Department of Electrical & Computer Engineering

Boston University
Electrical & Computer Engineering
EC463 Capstone Senior Design Project

First Prototype Testing Plan

by

Team 3
Opticle

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I. Required Materials

A. Hardware:
- Raspberry Pi 4 Model B (with 16 GB MicroCenter SD card)
- 15W Power Supply (Pi 4)
- OpenCV AI Kit: OAK-D Camera
- Linear Resonant Actuators
- SB300 Solderable PC Breadboard
- Desktop monitor
- Keyboard
- Mouse

B. Software:
- Python 3 Scripts:
  - Object detection (YOLO with SSD)
- Motor Control:
  - Raspberry Pi GPIO

C. Other:
- Platinum Extreme Accessory Kit (Chest Mount)

II. Set-Up

Our set-up includes both software and hardware components: an object detection Python script that is run on a Raspberry Pi 4, which is connected to an OAK-D camera and wired to two linear resonant actuators. The hardware is attached to a chest mount where the camera is mounted to a screw in the middle and the pi is attached to the body of the user. For this prototype, the actuators are tucked behind the shoulder straps of the chest mount; one on the left side and one on the right. The Pi is connected to a monitor display via HDMI so that the Raspberry Pi Desktop can be used to run the script. The python script utilizes the OAK-D camera where it uses a trained algorithm Yolo, which performs real-time object detection. When an object is detected, an appropriate label is assigned to it as well as the spatial coordinates of the object relative to the camera. Using the z-coordinate, the strength of a PWM signal is scaled accordingly and sent to the appropriate GPIO pin on the Raspberry Pi. The closer an object, the stronger the vibration. To determine which of the two actuators should vibrate on the chest mount (right or left), the x-coordinate of the object is used; any negative coordinates should cause the left actuator to vibrate and positive coordinates should cause the right actuator to vibrate. Each actuator is wired to its respective GPIO pin to receive a PWM signal when the camera detects an obstacle.

III. Pre-Testing Setup Procedure

1. The user should put on the chest mount and ensure a snug fit.
2. Mount the Raspberry Pi and OAK-D camera onto the mount and ensure that they are tightly secured on the side of the belt and in the center respectively.
3. Connect the HDMI, micro usb, and OAK-D to the Raspberry Pi.

4. Connect the ground wire of the PCB to GND on the Pi, and the other wires to GPIO Pins 8 and 10 respectively.
5. Connect both the Raspberry Pi and the OAK-D to the power supply.
6. Power on the Raspberry Pi and go into the directory where the required files are stored by running the following: "*cd BUseniordesign/examples/test"*

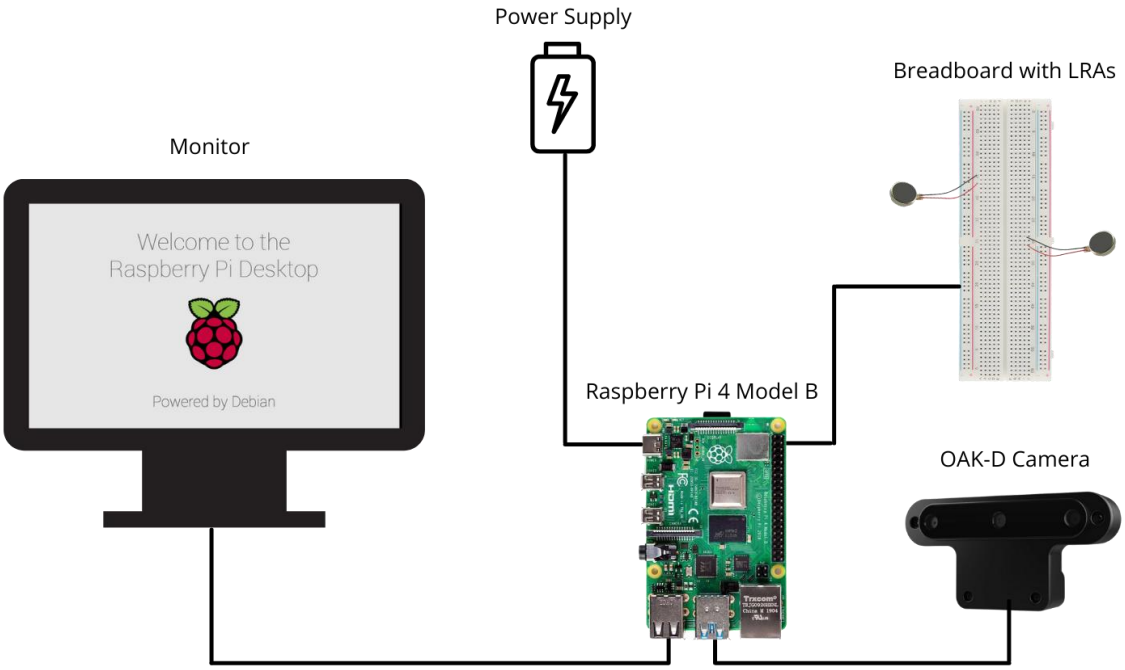

Figure 1: Illustration of Setup

IV. Testing Procedure

1. Run "*python3 spatial_tiny_yolo.py"*
2. There will be two people standing approximately 2m away from the user. One on the left and one on the right.
3. The left person will move forward by 1m.
4. The right person will move forward 1m.
5. The left person will leave the frame of the camera.
6. The right person will leave the frame of the camera.
7. One person will stand 5m away from the user.

V. Measurable Criteria

The criteria for successful running and output is as follows:

1. The Raspberry Pi should successfully power on the OAK-D camera and begin object detection.

2. There are two LRAs connected to the PCB board. The two motors will be placed on each side, left and right, of the user's chest. When the OAK-D camera detects an object on the left side, the left motor should subsequently vibrate and when the camera detects an object on the right side, the right motor should vibrate.
3. The user should be able to feel variations of the vibration intensity to indicate the proximity of the object relative to them.
4. The camera should be able to detect objects/obstacles up to 5m.
5. When an object is detected, the object name, motor number, and motor intensity is outputted to the terminal.
6. The motors should only vibrate when the camera detects people.

Hardware Pinout

Pin	**Usage/Description**
Gnd	Ground
GPIO-8	PWM output for left motor
GPIO-10	PWM output for right motor

Score Sheet

Object	**Distance**	**Detected? (Y/N)**	**Correct vibration strength? (Y/N)**	**Correct motor vibrated? (Y/N)**
Left Person	2 m			
Right Person	2 m			
Left Person	1 m			
Right Person	1 m			
Only Right Person	1 m			
Only Left Person	1 m			
One Person	5 m			
Result		/7	/7	/7