

# Team D3: Theia

---

Evan Compton, Will Mitchell, Alli Scibisz



## Application Area

- » Many pedestrians use headphones, limiting their awareness of their surroundings
- » Our goal: give these pedestrians information about what they do not see, making them more aware and reducing the risk of unexpected encounters / collisions
- » This is a piece of wearable technology that detects objects approaching from behind and alerts the user



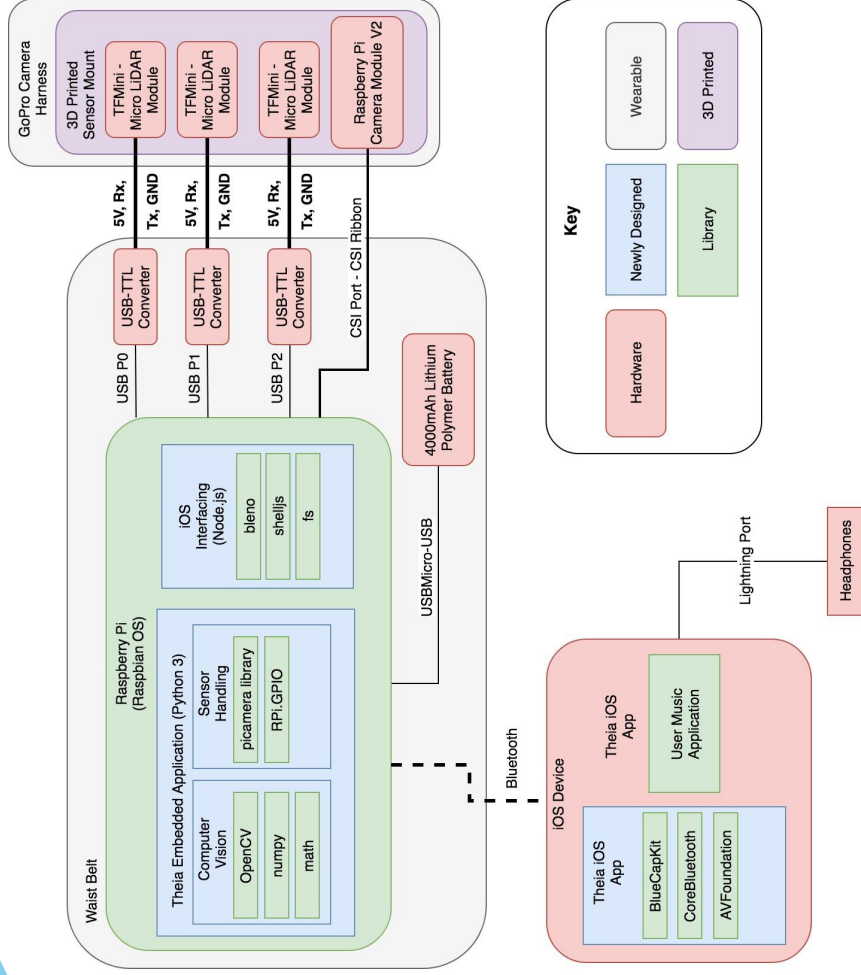


# Changes Since Design Review

- » Object Detection: 3 LiDAR Sensors
- » Section Picking for images based on what is most similar to training data
- » Bluetooth Communication Protocol: Bleno



# New Block Diagram



# Solution Approach: Theia Wearable



**3 LiDAR sensors**

**Battery**

**Raspberry Pi Cam V2**

**USB-TLL Converter**

**Raspberry Pi**



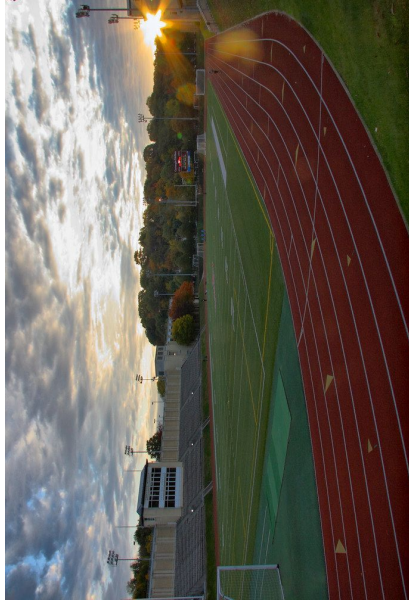
# Solution Approach

- » Incoming Object Detection Algorithm
  - ◇ Threshold Algorithm
  - ◇ Advanced Relative Velocity Algorithm:
    - ◇ Parameters (Outlier removal, soft thresholds, sampling size)
- » Object Recognition Algorithm
  - ◇ SIFT Key Points
  - ◇ k-Nearest Neighbors



# Plan for Public Demo

- » Live demos every 15 minutes outside in Gesling Stadium (weather permitting)
- » Video demonstrating functionality
- » Poster board detailing design approach and results





## Metrics & Validation

### Requirements:

- Detect approaching objects with 90% accuracy
- Differentiate pedestrian/car/bike with 50% accuracy
- Battery life of at least 45 min
- Results reported on iOS application within 5 seconds

Tested around campus in cloudy and partially sunny conditions

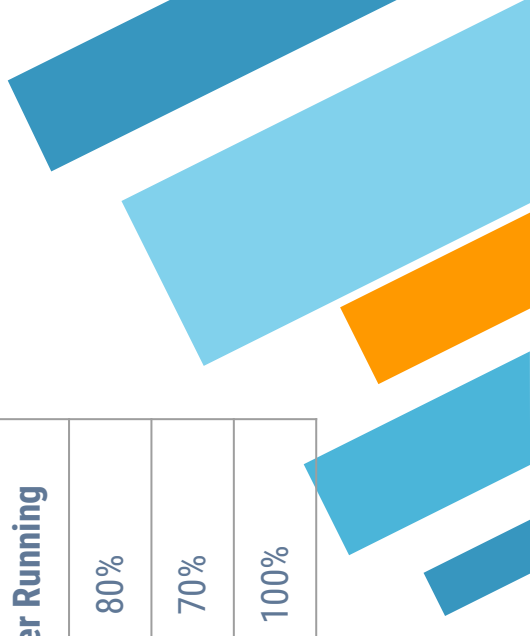




# Metrics & Validation


Accuracy detecting objects approaching from straight behind  
(10 trials in each situation)

|            | User Not Moving | User Walking | User Running |
|------------|-----------------|--------------|--------------|
| Pedestrian | 100%            | 100%         | 80%          |
| Bike       | 100%            | 80%          | 70%          |
| Car        | 100%            | 100%         | 100%         |

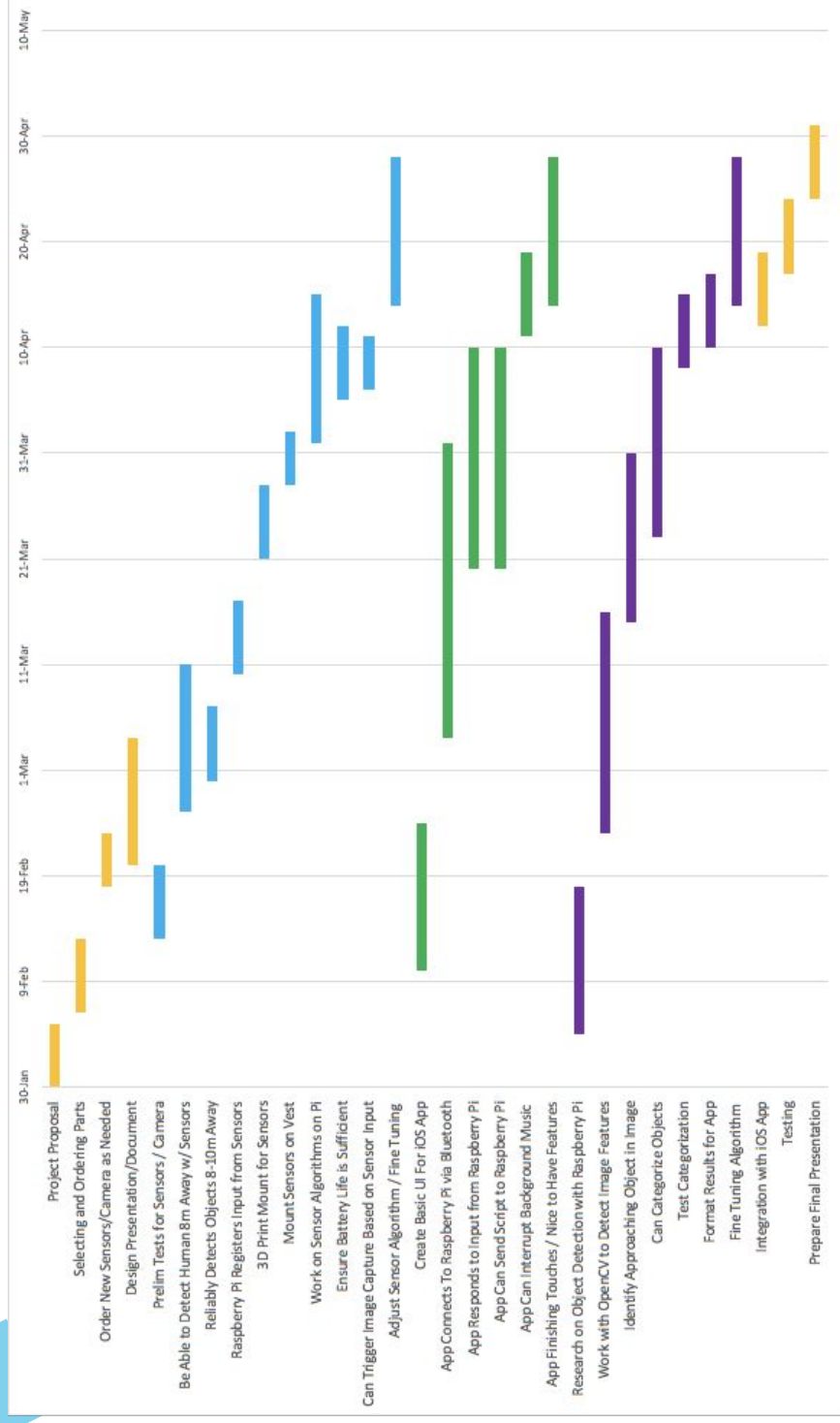




## Metrics & Validation

- » Latency of notification: <2s (integrated)
    - ◇ Object detection : avg: .3s
    - ◇ Object recognition: avg: 1.5s
    - ◇ Bluetooth Communication: <.1s
  - » Object recognition:
    - ◇ 66.67% Accuracy (21 varying tests)
  - » Battery:
    - ◇ >7 hours with 4000mAh battery (running theia)
- 

# Schedule





## Lessons Learned

- » Allow more time for integration than you think you'll need
- » Things break, get spare parts!
- » Be cautious of pushing limits of sensors / hardware
- » Cheap sensors are cheap for a reason
- » Design process from beginning to (near) end

