



Digital Guide Dog

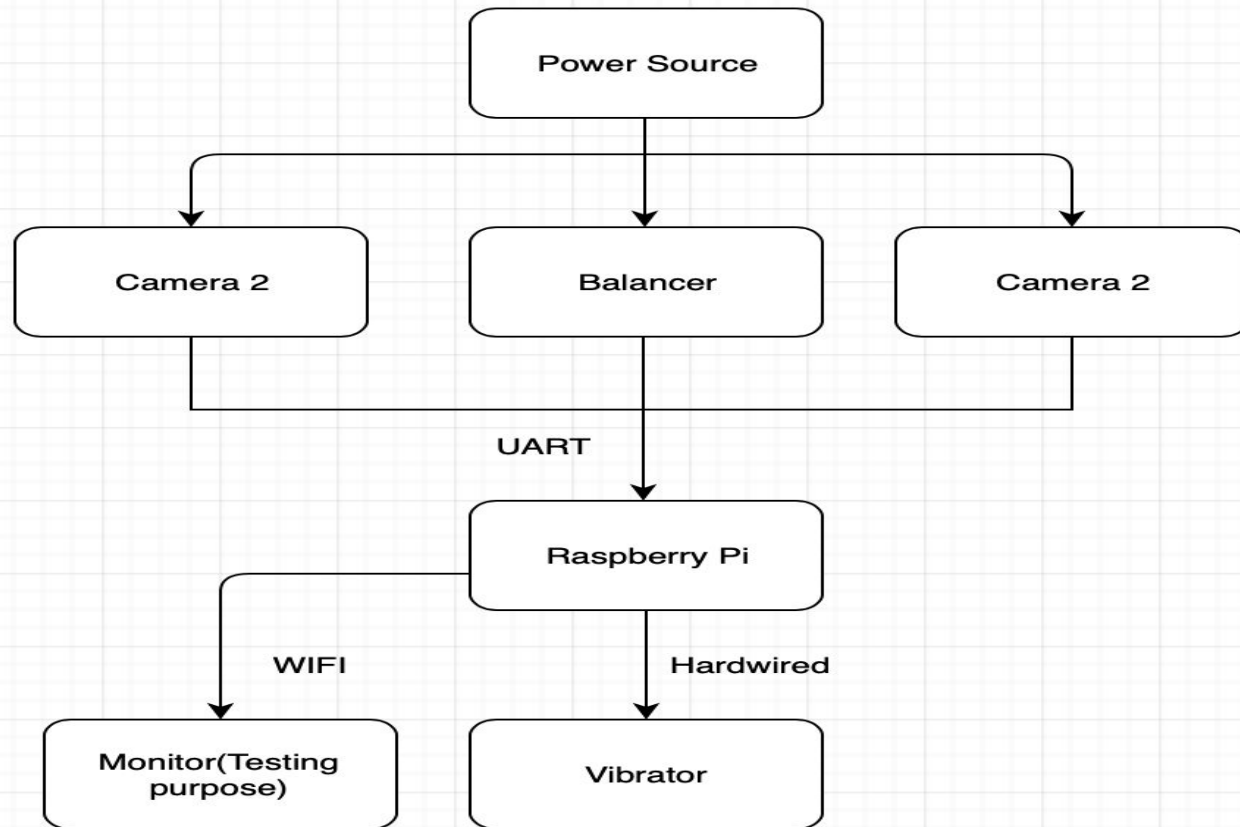
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He Zhang (Vincent),
Dongxun Sun (Ricky)
Advisor: Prof.Christopher V. Hollot

Problem Statement



There are about 10 million visually impaired people in the US. It's always hard for them to go outside to fit in the world with all the inconveniences. They usually go out with guide dogs, but it's not easy to train a dog to be a qualified dog. It might cost more than 48,000 dollars for training a guide dog. In this project, we would like to create a system called "Digital Guide Dog" to offer them an easier way to avoid hitting any obstacles in a path.

Block Diagram



Outcome at Comprehensive Design Review

Prototype Overview

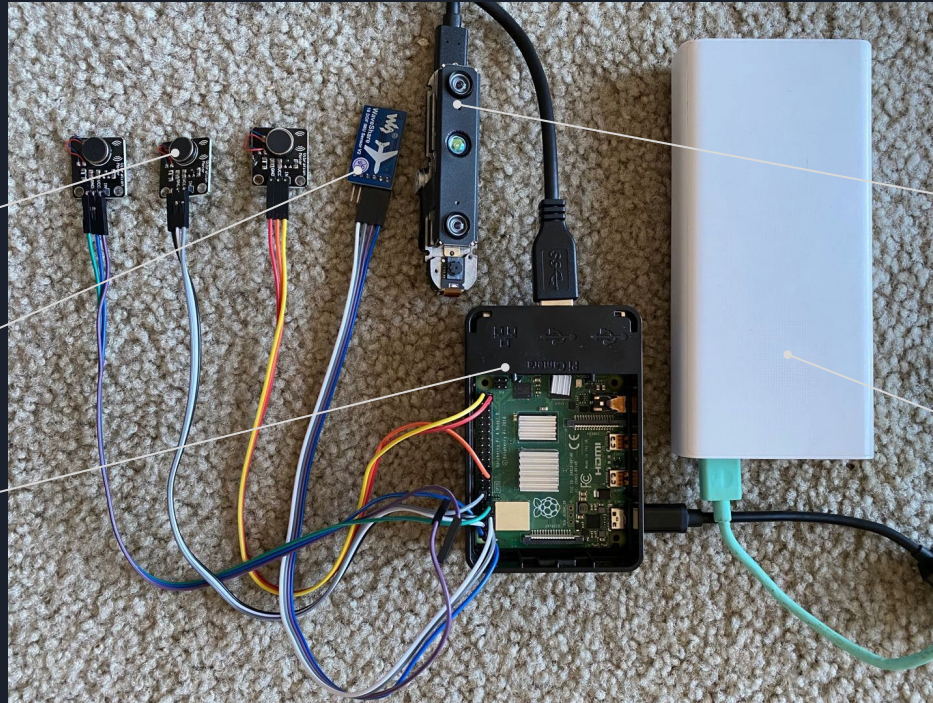
Vibrator

Gyroscope

Raspberry PI

Stereo
Camera

Power Bank

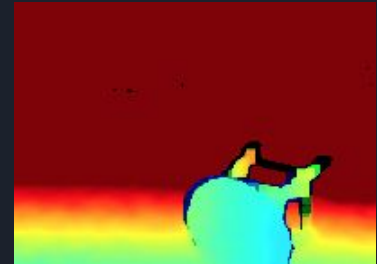
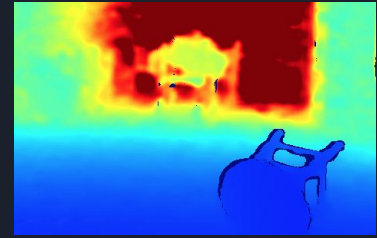
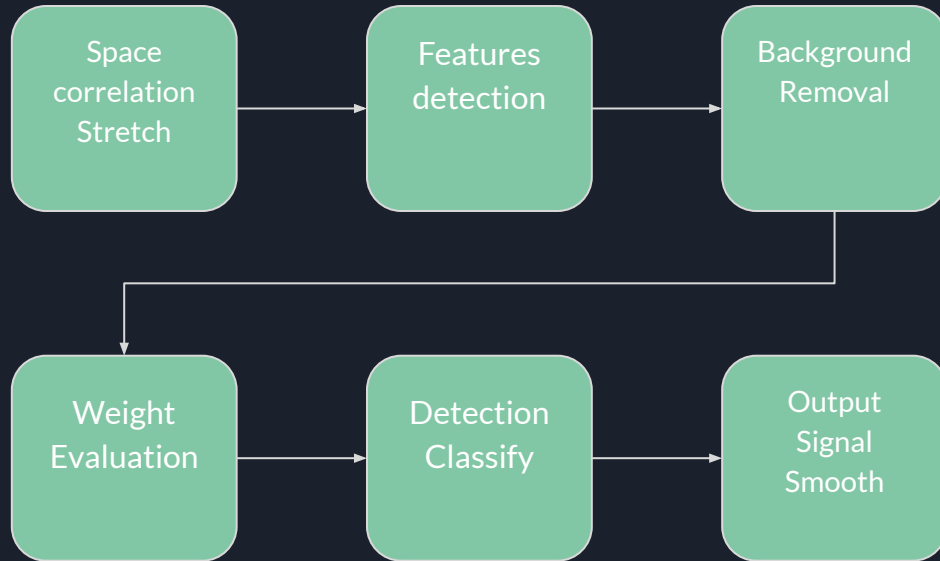


Outcome at Comprehensive Design Review

Prototype Demo

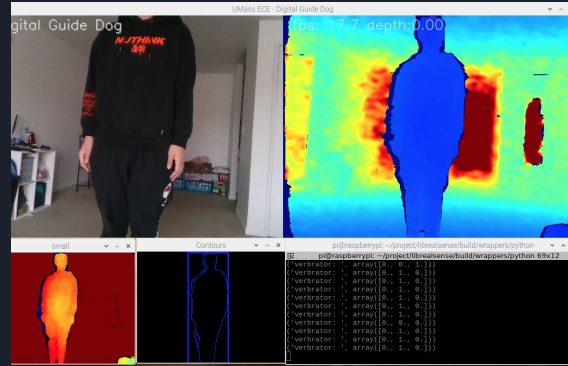
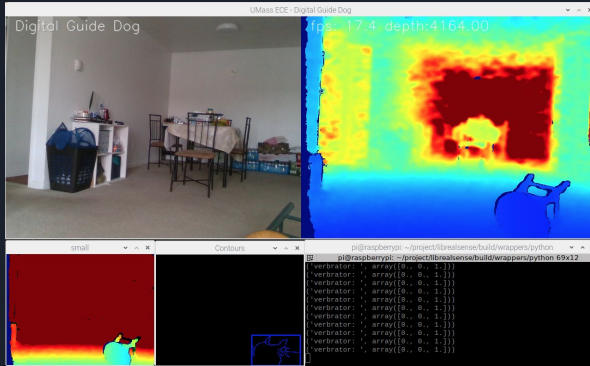


Algorithm Implementation

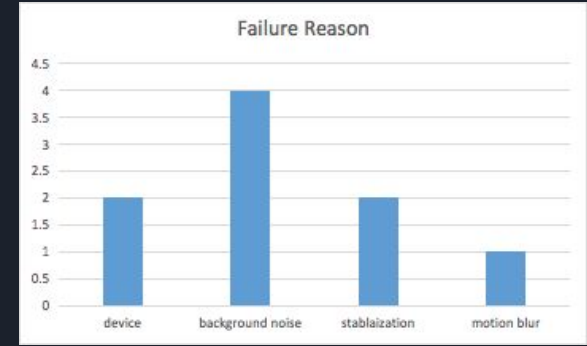
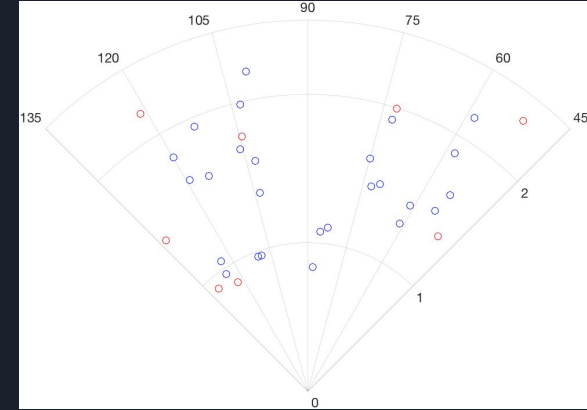


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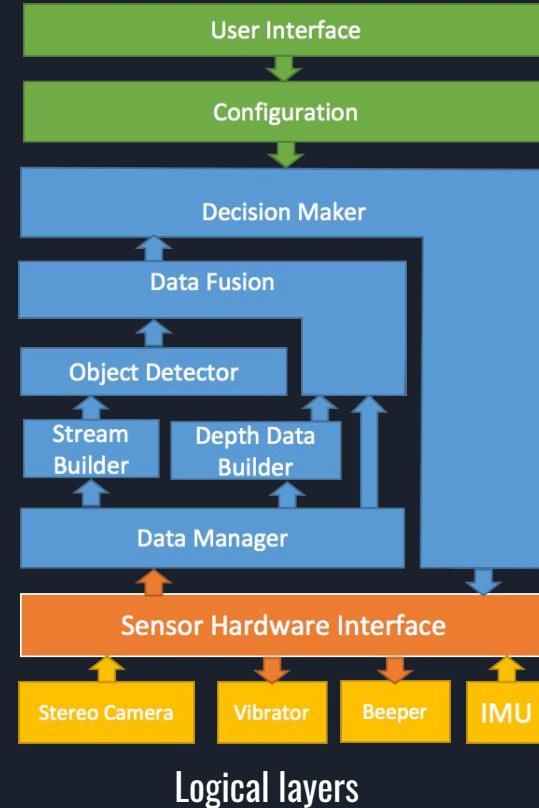
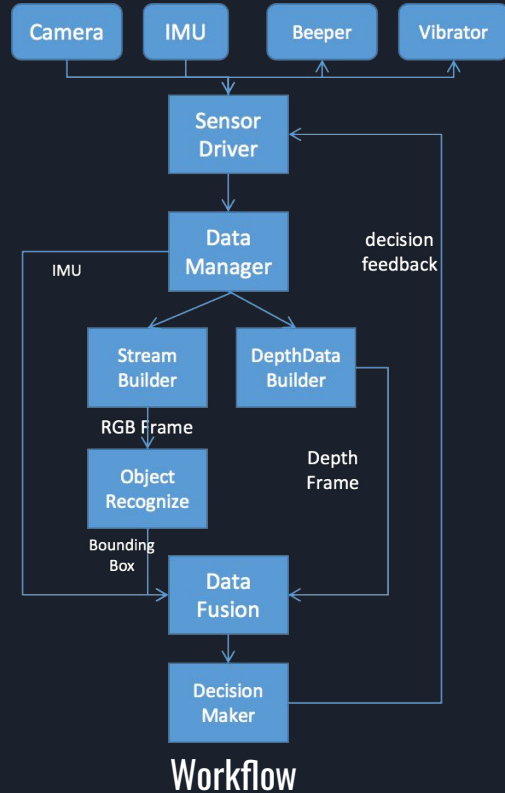

Evaluation on detection



correctness rate: 77.14%



Software Design Framework





Sensor Implementation

1. Vibrator Sensor

*Use GPIO to drive the high and low levels ;
PWM to control those vibrator frequencies.*

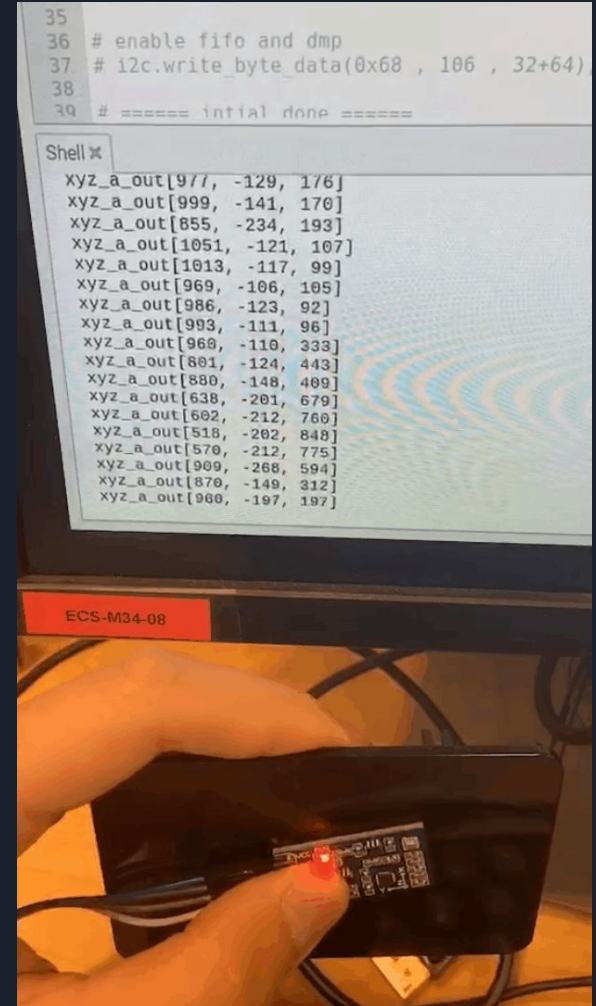
2. IMU Sensor

*Use IIC bus protocol to read each bit of data ;
Capacitance conversion was used to calculate the relative tilt value.*

Gyroscope data test

pi@raspberrypi: ~	pi@raspberrypi: ~
[-63.0, 38.0, 992.0]	[193.0, -950.0, -264.0]
[-61.0, 31.0, 1007.0]	[175.0, -942.0, -178.0]
[-59.0, 37.0, 1014.0]	[194.0, -950.0, -230.0]
[-64.0, 36.0, 1007.0]	[204.0, -962.0, -223.0]
[-55.0, 45.0, 1000.0]	[175.0, -955.0, -190.0]
[-63.0, 43.0, 998.0]	[162.0, -950.0, -235.0]
[-55.0, 39.0, 993.0]	[215.0, -961.0, -234.0]
[-55.0, 36.0, 993.0]	[172.0, -951.0, -177.0]
[-56.0, 40.0, 1000.0]	[211.0, -950.0, -182.0]
[-56.0, 26.0, 1005.0]	[220.0, -947.0, -263.0]
[-58.0, 32.0, 1004.0]	[169.0, -944.0, -180.0]
[-59.0, 38.0, 995.0]	[162.0, -940.0, -258.0]

Working voltage	3.3V, 5V
Supported interface	I2C
Dimensions	31.2mm*17mm





What we got

1. Low cost array of wearable sensors collects movement and information obstacle distance ahead
2. Provide real-time information and devices working status feedback
3. Assist the blind to move more safely and efficiently.

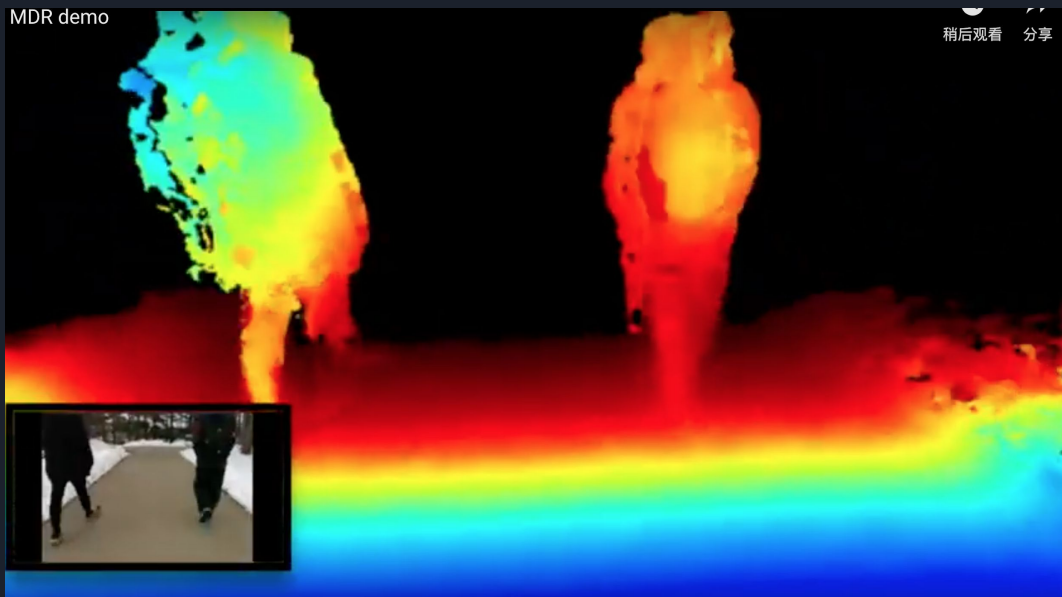


Hardware Specification Table

Features	Use Environment	Detection Range
	Indoor/Outdoor, Enough light	Within 3 meters. Accuracy varies depending on calibration, scene, and lighting condition.
	Image Sensor Technology 3 μ m x 3 μ m pixel size	
Depth	Depth Field of View (FOV): Approx. 90° x 60° x 95°	
Components	Raspberry Pi 4B Intel RealSense D430	IMU Sensor 3 Vibration Sensors
Physical	Length x Depth x Height To be further determined	Power 5V, 2A

Issues

The depth video needs to have better fluidity and the rate of recognition needs to improve.





Breakdown of Tasks

- Hui Sun: Hardware Engineer
- He Zhang: Software Engineer generated the depth film
- Dongxun Sun: Project Manager, Software Engineer



Budget

- **Raspberry Pi 4 Model B & SD Card: \$98**
- **Intel RealSense D435: \$180**
- **IMU Sensor: \$22**
- **Vibrator Sensor:\$10**
- **Others: \$20**
- **Totally: \$330**




Future Plan


1. Make the device wearable
2. Optimize the algorithm

Team Website


MDR Demo




Team




Prof. Christopher V. Hollot
Professor, Department of Electrical and Computer Engineering, University of Massachusetts



Dongxun Sun
dsun@umass.edu
Graduate student in Electrical and Computer engineering, expected to graduate in May 2020. Working as the project manager and data analyst in this project including cleaning data, data analysis and predict possible objects in the path using machine learning. In the meantime, as a project manager, maintain the entire project on the right track, make sure every task is finished on time, communicate with the advisor and keep him updated the whole time.




Hui Sun
huisun@umass.edu
I have a strong interest in the development of single-chip microcomputer. I am good at the development of sensors and control systems and system scheme design based on the Internet of things. Mainly responsible for the hardware frame construction and circuit debugging of the project, planning the interface of the microcontroller and conducting the sensor debugging in the later stage.



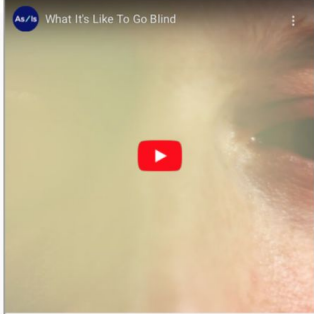
He Zhang
hezhang@umass.edu
Graduate students in ECE, expected to graduate in May 2020. Working as the software engineer, responsible for implementing the software architecture and algorithms used in this project.

[Project](#) [Design](#) [Team](#) [Contact](#)




The Project of Digital Guide Dog

There are about 10 million visually impaired people in the US. It always hard for them to go outside to fit in the world with all the inconveniences. They usually go out with guide dogs. In this project, we would like to create a system called "Digital Guide Dog" to offer them an easier way to avoid hitting any obstacles in a path.



How much does a guide dog cost?

The cost to put one guide dog team – as our guide dog recipients and their guide dogs are known – into service is \$48,000. That cost include the breeding, raising, and training of the dog, instruction for the guide dog user, and instruction for the guide dog team.





Thanks for your attention