Department of Electrical & Computer Engineering

Boston University
Electrical & Computer Engineering
EC464 Capstone Senior Design Project

Second 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)
- Charmast Portable Power Bank
- OpenCV AI Kit: OAK-D Camera
- Linear Resonant Actuator
- SB300 Solderable PC Breadboard
- Desktop monitor
- Keyboard
- Mouse

B. Software:
- Python 3 Scripts:
  - Point Cloud Detection
- Motor Control:
  - Raspberry Pi GPIO

C. Other:
- Platinum Extreme Accessory Kit (Chest Mount)
- 3-D Printed Wrist 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 a linear resonant actuator. The hardware is attached to a chest mount where the camera is mounted to a screw in the middle and the pi and portable battery is attached to the body of the user. Both the Pi 4 and OAK-D are connected to the portable battery to receive power. The actuator is attached to a 3-D printed wrist mount, where it is soldered to wires that run along the user's arm and back to the Pi 4. This wrist mount will be meant to be worn like a watch where the actuator is touching the user's skin. The Pi is connected to a keyboard, mouse, and 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 point cloud data to determine whether an immediate obstacle is in front of the user. Point cloud data is generated by combining both RGB and depth data. By drawing a cuboid of space in front of the user and looking at the density of data points in that cuboid, the system is able to alert the user of nearby obstacles. When an object is detected, the script will send a PWM signal to the appropriate GPIO pin on the Pi 4. The LRA is wired to this GPIO pin which will allow the LRA to receive the pwm signal and vibrate to alert the user whenever an object is detected.

III. Pre-Testing Setup Procedure

1. The user should put on the chest mount and ensure a snug fit.
2. Mount the Raspberry Pi, portable battery, and OAK-D camera onto the mount and ensure that they are tightly secured on the back 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 wire to GPIO Pin 8.
5. Connect both the Raspberry Pi and the OAK-D to the portable battery.
6. Have user hold the wrist mount in one of their hands.
7. Power on the Raspberry Pi and go into the directory where the required files are stored by running the following: "*cd BUSeniorDesign-Opticle-21-22/point-cloud-projection"*

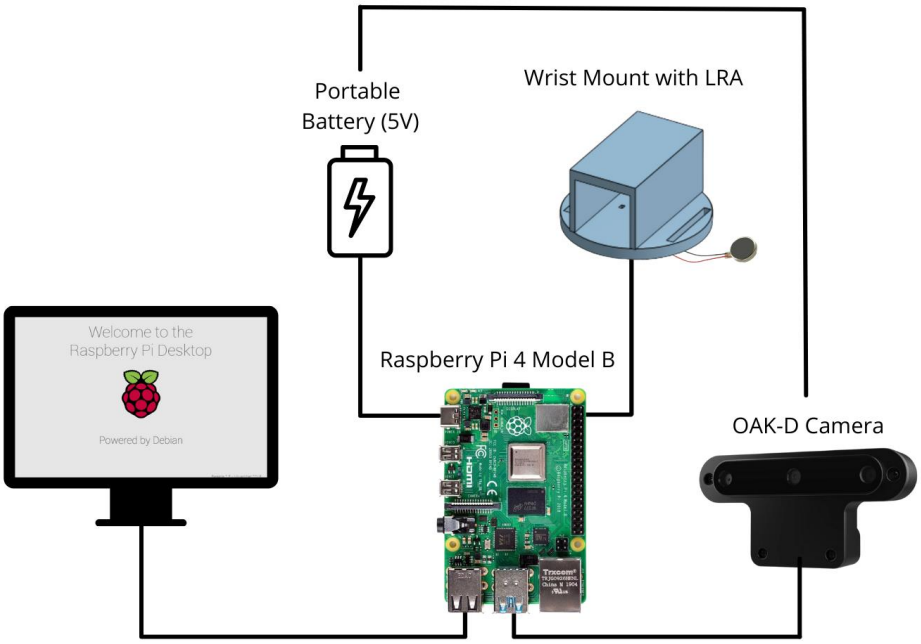

Figure 1: Illustration of Setup

IV. Testing Procedure

1. Run "*main.py*"
2. One person will stand in front of the user by 1.5 m.
3. The person will then move forward until they are 0.5 m in front of the user.
4. The person will then leave the frame.
5. Another person will stand in front of the user by 5 m.
6. The person will then move forward until they are 1.5 m in front of the user.
7. The person will then leave the frame.
8. A chair will be placed 3 m in front of the user.
9. The user will then walk 1.5 m forward.

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 is an LRA connected to the PCB board. When the OAK-D camera detects an object in front of the user, the LRA should vibrate.
3. The camera should be able to produce an appropriate point cloud visual and display this on the monitor.
4. When an object is detected, the detection should be outputted to the terminal.
5. The LRA should only vibrate when the camera detects an obstacle between 0.7 and 1.7 m in front of the user.
6. When no objects are in front of the user, the LRA should not vibrate.

Hardware Pinout

Pin	**Usage/Description**
Gnd	Ground
GPIO-8	PWM output for LRA

Score Sheet

Object	**Distance**	**Point Cloud Correct? (Y/N)**	**Detection Prompt Correct? (Y/N)**	**Motor Vibration Correct? (Y/N)**
Person	1.5 m			
Person	0.5 m			

Person	5 m			
No Person	N/A			
Chair	1.5 m			
No Chair	N/A			
Result			/6	/6