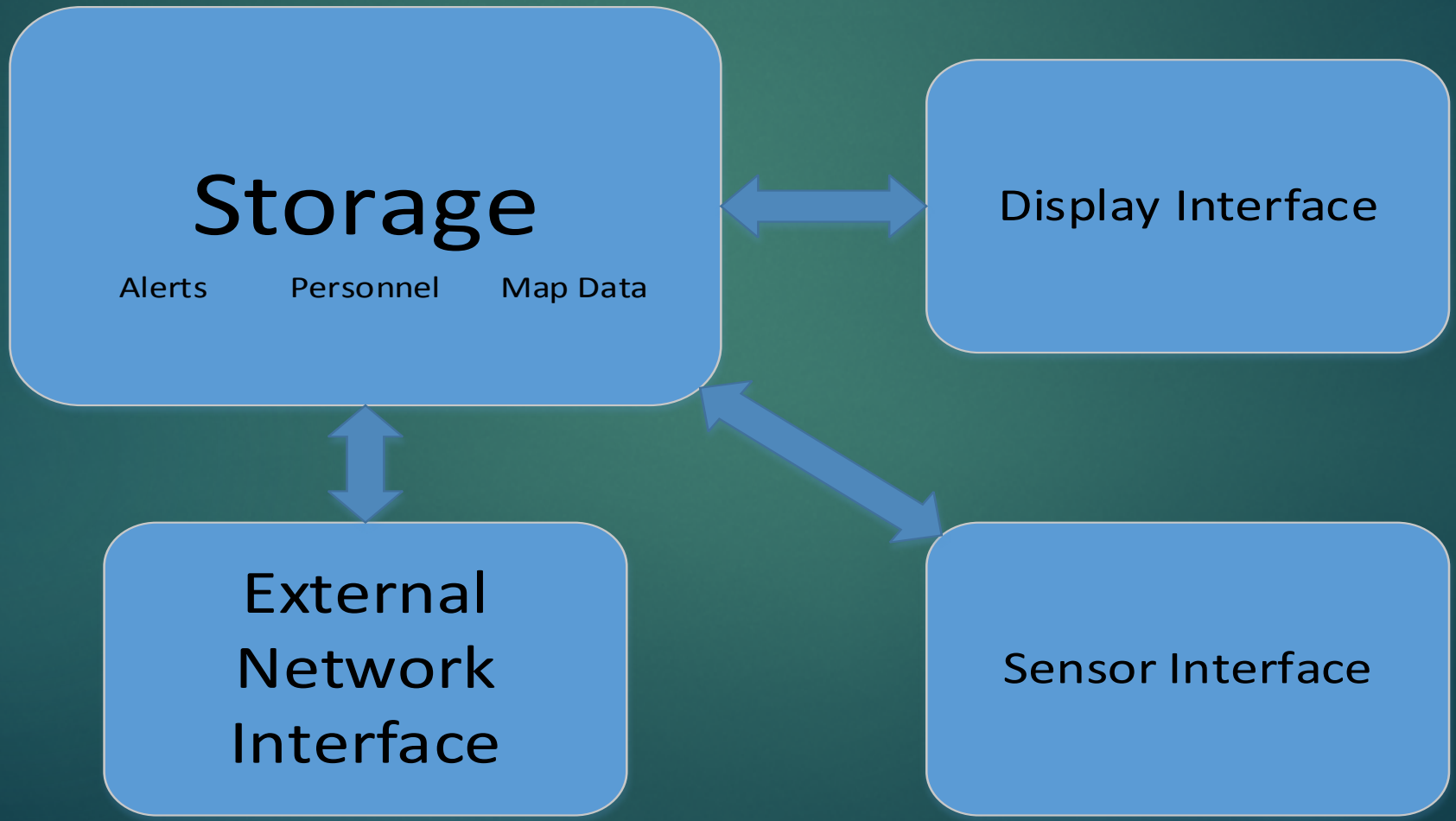


Fall Progress - Software

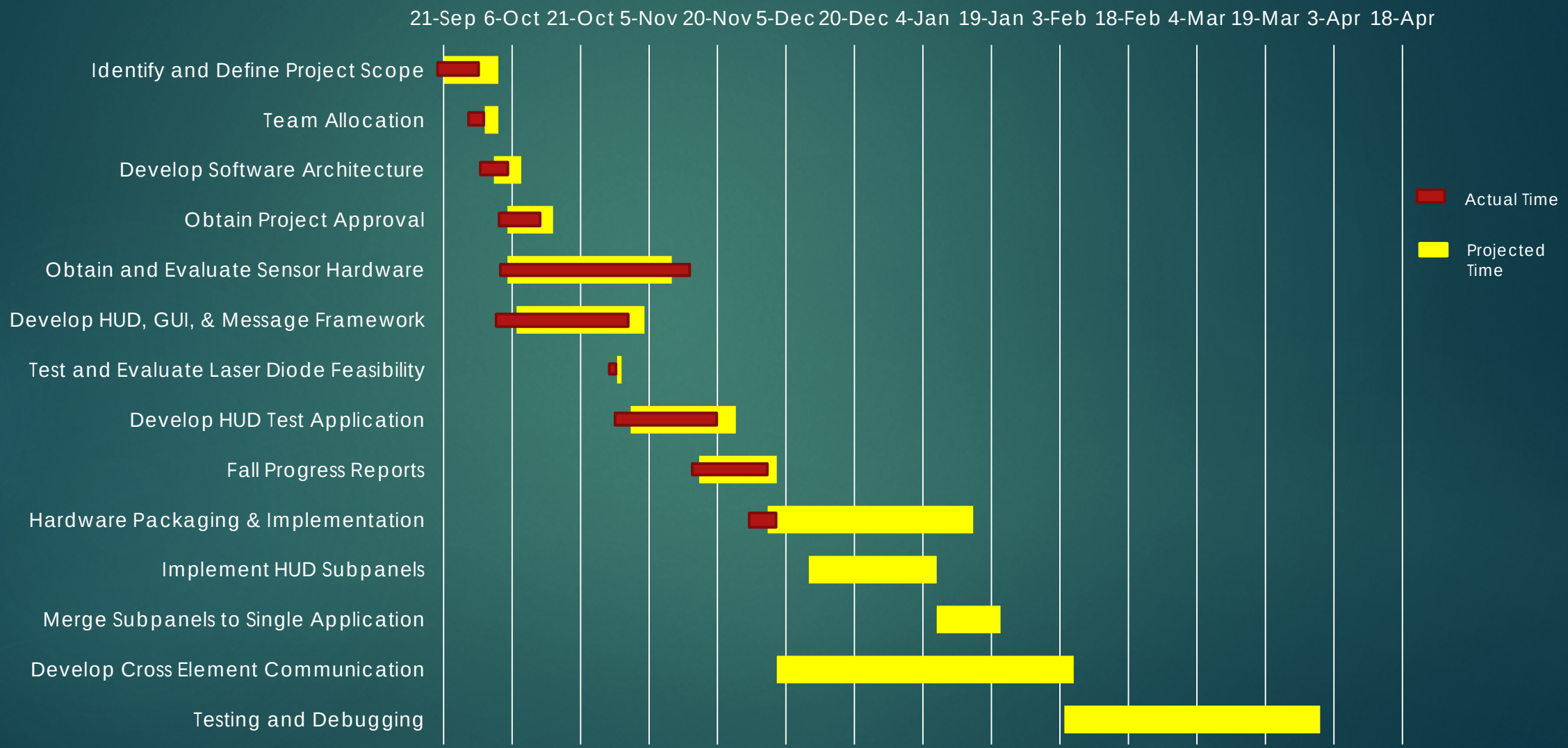
- Base classes for GUI display framework
  - Moving Map Overlay
    - Utility classes (i.e. Latitude/Longitude to Pixel Position)
    - Supplemental classes (i.e. overlay constructors, icons, alert formatting, etc.)
  - Air Tank Readout and Paint Level Overlay
- Python Application Packaging for Android
- Data Collecting Utility
  - Gathered important data from Pressure Sensor
  - Paint detection algorithm

Fall Progress – Software Architecture

- Basic network framework
  - Communication of JSON formatted messages
  - Uniform solution to communicate between PI, display, sensors and users



Work Schedule / Timeline



Team Member Responsibility

Team Member	Completed	In Progress	Future
Richard Taylor	• Graphical Display Framework • Assisted with Wireless Data Transfer Framework	• Application Packaging for HUD • Implementing Moving Map Subpanel	• Further GUI Subpanel Implementation
Brett Reich	• Threaded Network Sockets • JSON Message Passing • Shared Message Server	• Application Packaging for HUD • Map Data URL Generation • Map Data Downloading	• Map Data Storage • Sensor Data Storage • Automatic Unit Detection
Kenneth Hale	• Sensor Research • Sensor Test and Evaluation • Data Collection Methods	• Software Development Ramp-up • Assist in Break Beam System Development	• Assist in GUI Development • Product Packaging • Break Beam Software Development
Anthony (AJ) Schmidt	• Sensor Research • Sensor Test and Evaluation • Data Collection Methods	• Break Beam Hardware Development • Hopper Design	• Hopper Construction • Product Packaging • Mask Modification
Antonio Foster	• Sensor Research • Sensor Test and Evaluation • Data Collection Methods	• Break Beam Hardware Development • Hopper Design	• Break Beam Software Development • Product Packaging • Mask Modification

Budget - Industrial

Planned Expenses	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	YEAR
Employee Costs													
Wages	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$300,000.00
Benefits	$6,750.00	$6,750.00	$6,750.00	$6,750.00	$6,750.00	$6,750.00	$6,750.00	$6,750.00	$6,750.00	$6,750.00	$6,750.00	$6,750.00	$81,000.00
Subtotal	**$31,750.00**	**$31,750.00**	**$31,750.00**	**$31,750.00**	**$31,750.00**	**$31,750.00**	**$31,750.00**	**$31,750.00**	**$31,750.00**	**$31,750.00**	**$31,750.00**	**$31,750.00**	**$381,000.00**
Office Costs													
Office lease	$1,720.00	$1,720.00	$1,720.00	$1,720.00	$1,720.00	$1,720.00	$1,720.00	$1,720.00	$1,720.00	$1,720.00	$1,720.00	$1,720.00	$20,640.00
Gas	$200.00	$200.00	$200.00	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00	$200.00	$200.00	$1,350.00
Electric	$80.00	$80.00	$80.00	$150.00	$150.00	$150.00	$150.00	$150.00	$150.00	$150.00	$80.00	$80.00	$1,450.00
Water	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$300.00
Telephone	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$300.00
Internet access	$75.00	$75.00	$75.00	$75.00	$75.00	$75.00	$75.00	$75.00	$75.00	$75.00	$75.00	$75.00	$900.00
Office supplies	$40.00	$40.00	$40.00	$40.00	$40.00	$40.00	$40.00	$40.00	$40.00	$40.00	$40.00	$40.00	$480.00
Subtotal	**$2,165.00**	**$2,165.00**	**$2,165.00**	**$2,085.00**	**$2,085.00**	**$2,085.00**	**$2,085.00**	**$2,085.00**	**$2,085.00**	**$2,085.00**	**$2,165.00**	**$2,165.00**	**$25,420.00**
Unit Component Cost													
(2) Micro-Bluetooth 4.0 LE	$17.98												$17.98
(2) Micro-SD 16GB (Sony 70Mbps)	$17.98												$17.98
(2) CanaKit Raspberry Pi-2 + Case	$93.98												$93.98
(2) Reacon Snow2 (HUD)	$798.00												$798.00
Reacon Snow2 (HUD + Goggles)	$549.00												$549.00
(2) MLH05KPSL06A Pressure Sensor	$292.28												$292.28
(2) Edimax EW-781Un Wi-Fi Adapter	$19.98												$19.98
(2) AA Battery Pack	$38.98												$38.98
Laser Diodes 5-pack	$11.89												$11.89
Photo-Resistors 20-pack	$4.69												$4.69
Misc Materials	$83.11												$83.11
Subtotal	**$1,927.87**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$1,927.87**
TOTALS													
Monthly Planned Expenses	**$35,842.87**	**$33,915.00**	**$33,915.00**	**$33,835.00**	**$33,835.00**	**$33,835.00**	**$33,835.00**	**$33,835.00**	**$33,835.00**	**$33,835.00**	**$33,915.00**	**$33,915.00**	**$408,347.87**
TOTAL Planned Expenses	**$35,842.87**	**$69,757.87**	**$103,672.87**	**$137,507.87**	**$171,342.87**	**$205,177.87**	**$239,012.87**	**$272,847.87**	**$306,682.87**	**$340,517.87**	**$374,432.87**	**$408,347.87**	

Total - $408,347.87

Budget – Out of Pocket

Model Name	Unit Cost	Units	Sub-total
AA Battery Pack	$19.49	2	$38.98
Micro-Bluetooth 4.0 LE	$8.99	2	$17.98
Micro-SD 16GB (Sony 70Mb/s)	$8.99	2	$17.98
CanaKit Raspberry Pi 2 + case	$46.99	2	$93.98
SNOW2 (HUD only)	$399.00	2	$798.00
MLH05KPSL06A – Pressure Sensor	$146.14	2	$292.28
Photo-Resistor (20pcs)	$4.69	1	$4.69
SNOW2 (HUD + Goggles)	$549.00	1	$549.00
Laser Diode (5 pcs)	$3.54	1	$3.54
Edimax EW-7811Un Wi-Fi Adapter	$9.99	2	$19.98
Female / Male / Male 1/8th	36.47	1	$36.47
Shipping (for goggles)	$54.99	1	$54.99
		Total	**$1,927.87**
		Per Person	**$385.57**

Potential Societal Impacts

- Targets existing players and large gaming community
- Potential to get thousands of people out of the house and be more active
- Possible Integration into Civil Service/Military Applications

Summary

- Important technological change to a popular game
  - Eliminate common game distractions
  - Enable players to utilize pertinent data
- A lot of work to be done, but a lot had been accomplished
  - External sensors tested and mounted
  - Initial Laser Diode testing for low paint count
  - Networking Software framework developed
  - Display Software framework developed

References

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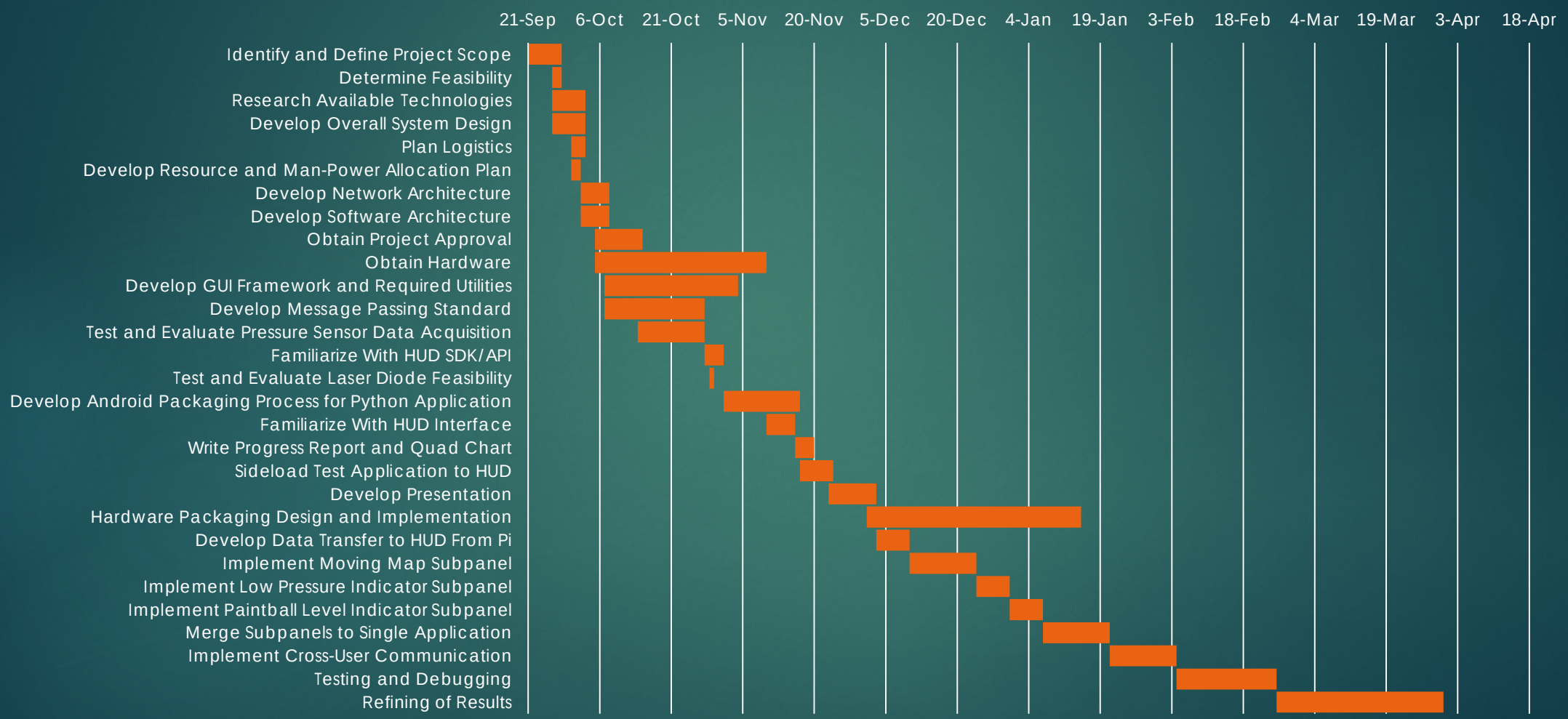
Questions

Challenges Found

- Hardware
  - Acquiring pressure sensor data that satisfied the real-time requirement
  - Acquiring a viable solution to paint level indication
- Software
  - Different map projection types creates multiple problem sets in terms of determining player position on the map
  - Kivy's *Buildozer* APK-build tool setup
- General
  - Project Logistics

Work Schedule / Timeline



Break-Beam Circuit