HOWARD UNIVERSITY

1867

CTRL - B

By Team Ctrl

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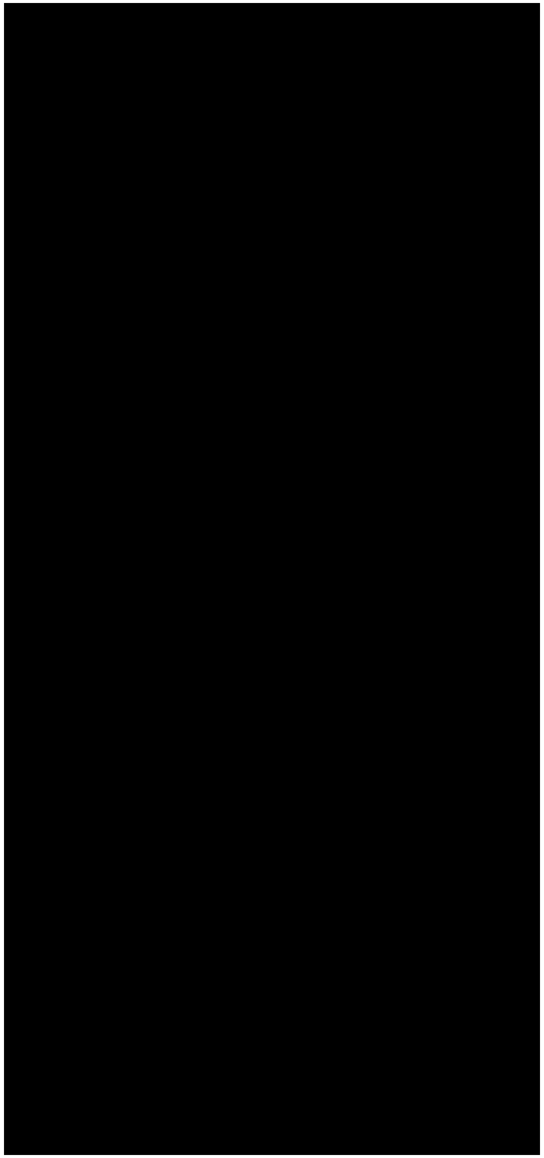
Background

- Imagine riding an e-scooter and suddenly colliding with an obstacle unexpectedly
- We need a cutting-edge braking system made especially to help avoid unplanned collisions
- Aims to enhance safety for riders
- Provides a more reliable solution in collision scenarios



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Problem Statement

- Limited visibility on non-motor vehicles hinders timely object/pedestrian detection
- System equipped with portable, mobile sensors
- Utilizes object detection technology
- Assists in braking when approaching objects at high speeds
- Attaches to e-scooters
- Reduces collision likelihood in low-visibility conditions

Design Constraints

Environmental Constraints

- System must be compatible with existing braking mechanisms and securely attachable/detachable to scooters and bikes
- Device must have a rechargeable power source

Socio-Cultural Constraints

- System should be simple to attach for user feasibility
- Device should be compact without interfering with vehicle functionality

Compliance

- The Consumer Product Safety Commission (CPSC) sets federal safety standards for bicycles
- CPSC does not have specific federal regulations for e-scooters
- CPSC monitors e-scooter safety under general consumer product authority, focusing on battery safety, mechanical components, and conducting recalls when necessary

Design Constraints

Consumer Product Safety Commission (CPSC)

- Protects the public from unreasonable safety risks
- Safeguards thousands of consumers from fire, electrical, mechanical and chemical hazards

IEEE P2020 - Automotive Sensors

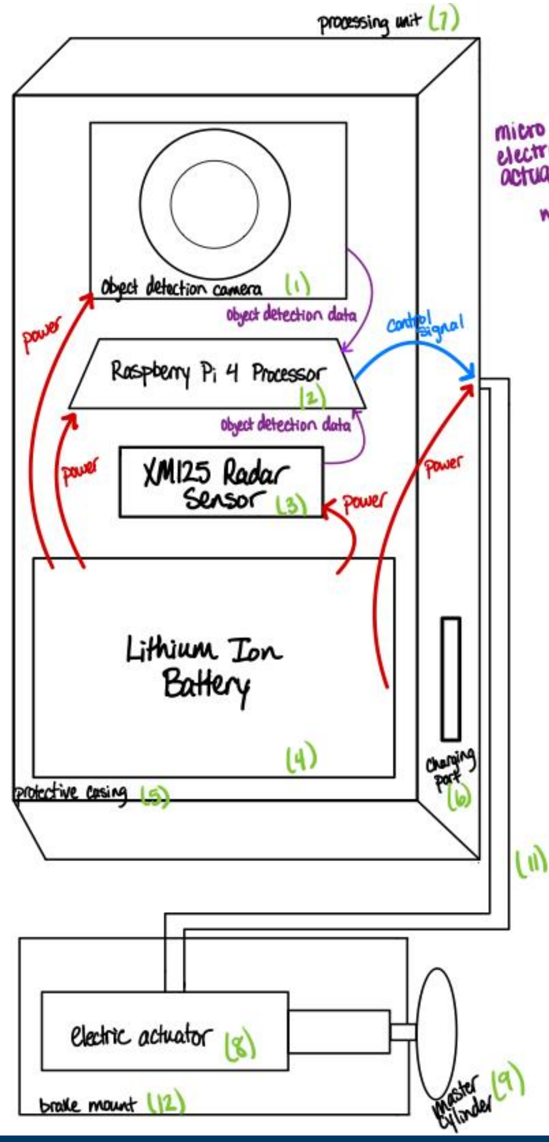
- Sets automotive system image quality standards for all manufacturers
- Ensures regulatory compliance and meets performance expectations

Design 3 – Top Solution

Hybrid Object Detection and Radar System with Adaptive Braking

- Object detection camera and radar sensor work together in hybrid system
- Camera detects and classifies obstacles
- Radar measures distance and speed
- Raspberry Pi calculates required braking force
- Micro electric actuator provides smooth braking
- Lithium battery powers the entire system

Details of the Top Design



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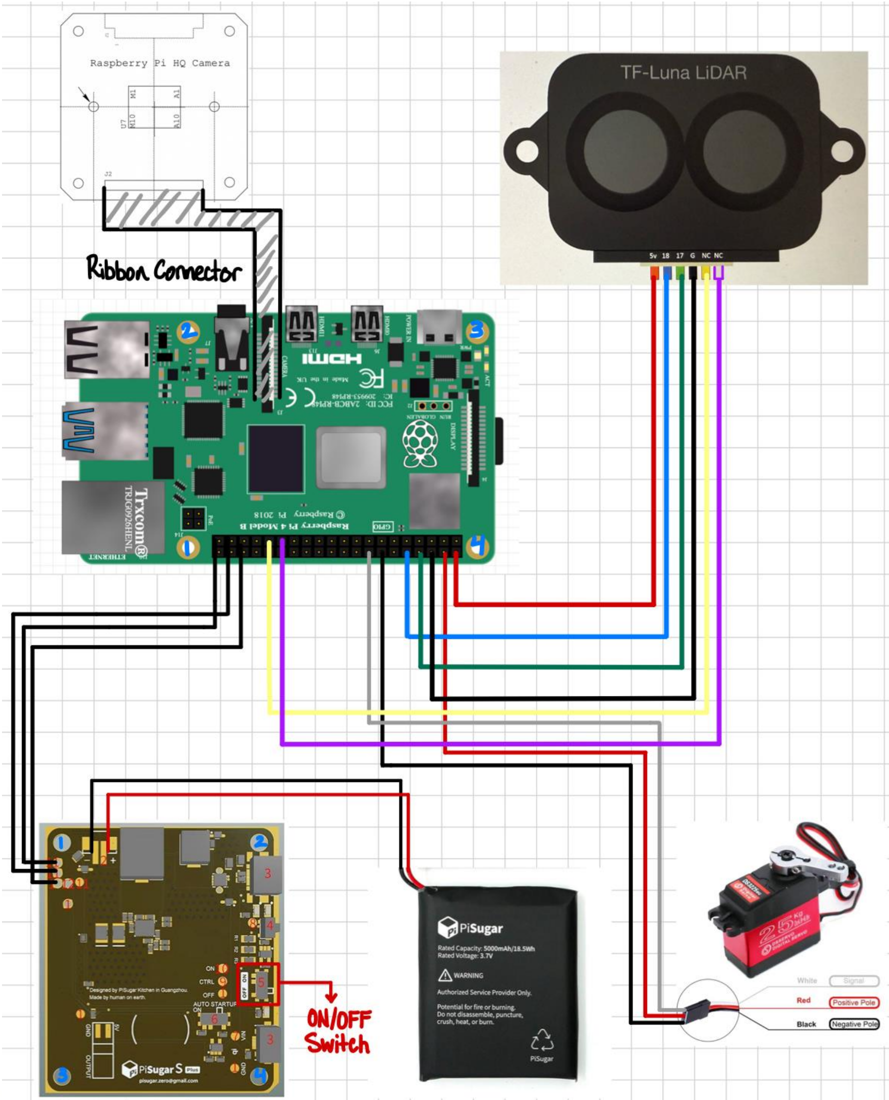
Component-Level Schematic

- Pi Sugar Battery Pack 5V3A Input/Output (Approx. ~8+hrs)
- Raspberry Pi HQ Camera
- TF-Luna LiDAR (GPIO 14 & 15)
- Servo Motor (GPIO 23), applies mechanical force to the external string
- Implement Object Detection Algorithm

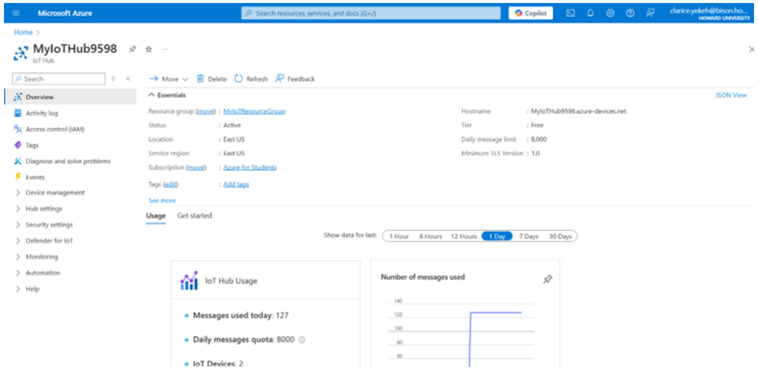


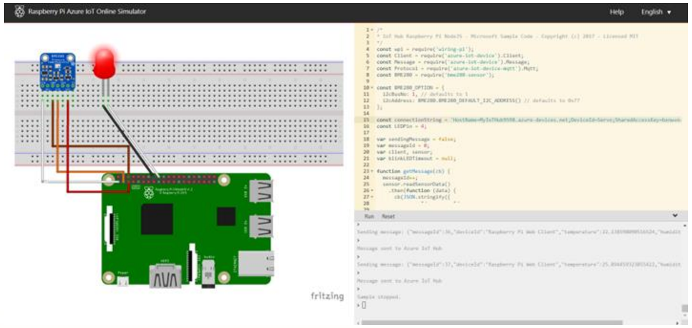
Sprint 1: Detection algorithm that processes data from internal components

Week 1: Obtain and examine scooter braking system feasibility

Week 2: Research and develop a virtual coding environment (Microsoft Azure)

Week 3: Raspberry Pi code setup using each component (radar sensor, object detection camera, and servo motor)






```
import time
import random
from azure.iot.device import IoTHubDeviceClient, Message
import threading

# Replace with your Azure IoT Hub device connection string
connection_string = "HostName=MyIoTHub9598.azure-devices.net;DeviceId=CTRL_0;S
client = IoTHubDeviceClient.create_from_connection_string(connection_string)

# Servo simulation (sending servo position data)
def send_servo_data():
    position = random.randint(0, 180)
    telemetry = {
        "servo_position": position
    }
    message = Message(str(telemetry))
    client.send_message(message)
    print(f"Sent servo data: {telemetry}")

# Radar simulation (sending radar distance data)
def send_radar_data():
    distance = random.uniform(0, 10)
    telemetry = {
        "radar_distance": distance
    }
    message = Message(str(telemetry))
    client.send_message(message)
    print(f"Sent radar data: {telemetry}")

# Battery simulation (sending battery charge and voltage)
def send_battery_data():
    charge = random.randint(0, 100)
    voltage = round(random.uniform(3.0, 4.2), 2)
```

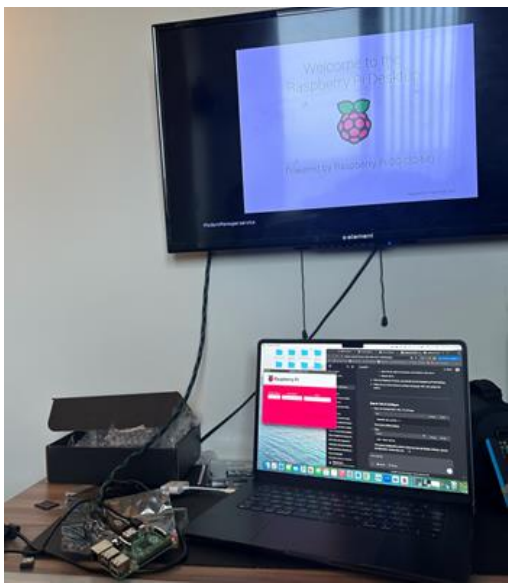
Sprint 2: Obtain Components and Wire System

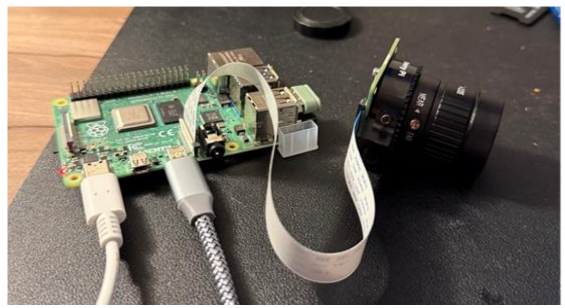
Week 1: Obtain a Raspberry Pi 1B+, and set it up

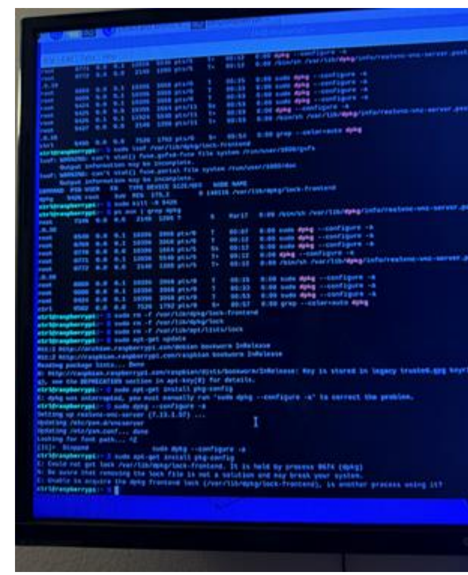
Week 2: Order new Raspberry Pi, setup and connect camera

Week 3: Explore using Open CV with computer vision for Object Detection

Implement code from sprint 1

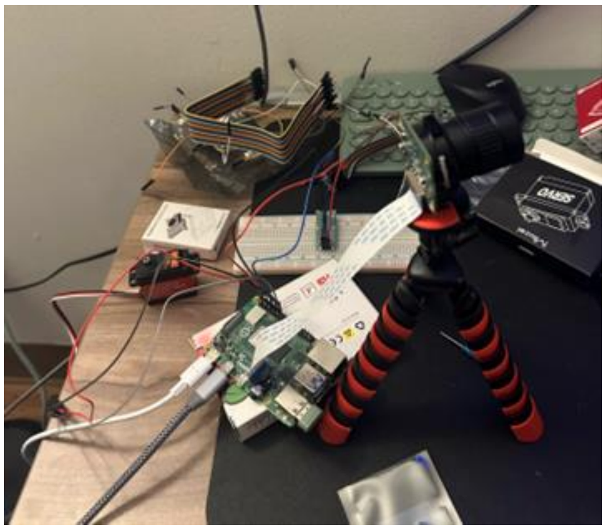


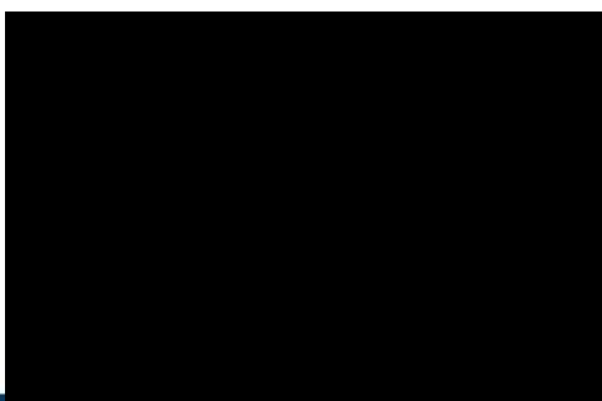




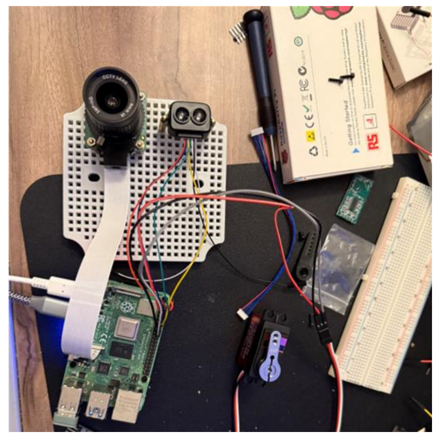
Sprint 3: Mounting and System Level Testing

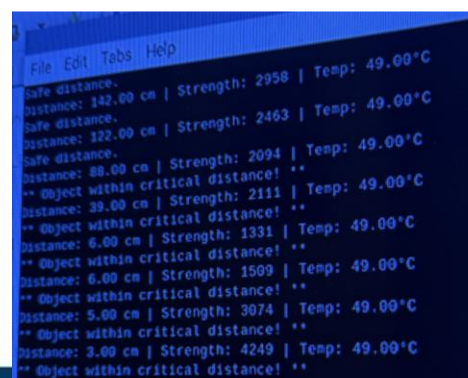
Week 1: Wire the entire system and confirm



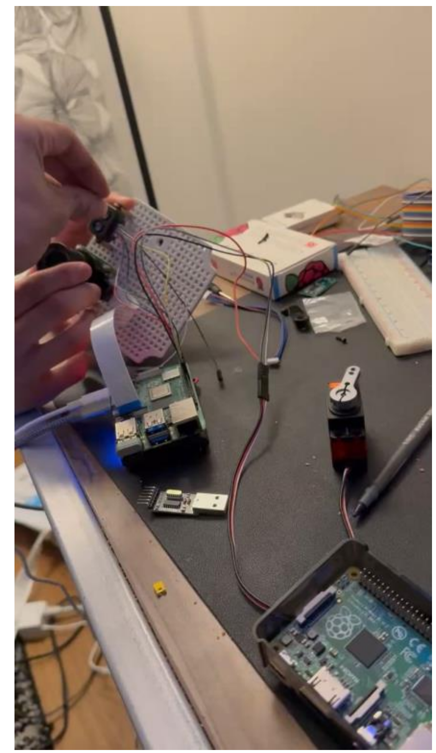


Week 2: Combine sensor and servo code and test

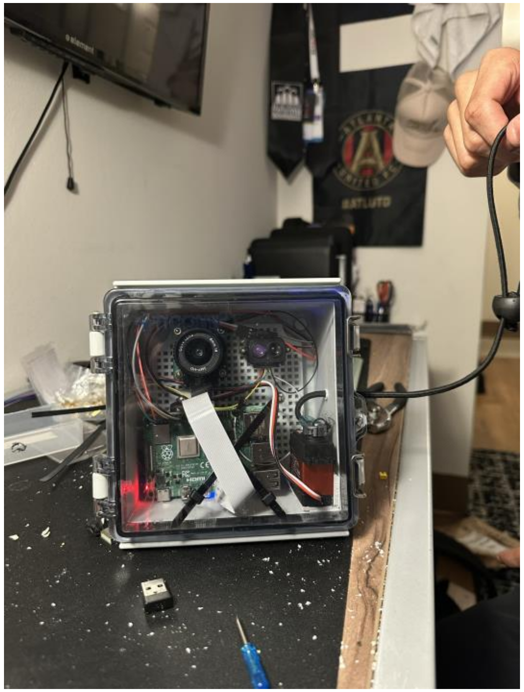




Week 3: Have portable battery power the system, mount sensing system to protective casing



Final Solution Design



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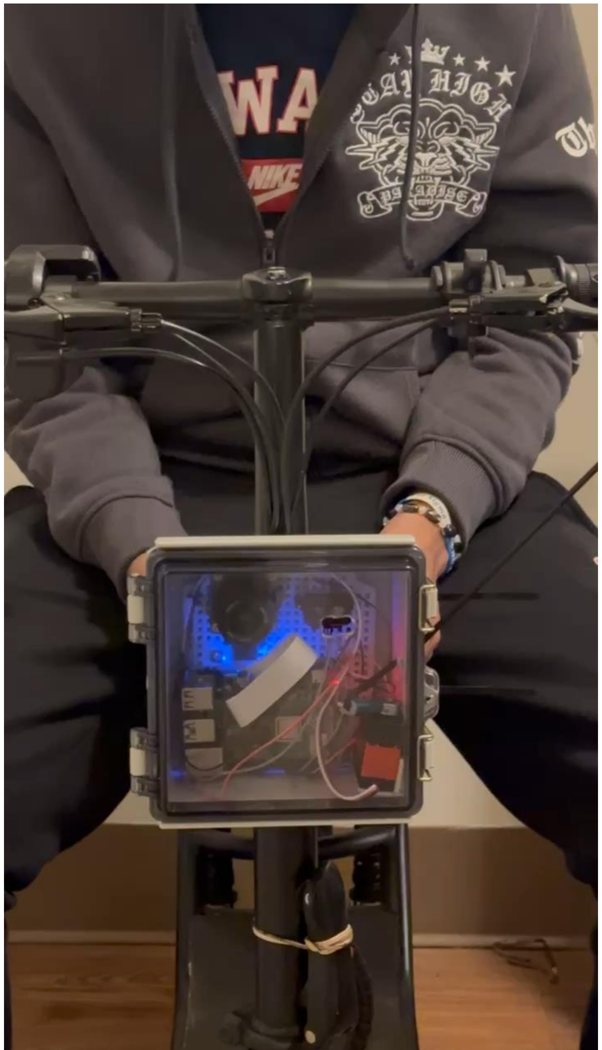
Final Solution Design



Conclusion

- Everything is working as intended
- With a different type of rope, we anticipate that our system will properly assist in braking
- Learned a lot about scooters, raspberry pi's and python
- Is all about the journey and not the outcome, we learned a lot from the mistakes made and will apply these lessons to future projects

Thank You!