

SMART HELMET FOR RIDER SAFETY

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Abstract

This paper presents the design and implementation of a Smart Helmet for Rider Safety that integrates IOT technology to reduce road accidents and improve emergency response time. The proposed system includes accident detection using vibration sensors, GPS tracking, GSM communication, and helmet-wearing detection. The system ensures that the motorcycle starts only when the rider wears the helmet and passes the alcohol test. In case of an accident, the system automatically sends the rider's location to predefined emergency contacts. The smart helmet enhances road safety, minimizes fatalities, and promotes responsible riding behavior. The proposed solution enhances rider safety, reduces accident-related fatalities, and provides an intelligent, automated safety mechanism suitable for modern two-wheelers.

Keywords: Smart Helmet, IoT, Accident Detection, GPS Tracking

I. Introduction

Road accidents are one of the major causes of death worldwide. Many deaths occur due to not wearing helmets or driving under the influence of alcohol. The Smart Helmet system integrates sensors and IoT modules to enhance rider safety by ensuring helmet usage, detecting alcohol consumption, and sending emergency alerts during accidents. The system will also alert the bike rider if any obstacle comes too close while riding the bike. This is found to be useful at night or when the rider is tired. By this accidents can be prevented. Also GSM technology is used to inform the family members in case of an accident. Accident detection is done using accelerometer. Wireless communication through Ask module is done between the helmet and motorbike.

II. Literature Survey

Motorcycle rider safety has been a significant research area due to the increasing number of road accidents involving two-wheelers. Various studies have focused on helmet enforcement, accident detection, and real-time emergency alert systems using embedded and IoT technologies. The National Highway Traffic Safety Administration (NHTSA) [1] (2008) provided statistical evidence highlighting the high rate of fatalities and severe head injuries among motorcycle riders. Their report emphasized that proper helmet usage significantly reduces mortality and traumatic brain injuries. This study laid the foundation for technological systems aimed at enforcing helmet compliance. In 2011, Megalingam et al. [2] proposed an embedded system-based smart helmet integrating sensors to ensure helmet usage before vehicle ignition. Their system incorporated alcohol detection and ignition control mechanisms, demonstrating how embedded systems can enhance rider safety by preventing unsafe riding conditions. Similarly, Kumar and Bhardwaj [3] (2012) developed a Vehicle Accident Alert and Locator System using GSM and GPS technologies. Their work focused on detecting accidents and automatically transmitting location details to emergency contacts, thereby reducing response time and potentially saving lives. In 2015, Rani and Rao [4] introduced an accelerometer-

based accident detection system that analyzed vibration and motion patterns to identify crashes. This system demonstrated the effectiveness of motion sensors in detecting impact forces during collisions. The integration of IoT into smart helmet systems began gaining attention with Karthik and Prakash [5] (2017), who developed an IoT-based smart helmet capable of accident detection and remote alert transmission. Their approach enabled real-time monitoring but required reliable internet connectivity and infrastructure. Further improvements were introduced by Kulkarni and Patil [6] (2020), who proposed a low-cost two-wheeler accident detection and alert system using microcontrollers, vibration sensors, and GSM modules. Their work focused on affordability and practical implementation for common motorcycle users. With advancements in intelligent transportation systems, Mehta and Choudhary [7] (2023) explored IoT and sensor-based road safety systems integrating data analytics and IoT dashboards. Their research emphasized centralized monitoring and improved emergency response mechanisms, although it involved higher infrastructure costs. Recent developments in 2025 demonstrate significant technological enhancement. Varun et al. [8] proposed an enhanced IoT smart helmet with real-time tracking and alert systems, combining GPS, GSM, and sensor fusion for improved reliability. Similarly, Rudresha et al. [9] developed an IoT-based smart helmet integrating accident detection, alcohol monitoring, and cloud-based alert mechanisms for improved safety. Most recently, Gupta and Sharma [10] (2025) designed and implemented an IoT-enabled smart helmet incorporating multiple sensors, GPS tracking, and emergency communication systems. Their work highlights the trend toward integrated, real-time, and intelligent safety systems capable of preventing accidents and providing immediate response.

III. System Design / Methodology

A. Hardware Components

Arduino Uno: Acts as the main microcontroller to process sensor inputs and control outputs.

IR Sensor: Detects whether the rider is wearing the helmet properly. Engine will not start unless helmet is worn.

Vibration / Impact Sensor: Detects sudden collision or accident. GPS Module: Tracks real-time location during emergency situations. Power supply / Battery: Powers the system

GSM Module: Sends SMS alerts with location to emergency contacts.

B. Software Components

Arduino IDE: Used to program the microcontroller. It:

- Reads sensor data
- Compares values with threshold
- Controls relay and buzzer
- Sends SMS through GSM module Threshold Conditions
- Alcohol Level: If above safe limit → Engine OFF
- Helmet Detection: If helmet not worn → Engine OFF
- Accident Detection: Sudden high vibration → SMS alert with GPS location

Conclusion

The proposed Safety Helmet for Rider Safety system enhances road safety by integrating alcohol detection, helmet detection, accident monitoring, and emergency alert systems. The automatic engine cut-off feature prevents drunk driving and ensures helmet usage before ignition. Real-time GPS tracking and GSM alerts reduce emergency response time during accidents. The integration of Arduino, sensors, GSM, and IOT makes the system cost-effective and practical for large-scale implementation. Future work may include AI-based crash detection, cloud analytics, and mobile application integration for advanced monitoring.

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