



UNIVERSITY OF
ILLINOIS
URBANA-CHAMPAIGN

Team 55 Final Presentation

Electrical & Computer Engineering

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- Rodents destroy lawns, gardens, and farmer's soil
- Current systems are ineffective
- Create a new solution using novel technologies





Design



- Naïve method needs manual application



- Ultrasonic methods are binary and inefficient
- No localization

Requirements



Accuracy

Detect rodent with accuracy of >90%



Durability

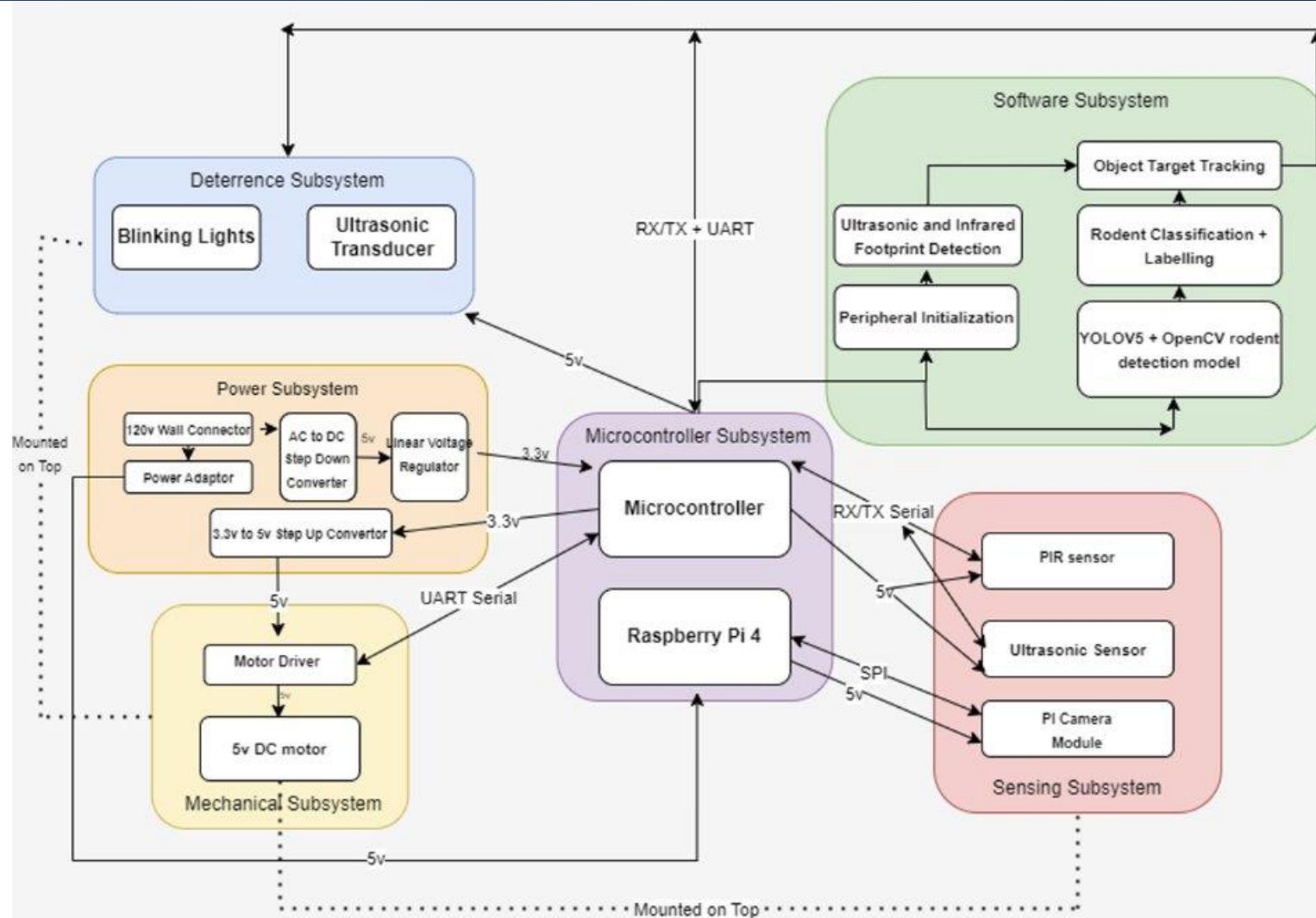
Long lasting parts for extended use



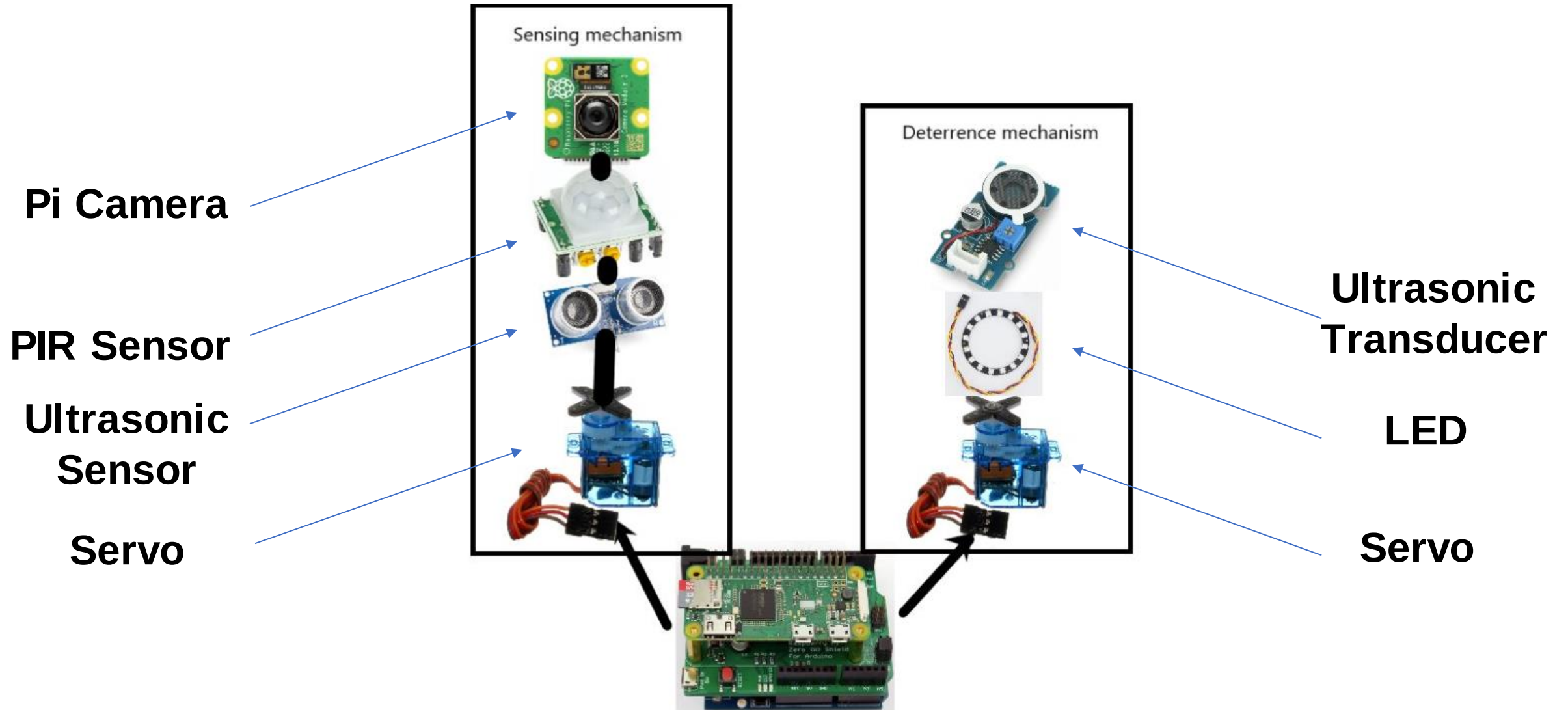
Range

Detect up to 10m with 360° FOV

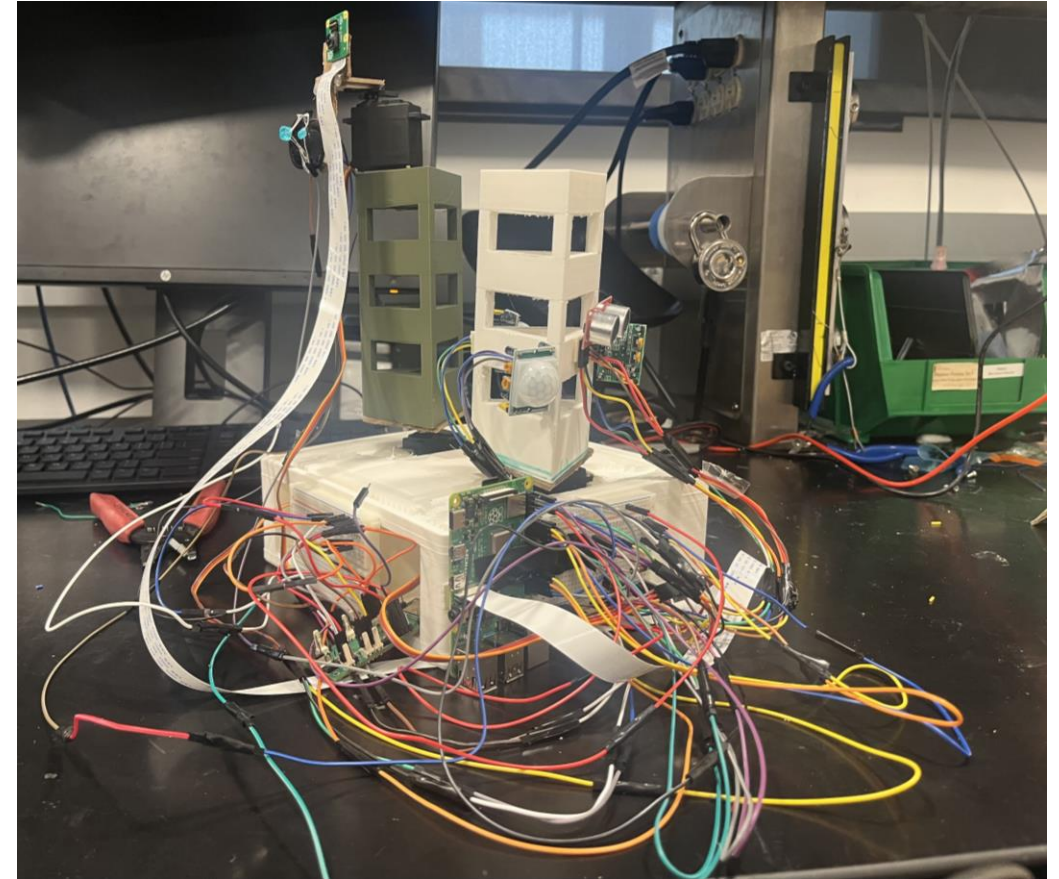
Block Diagram



Block Diagram



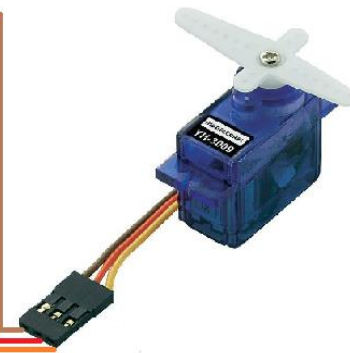
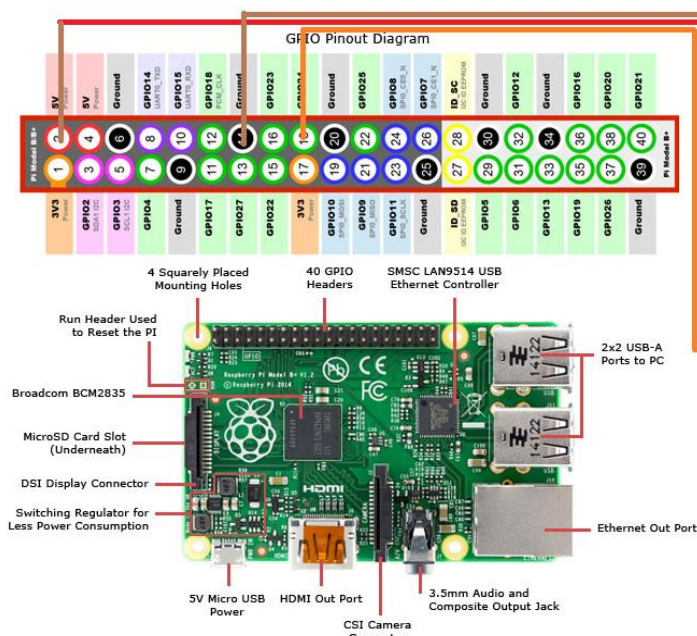
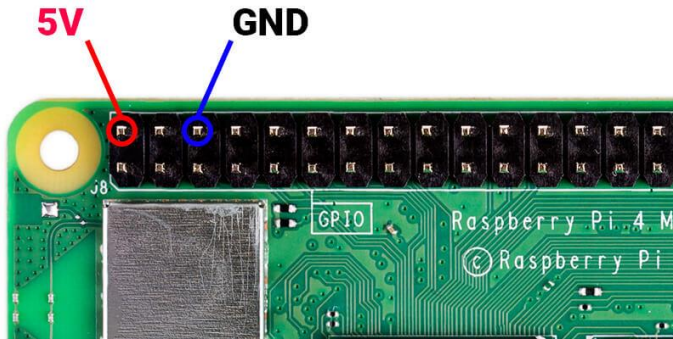
Final Design



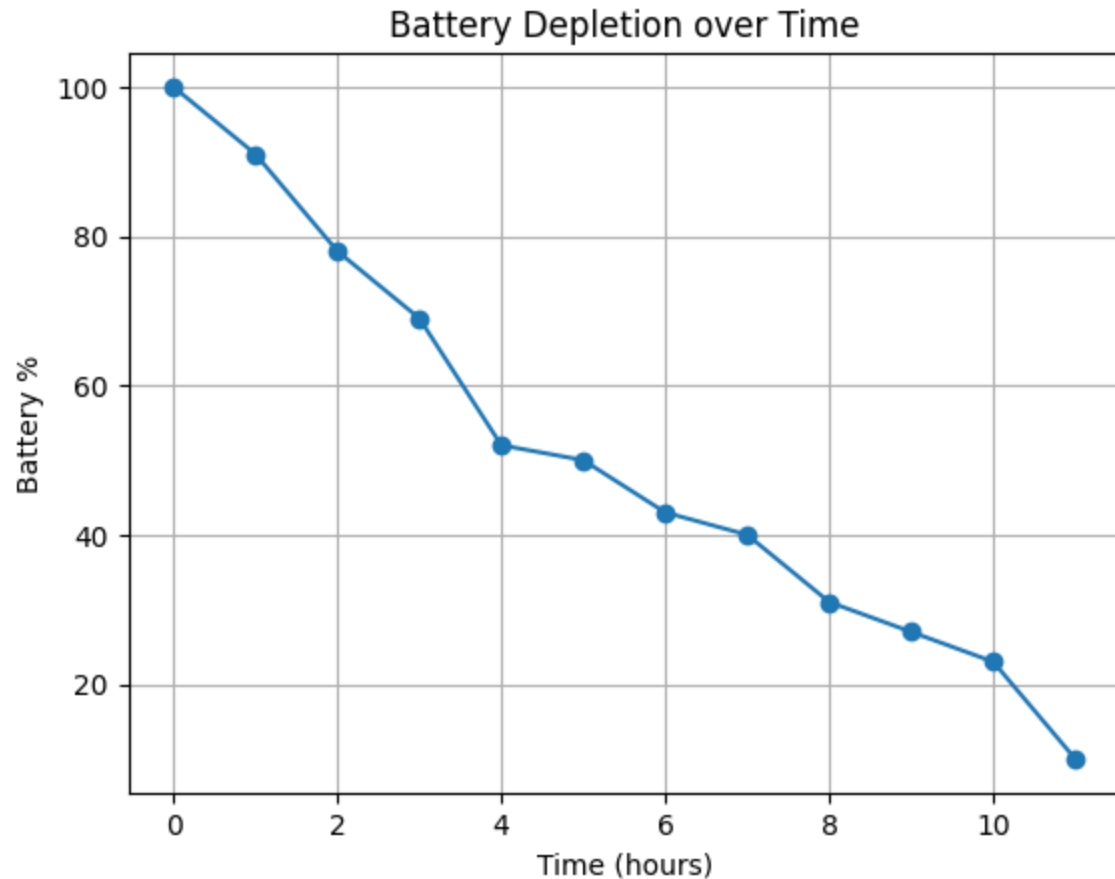
Subsystems

1. Power
2. Sensing
3. Software
4. Mechanical
5. Deterrent
6. Microcontroller

Power Input for Sensors



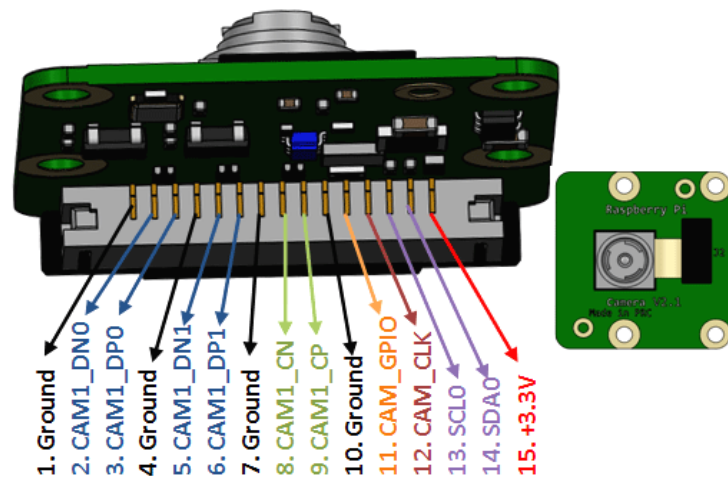
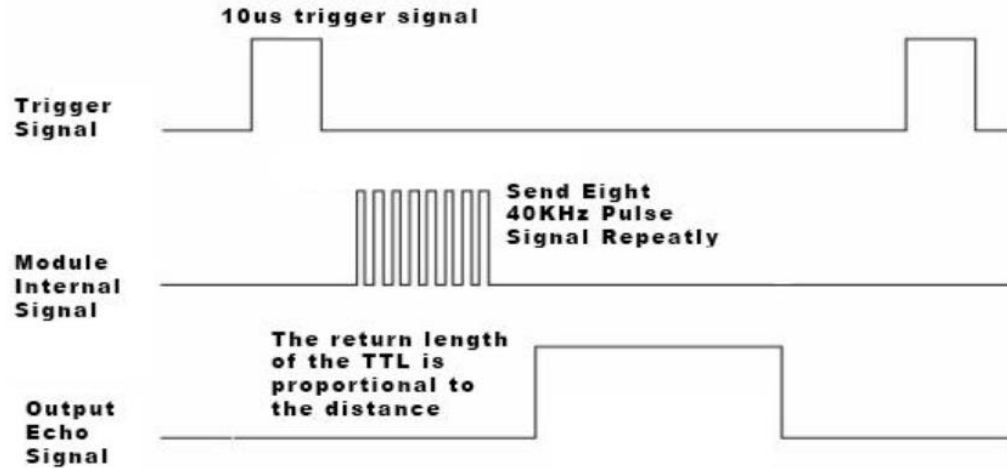
- 5V I/O for Raspberry Pi 4
 - Servo
 - PIR
 - Ultrasonic
- RPI 4 3.3V GPIO
 - PIR Sensor
 - Ultrasonic TRIG & ECHO
 - Strobe LED
 - Ultrasonic Transducer
 - Camera through Ribbon Cable
 - Signals for Servo



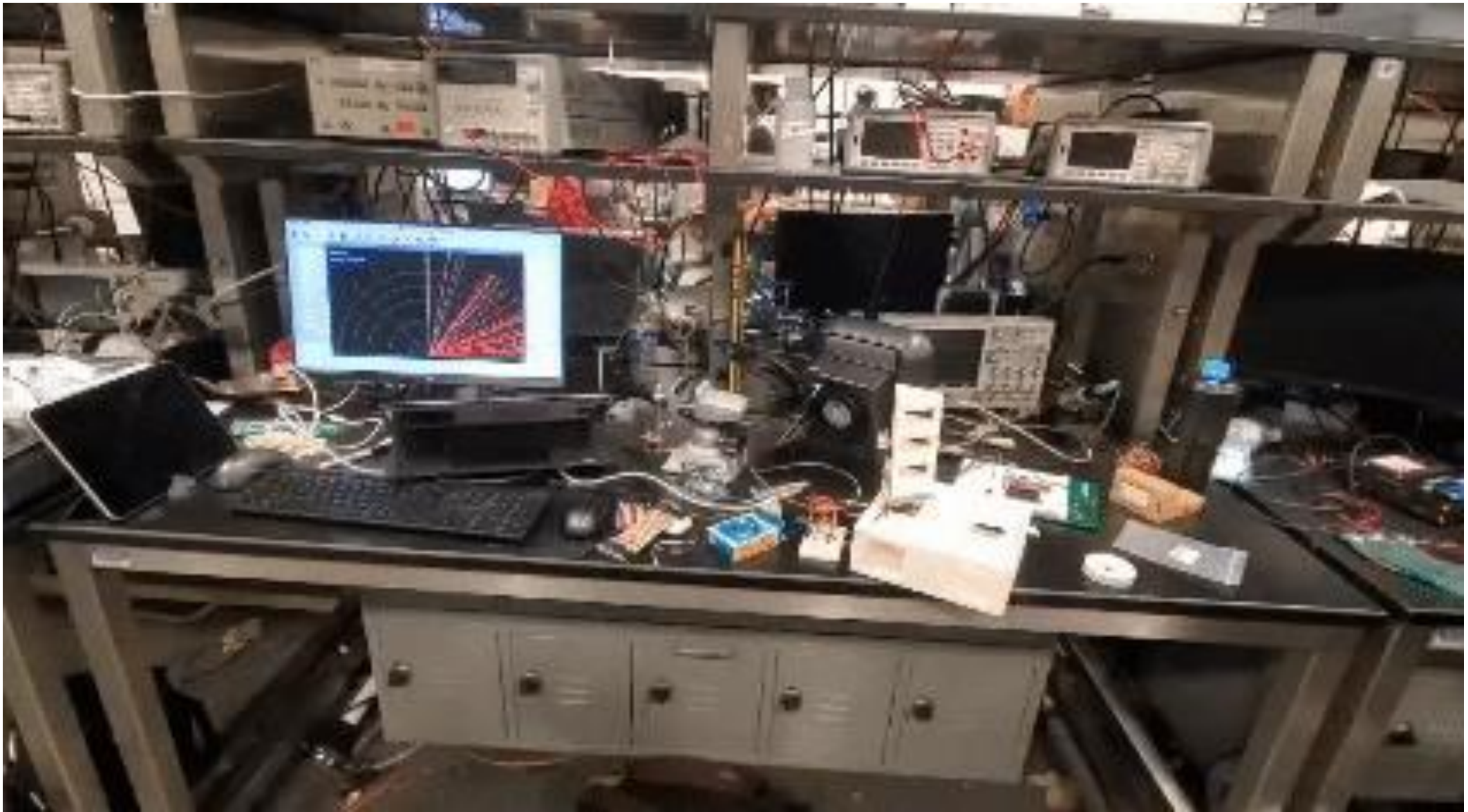
- Raspberry Pi frequently runs into Low Voltage Errors
- Use of Custom PCB
- Custom Logic to conserve power and only use servos when necessary
- Tested on 10000 mAh battery

Subsystems

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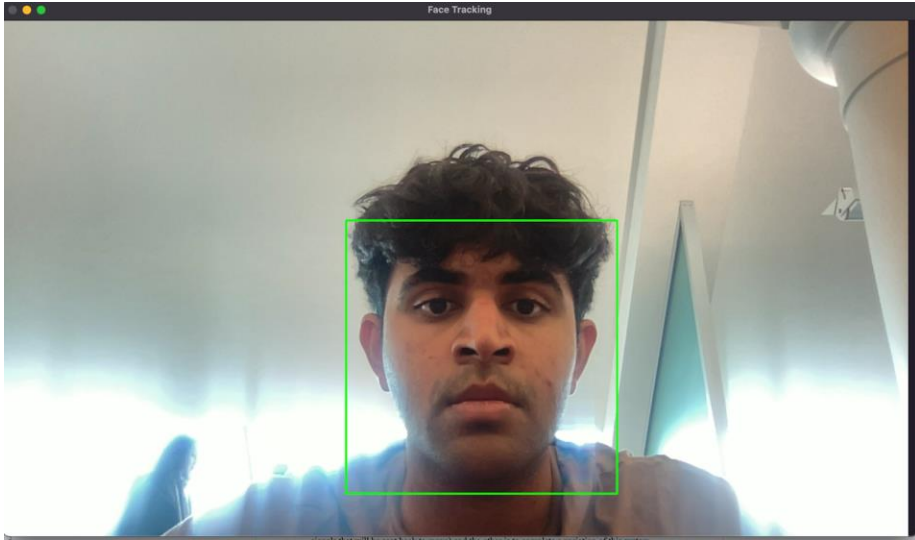


- PIR Motion Sensor
 - Used to detect motion
- Ultrasonic Distance Sensor
 - Sends frequent ultrasonic pulses to detect distance and surrounding area
- Raspberry Pi Camera Module
 - Used for target detection and target tracking

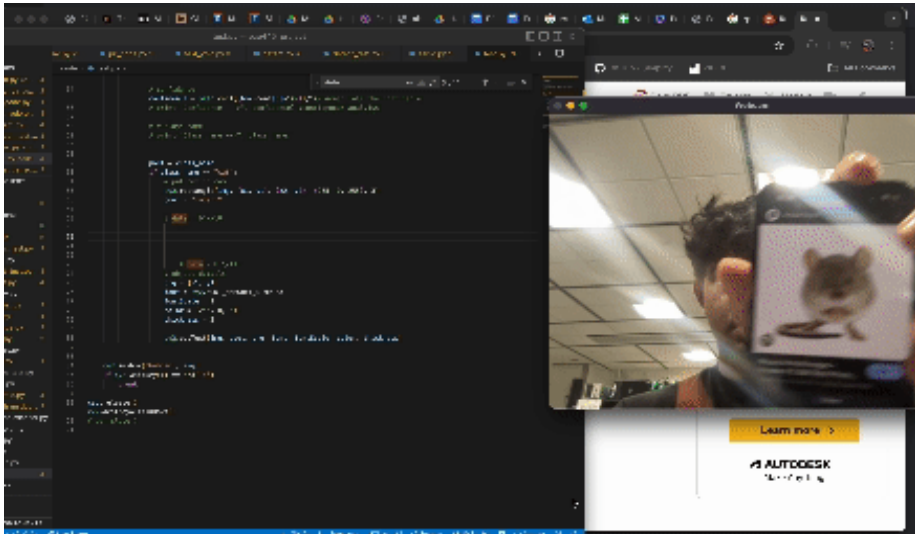


Subsystems

1. Power
2. Sensing
3. **Software**
4. Mechanical
5. Deterrent
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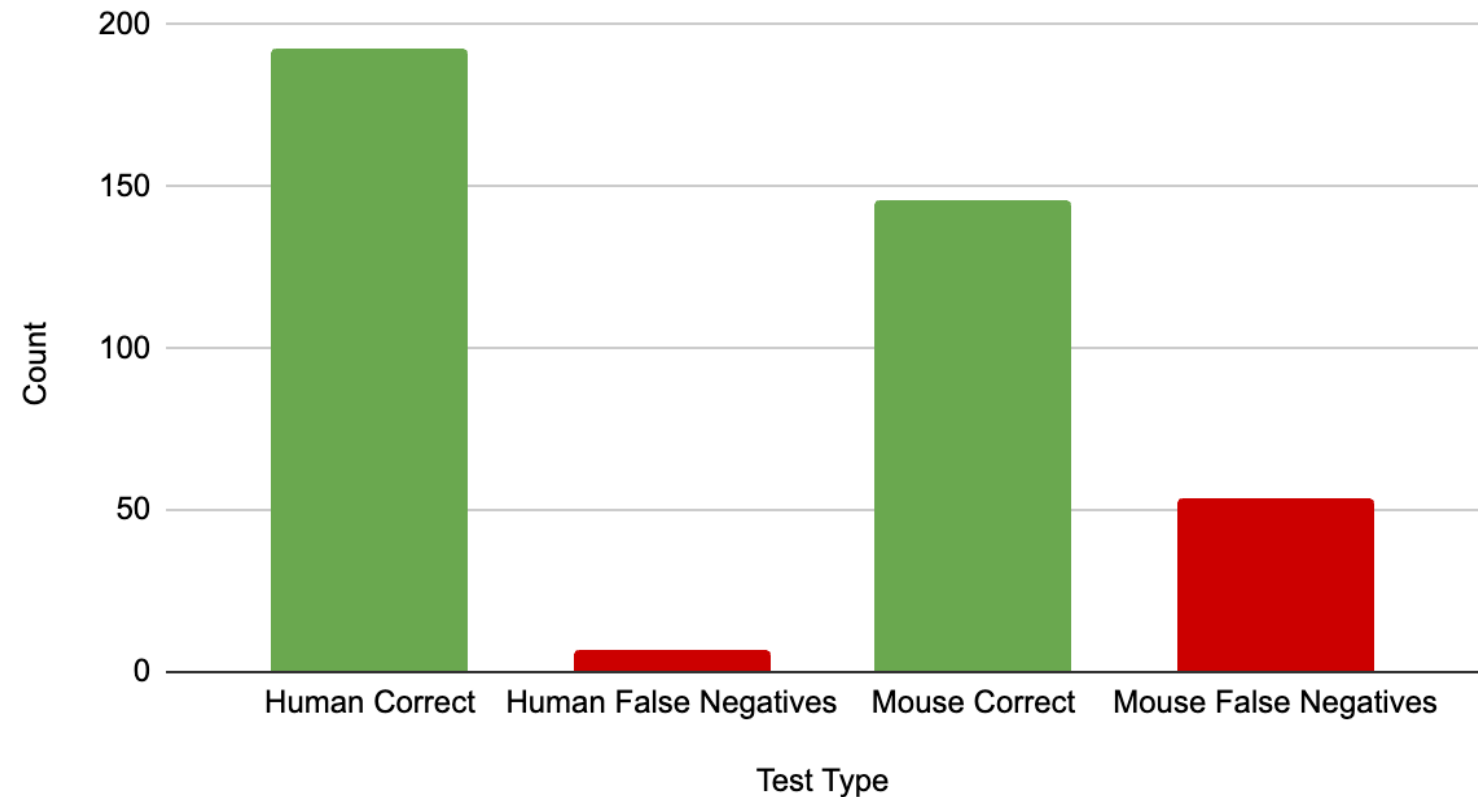


- Human detection models
- YOLOv8n Model (3.2 million params)
- Finetuned model to detect certain rodents on dataset (mouse, racoon etc.)



- Object Detection Difficulty
- Model Accuracy Reduced
- Expensive to Run

Humans vs Mouse Recognition Accuracy



Subsystems

1. Power
2. Sensing
3. Software
- 4. Mechanical**
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High Torque – 9.4 N•m



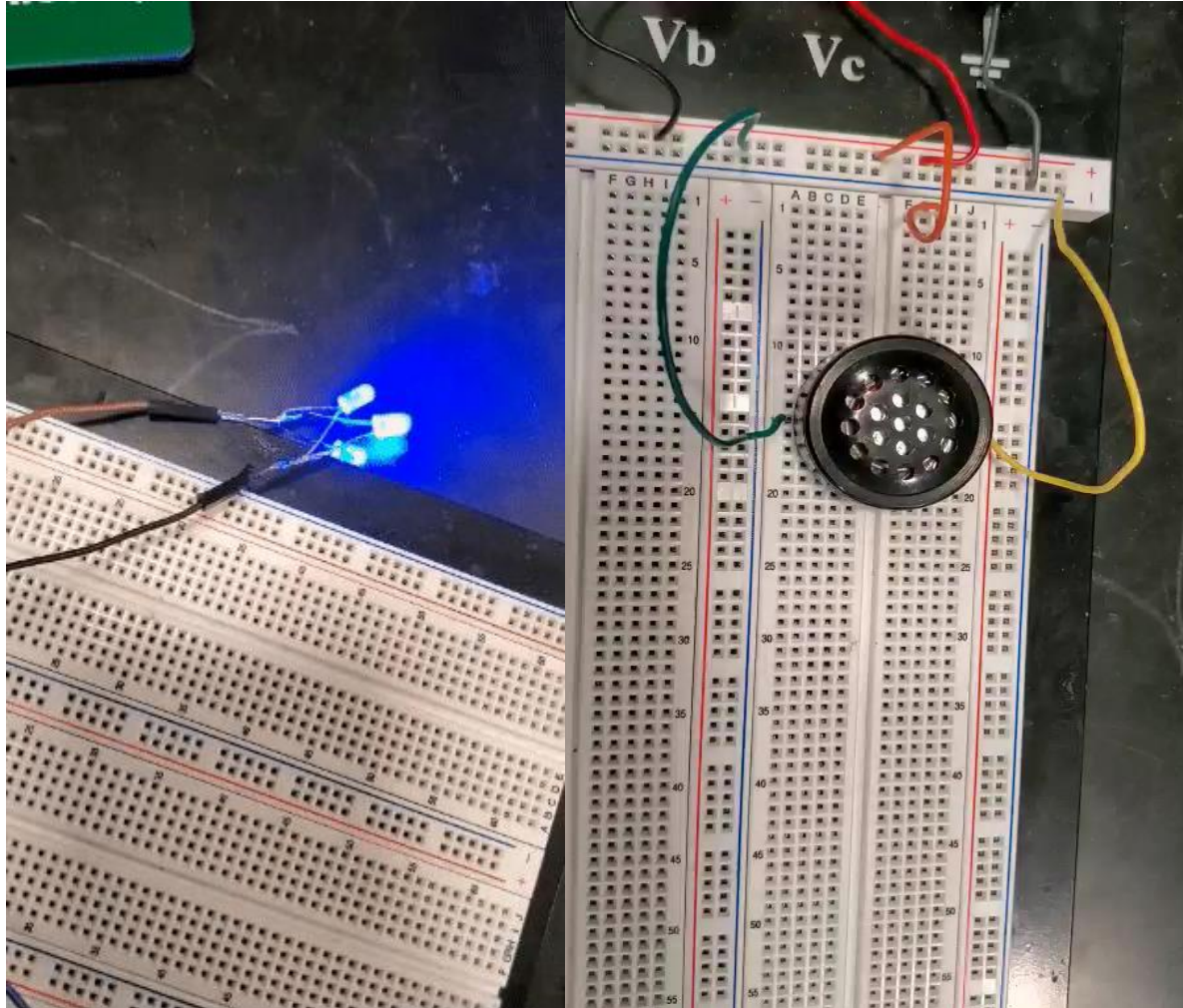
Precision rotations



Double Servo Integration for 360°
FOV

Subsystems

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- 5. Deterrent**
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Strobe Lights

- Three blue LEDs in parallel
- 3.3V
- Input – Raspberry GPIO 10Hz

Buzzer/Ultrasonic Transducer

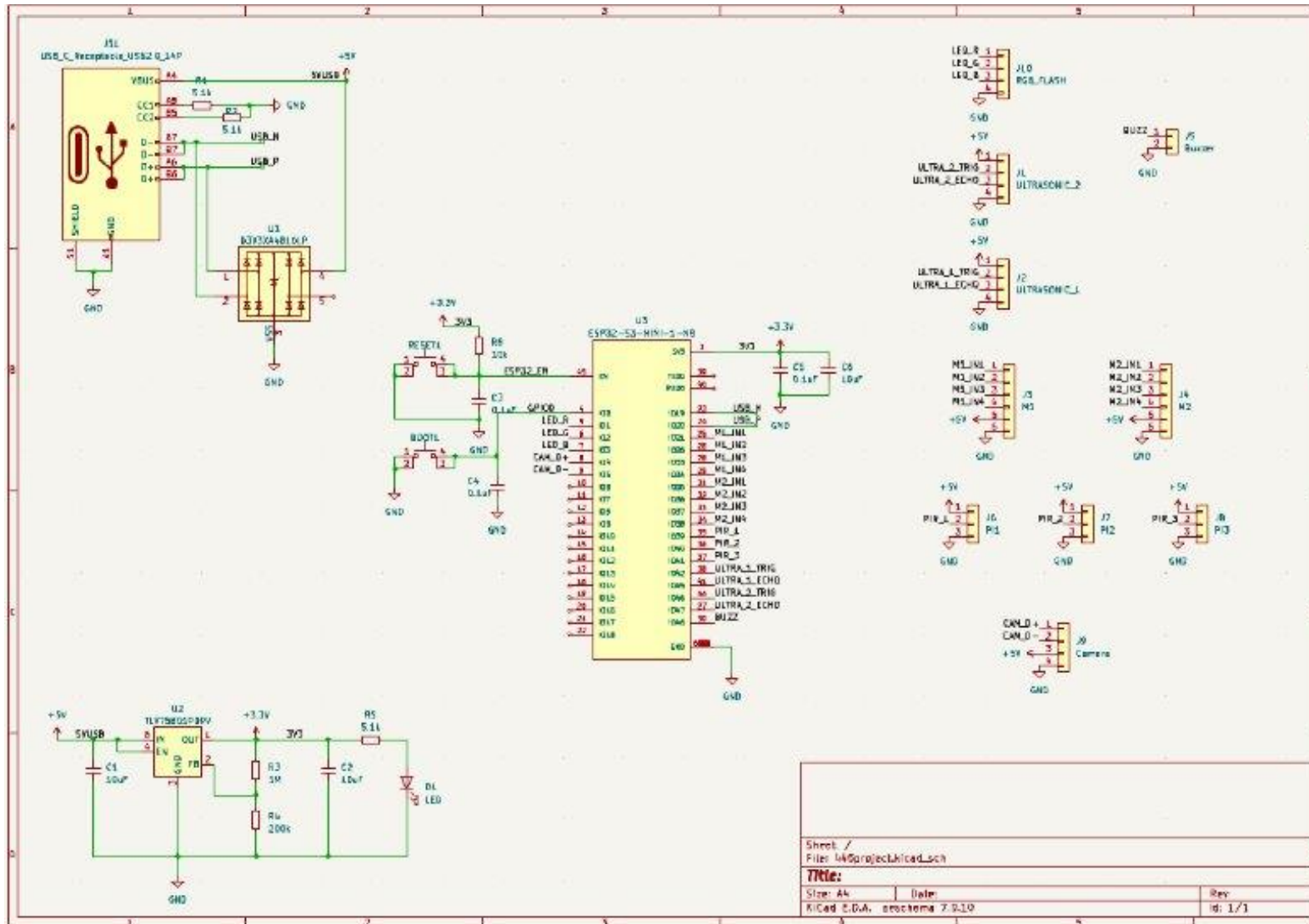
- 3.3V
- Input – Raspberry GPIO 20kHz

Ultrasonic Frequency Range

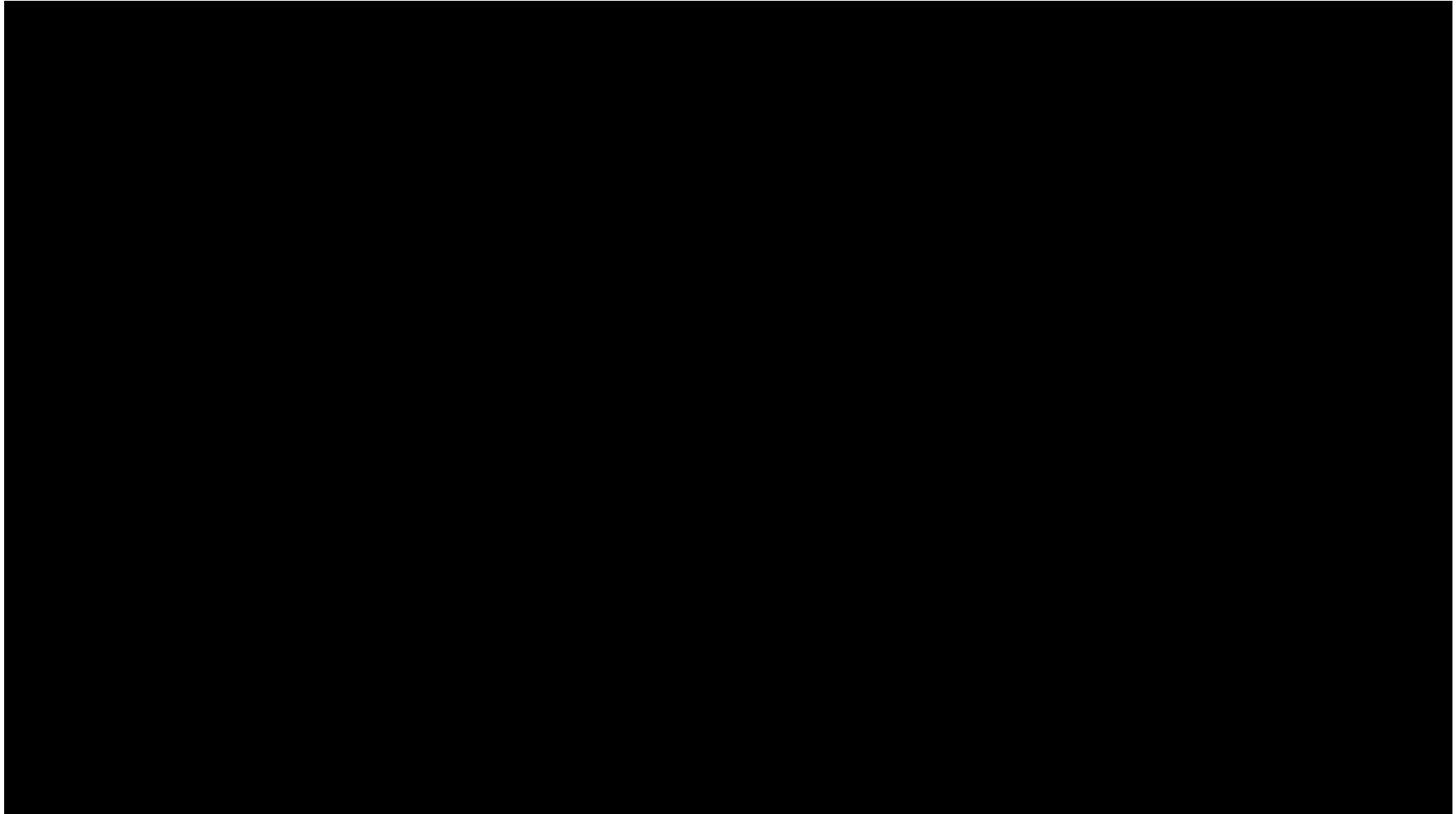


Subsystems

1. Power
2. Sensing
3. Software
4. Mechanical
5. Deterrent
6. **Microcontroller**



Results



Conclusion



Compute

More compute power to perform CV based code



Adapt

Changes to design based on unexpected obstacles



Strategic

Big picture thinking to combine multiple complex parts

Future Work



Recognize new targets



Efficient cameras and algorithms



Handling for multiple objects in view



Localize work



Improved packaging



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