

A Review of Smart Helmet and Accident Alert System

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Abstract - Vehicles have greatly contributed to the progress of human civilization, yet their increasing speed and the declining attention to safety measures have led to a rise in severe injuries and fatalities. This project aims to address one of the most essential road-safety requirements: ensuring that riders wear a helmet and receive timely assistance in the event of an accident. We designed a system that automatically verifies whether the rider is wearing a helmet and allows the vehicle to start only when both the key is inserted and the helmet is detected. In addition, the system includes an accident-detection and alert mechanism that can quickly notify for help. Our prototype demonstrates the potential to save lives by enforcing basic safety practices and reducing the response time following an accident.

1. INTRODUCTION

The idea for this project emerged from the desire to contribute something meaningful to society. Road accidents have been rising across many states, with daily accident rates reaching 7–15%. A major reason for the increasing number of fatalities is the lack of timely medical assistance. In many cases, if emergency services or family members could be informed immediately, the victim's chances of survival would be much higher. To address this issue, we propose the concept of a "Smart Helmet." This system uses sensors to detect accidents and communicates with emergency contacts through GSM and GPS modules during critical situations. A push button inside the helmet checks whether the rider is wearing it. If the helmet is not properly worn, no signal is generated, and the motorcycle will not start. An override switch is included for exceptional circumstances where the bike must be started without the helmet. This smart helmet system ensures that the rider follows basic safety practices and also sends accident location coordinates to a designated contact, enabling quick assistance and potentially saving lives.

2. STATEMENT OF PROBLEM

To develop a system that detects whether the rider is wearing a helmet and permits the vehicle to start only when the helmet is properly worn, along with an accident-detection mechanism that reports the location to emergency contacts.

3. PROPOSED SYSTEM

The proposed system focuses on designing and implementing a Smart Helmet that enhances rider safety by detecting accidents, verifying helmet usage, and automatically sending emergency alerts. The system combines multiple sensors

and communication modules to monitor critical parameters and respond intelligently during emergencies.

A. Objectives:

The primary objectives of the system are:

Helmet Detection: Ensure the rider is wearing the helmet before the vehicle can be started, using a helmet-detection sensor.

Alcohol Detection: Prevent drunk driving by identifying alcohol presence through an alcohol sensor.

Accident Detection: Automatically detect accidents using accelerometer and vibration sensors.

Emergency Alert System: Send immediate alerts along with GPS coordinates to pre-registered contacts through a GSM module when an accident is detected.

Safety and Reliability: Develop a cost-effective, efficient, and reliable system that improves rider safety and reduces emergency response time.

B. System Architecture: When the GISMO-VI board is powered on, the MPU6050 sensor begins continuously measuring the helmet's rotation along the three axes (X, Y, and Z) in degrees per second. These readings help the system monitor the helmet's orientation in real time. If the MPU6050 detects abnormal rotation patterns in all three axes—indicating a sudden impact or fall—the system interprets it as a potential accident. Once an accident is confirmed, the system automatically sends an emergency message and initiates a phone call to the rider's registered contacts and the nearest ambulance service provider. The alert includes the rider's GPS location to ensure timely assistance. In situations where no abnormal movement is detected, no alerts are triggered. Many accident victims lose their lives because help is delayed due to remote locations or lack of nearby witnesses. This Smart Helmet addresses such issues by constantly monitoring the rider's condition via cloud communication. Any detected anomaly triggers an immediate SOS message and phone call to the rider's emergency contacts.

C. Module Descriptions:

Module 1: Data Collection Module

The MPU6050 accelerometer and gyroscope sensor measures the helmet's rotation along the X, Y, and Z axes.

These readings are continuously transmitted to Firebase for real-time monitoring.

Module 2: Accident Detection Module

If the rotation data shows a sudden and significant deviation beyond normal limits, the system classifies the event as an accident.

This decision is based on predefined thresholds for abnormal axis movement.

Module 3: Notification System Module

Once an accident is detected, the system immediately alerts the registered emergency contacts and the nearest ambulance service provider.

A Python script utilizing the Twilio API handles both SMS alerts and automated phone calls, ensuring fast and reliable communication.

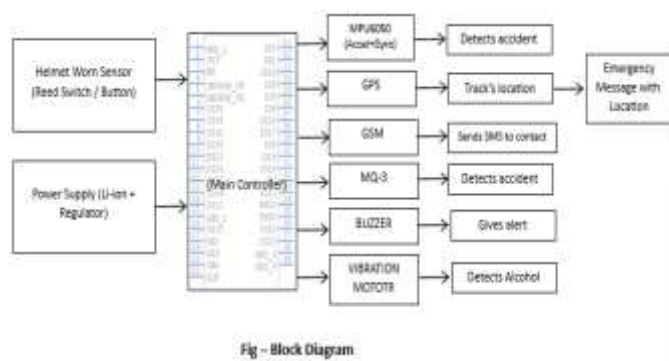


Fig - Block Diagram

4. METHODOLOGY

The motivation for developing this system came from a personal loss—one of our close friends passed away in a road accident due to the absence of immediate help. This incident encouraged us to design a solution that could prevent similar tragedies in the future. Our system ensures that the rider wears a helmet before the motorcycle can be started. However, in exceptional situations where the rider does not have the helmet, an override switch is provided. When this switch is used, the bike can start, but an automatic notification is sent to the rider's registered contacts, informing them that the override mode was activated. The helmet also includes sensors that detect impacts or abnormal motion during an accident. Once an accident is detected, a signal is sent to the bike's control unit, which tracks the rider's GPS coordinates. These coordinates are then transmitted through a GSM module to the nearest ambulance service and the rider's emergency contacts, enabling faster response and assistance.

System Components:

Hardware

- ESP32 Microcontroller
- MQ-3 Alcohol Sensor
- MPU6050 Accelerometer & Gyroscope
- IR / Pressure Sensor
- NEO-6M GPS Module
- SIM800L GSM Module
- Battery / Power Supply

Software

- Arduino IDE
- Embedded C/C++
- Libraries: TinyGPS++, Wire.h, SoftwareSerial

Communication

- GSM for sending SMS alerts
- GPS for real-time location tracking

- Optional IoT connectivity (Blynk / ThingSpeak) for online monitoring

Tools

- Fritzing or Proteus for circuit design
- Serial Monitor for hardware testing and debugging

5. EVALUATION AND EXPECTED OUTCOMES

The system is designed to continuously monitor the rotation of the helmet and update the readings every second. These real-time values are analyzed to detect any abnormal movement that may indicate an accident. At the same time, the collected data is uploaded to Google Firebase for remote monitoring and storage. The MPU6050 IMU module used in the system contains a three-axis accelerometer and a three-axis gyroscope. The gyroscope measures the rotational velocity—also known as the rate of change in angular position—along the X, Y, and Z axes. These measurements are obtained using MEMS technology and the Coriolis Effect, and the readings are provided in degrees per second. All sensor outputs can be viewed through the Serial Monitor of the Arduino IDE for testing and verification. The expected outcome of this system is accurate, real-time accident detection based on helmet movement data. By reliably identifying abnormal rotation patterns, the system aims to reduce response time during emergencies and improve the overall safety of the rider.

6. CONCLUSIONS

Road accidents are a major global concern, causing an estimated 1.3 million deaths every year. Beyond the loss of life, traffic accidents create significant financial strain on individuals, families, and national economies. Many countries lose nearly 3% of their annual GDP due to road-traffic incidents. In India and other regions of the subcontinent, the rising number of road accidents has become particularly alarming. In 2020 alone, approximately 132,000 people lost their lives in road accidents across India. Highway-related accidents continue to cost the nation between three and five percent of its GDP annually. Although India represents only about 1% of the world's vehicle population, it accounts for nearly 6% of global road accidents. To reduce the loss of human life and minimize the economic burden, it is essential for all stakeholders to adopt effective safety measures and implement strong preventive strategies.

REFERENCES

1. A. Jesudoss, R. Vybhavi, B. Anusha, Design of Smart Helmet For Accident Avoidance, in the Proceedings of the International Conference on Communication and Signal Processing (ICCSP2019) , April 4-6, 2019, India, (2019)
2. N. Divyasudha, P. Arulmozhiarman, E. R. Rajkumar, Analysis of Smart helmets and Designing an IoT based smart helmet: A cost effective solution for Riders, in the Proceedings of 1st International Conference on Innovations in Information and Communication Technology (ICIICT2019), Chennai, India, (2019)
3. P. Ahuja and K. Bhavsar, Microcontroller Based Smart Helmet Using GSM & GPRS, in the Proceedings of the 2nd International Conference on Trends in Electronics and Informatics (ICOEI2018), Tirunelveli, India, (2018)
4. M. Uniyal, H. Rawat, M. Srivastava and V. K. Srivastava, "IOT based Smart Helmet System with Data Log System," 2018 International

Conference on Advances in Computing, Communication Control and Networking (ICACCCN2018), Greater Noida, India, (2018)

5. K. Mhatre, R. Nandwadekar, A. Patil, R. Shinde, P. Kamble, Smart Helmet With Intercom Feature, in the Proceedings of the 3rd International Conference on Advances in Science & Technology (ICAST2020), April 8, 2020, (2020)

6. M. Jeong, H. Lee, M. Bae, D. -B. Shin, S. H. Lim and K. B. Lee, "Development and Application of the Smart Helmet for Disaster and Safety," 2018 International Conference on Information and Communication Technology Convergence (ICTC2018), Jeju, Korea (South), (2018)

7. S. Tapadar, S. Ray, A. Kumar, R. Karlose, H. N. Saha, Accident and Alcohol Detection in Bluetooth enabled Smart Helmets for Motorbikes, in the Proceedings of the IEEE 8th Annual Computing and Communication Workshop and Conference (CCWC2018), 2018