Rid3

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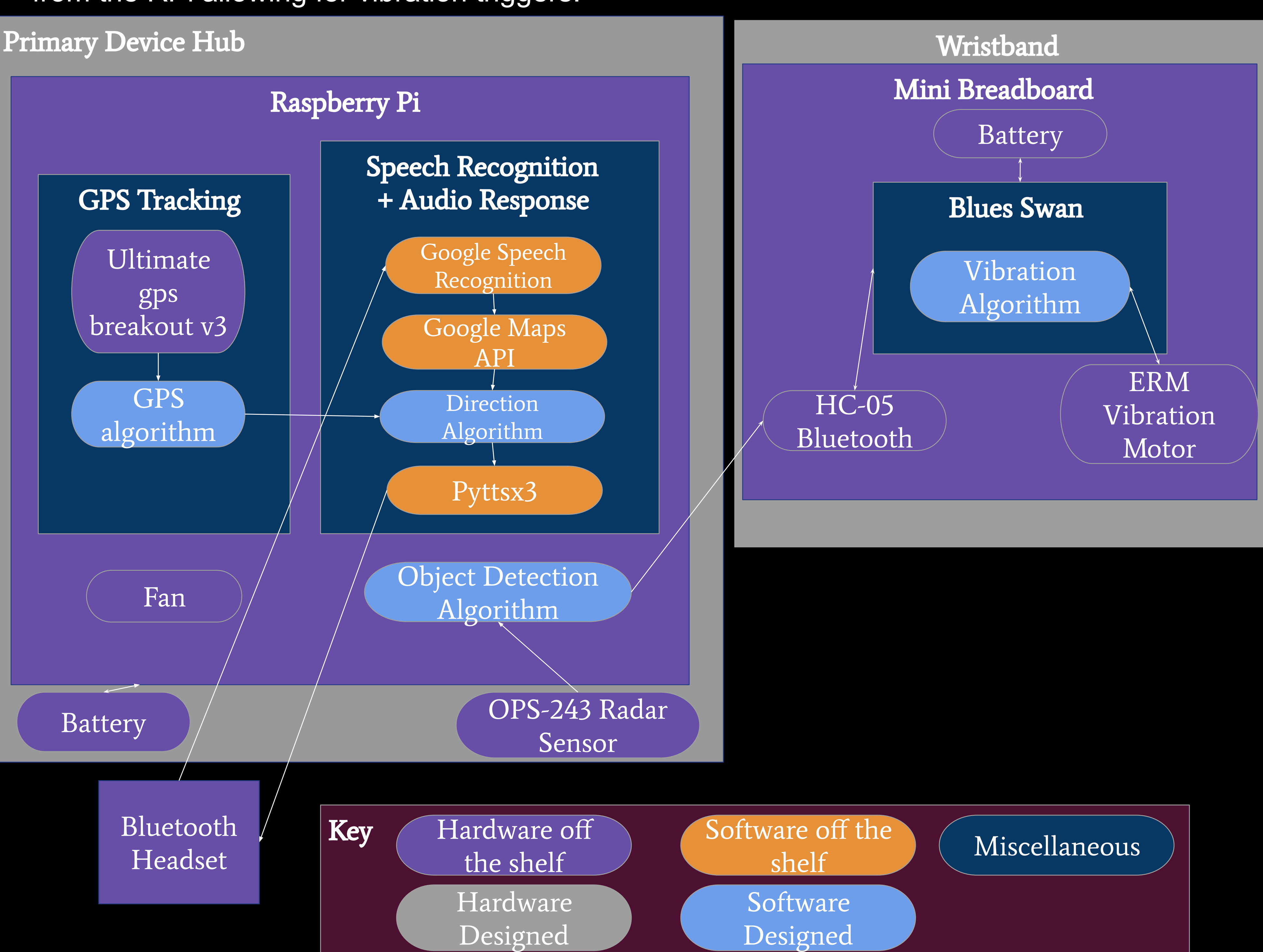
Product Pitch

Rid3 makes navigating while riding a bicycle easier for people. Most riders often have to ride with one hand while looking at their phone or smart watch in order to navigate their surroundings when they are riding. These methods can be dangerous and many smart watches are quite costly. Currently, audio guided GPS systems exist that can help with navigation but there is lack of support for increased awareness while riding to avoid obstacles that may appear in a riders' blindspot. We believe a device like Rid3 which provides haptic feedback through vibrations coupled with audio feedback will be beneficial for providing a safer riding experience for bicycle owners. **Rid3 guides users where to go based on audio and haptic feedback and detects when obstacles are in the user's blind spots.** Vibrations tell users when objects are in their blind spots. So come along and join us for the Rid3!

System Architecture

The system in broken up into two main pieces. The primary device hub holds our RPi 4, which acts as a centralized system for most of our hardware and software. The radar sensor, fan, GPS module, and battery are all attached to the RPi. We host our speech recognition, audio response, gps tracking, object detection, and navigation algorithm on our RPi. Our wristband holds the Blues Swan device which acts as a centralized system for our wristband battery, HC-05 bluetooth module, and vibration motor. Through the Vibration algorithm hosted on the swan, we use the HC--05 to receive bluetooth signals from the RPi allowing for vibration triggers.



Use - Case Requirements

Metric	Target	Actual
Wristband Battery Life Main Device Battery Life	≥ 5 hours ≥ 10 hours	≥ 50 hours ≤ 8 hours
Detection to Haptic Feedback Latency	≤ 1 seconds	.979 secondes
Blind Spot Detection Rate/Range	≥ 95%/ ≤ 10 ft	≥ 66%/ ≤ 34.9 ft
Distance to Receive Instructions	200-300 ft	200-350 ft
Destination Speech Recognition Accuracy	≥90%	≥ 73%

Conclusions & Additional Information

What Worked:

Our device offers voice-activated audio navigation for an entire journey and uses vibration alerts to notify riders of objects entering a 20-degree blind spot detection zone.

What Didn't Work:

Field of view not as large as we wanted it to be. Accuracy of blind spot detection, speech recognition, and audio feedback not as high as we wanted.

Our Blog QR

Lessons Learned:

- Slack time is important
- Test as early as possible
- Software might work standalone, but is a lot harder to integrate with different hardware.

Future Improvements:

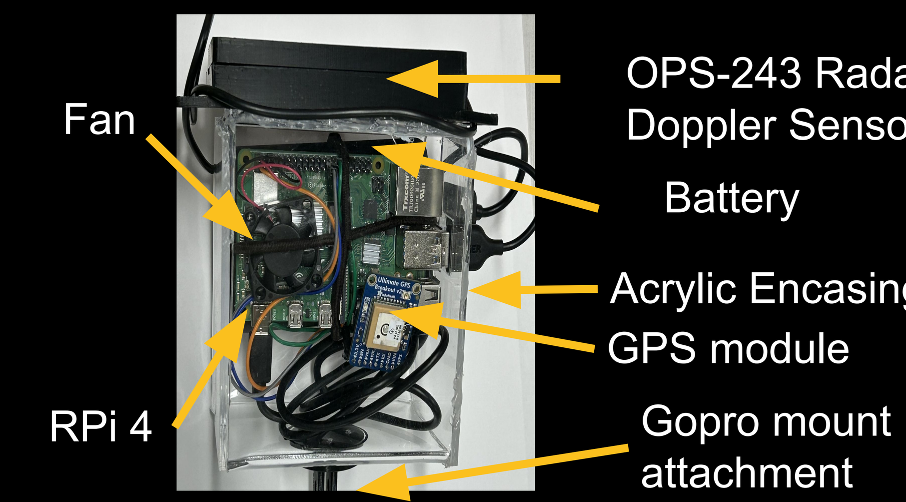
- Larger FOV for BSDS
- Minimizing wristband size
- Interactive audio for dynamic journeys

System Description

Sony Bluetooth Headset

Device on POGOH Bike

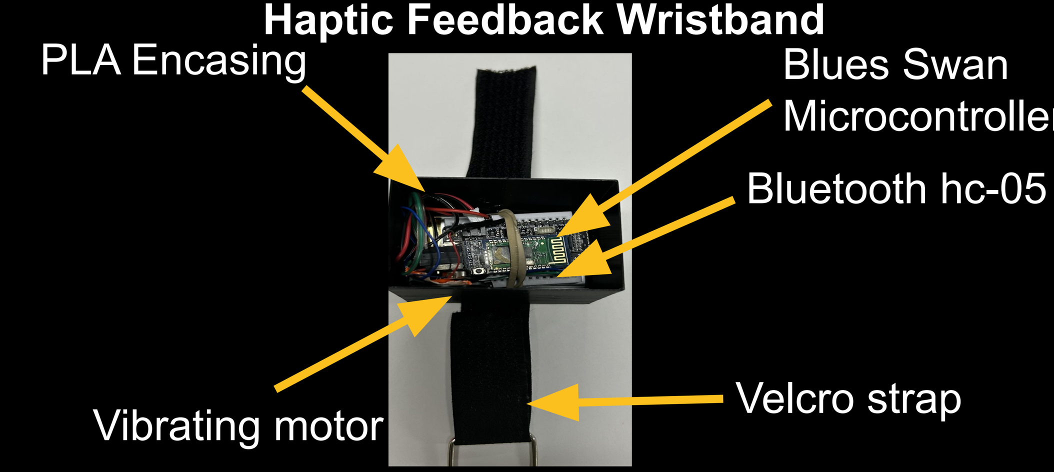
Primary Device Hub (Top view)



Device attaches under bike seat with GoPro mount. User uses bluetooth headset to initiate journey by saying destination. Routes get generated using Google maps API. GPS data is being collected through GPS module, and converted to longitude and latitude for direction algorithm. Algorithm uses longitude and latitude to estimate nearest turn for direction instructions. Simultaneously the radar sensor is checking blind spots for any incoming objects. If object is detected, sends bluetooth ping to HC-05, initiating vibrating motor to trigger on the Blues swan.

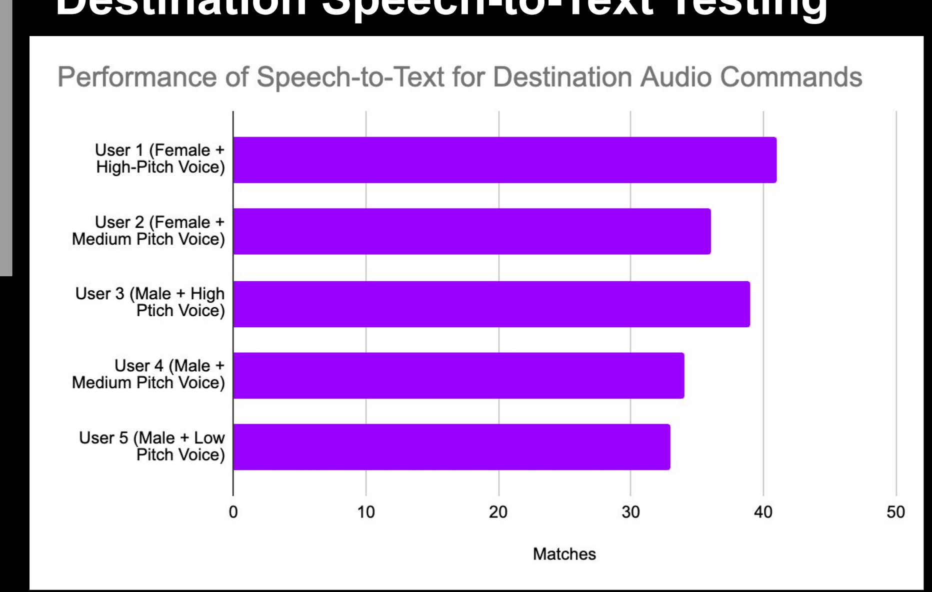
Wristband on Hand

Haptic Feedback Wristband

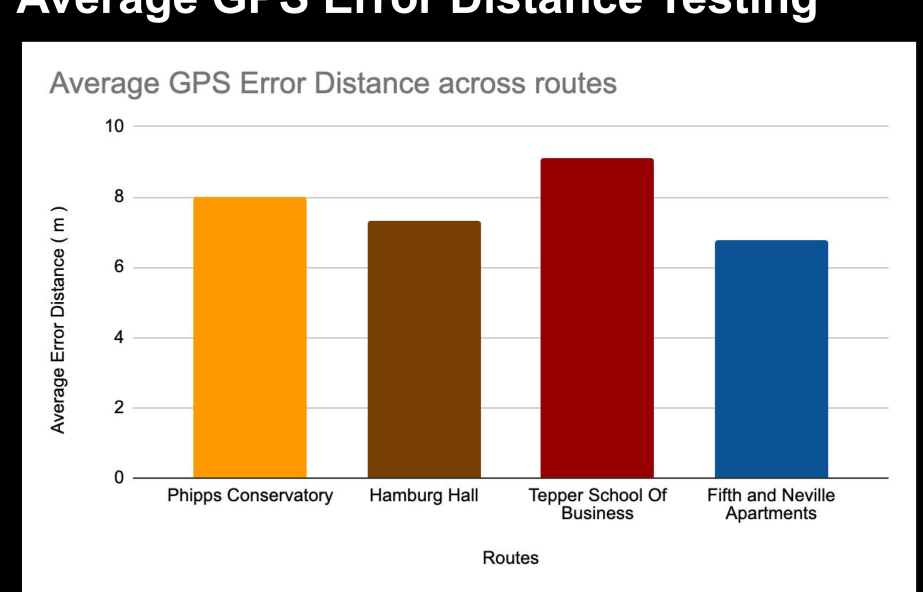


System Evaluation

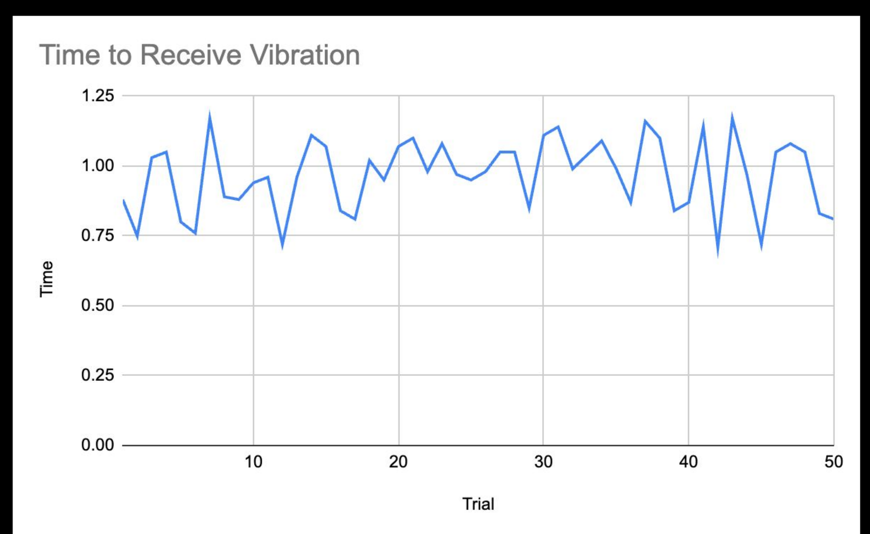
Destination Speech-to-Text Testing



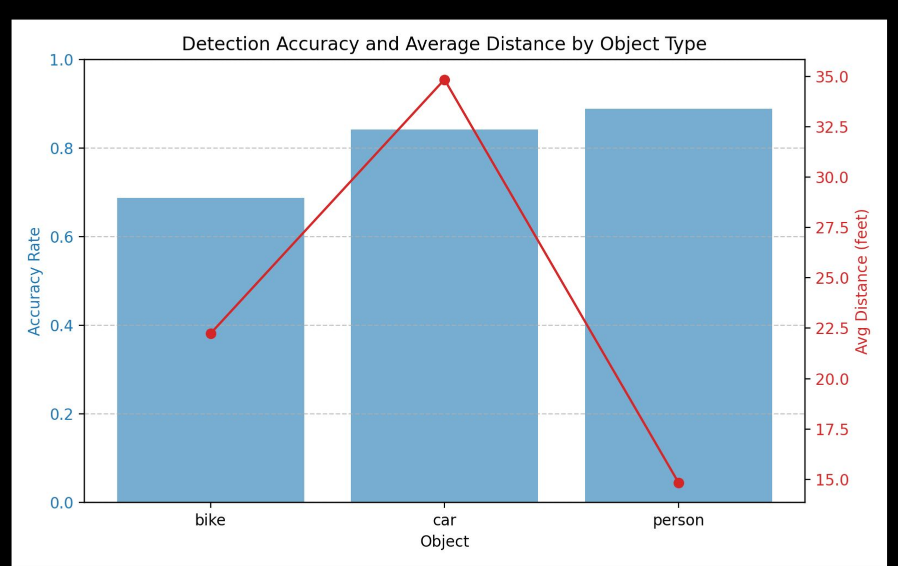
Average GPS Error Distance Testing



Time to receive a vibration from when object is detected



Sensor detection accuracy rate for different objects



Blind Spot Detection System:

- 50 time trials revealed average vibration response time of .979 seconds
- 50+ trials testing sensor against different objects (stationary and moving), from multiple distances,angles and speeds.
- **Bikes** averaged 22.2 ft detection distance with **~69% accuracy**.
- **Cars** averaged 34.9 ft detection distance with **~84% accuracy**.
- **People** averaged ~14.8 ft detection distance with **~89% accuracy**.
- No false positives
- OPS-243 has limited FOV(20 degrees) but greater accuracy for detecting incoming objects compared to ultrasonic sensor originally used.

Navigation Algorithm:

- Tested **10 distinct journeys** (with different start and end points) with the navigation algorithm
- **Manually inputted GPS coordinates** that simulated a user's bike journey and checked the outputted navigation instruction as well as the distance threshold where the algorithm produces the instruction
- Used Google Maps and the coordinates to visually check whether the appropriate direction was outputted by the algorithm
- Distance threshold within where the **instruction is produced: 200-350** ft from the actual turn
- Distance threshold where a **new route is generated: ≥ 1200** ft from current coordinates

GPS:

- Testing for average GPS Error distance across 4 routes.
- Took 10 points across each route, and compared Google Maps coordinates at these points to longitude and latitude coordinates outputted by GPS script.
- Used Haversine Formula as a means to calculate Error distance between the two coordinates.
- Average GPS Error Distance across all four routes was an average of ~7.81 meters. <10 meters good for most standard GPS modules.