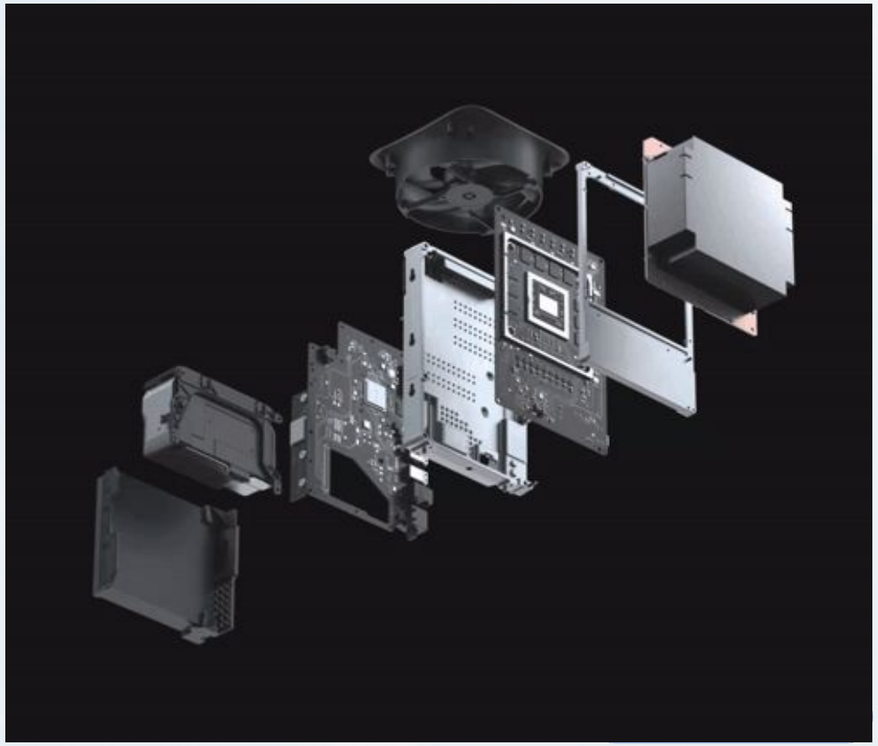
Enhancing Two-Wheeler Safety: The Smart Helmet System



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Project Overview

The Urgent Need for Smarter Road Safety

Road accidents involving two-wheelers are a significant concern globally. A substantial number of these incidents are directly linked to riders not wearing helmets, operating vehicles under the influence of alcohol, or delayed emergency intervention post-accident. Our project directly addresses these critical issues.

Helmet Compliance

Ensuring riders wear protective helmets at all times.

Sobriety Assurance

Preventing riding under the influence of alcohol.

Rapid Emergency Response

Providing immediate alerts in case of accidents or falls.

Core Objectives

Designing a Comprehensive Safety Solution

Our primary objective is to develop a smart helmet system that actively monitors rider conditions and vehicle status to prevent accidents and facilitate rapid assistance.

Helmet Wear Detection

Confirming the helmet is correctly worn before ignition.

Alcohol Detection

Sensing alcohol consumption to disable vehicle operation.

Fall/Accident Detection

Identifying sudden impacts or abnormal tilts indicative of a fall.

Vehicle Ignition Control

Interlocking vehicle start with safety parameters.

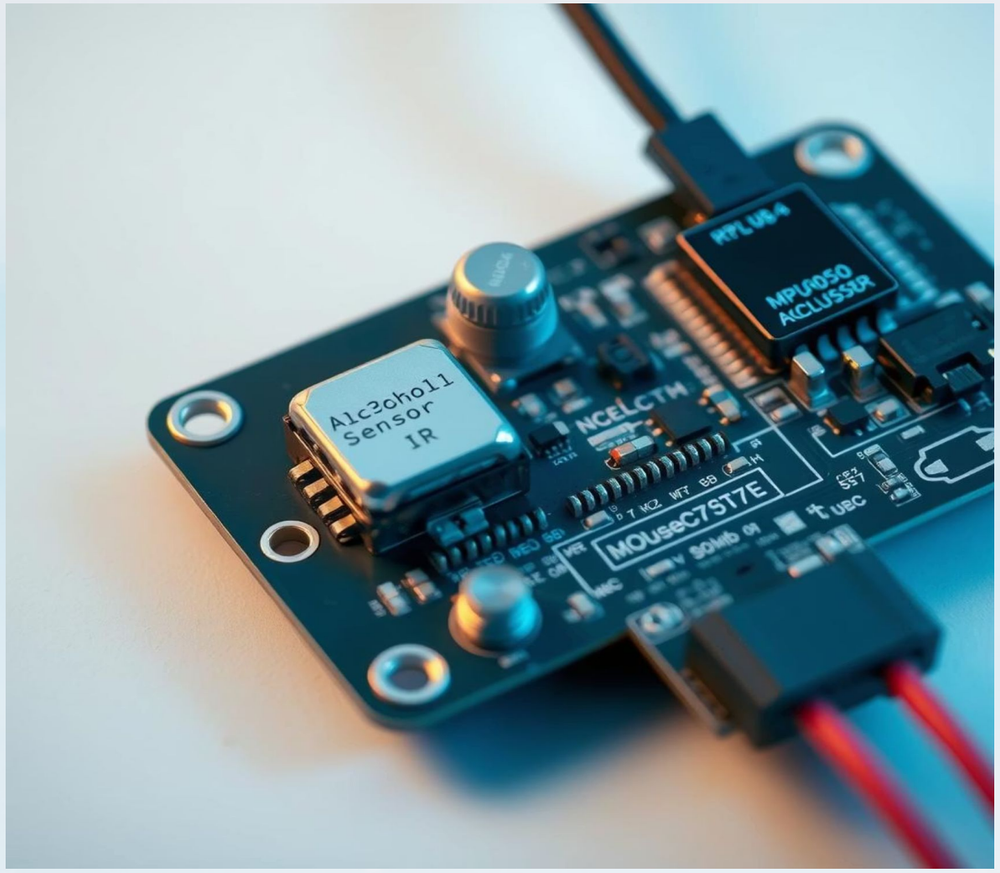
Emergency Alert System

Automatic notification of predefined contacts with location data post-fall.

Methodology: Sensor Integration

How the Smart Helmet Works: Sensing the Environment

The smart helmet system relies on a suite of sensors to gather crucial data about the rider's status and potential incidents. Each sensor plays a vital role in ensuring comprehensive safety monitoring.



1

Helmet Detection (IR Sensor)

An IR sensor precisely positioned inside the helmet verifies the presence of the rider's head, ensuring the helmet is properly worn.

2

Alcohol Detection (MQ-3 Sensor)

An MQ-3 alcohol sensor, strategically placed near the mouth, detects alcohol vapor, acting as a crucial pre-ignition safety check.

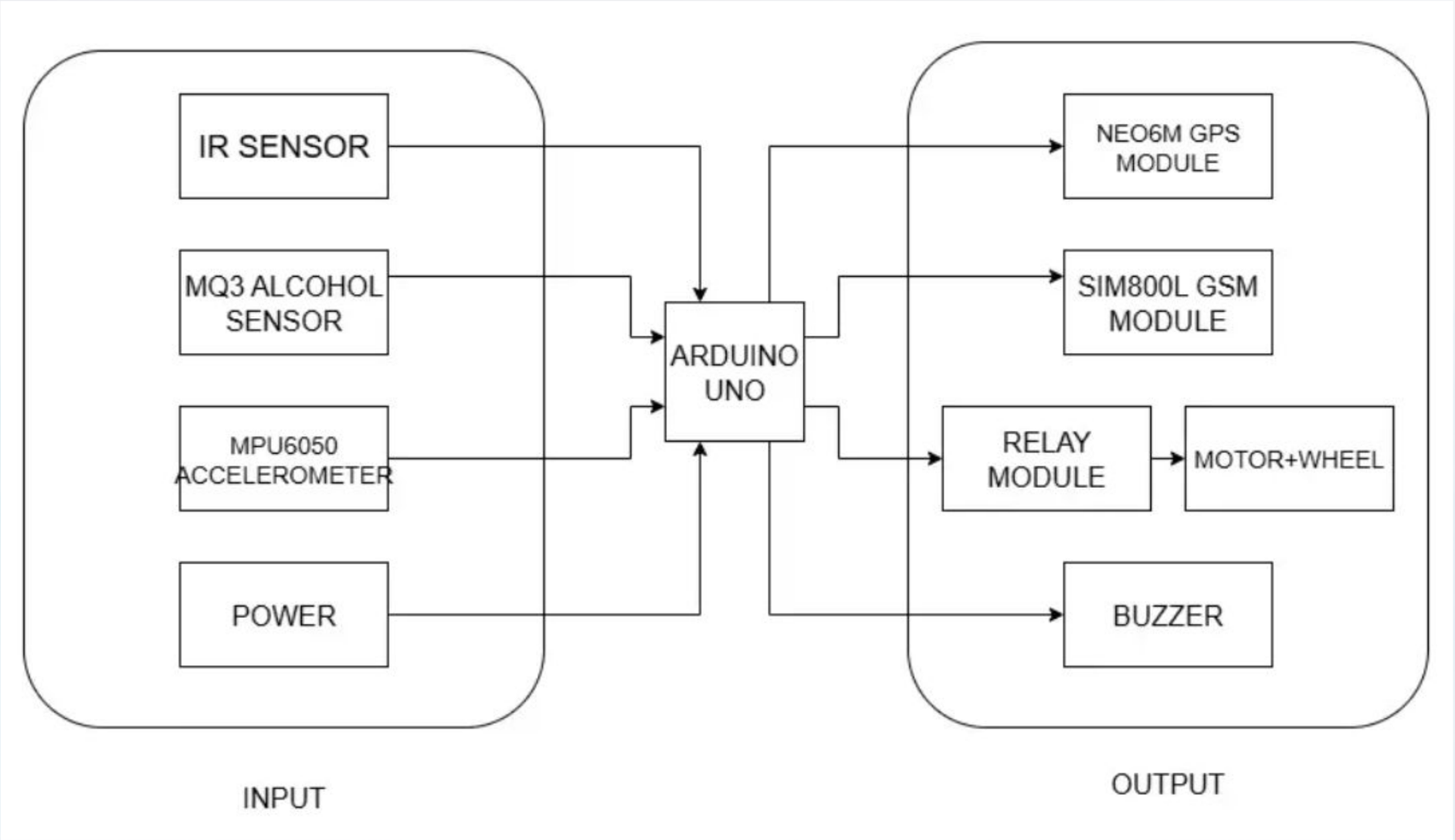
3

Fall Detection (MPU6050)

The MPU6050 accelerometer and gyroscope monitor the helmet's orientation and sudden movements, identifying abnormal tilts or impacts characteristic of a fall.

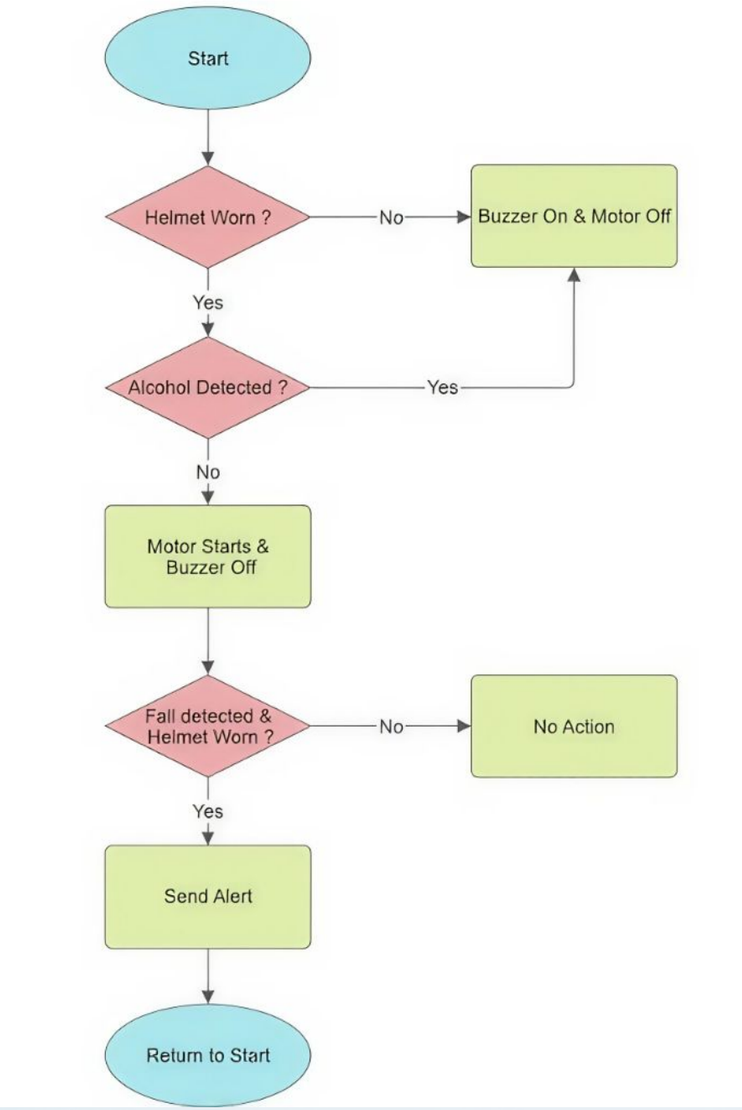
Methodology:

Hardware Block Diagram



Methodology:

Software Flow Diagram



System Initialization

- The Arduino-based control system starts and initializes all sensors and modules: Helmet detection sensor (IR), alcohol sensor (MQ-3), fall detection sensor (MPU6050), GSM (SIM800L), GPS module, relay, and buzzer.

Helmet Detection

- **Check:** If the helmet is worn (sensor detects presence), proceed to alcohol detection.
- **If NOT worn:** Activate buzzer, keep motor OFF, and loop back to check again.

Alcohol Detection

- **Check:** If alcohol is detected by the MQ-3 sensor, activate buzzer, keep motor OFF, and loop back.
- **If NO alcohol:** Turn motor ON and stop buzzer.

Motor Running State

- Motor runs normally when both conditions (helmet worn & no alcohol) are satisfied.

Fall Detection with Helmet Check

- MPU6050 detects abnormal tilt/impact.
- **If fall is detected AND helmet is worn:** Trigger emergency alert procedure.
- **If fall is detected but helmet is NOT worn:** No action is taken.

Emergency Alert

- When both fall detection and helmet worn conditions are met:
    - GPS module gets location coordinates.
    - GSM module sends an SMS with location details to a predefined phone number.

Return to Monitoring

- After sending alert or if no fall is detected, system returns to continuously monitor helmet, alcohol, and fall conditions.

System Components

Components required with justification

Arduino Uno R3 DIP	Easy to use, compatible, affordable, and reliable for real-time safety checks.
MQ-3 Alcohol Sensor	To detect the presence of alcohol in the driver’s breath.
IR Module	To detect whether the helmet is worn or not.
MPU6050 Accelerometer	To detect falls by measuring sudden changes in motion and orientation.
SIM800L GSM Module	To send SMS alerts with location during emergencies.
NEO-6M GPS Module	To provide real-time location data for emergency alerts.

Components required with justification

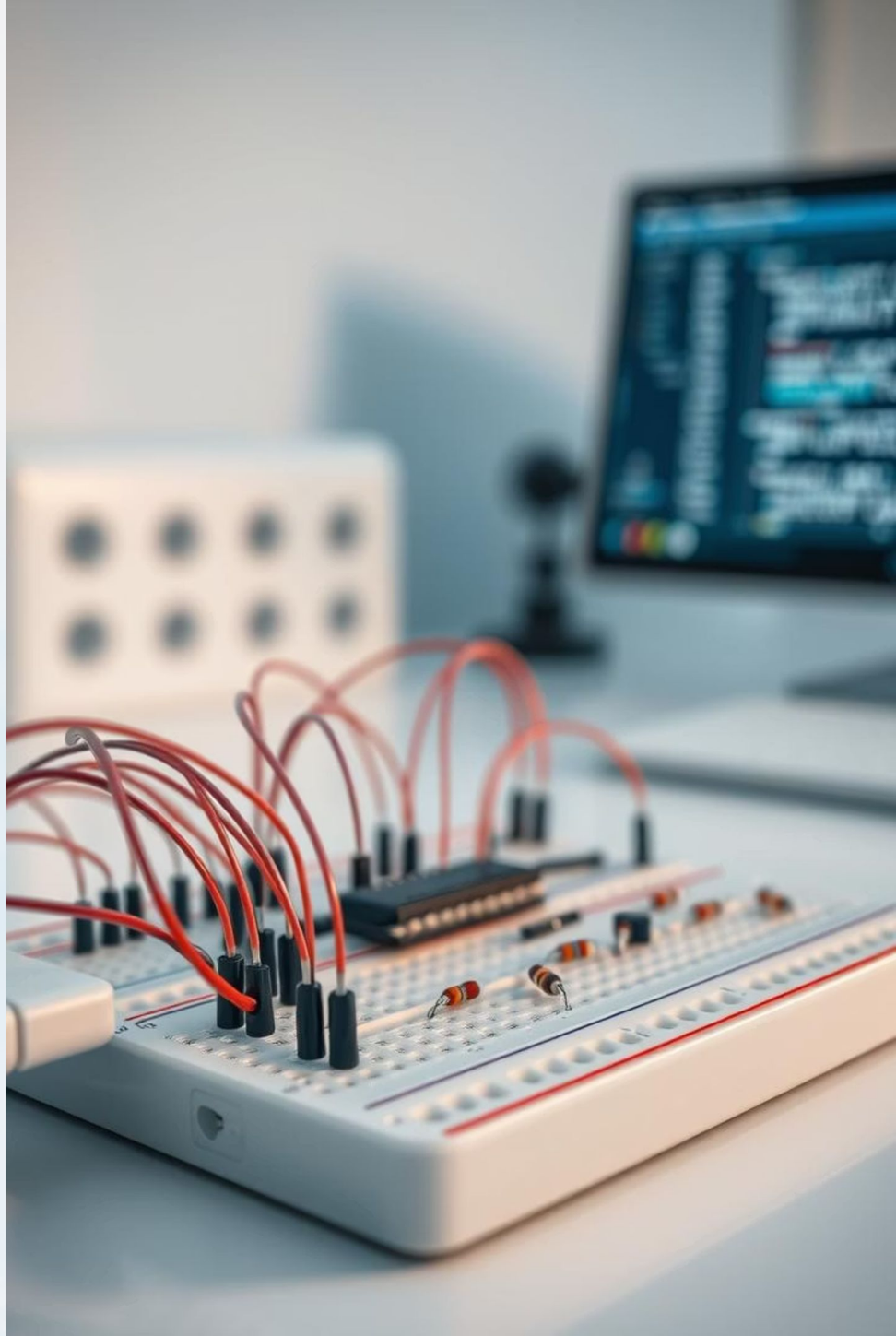
Motor+Wheel	To simulate vehicle movement control in the prototype.
Breadboard	For easy, solderless connections of all components during prototyping.
Relay Module	To safely control motor power based on sensor inputs.
Jumper & Breadboard Wires	For the connections.
Buzzer	To provide an audible alert during unsafe conditions.
9V Battery	To power the DC motor

Software Required:
Arduino IDE: The primary environment for writing, compiling, uploading code to the Arduino, and debugging the system logic.

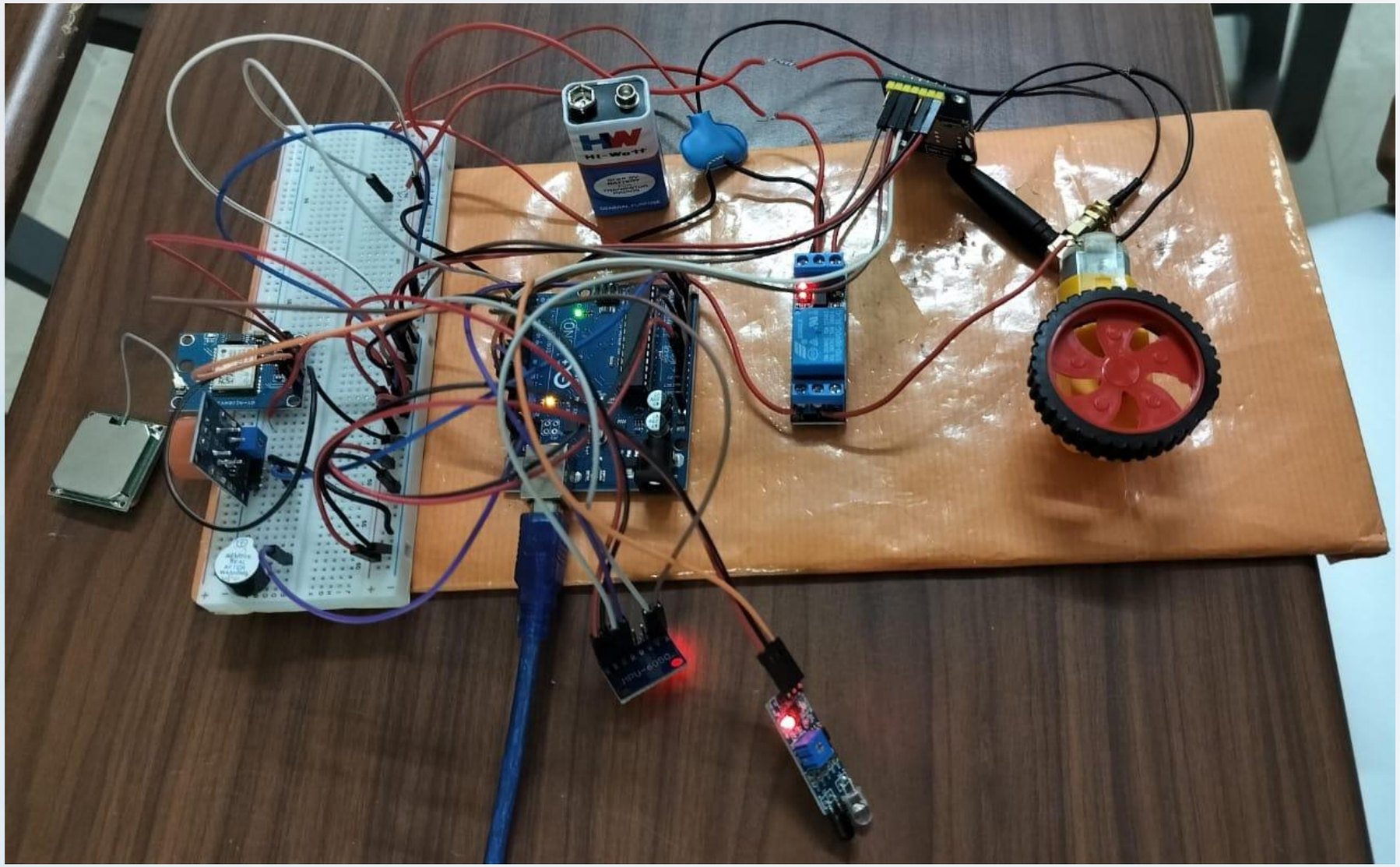
Cost Analysis (INR) for us to implement

S. No	Product	Rate
1	GEAR MOTOR	45
2	MOTORWHEEL	6
3	MQ3 ALCOHOL SENSOR	120
4	ARDUINO UNO R3 DIP	565
5	BREADBOARD	65
6	UNO CABLE BLUE (30 CM)	40
7	RELAY MODULE	58
8	JUMPERS M-M (40 PCS)	48
9	JUMPERS M-F (40 PCS)	48
10	JUMPERS F-F (40 PCS)	48
11	BREAD BOARD WIRE (2 MTS)	18
12	SIM 800L FULL SET	495
13	NEO6M GPS	290
14	MPU6050	160
15	IR MODULE	32
16	Buzzer	15
17	Perf Board	100
18	Soldering kit	200
	Total	**2353**

For full automotive-grade parts, paid installation, transmitter, receiver , high-quality enclosure it may cost around ₹7000 – ₹8,000.



Screenshot of the Breadboard working

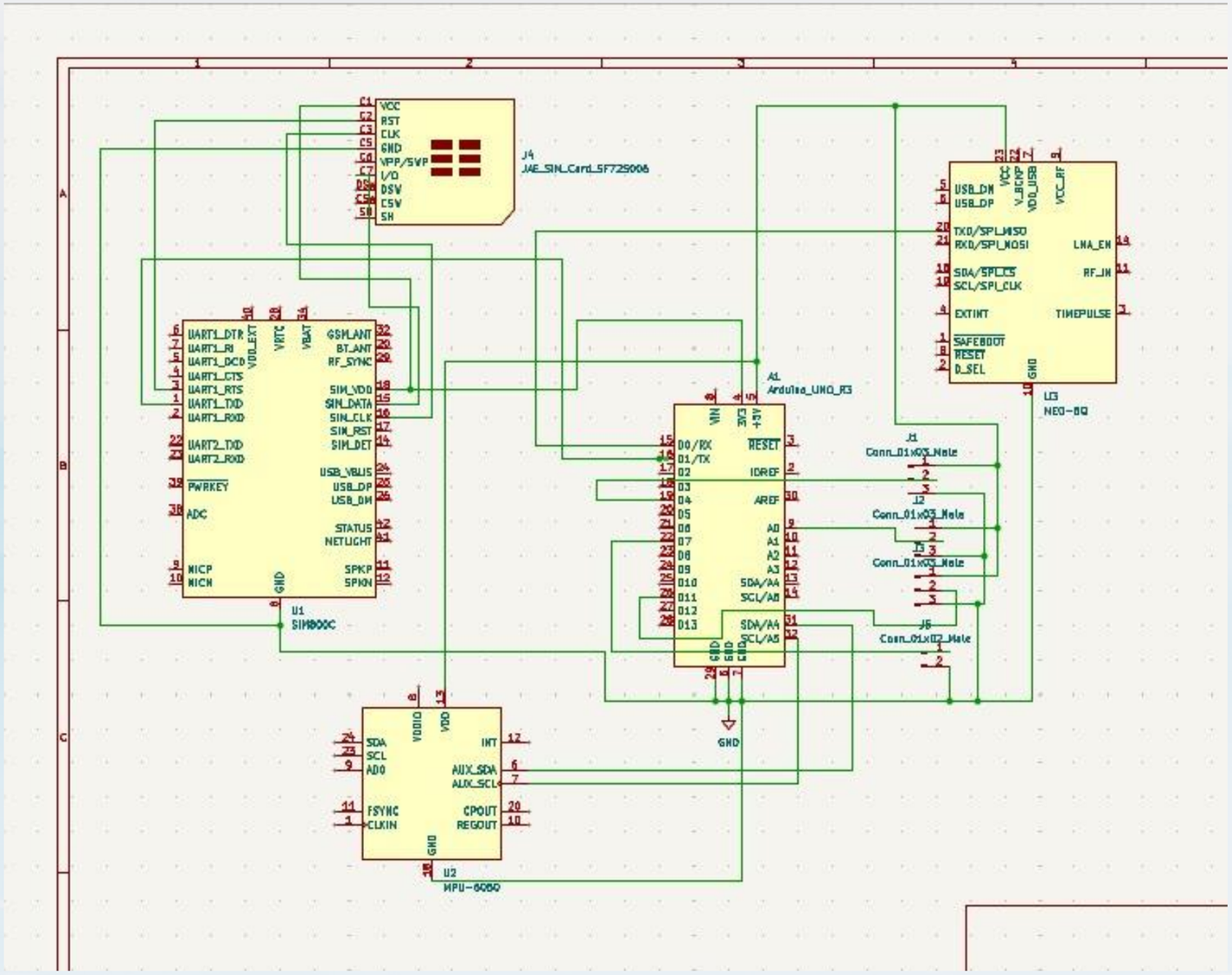


Demo Videos (Click to watch)

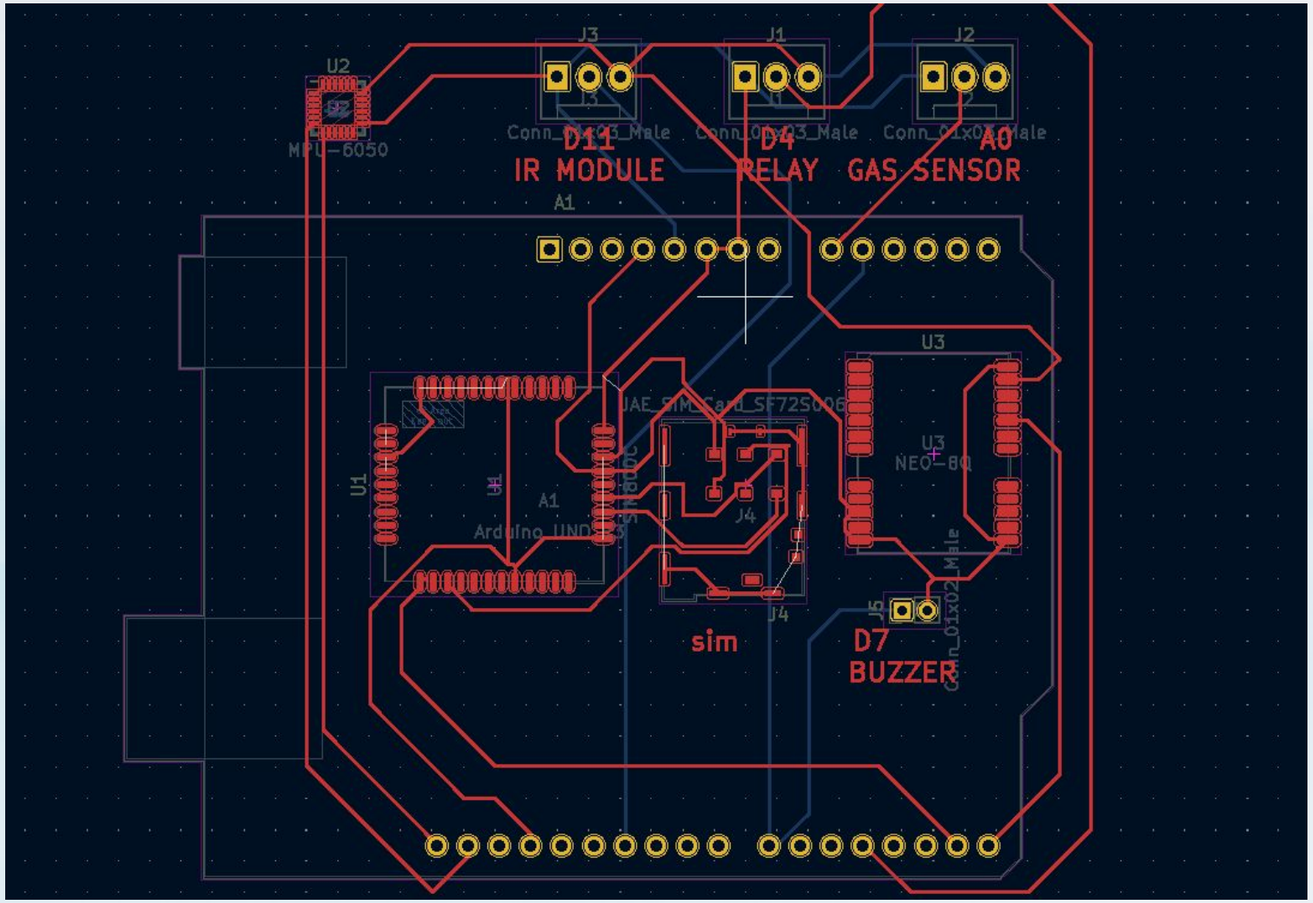
Part 1 (Helmet & Alcohol Check)

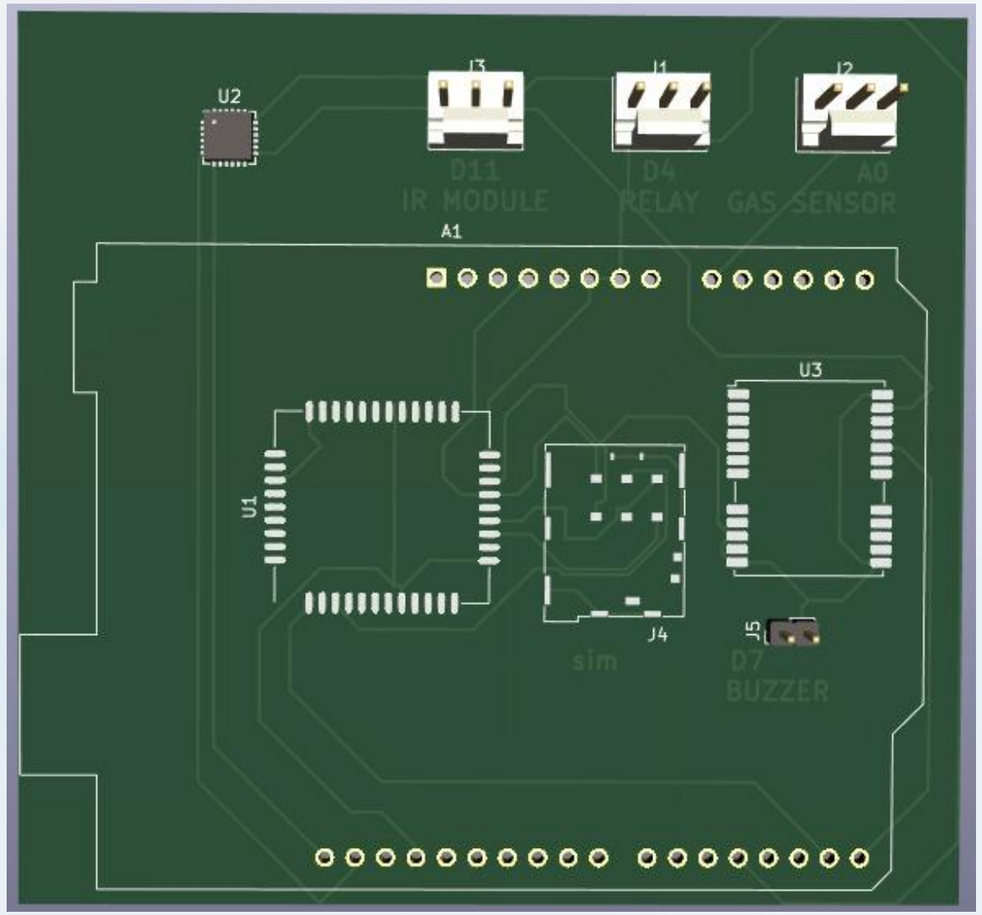
Part 2 (Fall Detection + Alert)

PCB Schematic Diagram



PCB Layout


U2
MPU-6050
J3
J1
J2
D11
IR MODULE
D4
RELAY
A0
GAS SENSOR
A1
U3
NEO-8Q
U1
A1
J4
sim
J5
D7
BUZZER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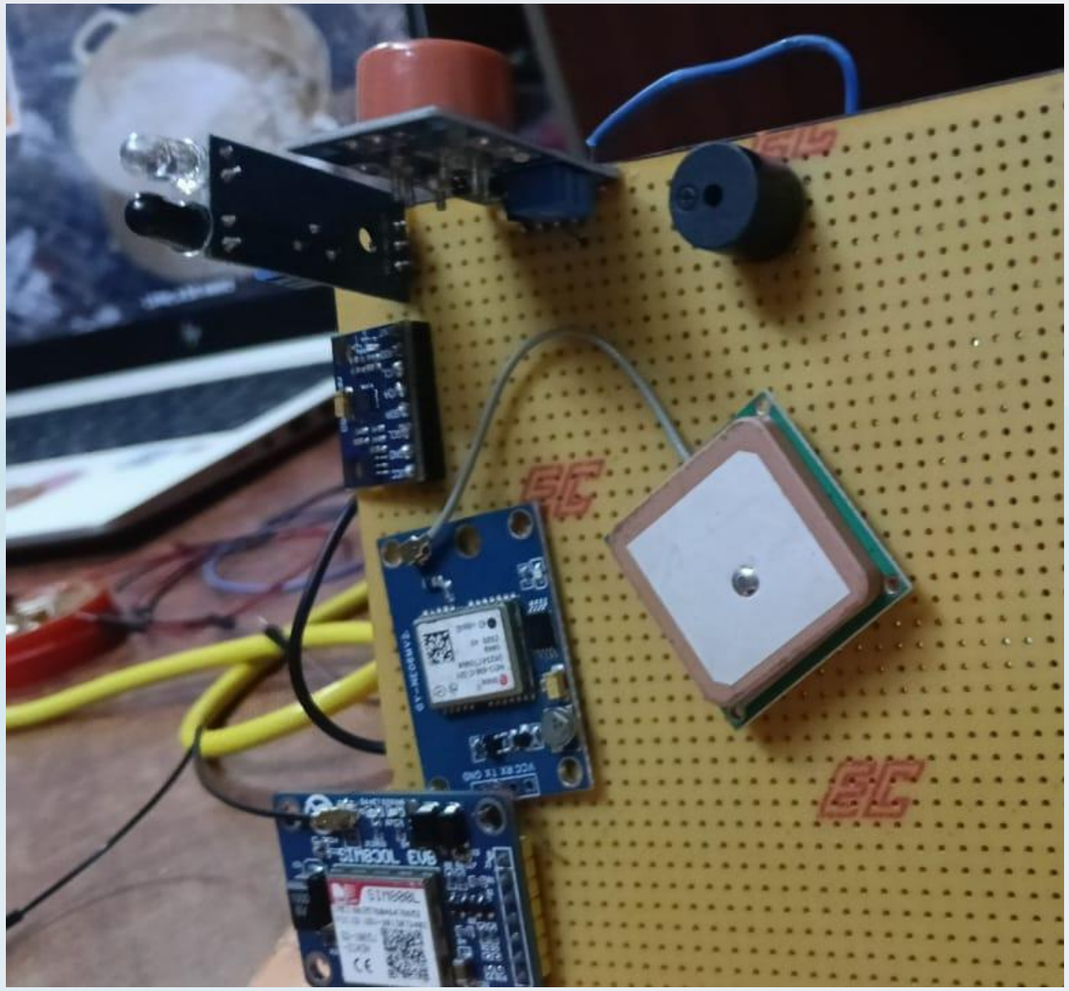
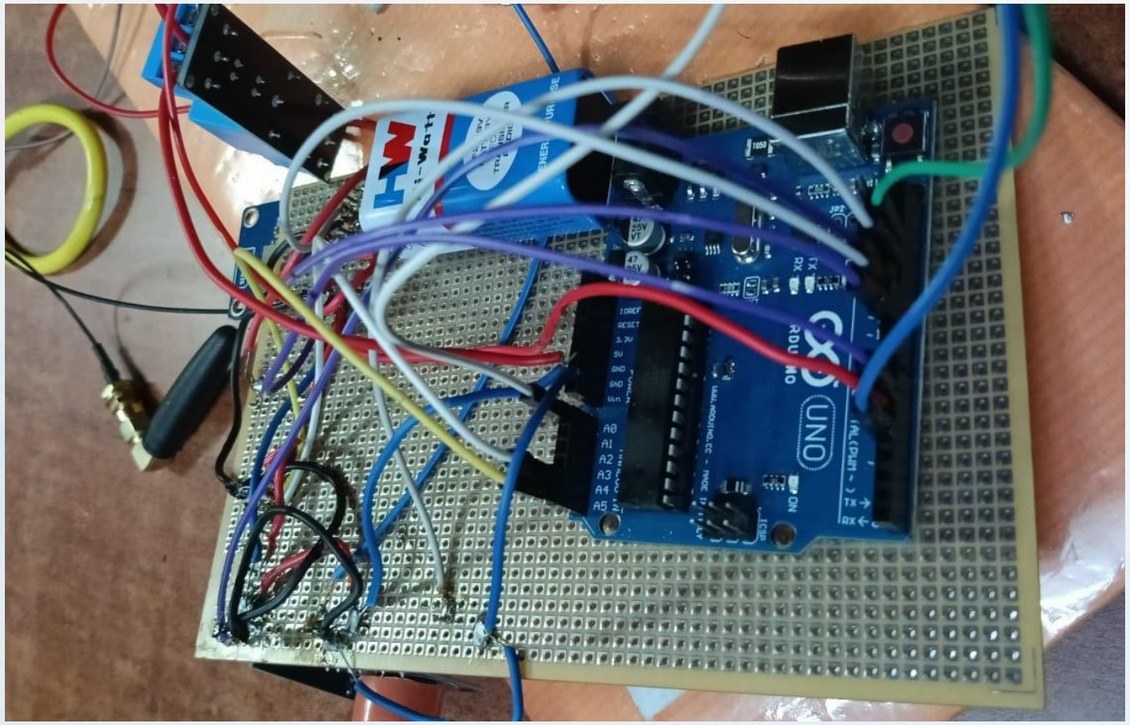
Perf Board





Conclusion & Future

Safer Rides, Smarter Roads

The Smart Helmet System represents a significant step towards safer two-wheeler commuting. By combining prevention and rapid response, it embodies a holistic approach to rider safety.

Key Takeaway: This system offers a comprehensive, proactive, and reactive solution to mitigate two-wheeler accident risks.

Future Enhancements: Integration with mobile apps for ride tracking, advanced AI for predictive accident analysis, and modular designs for wider helmet compatibility.

Call to Action: We believe this technology can set new standards for rider safety. We invite collaboration to bring this vital innovation to widespread adoption.