U.M.B.R.A.

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Abstract

Our project enhances motorcyclist safety and comfort by integrating a heads-up display (HUD) and blind spot monitoring into the helmet. A network of sensors gathers real-time data, which is shown via discreet LEDs and a minimalist HUD, helping riders stay informed without distraction. The helmet's UI allows for customization, while features like auto-adjusting brightness ensure visibility in all conditions. By reducing the need for manual blind spot checks, our design offers a safer, more seamless riding experience.

Hardware

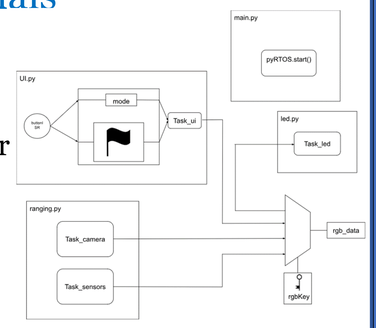
- OpenMV CamH7 Plus
- Arduino UNO (C)
- VL53L1X ToF sensors
- PCBs and breakout boards
- Rotary encoder
- Switch & Reed switch
- NeoPixel LEDs
- OLED 128x32 mm

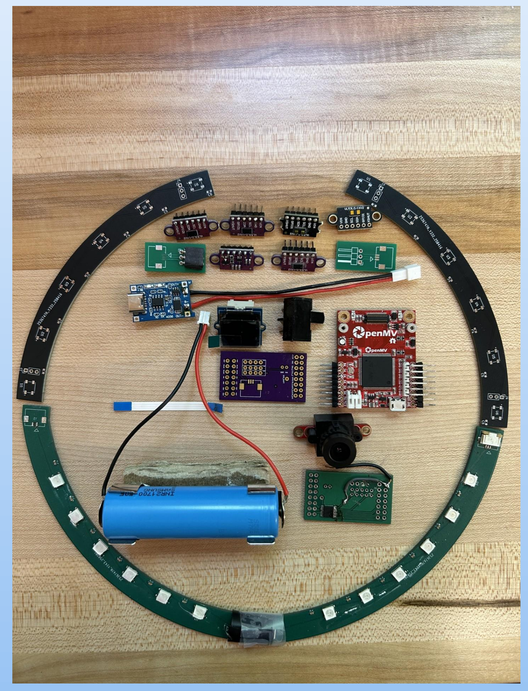
Software

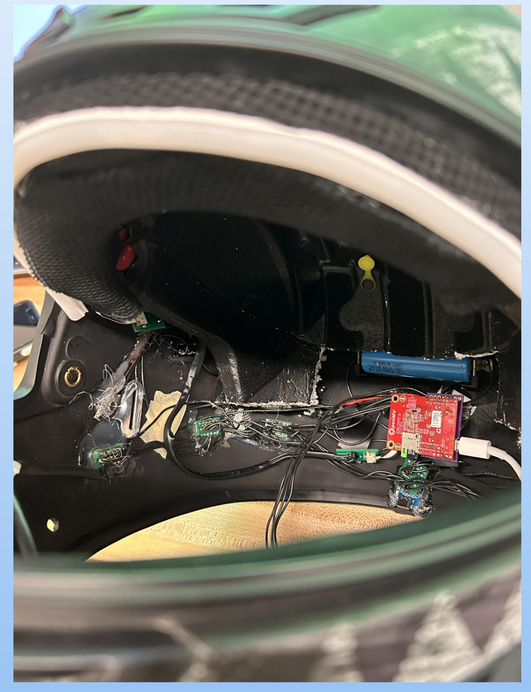
- VS Code
- OpenMV IDE (MicroPython)
- Arduino IDE
- GitLab
- Jupyter Notebook
- KiCad
- LTspice

Tools and Materials

- Oscilloscope
- Multimeter
- Power supply
- Waveform generator
- Soldering iron
- Drill and Dremel
- Helmet
- LED diffuser
- Magnets







Capstone Project 2025
Electrical & Computer Engineering Program

Motivation

A substantial portion of motorcycle collisions involve other vehicles entering the rider's path. These types of incidents happen too quickly for many riders to respond, especially when the threat comes from behind or a blind spot. Traditional motorcycle helmets are a passive safety measure meant for reducing injury. However, we were motivated to create a proactive safety measure that held the sane protective capabilities but also could aid in the prevention of an accident all together.

Results

- ToF sensors are accurate up to 3 meters in minimal to medium light conditions
- ADC reads and sends accurate voltage measurements
- OLED displays correct color mode, battery percentage, LED brightness and bootup
- Expected battery life at full operation 20+ hours and approximately 3 hour charge time
- UI responds promptly (milliseconds)
- Machine learning model detects objects at 98% accuracy up to 120 feet.

Future Direction

- Improve Model for better accuracy
- Include LiDAR
- Develop project specific version of OpenMV Dev Board
- More exhaustive testing
- DOT compliant

Thank You

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