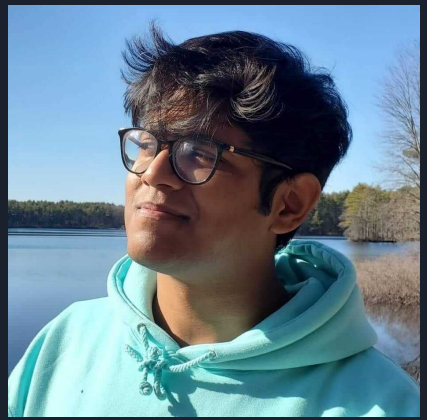

SafeX
Helping Riders Stay Safe

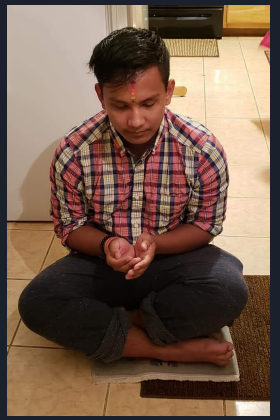
# The Team



Dhruv Vikram Krishna
Computer Engineer

Jeffrey Wang
Computer Engineer

Paige Wadas
Electrical Engineering



Siddhanta Shrestha
Computer Engineer

# Our Project

# Problem Statement

Majority of products for motorcyclists are tailored for convenience rather than safety.

Typically riders must manually check their blindspots via side-mirrors and shoulder checks.

This becomes a hazard for riders as they become distracted when doing so. After vehicle accidents, there is no efficient way contacting emergency services in products on the market.

Our solution will address these issues by notifying riders of necessary information while on the road and providing post-crash safety measures to better their safety.

# Quick Review of SafeX

- There are alot of safety features available for cars that are not accessible to motorcycles.
  - Additionally, there are also missing features that should be available to motorcyclists.
- We hope to bring some of those safety features to motorcycles in order to ensure the safety of riders.

# Project Goal

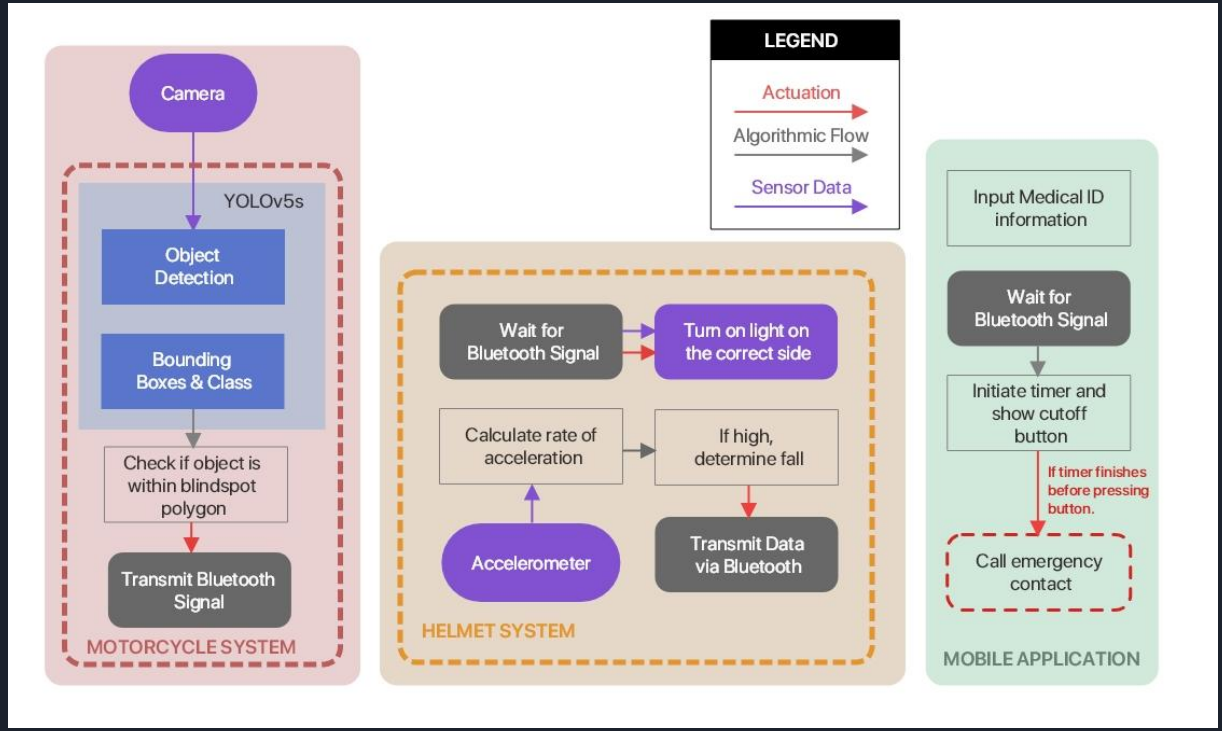
To create a two part device that is attachable to a motorcycle and helmet. The system should notify riders of oncoming vehicles within their blindspots to increase rider safety, and alert emergency services if the rider gets into a crash.

# Design

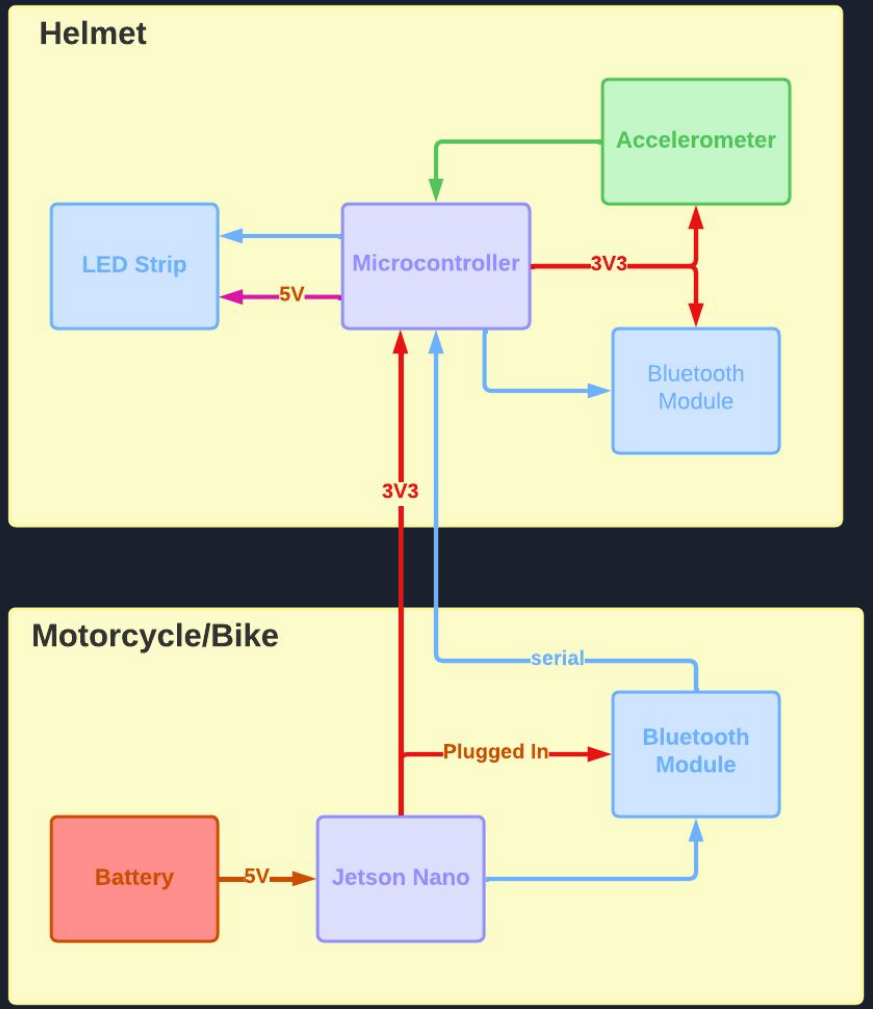
# Updates

- Moved to App
  - Cutoff sequence
  - Cellular and GPS module
- No PCB on the motorcycle
  - Only using the Jetson Nano and Camera on the motorcycle

# Software Design



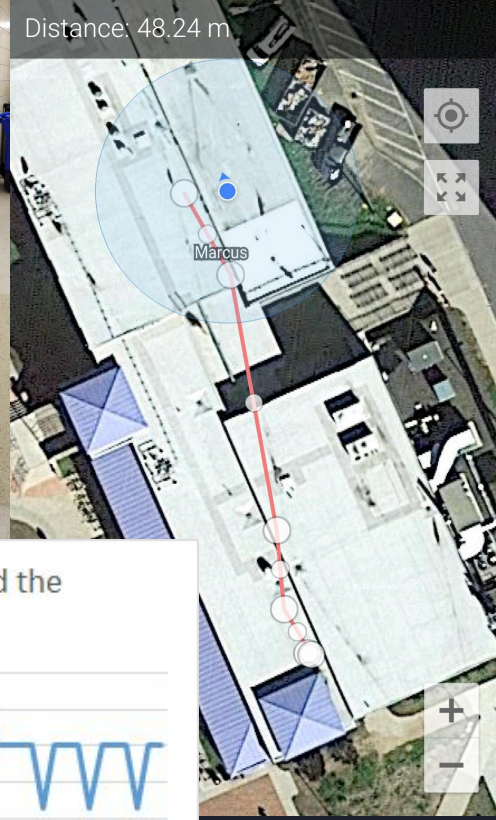
# Hardware Design

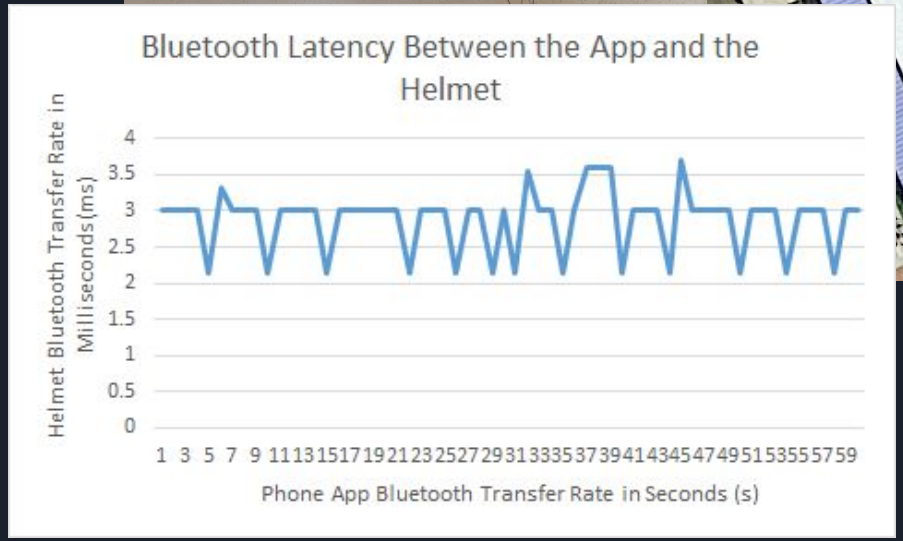


# Specifications: Bluetooth

- The EMB1061 on the helmet
  - Bluetooth 4.2
  - Data Rate 2 Mbps
    - *Specification Verified*
  - 0.105822 Ounces
  - Range of appx 50 meters
    - *Specification Verified*

- The USB Bluetooth Adapter on the Jetson Nano
  - Bluetooth 4.0
  - Data Rate 3 Megabits Per Second
    - *Specification Not Verified*
  - Weight 0.1 Ounces
  - Range of appx 50 meters
    - *Specification Not Verified*



# Specifications: Blind Spot Detection

- The blind spot detection system must identify the user of dangerous vehicles in the blindspot in highway scenarios, adjacent lanes and behind.
  - *Specification Verified*
- If a vehicle is detected in the blind spot of the motorcycle, color LEDs will change to indicate how close the vehicle/object is to the motorcycle.
  - *Specification Not Verified*
- If a vehicle is detected in the blind spot of the motorcycle, LEDs will be used to notify the rider on the correct side of the object detected – left or right or both.
  - *Specification Verified*
- The blind spot detection algorithm will process at least 10 frames per second.
  - *Specification Verified*
- The blind spot detection system must detect all vehicles within the blind spot region with a detection accuracy of at least 91%.
  - *Specification Verified*

# Specifications: Fall Detection

- The true fall detection rate for 4 types [1] link of falls should be no less than 93% [2]link with no more than 10% error margin false fall detection for each type of fall.
  - *Specification Verified*
- If a fall is detected, LEDs and phone app will be used to notify the rider.
  - *Specification Verified*

| Type of Fall | Number of Falls | Number of Detected Falls | Number of false positive | Number of False Negatives |
|---|---|---|---|---|
| Left High | 30 | 27 | 0 | 3 (9%) ~7m/s² |
| Left Low | 30 | 26 | 0 | 4 (13.33%) ~9.5m/s² |
| Right High | 30 | 29 | 0 | 1 (3.33%) 13.43m/s² |
| Right Low | 30 | 30 | 0 | 0 |
| **Total** | 120 | 112 | 0 | 8 (6.67%) |


[1] Petit, Logan et al. "A review of common motorcycle collision mechanisms of injury." *EFORT open reviews* vol. 5,9 544-548. 30 Sep. 2020, doi:10.1302/2058-5241.5.190090

[2] Tran Tri Dang, Hai Truong and Tran Khanh Dang, "Automatic Fall Detection using Smartphone Acceleration Sensor" International Journal of Advanced Computer Science and Applications(IJACSA), 7(12), 2016. http://dx.doi.org/10.14569/IJACSA.2016.071216

# Specifications: Hardware

Helmet

- PCB size does not exceed 3.5’’x3.5’’
  - *Satisfaction verified*: 2.66’’ x 3.12”
- Does not consume more over 2A
  - *Satisfaction verified*: absolute max 1.85A
- System will last for at least 2hrs
  - *Satisfaction verified*: minimum of 4 hr 25 min
    - Battery: 5V 2A; 5Ah

Motorcycle

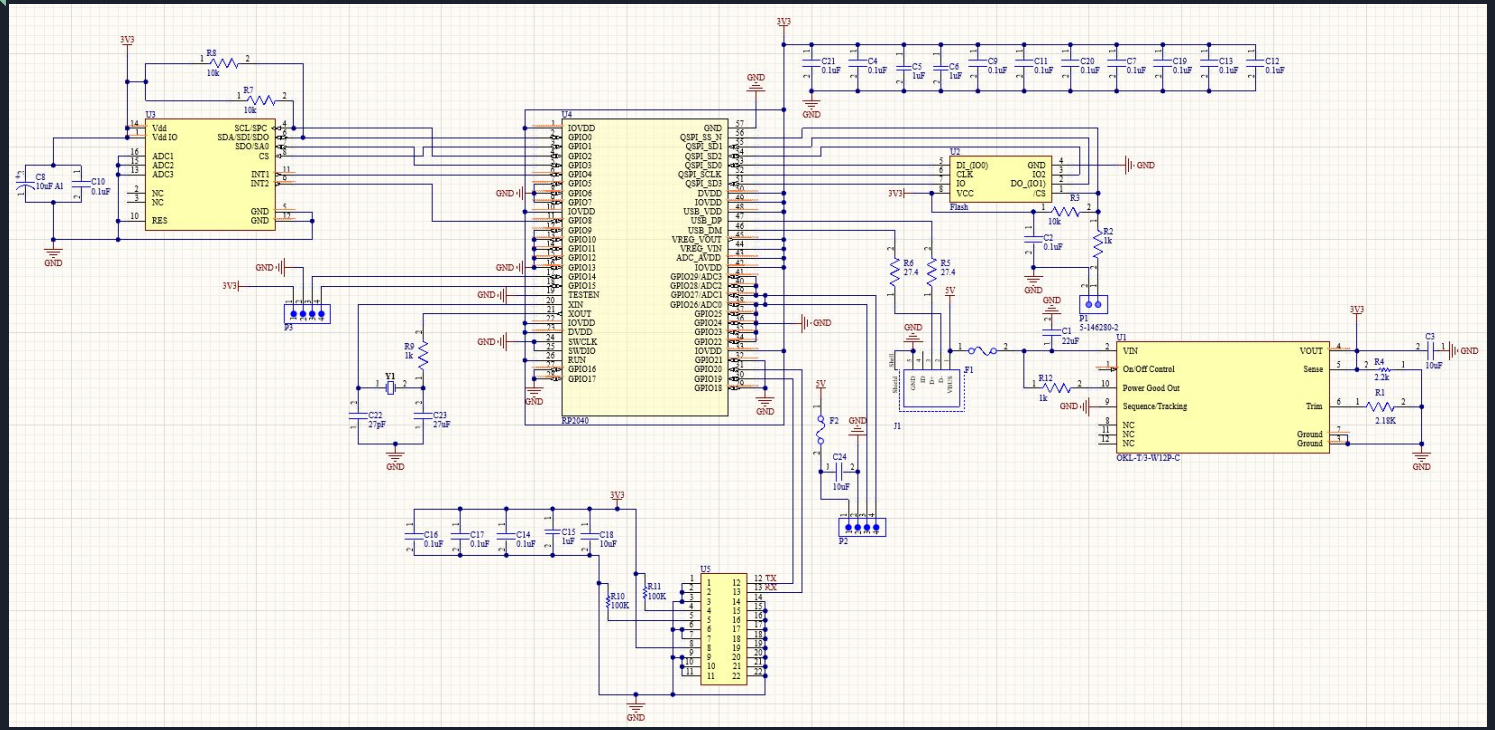
- Power consumption is within range for  a motorcycle port to use as the external 5V power source
  - *Satisfaction verified*

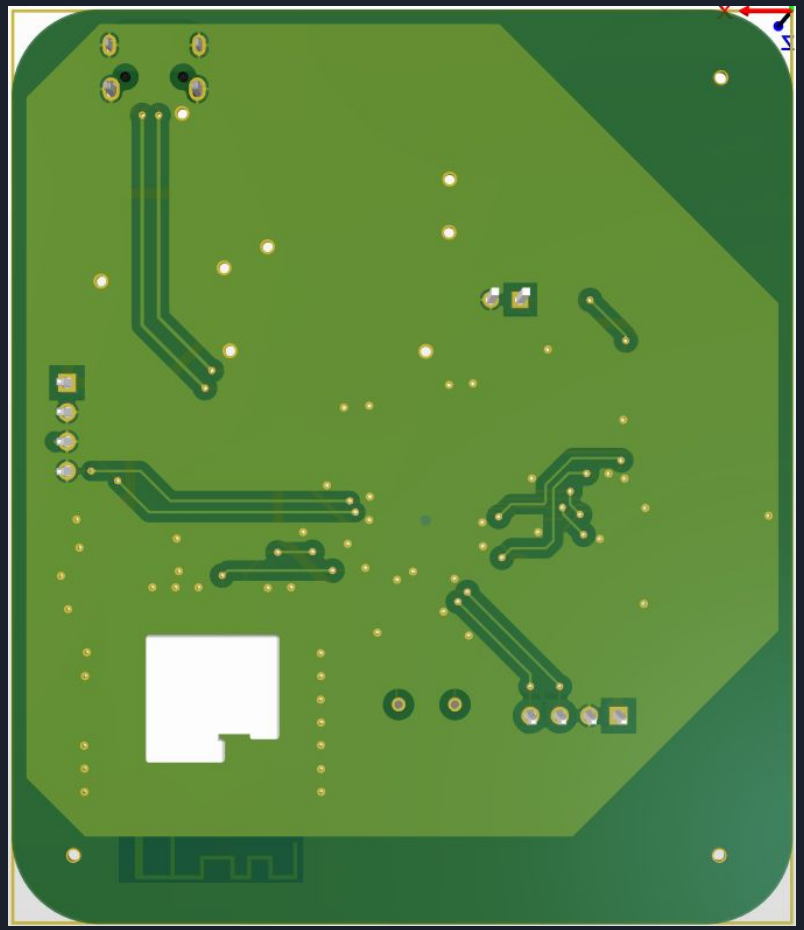
System

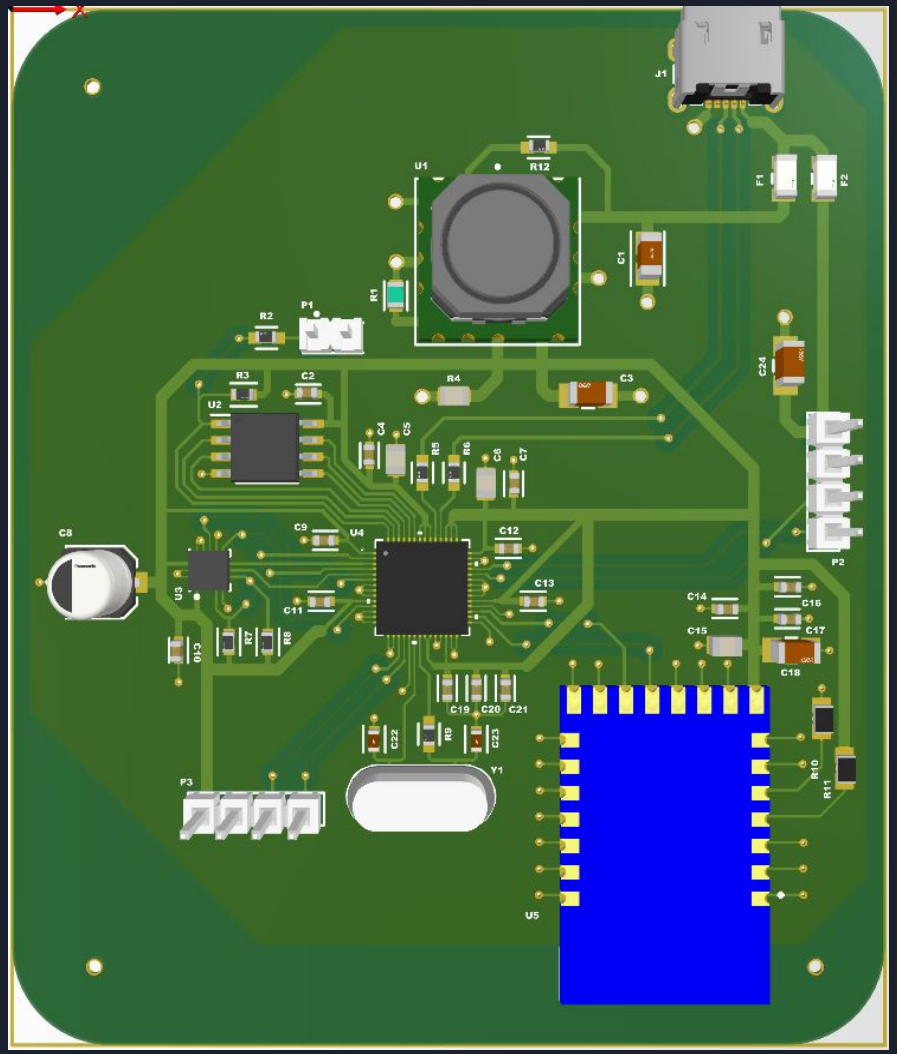
- System is portable and compact
  - *Satisfaction verified*
    - *AC battery bank is only for demo*

# PCB

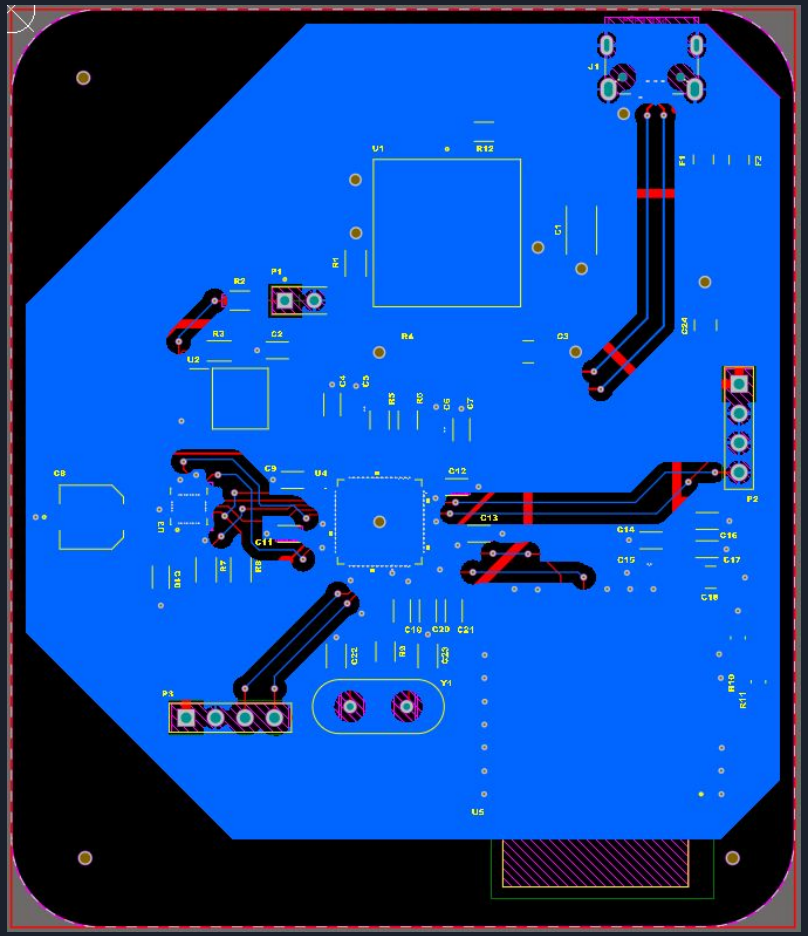
# PCB: Schematic

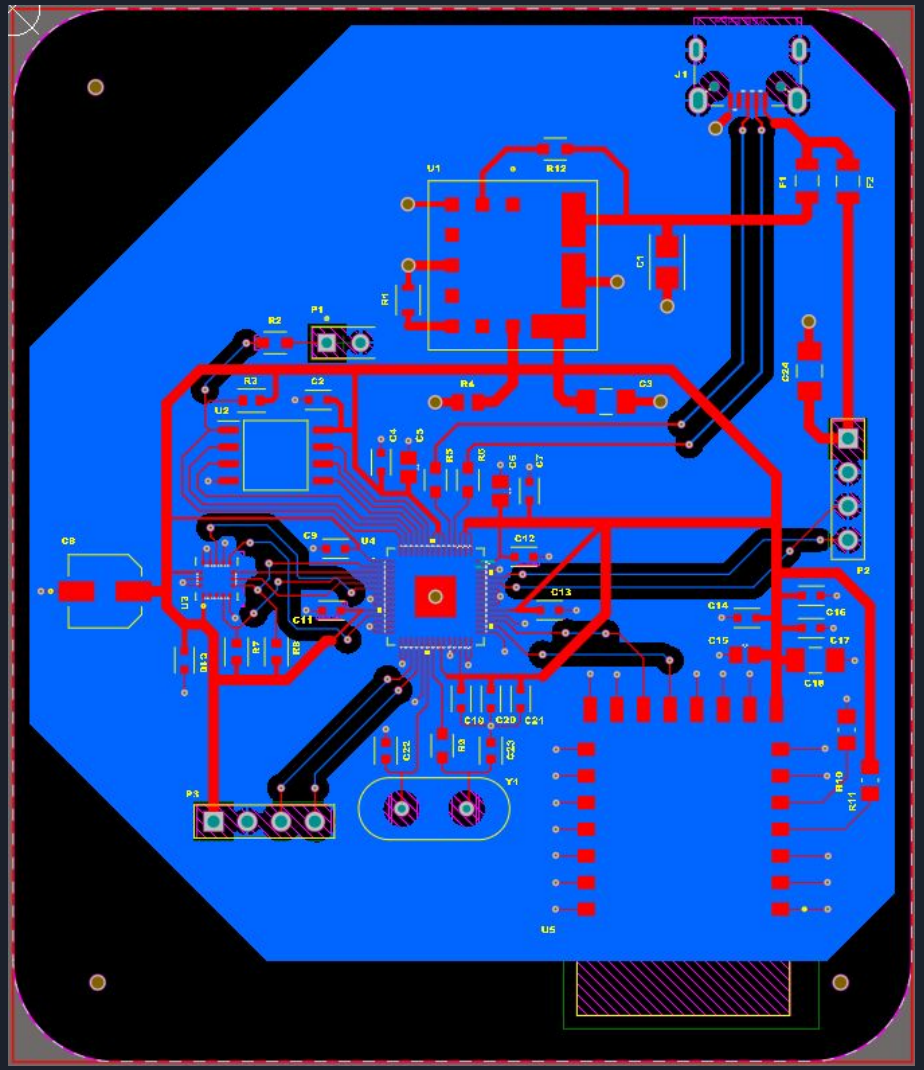







# PCB: Board Layout





# PCB: Board Layout

# FPR

# Deliverables

- Refurbished website
- Built and functioning custom PCB
- Helmet and Motorcycle components mounted in compact custom enclosures
- Proximity detection implemented for at least 2 ranges
- Luminosity of LEDs determined by light sensor
- Wireless bluetooth connection from motorcycle to helmet
- Refurbished app
- GPS tracking for emergency services alert on app
- Implementation of API for calling emergency services

# Timeline

***Legends***
**Dhruv = DVK**
**Jeff = JW**
**Paige = PW**
**Sidd = SS**

| Task | | Team Member(s) | Start — End Dates | Spring Break 3/14 — 3/19 | | | | | Week 1 3/21 — 3/25 | | | | | Week 2 3/28 — 4/1 | | | | | Week 3 4/4 — 4/8 | | | | | Week 4 4/11 — 4/15 | | | | | FPR 4/19 — 2/22 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | M | T | W | TH | F | 1 | 2 | 3 | 4 | 5 | M | T | W | TH | F | M | T | W | TH | F | M | T | W | TH | F | M | T | W | TH | F |
| **Overall System** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Website Design refined | SS | Spring Break | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | PCB Building and Testing | PW | 12/20 — 2/1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Enclosures for motorcycle and helmet | PW, DVK | 2/2 — 2/11 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Phone app refined | JW | Winter Break | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Blindspot Detection** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Proximity Detection | DVK | 12/20 — 1/28 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Implimention for light sensor to determine intesity of the lights | DVK | 1/31 — 2/11 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Bluetooth transmission for motorcycle to helmet | JW | 2/8 — 2/23 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Fall/Crash Detection** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | GPS tracking for ES alert on app | JW, SS | 2/2 — 2/22 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Fall detection functioning on PCB microcontroller | SS | 2/10 — 2/22 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Implimentation of Noonlight API for calling ES | JW | 2/22 — 2/4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

# Budget

| Item | Cost | Quantity | Total |
|---|---|---|---|
| **Motorcycle:** | | | |
| HQ Camera | $50.00 | 1 | $50.00 |
| Wide Angle Lens | $25.00 | 1 | $25.00 |
| Accelerometer & Gyroscope (MEMS) | $6.95 | 1 | $6.95 |
| Raspberry Pi 3 A+ | $25.00 | 1 | $25.00 |
| USB V4.0 Bluetooth Adapter | $13.95 | 1 | $13.95 |
| | | | |
| | | **M Subtotal** | $120.90 |
| | | | |
| Item | Cost | Quantity | Total |
| **Helmet** | | | |
| Light Sensor | $4.50 | 1 | $4.50 |
| Accelerometer | $4.95 | 1 | $4.95 |
| Raspberry Pi Zero W | $14.00 | 1 | $14.00 |
| SD Card | $9.99 | 1 | $9.99 |
| LED RGB Strip NeoPixel | $17.95 | 1 | $17.95 |
| Level Shifter | $3.95 | 3 | $11.85 |
| Helmet | $69.99 | 1 | $69.99 |
| Dot Star LED | $24.95 | 1 | $24.95 |
| 113990637 Bluetooth Module | $4.00 | 1 | $4.00 |
| Raspberry Pi RP2040 Microcontroller | $1.00 | 1 | $1.00 |
| Adafruit LIS3DH Triple-Axis Accelerometer | $4.95 | 1 | $4.95 |
| PCB Parts | $67.66 | Various | $67.66 |
| | | | |
| | | **H Subtotal** | $235.79 |
| | | | |
| **H & M Subtotal** | $356.69 | | |
| **Total Shipping Costs:** | $93.39 | | |
| **Total** | $450.08 | | |

# Individual Responsibilities

## Dhruv:

- Blindspot Detection Software Lead:
  - Responsible for training machine learning algorithm to detect vehicles in motion and classify them
  - Developing algorithms for object detection and classification for hazards in blindspots with proximity

## Sidd:

- Fall detection software
  - Detection algorithm
- System integration supervisor
- LED user interface
  - Blindspot notification
  - Crash detection notification
  - Fall detection notification
- Website

## Jeff:

- Bluetooth
  - Helmet:
    - Programming
    - Integration with app and bike
  - App: android connection to helmet
  - Bike: accessory on Jetson to connect with helmet
- App programming

## Paige:

- Team Manager
- Hardware Lead
  - Research for system components
  - System design
  - Power considerations
- PCB Lead
  - Altium PCB design
  - Building/Soldering
  - Testing