Digital Guide Dog

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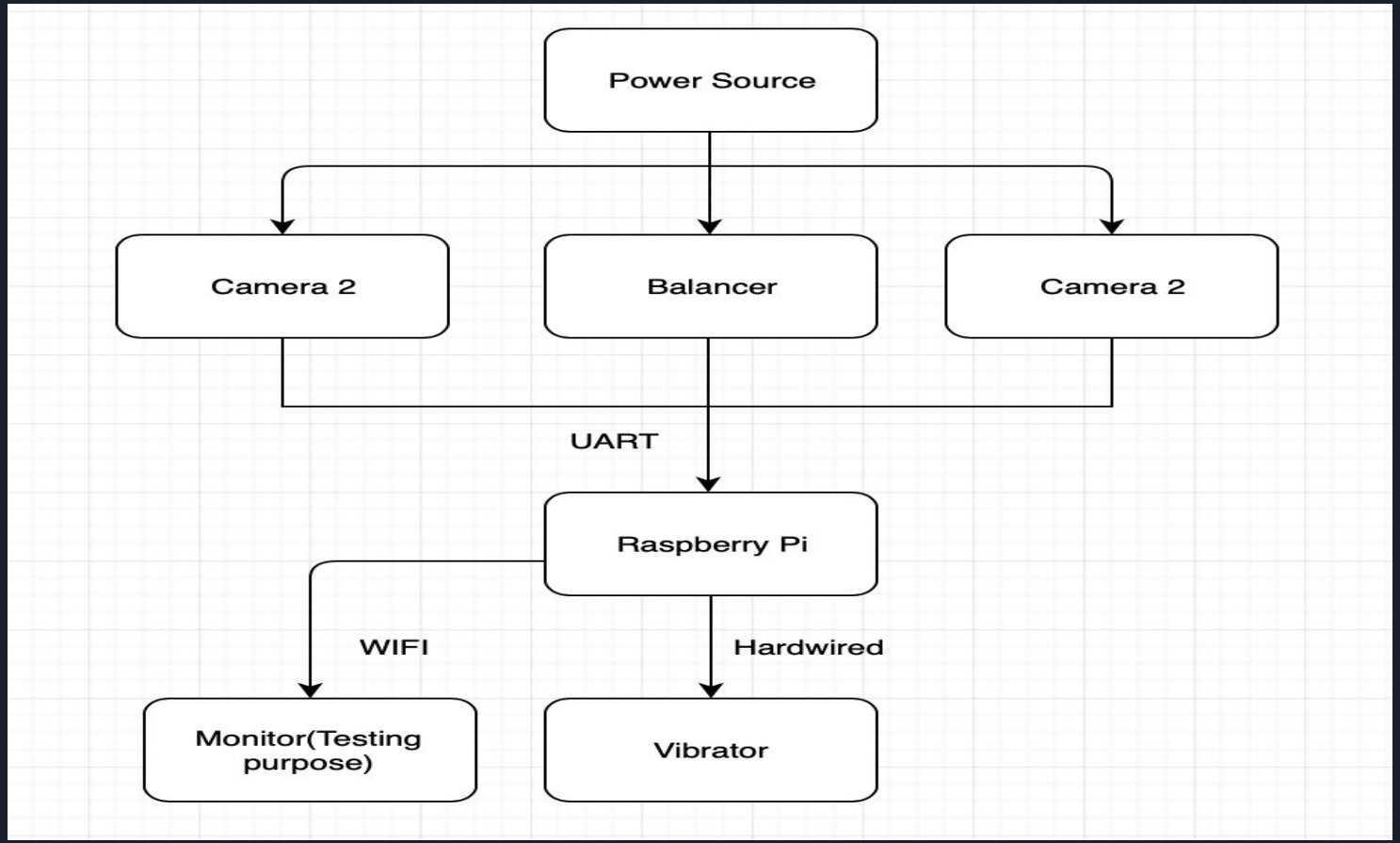
Problem Statement

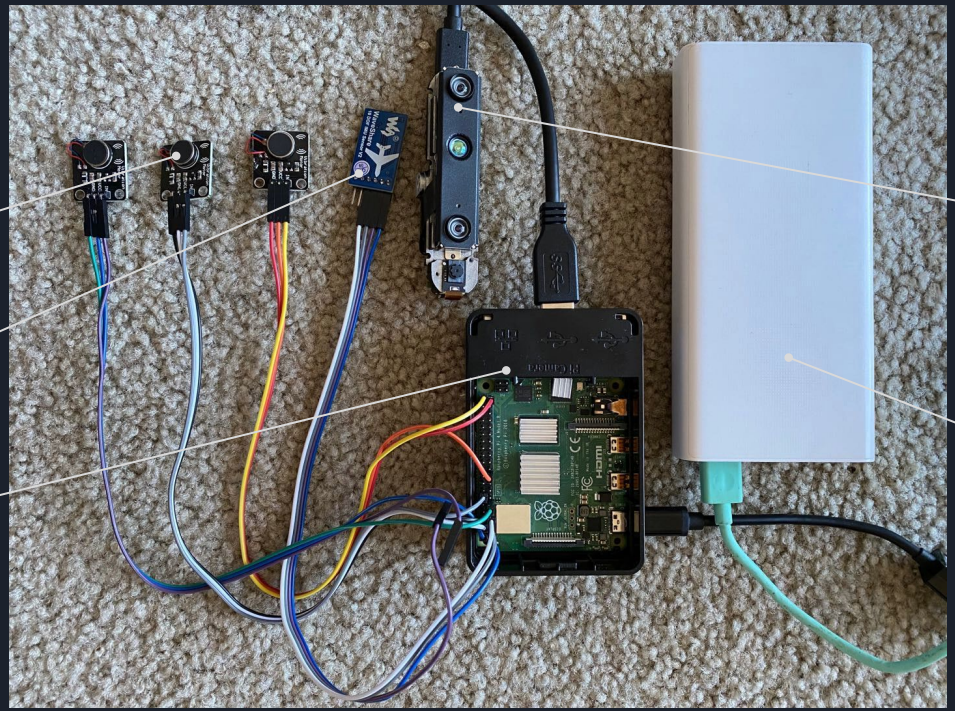
There are about 10 million visually impaired people in the US. It always hard for them to go outside to fit in the world with all the inconveniences. They usually go out with guide dogs, but it's not easy to train a dog to be a qualified dog. It might cost more than 48,000 dollars for training a guide 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

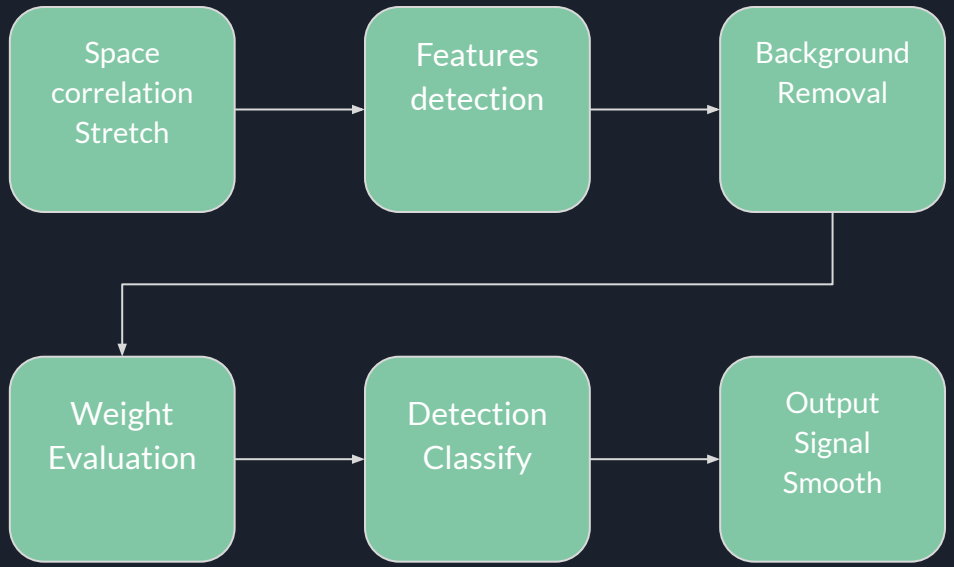
Prototype Overview

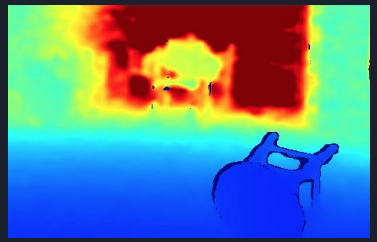


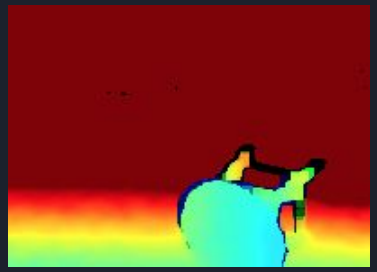
Outcome at Comprehensive Design Review

Prototype Demo

Algorithm Implementation







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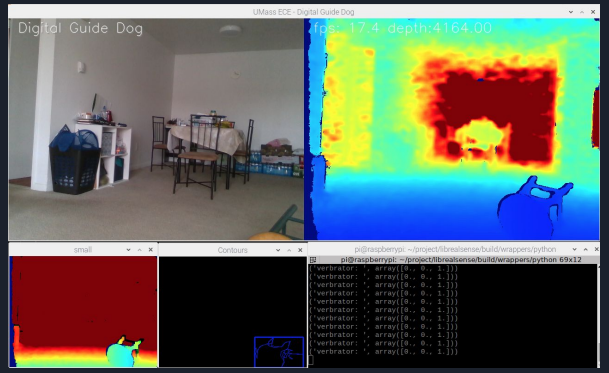
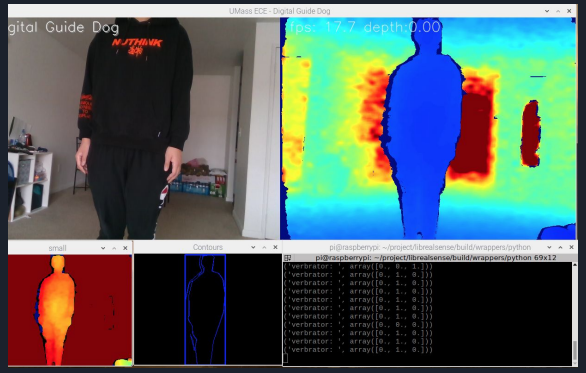
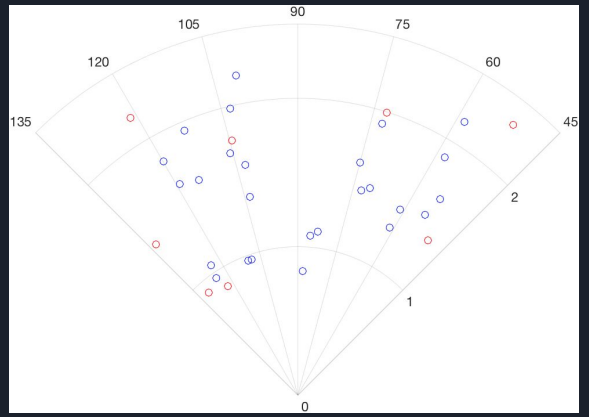
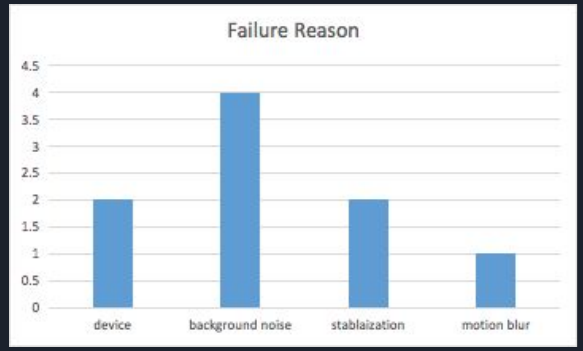
Evaluation on detection



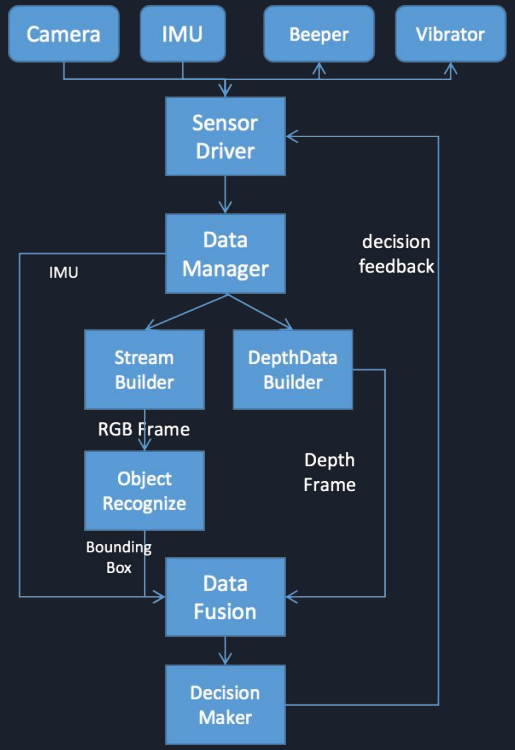




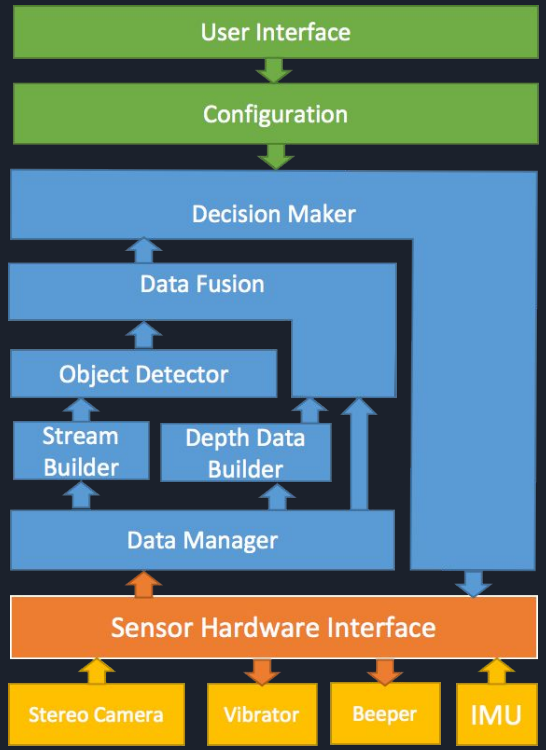


correctness rate: 77.14%

Software Design Framework



Workflow



Logical layers

Sensor Implementation

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

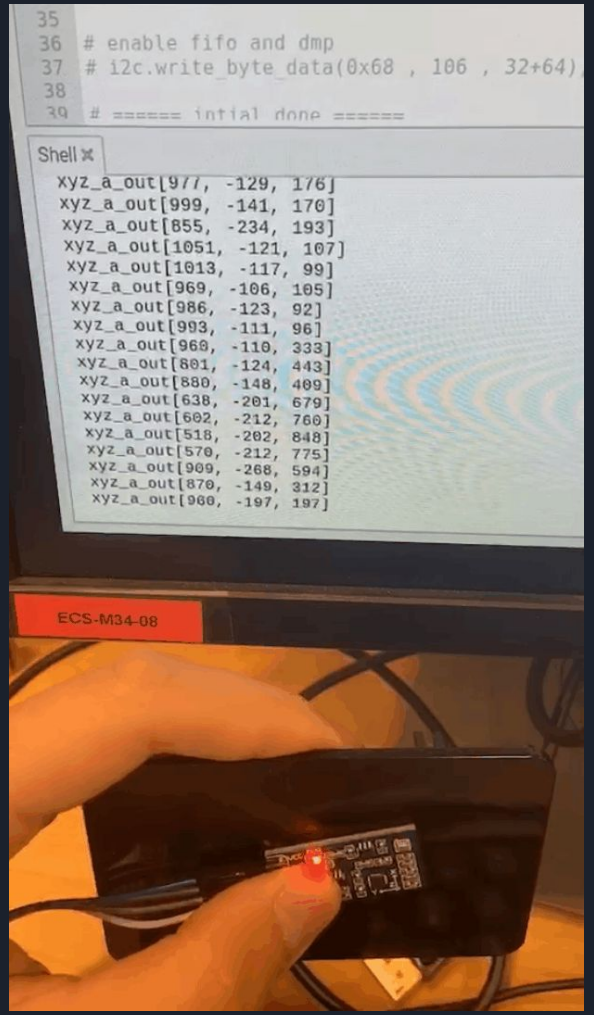
2. IMU Sensor
   Use IIC bus protocol to read each bit of data ;
   Capacitance conversion was used to calculate the relative tilt value.

Gyroscope data test

pi@raspberrypi: ~

[-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

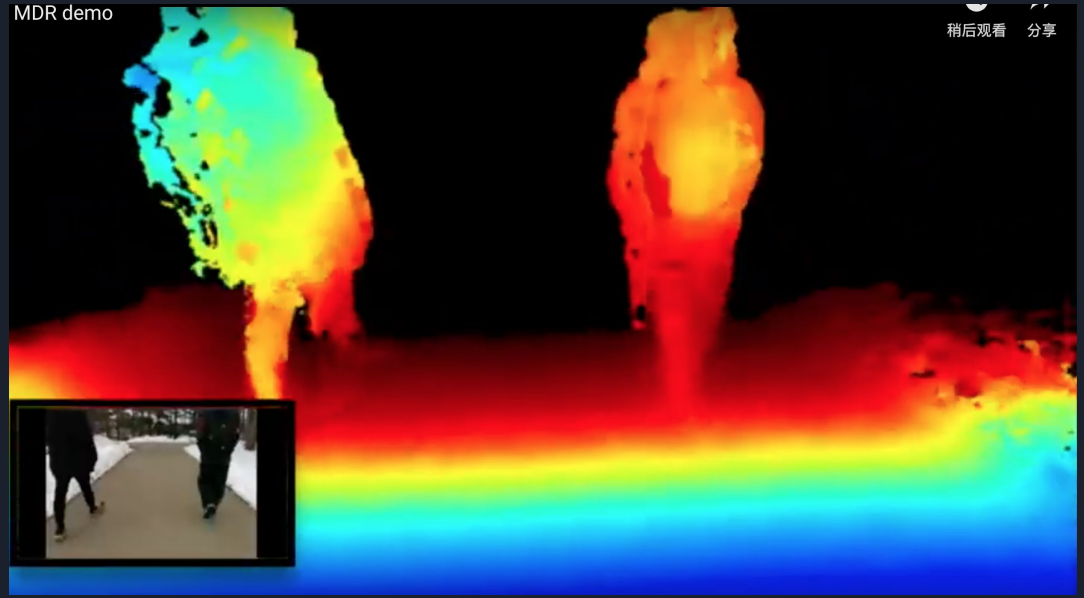
3. Assist the blind to move more safely and efficiently.

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 3µm x 3µm 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

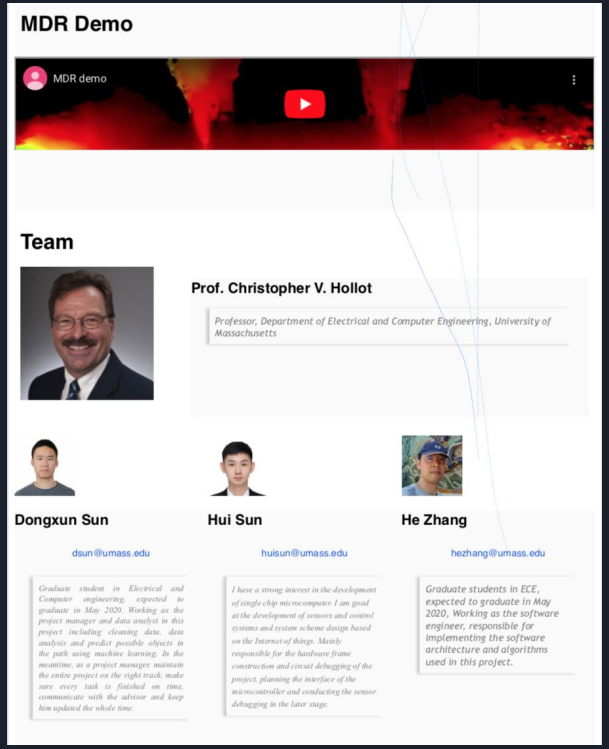
- **Raspberry Pi 4 Model B & SD Card: $98**
- **Intel RealSense D435: $180**
- **IMU Sensor: $22**
- **Vibrator Sensor:$10**
- **Others: $20**
- **Totally: $330**

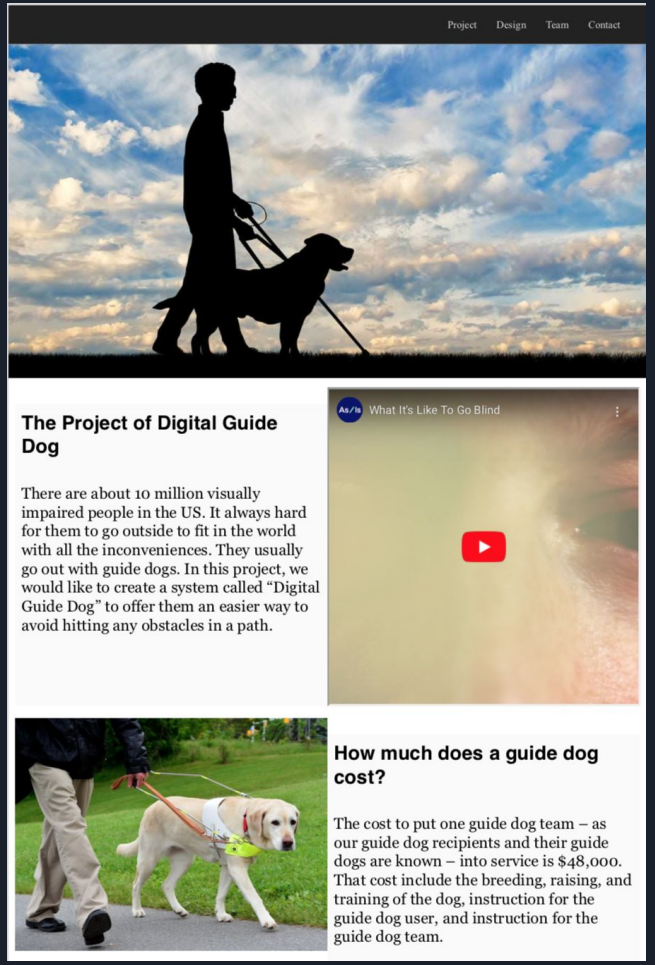
Future Plan

1. Make the device wearable

2. Optimize the algorithm

Team Website





Thanks for your attention