

Smart Helmet with Safety and Monitoring Features

P. Rajesh¹, Prof. M. V. Raghavendhra², A. Prem Kumar³, G. Srinivas⁴, K. Sri Ram⁵, P. Varsha⁶,

¹³⁴⁵⁶Department of Electrical and Electronics Engineering & Sir C R Reddy College of Engineering, Eluru

²Professor of Department of Electrical and Electronics Engineering & Sir C R Reddy College of Engineering, Eluru

Abstract - Smart Helmet with Safety and Monitoring Features, this project seeks to promote the safety of cyclists riding two-wheelers using accident-preventing real-time monitoring and controls. In particular, the project utilizes a bike control unit featuring an ESP32, LCD screen, DC motor controlling bike movement, MPU6050 tilt sensor detecting any accidents, GPS tracking device, and an RF433 receiver. A smart helmet control unit comprises the following components: RF433 transmitter, limit switch that detects whether or not the cyclist is wearing a helmet, and an alcohol detector to measure the sobriety level of the cyclist. Information concerning whether the helmet and alcohol detector indicate that the cyclist is sober or not is transmitted from the smart helmet unit to the bike unit. Apart from providing accident-preventing control, the project also features accident monitoring capabilities. The bike unit transmits real-time data concerning accident indication, helmet presence, alcohol indication, and GPS coordinates to the Mobile Application.

Key Words: Smart Helmet, Accident Detection, Location, ESP32, Alcohol Sensor, Monitoring

1. INTRODUCTION

The risk of accidents faced by motorcyclists is higher than those faced by passengers of other modes of transport. The accidents are often characterized by either serious harm to the rider or fatality, as in most instances the rider fails to adhere to safety guidelines like using helmets or riding when under the influence of drugs or alcohol. Additionally, the delay of medical intervention may arise as the rider is not in a position to report the accident due to the absence of an accident reporting platform. Lastly, intoxicated riders cannot be stopped since there is no mechanism for detecting them. This project seeks to solve these problems through incorporation of various safety technology tools in smart helmets. Road accidents caused by the use of two-wheeled motorbikes lead to fatalities and serious bodily harm because of lack of proper safety measures such as safety gear like helmets, use of alcohol, and lack of rapid emergency response system. Traditional helmets protect the wearer but do not offer any means of tracking and analysis of accident situations. Considering the fast growth of IoT and Embedded systems in modern technologies, it is very important to incorporate smart safety systems.

2. OBJECTIVES

a. Helmet and Alcohol Compliance Enforcement

To ensure rider safety by detecting helmet usage and alcohol consumption using Limit Switch and MQ3 sensor and preventing bike operation if safety conditions are violated.

b. Real-Time Accident Detection

To detect accidents using MPU6050 tilt sensor.

c. Wireless Helmet-Bike Communication

To establish reliable RF433 communication between the smart helmet and bike unit for continuous transmission of helmet and alcohol status.

d. IoT-Based Monitoring and Cloud Integration

To continuously upload accident data, rider safety status and GPS location to the ThingSpeak cloud for real-time monitoring.

3. LITERATURE SURVEY

A. Rahul Kamdi et al. (2024) – IoT-Based Intelligent Smart Helmet for Bike Riders

This system uses vibration sensors for accident detection, alcohol sensing, and a transmitter-receiver setup to prevent ignition without helmet or with alcohol consumption.

Drawbacks:

- Relying primarily on vibration detection, it is susceptible to false alarms in normal operating conditions.
- Does not feature wireless connectivity to a cloud service for remote monitoring.
- Emphasizes hardware design without considering performance evaluation during actual road operation.

B. Simi M. S. et al. (2025) – Real-Time Accident Detection and Alcohol Monitoring Smart Helmet

This work proposes a smart helmet that detects intoxication, collision events, and sends emergency SMS with location using GSM-GPS.

Drawbacks:

- The method using SMS alerts may fail due to limited signal reception.
- Does not take advantage of cloud services for IoT or machine learning algorithms.
- Detection of accidents is based on vibration sensors that may be inaccurate.

C. Aswathy J. S. et al. (2025) – Smart Helmet System with IoT and Sensor Integration

The study integrates helmet detection, alcohol monitoring, and accident alerts using IR sensors, accelerometers, and Telegram messaging through ESP32.

Drawbacks:

- IR sensors for detecting helmets could prove ineffective when light conditions change.
- Notifications via Telegram require constant access to smartphones and are thus inconsistent.
- The severity of the situation is not analyzed.

D. B. Alekhya et al. (2025) – IoT Based Smart Helmet for Drivers

This comprehensive design integrates alcohol detection, accident detection, GPS location alerts, pollution monitoring, and health tracking (e.g., heart rate) — pointing toward multifunctional smart helmet systems.

Drawbacks:

- Multi-sensor integration becomes complicated and costly.
- Additional functions relating to the environment or health could detract from safety aspects such as predicting the severity of accidents.
- There is no real-time analysis or machine learning involved.

4. METHODOLOGY

a. Basic Block Diagram

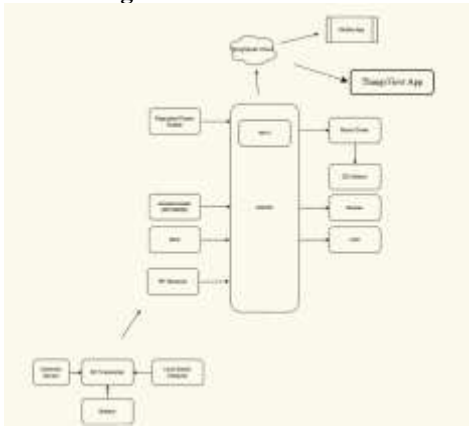


Fig -1: Block Diagram of Smart Helmet with Bike Unit

Smart helmet collects the helmet wear-status and Alcoholic Consumption data and transmit it to Bike unit which is main unit because ESP32 microcontroller is used, it collects the data from smart helmet through RF Modules and also collects data from MPU6050 and GPS co-ordinates, take actions on Motor Driver, Buzzer, displayed on LCD and Send the data Mobile App through ThingSpeak IoT cloud which shown in Fig -1.

b. Sensor Data Acquisition

Helmet unit collects alcohol level of consumption using MQ3 or Alcoholic Sensor, Helmet-wear status using Limit Switch. An IC Voltage regulator using for the input Voltages(V_{cc}) to all the sensors, because voltage from battery is uneven so an IC regulator is used. which is shown in Fig -2. The collected data from helmet is Transmitted through RF 433MHz Transmitter to Bike Unit.



Fig -2: Smart Helmet

Bike unit collects tilt and GPS coordinates by ESP32 and also ESP32 verifies helmet-wear and alcohol conditions. If helmet is not worn or alcohol is detected, the motor is disabled, if conditions are safe, the motor is enabled which is shown in Fig -3.



Fig -3: Bike Unit

5. OUTPUT AND RESULTS

The output depends on conditions

- Driver starts bike without a Helmet; it will not start.
- Driver starts bike after consuming alcohol; it will not start.
- Driver starts bike without consuming alcohol and while wearing a helmet it will start.
- When bike accident occurred, it immediately stops bike and also sends its exact location to the family member through IoT app.

5.1 Driver starts bike without a Helmet; it will not start.

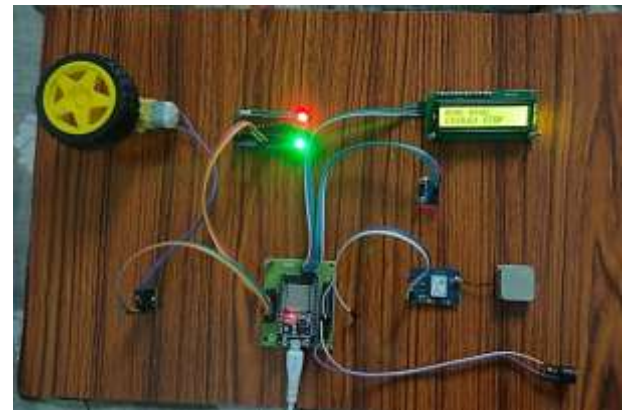


Fig -4: Without helmet condition

Without helmet bike will not start so, it is in stop position. Limit Switch is used for Detection of Helmet Wear or not. ESP32 collects the data and that data sends as notification to IoT app and also real time monitoring in ThingsView Application Shown in Fig-4.

5.2 Driver starts bike after consuming alcohol; it will not start.

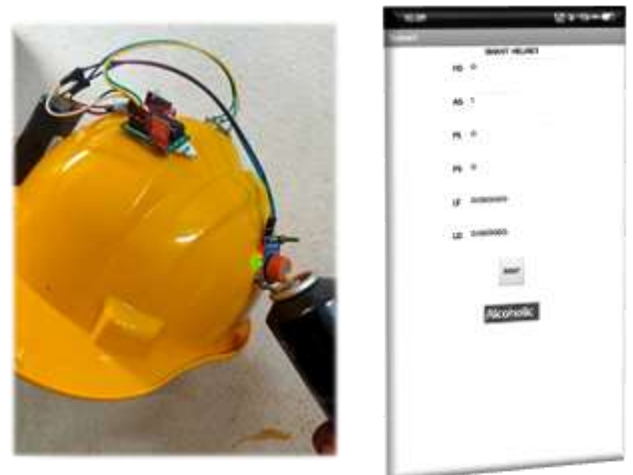




Fig -5: Consuming alcohol

With helmet and consumption of alcohol also bike will not start, so bike is in stop position. MQ3 Alcohol Sensor is used to detect is Driver Consuming Alcohol or not. That data sends as notification to IoT app and also real time monitoring in ThingsView Application in ML Model Shown in **Fig -5**.

5.3 Driver starts bike without consuming alcohol and while wearing a helmet, it will start.

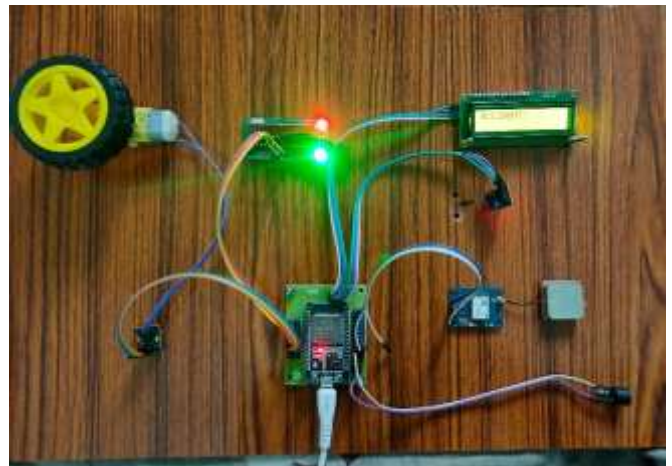


Fig -7: Accident Detected

Accidents detected by MPU6050 accelerometer module. Normally, horizontal position there is no accident detected. In the case of Accident, it detects by tilt sensing logics. It detects and sends exact longitude and latitude coordinates to Mobile App through ThingSpeak Cloud that shows the exact location which Shows in **Fig -7**.

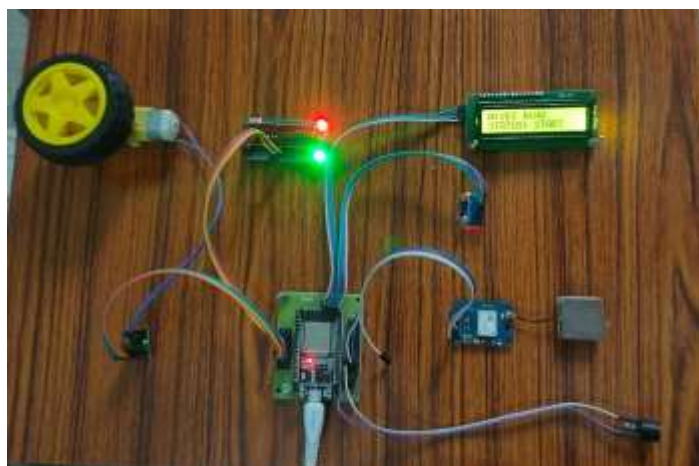


Fig -6: Helmet worn and no alcohol

With helmet and without consuming alcohol then Bike runs Shown in **Fig -6** and no data send to Application. In this Case limit switch is ON and No Alcohol sensed By MQ3 Sensor and also MPU6050 Accelerometer is in Horizontal position that means No Accident.

Bike will start in this Condition, because all required conditions are satisfied.

5.4 When bike accident, it immediately stops bike and also sends its exact location to the family member through IoT app.

6. FUTURE SCOPE

a. Incorporation of Machine Learning for Intelligent Accident Detection

Machine learning algorithms will be used to distinguish between minor accidents and severe incidents. Historical data from MPU6050 and other impact sensors can be used for predictive analysis. False positive incidents can be reduced by sensor fusion techniques.

b. Improved Communication Network

Instead of the existing RF433 technology, advanced communication protocols such as LoRa, NB-IoT, 4G, and 5G modules will be utilized.

c. Emergency Response System

Integrated emergency response system: Ambulances, nearby hospitals, traffic management system. The system automatically triggers emergency services based on real-time GPS location and the severity of the accident.

d. Enhanced Smartphone Application

MIT app should be upgraded with: Live tracking feature, Emergency contact management, Crash history and analysis, Push notification service instead of general alert system.

e. Additional Sensors for Vital Signs

Heart rate monitor, Body temperature sensors, SpO2 (Saturated Pulse Oxygen) sensors. These help to detect any potential medical issues that may arise while riding.

h. Anti-Theft and Safety Features

Includes features such as: Bike immobilization by application, Theft tracking by GPS system, Improves both bike safety and security.

7. CONCLUSIONS

The Smart Helmet with Safety and Monitoring Features project brings together different safety technologies into one smart and practical system designed to protect motorcycle riders. By making sure the rider is wearing a helmet and has not consumed alcohol before starting the vehicle, the system encourages safer and more responsible riding habits.

It also includes accident detection using an accelerometer and sends instant alerts through Wi-Fi if a crash occurs, helping emergency contacts respond quickly. The addition of an LCD display and buzzer makes the system easy to understand and use, keeping the rider informed at all times. Overall, this project focuses on improving rider safety in a simple, effective, and user-friendly way.

ACKNOWLEDGEMENT

We express our sincere thanks to all the individuals who contributed to the successful completion of this project.

We extend our heartfelt gratitude to our guide, **Mr. M. Vijaya Raghavendra sir**, for dedicating his valuable time and for guiding us in the selection and execution of this project. His experience, deep knowledge, and constant motivation have been a driving force throughout our work.

We are grateful to **Prof. Dr. A. Srinivasa Reddy sir**, Head of the Department of Electrical and Electronics Engineering, for his continuous encouragement and support. His guidance and instructions have been extremely helpful in completing this project.

We would also like to express our sincere appreciation to our Principal, **Dr. K. Venkateswara Rao sir**, for providing the necessary infrastructure and facilities for this project.

We also express our sincere thanks to all the faculty members of the Department of Electrical and Electronics Engineering, Library authorities for their co-operation, help and advice while carrying out this project work

REFERENCES

- [1] S. Vidhya et al., "Intelligent Helmet for Detecting Alcohol, Accident and Ignition Control Using IoT," International Journal of Advanced Research in Computer and Communication Engineering, 2024
- [2] R Kamdi and P. Patil, "IoT-Based Smart Helmet for Two-Wheeler Rider Safety," International Journal of Intelligent Systems and Applications in Eng, 2023.
- [3] Simi M. S. et al., "Real-Time Accident Detection and Alcohol Monitoring Using Smart Helmet," International Journal of Engineering Research & Technology, 2023.

- [4] S. M. Minhajul Alam, Arnob Barua, Ahamed Raihan, M. J. Alam, Rockey Chakma, S. S. Mahtab, and Chitra Biswas "Design and Implementation of a Smart Helmet System for Underground Miners Safety". International Conference on Communication, Computing and Electronics System, 2021.
- [5] P. A. Patil, Dr. P. N. Shinde, Pradip D Khorate, Suraj M Chinkate, Omkar D Munde, "Smart Helmet For Accident Detection", International Journal of All Research in Education and Scientific Methods.