
verifynd
Outdoor Asset Tracking Solutions
Team 5

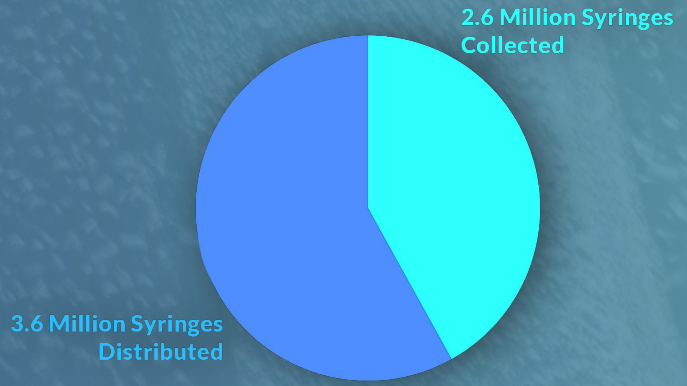
Many cities are in North America are experiencing an epidemic of intravenous drug use and overdose deaths [1].

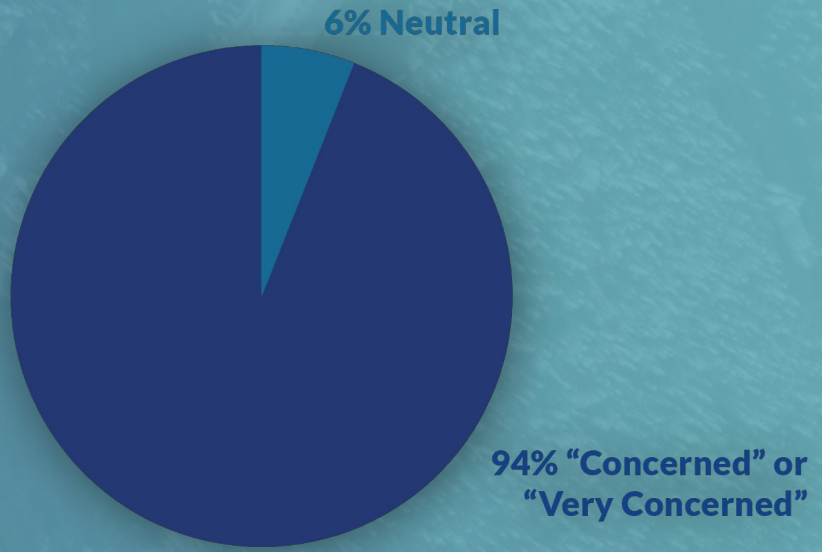
Photographed in Yaletown, June 2020

Clean syringe dispensaries offer a life saving service, unfortunately, many used needles are discarded in public spaces. [2]

Photographed in East Vancouver, July 2020

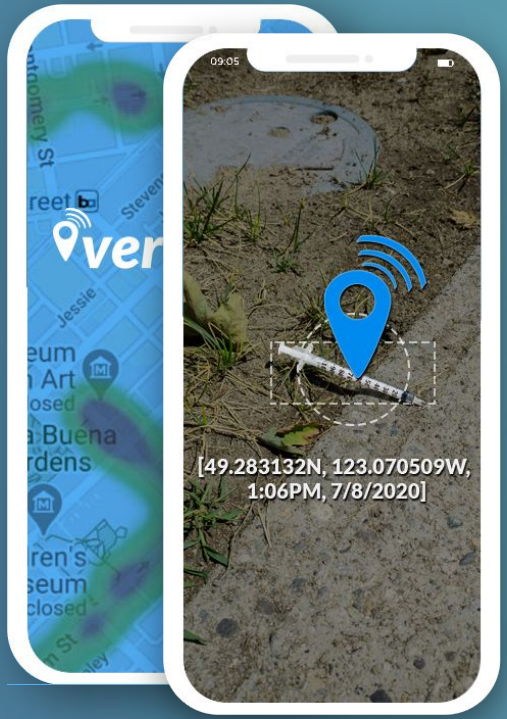
Frustrated Citizens





City of Vancouver Study [2]

The Urban Needle Locator



Our RFID-based system for geolocating used syringes is designed for increasing the efficiency & accuracy of cleanup.

A Tale of Two Systems

Madhu Udayakumar

Chief Operations Officer

Hardware Embedded Systems

- The main components of the Urban Needle Locator:
  - Passive tags embedded in syringes (sourced)
  - Active Mobile Antenna
  - Cloud-based maps for displaying Syringe locations

Passive RFID tags

Bella Xu

Electronic Power Systems

Chief Technology Officer

- Manufacture-produced passive tags embedded in syringes are pinged by active antenna
- Unique identification and Received Signal Strength Indicator(RSSI) value are acquired

Passive RFID embedded in syringe [3]

Transport System

Chief Communications Officer

Liam Goundrey

Mechanical Design

- System reads randomly oriented tags in a radius of 8m
- Antenna rotates at a constant rate controlled by PID feedback

Cloud Sync

Alex Makasoff

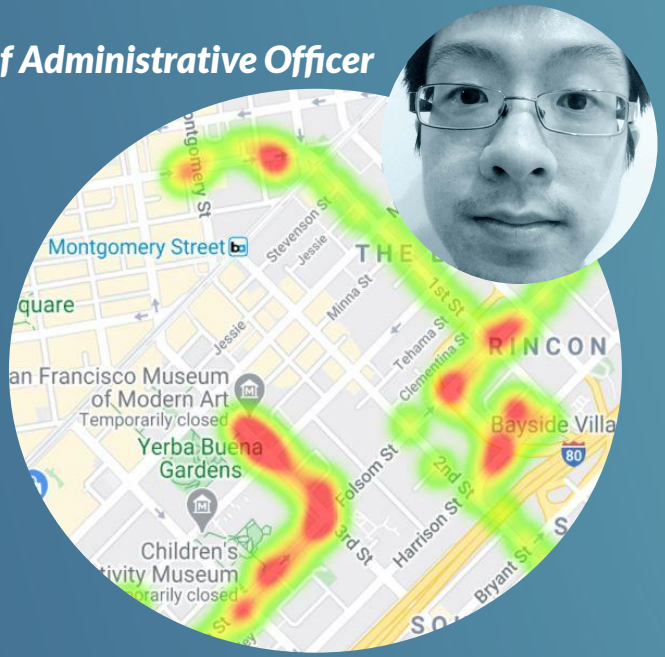
Software Embedded Systems

Chief Financial Officer

- RFID Antenna, Motor system, and GPS sensor need to work together to determine the location of the RFID tag
- UNL Mark I needs to respond to events in real-time and be able to operate in a uncontrolled environment

Google Maps Platform

Chief Administrative Officer



Eric Kwok

Software

- Mobile antenna system collects syringe location data which is uploaded to the Google Maps API
- Locations can be displayed individually, or it can be displayed as a heatmap for a broader overview
- Private, secure, customizable

Algorithm

Matthew Schilling

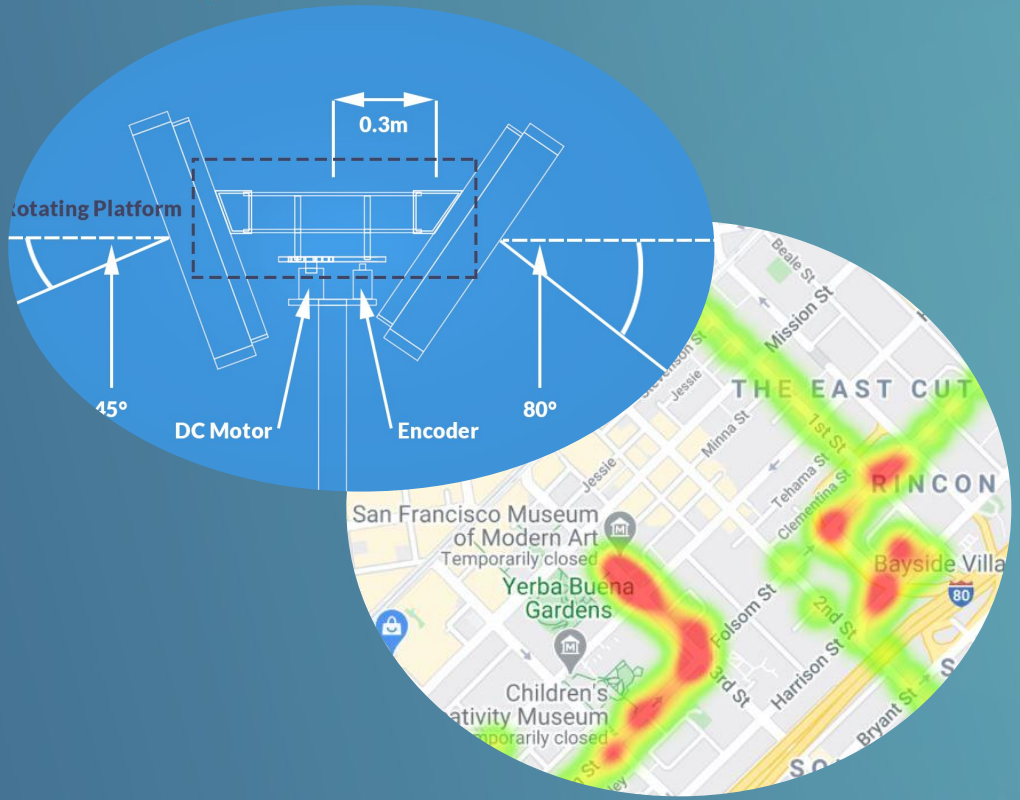
Design Integration & Algorithms

Chief Executive Officer

- RFID does not directly measure location
- We are exploiting aspects of RFID signals to predict where a tag is located within a few feet of estimation

PRODUCT VIDEO

Technical Case



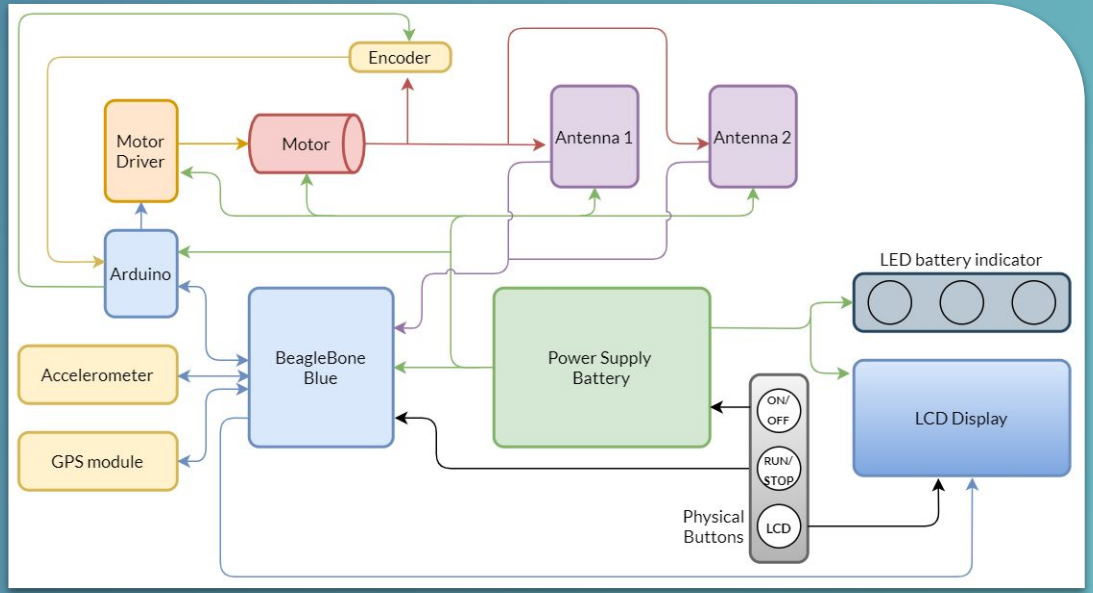
Main Functions

- Drive system will provide constant speed to rotate RFID antennas
- RFID system will detect tags with unique ID
- Characteristic received signal strength (RSSI) and unique phase will be used to identify location
- GPS coordinates will be uploaded to Google Maps Platform

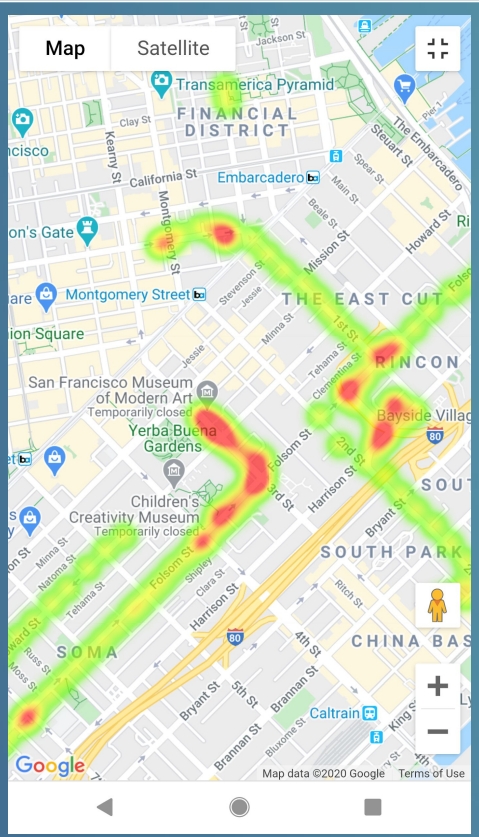
Technical Case

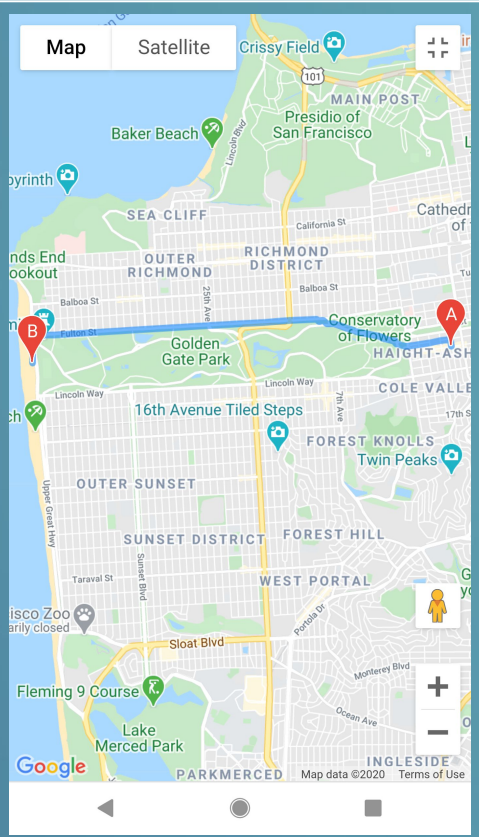
Project Modules

- **Drive System**
  - DC Motor
  - Motor Driver
  - Rotary Encoder
  - Gearing
  - Slip Ring
- **RFID antenna & reader**
- **Accelerometer module**
- **GPS module**



Technical Case





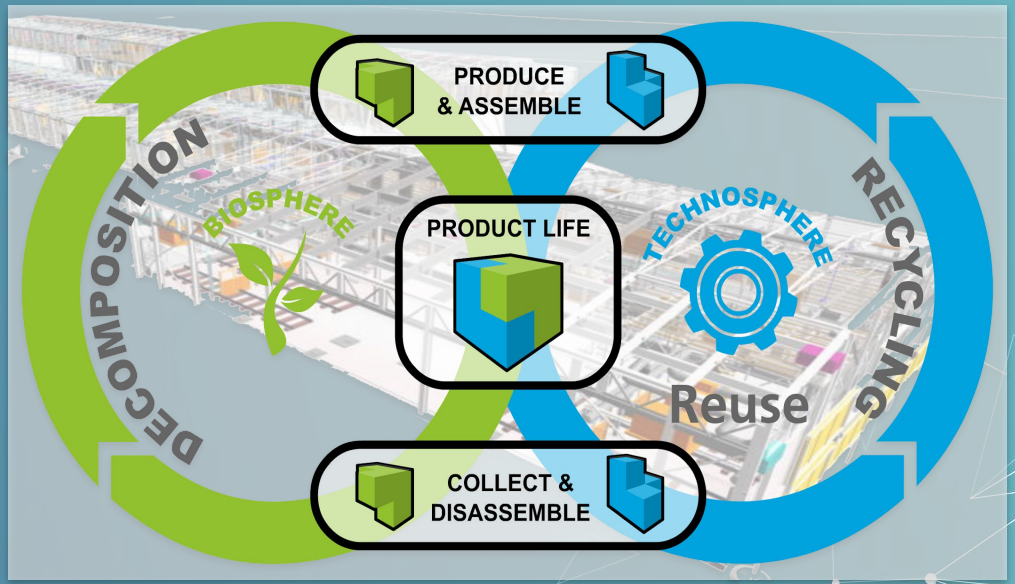
Software Development

- Triangulation can be done through GPS coordinates
- RFID system will detect tags with unique ID
- Characteristic received signal strength (RSSI) and unique phase will be used to identify location
- GPS coordinates will be displayed through Google Maps

Technical Case

Cradle to Cradle

- ABS plastic as component materials
- Electronic components recycled by Electronic Recycling Association

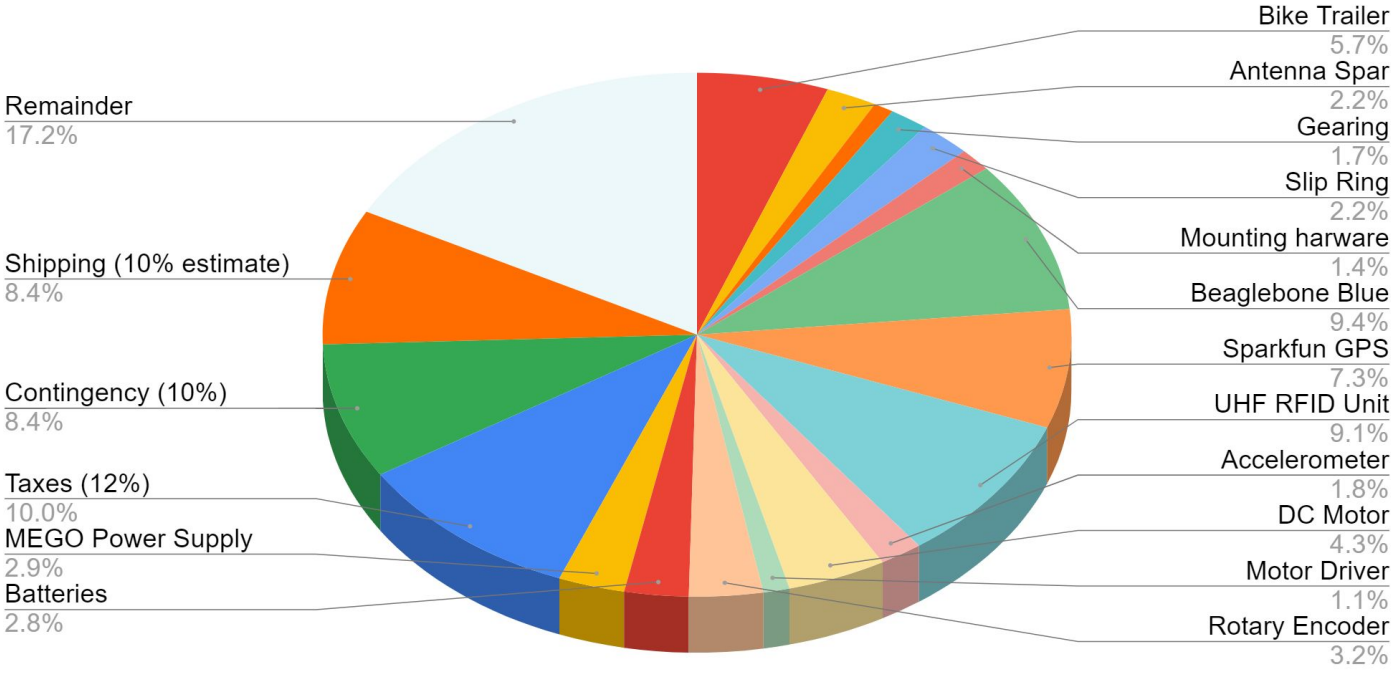


Cradle-to-Cradle Design [4]

Budgeting

- Initial budgeted values were based off of accessible prices of components outlined in the design specification
- Verifynd maintains an inventory containing all purchased parts, receipts and current holders
- The uncertain nature of the project has led to several budgetary changes.

Budget Breakdown



Market Analysis

Case Study: Harm Reduction Fund [5]

$ 7 M

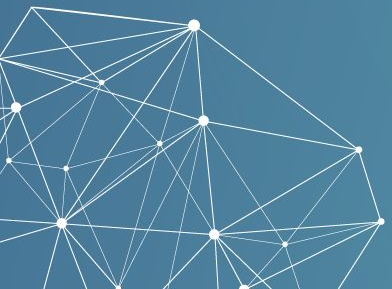
- $7M CAD funded annually to support projects across Canada reducing HIV and hepatitis C among drug users

20%

- Of federal funding goes toward BC organizations to support injection drug users

24 hrs

- Current goal by VCH is to recover all needles within 24 hours via a hotline



Vancouver: Break-Even Cost Analysis

CURRENT

LABOUR + SYRINGES
$775K + 936K

=

URBAN NEEDLE LOCATOR MARK I

1.05*(936k) +
INCREASED SYRINGE COST (5%)

10k +
DEVICE COST

775k*(1-eff)
REDUCED LABOUR COST

*If our system achieves an efficiency greater than **7.33%** it will save the city money.*

Ideal Customer

A tool within established workflows

Spikes on Bikes [6]

- Vancouver's Spikes on Bikes program gives needed supplies, including syringes, to community members.
- The UNL could be easily added as a bike trailer for passive operation during their usual 8am-8pm 7 day per week rides.

Adherence to Standards

- RFID Technology
- Electrical designs
- Software designs
- Safety considerations

Adhering to Engineering standards ensures UNLmkI can be used by consumers in the Canadian market.

Standards

RFID Technology

- Radio Frequency bandwidth:ISO/IEC 18000-6:2010 [7]
- UHF RFID identification and capture techniques: CAN/CSA-ISO/IEC 29143:2011 [8]
- Design parameters of item tagging information: ISO 17367:2013 [9]
- Data and data management of RFID passive tags: ISO/IEC 15961-3:2019 [10]

Electrical

- Computing and electrical design: ICES-003 [11]
- Rechargeable Batteries: 1625-2004 - IEEE [12]

Software

- Software used in the device or end user: ISO/IEC TR 25060:2010 [13]
- Design of the cloud computing service: ISO/IEC TR 23188:2020 [14]
- Google Cloud Maps: ISO/IEC TS 23167:2020 [15]

Safety

- Electronic components: IEC TR 62824:2016 [16]
- Electronics enclosure: CAN/CSA-C22.2 No. 94.2-07 (R2012) [17]
- Safety Requirements for Medical device: ISO/TR 24971:2020 [18]

Risks

User Safety

Users could be harmed by discarded needles during extraction

Product Adoption

If not enough RFID tagged syringes are adopted by users, system effectiveness will be diminished

Product Development

Inability to demonstrate effectiveness at early stages could hamper ability to garner support further

Financial

Manufacturing costs could increase the unit cost of the RFID tagged syringes

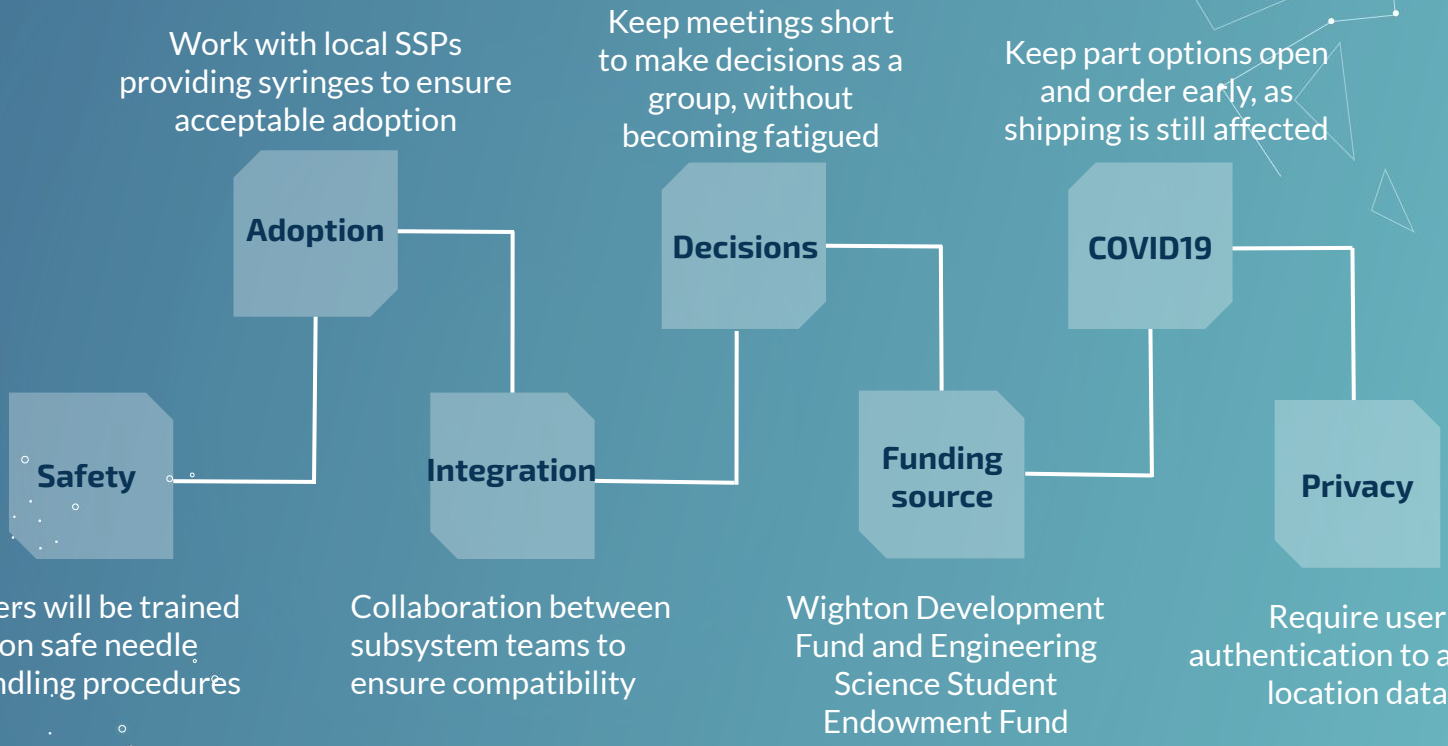
City Support

If cities don't believe in the device it will be very difficult to test effectively

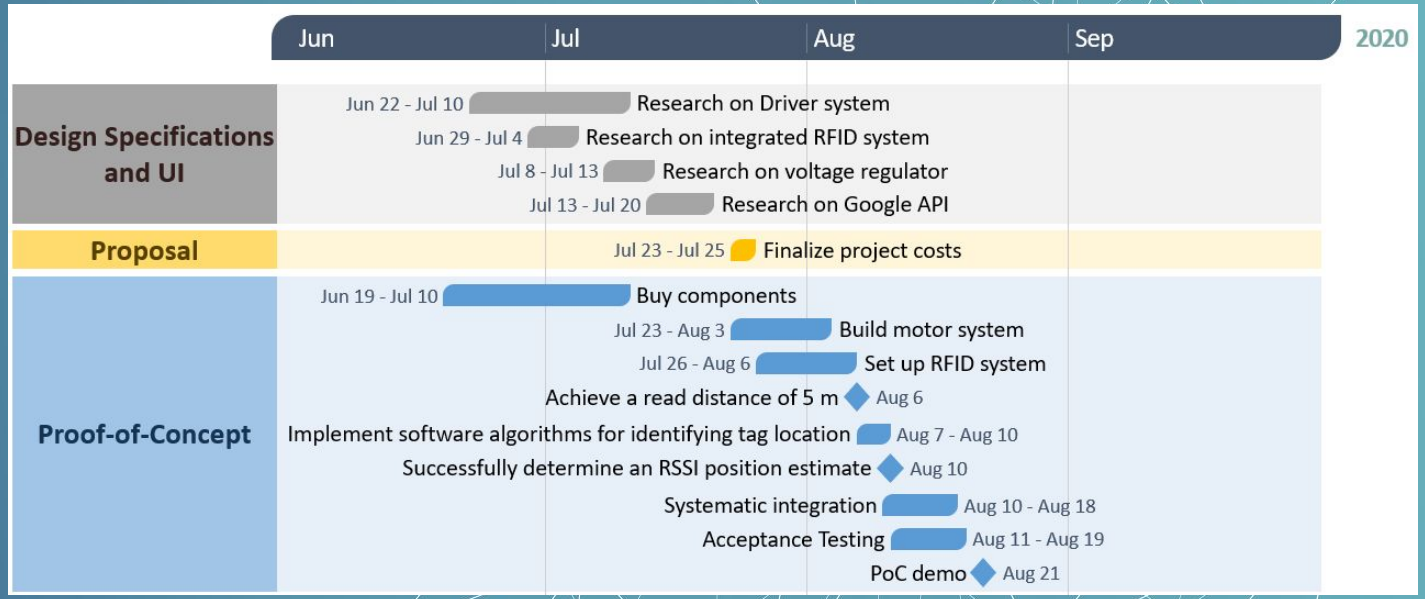
Data Security

Data collected shows a close proxy for the location of thousands of at-risk individuals

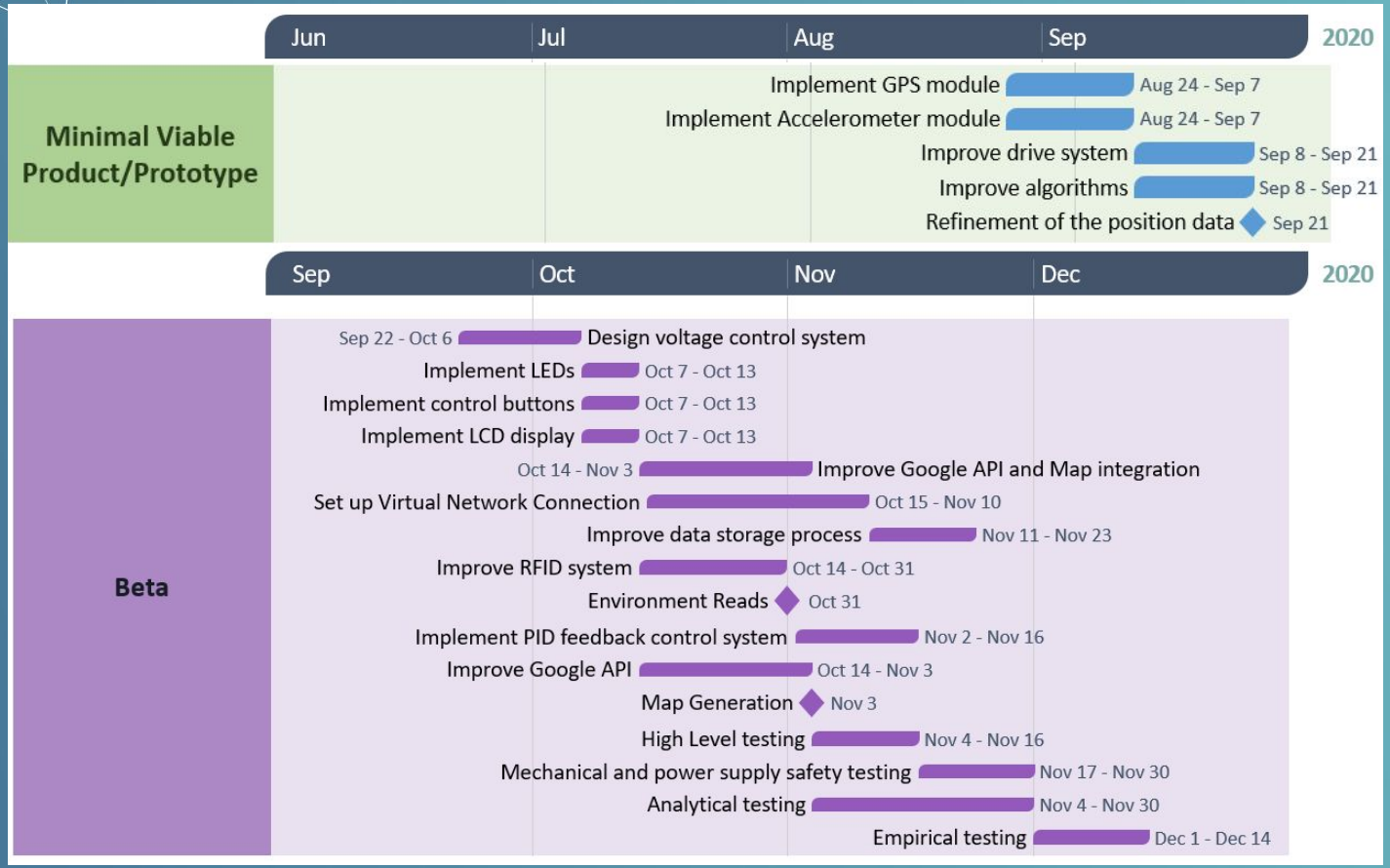
Risk Management



Schedule 405W



Schedule for 440



Plan for 440

Hardware

- Implement another RFID reader.
- Design efficient and reliable power sourcing circuits.
- Implement reliable button control system.

Software

- Improve Algorithm for precisely identifying the location of each tag.
- Improve Google Maps API

Integration

- Implement easy to use interface for tag locations on maps.
- Fine tune PID control and external user control features.

Self-Reflection:

Lessons Learned

- Time management in coordination with group
- Use online writing aids to improve written English
- Public speaking
- Importance of precise Technical Knowledge

Self-Reflection:
Improvement for ENSC 440

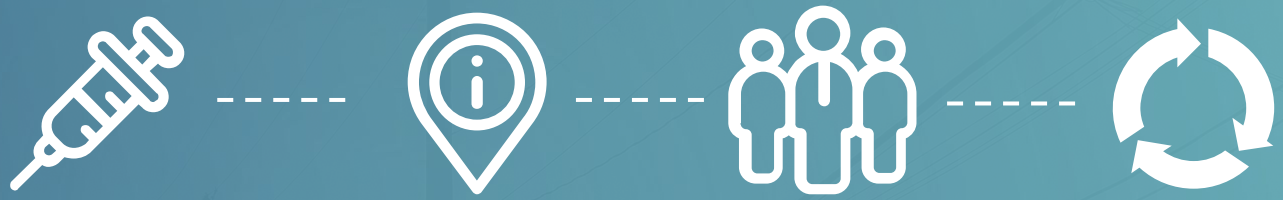
- Communication and coordination is a major difficulty without common scheduling at the SFU campus; weekly group meetings have been beneficial but we need to find a better way to production manage the project

- Time management and goal actualization have been difficult to manage in a work from home environment

Self-Reflection:
Improvement for ENSC 440

- Open ended problem solving, and operationalization of tasks has been a challenge, and requires more experience
- Purchasing equipment and supplies has been more expensive than anticipated as multiple pieces are often required to ensure work is productive and physically distant
- Planning for hardware modules malfunctioning and buying equipment and supplies at the same time to save on delivery time

Conclusion



ENSC 405W has been challenging and rewarding, learning valuable lessons about group work and overcoming setbacks in real world applications.

We look forward to applying all we have learned here to a successful implementation of the Urban Needle Locator prototype in 440.

Acknowledgements

- Professor Craig Scratchley
- Professor Andrew Rawicz
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- John Schilling

SFU SIMON FRASER UNIVERSITY
ENGAGING THE WORLD

Faculty of Applied Sciences

LIVE DEMO

Questions

Additional information:

verifynd.ca

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