Iot Based Multi Sensor Helmet for Real Time Accident ,Alcohol Monitoring,Gps Tracking and Emergency Alert System with Ignition Interlock

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ABSTRACT

The increasing number of road accidents, particularly involving two-wheeler riders, highlights the urgent need for intelligent safety systems. This project presents an IoT - based multi-sensor smart helmet designed to enhance rider safety through real-time accident detection, alcohol monitoring, GPS tracking, and an emergency alert system integrated with an ignition interlock mechanism.

The proposed system incorporates multiple sensors, including an accelerometer and vibration sensor for detecting accidents, an alcohol sensor to monitor the rider's sobriety, and a GPS module for real-time location tracking. A micro-controller processes sensor data and communicates with cloud platforms using IoT technology. In the event of a crash, the system automatically detects abnormal impact patterns and sends an emergency alert message along with the rider's location to predefined contacts or emergency services.

Keywords: **Smart helmet, Wi-Fi, IoT, GSM, GPS Sensors.**

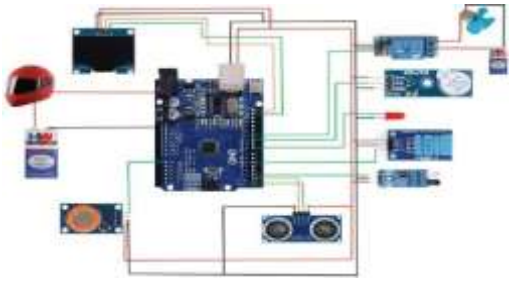
1. INTRODUCTION

Road accidents are one of the leading causes of death worldwide, especially among two- wheeler riders. Many of these accidents occur due to negligence such as not wearing helmets, driving under the influence of alcohol, and delayed medical assistance. With advancements in Internet of Things (IoT) technology, it is now possible to develop smart safety systems that can significantly reduce such risks.

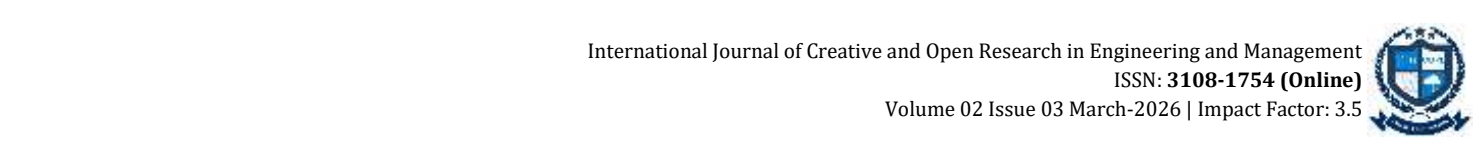
This project presents an IoT-based multi- sensor smart helmet designed to enhance rider safety and ensure responsible driving behavior. The system incorporates various sensors to monitor helmet usage, detect alcohol consumption, and identify accidents in real time. Additionally, it integrates a GPS tracking module to provide precise location data during emergencies.This is made possible by sensors like the Force Sensing Resistor (FSR) and IR/PIR sensors embedded in the helmet [2].To further promote safe riding habits, the system includes an alcohol detection mechanism using the MQ-3 alcohol sensor. Positioned near the rider's mouth, the sensor detects the presence of alcohol in the breath. If the alcohol level exceeds the permissible limit, the system prevents the motorcycle from starting. This feature is crucial in addressing the growing concern of drunk driving, which remains one of the leading causes of road accidents in India, as reported by the National Crime Records

Bureau.An important feature of the system is the ignition interlock mechanism, which prevents the vehicle from starting if safety conditions are not met. In case of an accident, the system automatically sends alerts along with location details to emergency contacts, ensuring timely assistance.

The concept of an **IoT-Based Multi-Sensor Smart Helmet** emerges as an innovative approach that combines advanced sensing technologies with real-time data communication. This system is designed not only to protect the rider physically but also to actively monitor, detect, and respond to critical situations. By leveraging the Internet of Things (IoT), the helmet becomes a connected device capable of transmitting crucial information to external systems, thereby enabling faster and more effective emergency interventions.



One of the core features of this smart helmet is **real-time accident detection**. Using sensors such as accelerometers, gyroscopes, and vibration detectors, the system can identify sudden impacts, abnormal motion patterns, or falls that indicate a potential accident.Upon detection, the helmet can instantly trigger an alert mechanism, reducing the delay in response time that often determines the severity of injuries or survival outcomes. This automated detection eliminates reliance on bystanders or the victim’s ability to call for help.Another critical component of the system is **alcohol monitoring**. Drunk driving remains one of the leading causes of road accidents globally. The integration of alcohol sensors within the helmet allows continuous monitoring of the rider’s breath.



ALCOHOL SENSOR

If alcohol levels exceed a predefined safe threshold, the system can prevent the vehicle from starting through an **ignition interlock mechanism**.

Overall, this smart helmet aims to leverage IoT technology to create a proactive safety solution that minimizes accidents, improves emergency response, and promotes safer riding practices.In addition to helmet and alcohol checks, the smart helmet system is equipped with accident detection and emergency alert functionality [3]. Accelerometers and vibration sensors detect impact or abnormal motion indicating a crash. Upon detection, the system sends an SMS alert to a pre- registered emergency contact using GSM technology, along with the real-time GPS location of the accident. This ensures rapid response from family members or emergency services, potentially saving lives by reducing the time between an accident and medical intervention.

LCD DISPLAY

To enhance riding safety, especially at night or when the rider is fatigued, the system can also notify the rider when an obstacle is detected at a dangerously close distance. The smart helmet and the motorcycle communicate wirelessly via an ASK module, ensuring seamless operation. The rider is also informed of vital data such as speed and location, improving situational awareness while riding.

2. PROBLEM STATEMENT

Two-wheelers are more likely than other vehicles to be involved in accidents over the project's study period, which considered a number of different circumstance.

though the government has put in place sufficient road rules and regulations to prevent accidents, the number of accidents that occur in remote areas are becoming more and more deadly because of the slow access to medical care; in some cases, the person does not receive medical assistance for six or seven hours, which raises the accident death rate. It is also clear that when an accident occurs in a city, the person receiving medical assistance receives it within thirty minutes.

Most often, riding while intoxicated and without the appropriate helmet protection results in traffic accidents. Not adhering to government traffic regulations. In addition to disregarding government traffic laws and regulations, careless driving can result in accidents. These can be lessened or resolved by utilizing the smart helmet system, which aids in bikers' safety, security, and accident detection. The project's primary goals are: to create an intelligent system that protects motorcyclists [5].

In recent years, there has been a significant rise in road accidents involving two-wheeler riders, many of which are due to the negligence of safety practices such as not wearing helmets and driving under the influence of alcohol. Despite various awareness campaigns and legal regulations, riders often ignore safety protocols, leading to severe injuries and fatalities. Additionally, in the event of an accident, there is often a delay in emergency response due to the lack of real-time information about the incident and the rider's location.

There is a pressing need for a reliable, intelligent system that can enforce the use of helmets, prevent drunk driving, and enable quick emergency response in case of accidents. Traditional helmets and bikes do not have integrated safety systems to detect whether the rider is wearing the helmet, assess the rider's sobriety, or communicate emergencies effectively. The absence of these safety features contributes to increased risk and delayed assistance [6].

3. PROPOSED METHOD

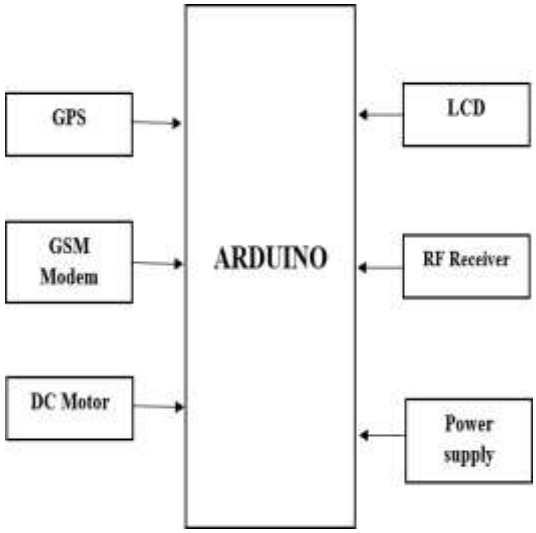


Figure 1: Helmet Unit

A Smart Helmet System for Bike Riders Using IoT, centered around an Arduino microcontroller**.** Each block represents a component that interacts with the Arduino to enhance rider safety. Here's a detailed explanation of each block.

The Arduino acts as the main controller of the system. It receives input from various sensors and modules, processes the data, and performs necessary actions based on predefined logic. It is responsible for coordinating the operation of all other component [7].

The Alcohol Sensor (commonly MQ-3) detects the presence of alcohol in the rider's breath**.**It sends an analog signal to the Arduino if alcohol is detected.If the alcohol level exceeds a safe threshold, the Arduino can prevent the vehicle from starting**,** ensuring that drunk driving is avoided.

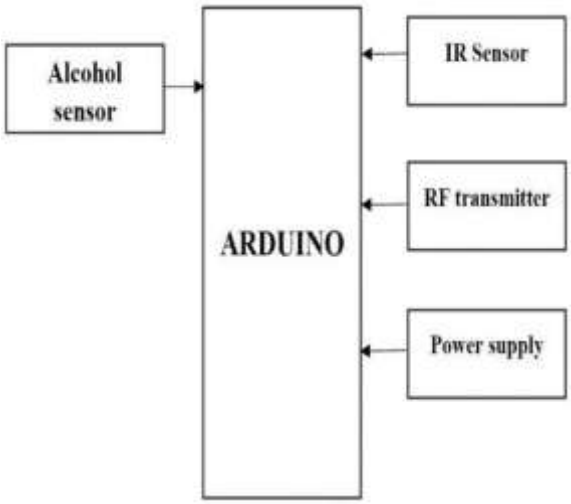


Figure 2: Bike Unit

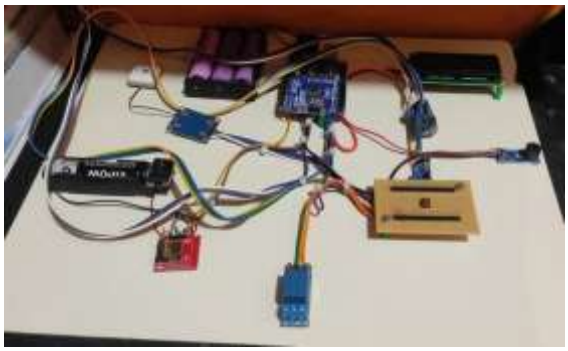
The Infrared (IR) Sensor is used for helmet detection.It detects whether the helmet is being worn by the rider. When the helmet is properly placed on the rider's head, the IR sensor sends a signal to the Arduino.If the helmet is not detected, the Arduino can disable the ignition system, enforcing helmet usage before the bike can be started.

The Radio Frequency (RF) Transmitter is used to send data wirelessly from the helmet to the bike's control unit or other devices.It could be transmitting the status of the helmet, alcohol level, or other safety-related information.This helps in wireless synchronization between the helmet and the bike system.The Power Supply provides the necessary voltage and current to the Arduino and all connected components.It ensures the system operates reliably and all sensors and modules function correctly without power disruption [8].
The Arduino serves as the core controller**,** processing inputs from various modules and triggering actions accordingly. It coordinates the entire system's operation, making decisions based on the data it receives.The GPS (Global Positioning System) module provides real-time location tracking**.**It sends coordinates to the Arduino, which can be used to:Track the vehicle's movement.Send the location to emergency contacts in case of an accident.The GSM (Global System for Mobile Communication)modem is used forwireless communication over a mobile network**.**It allows the Arduino to send SMS alerts (like accident notifications, location info) to predefined phone numbers (e.g., family, emergency services).The DC Motor represents the bike's ignition system or engine control**.**The Arduino can control this motor to enable or disable bike startup based on conditions like helmet detection or alcohol level (from the helmet system).

The LCD (Liquid Crystal Display) is used to show real-time data such as:GPS coordinates.System status messages.Alert confirmations or any other relevant info for the rider [9].The RF (Radio Frequency) Receiver receives wireless signals from the helmet's RF transmitter.It might receive data such as:Helmet status (worn/not worn).Alcohol sensor readings.Based on this data, the Arduino can take action(e.g., block ignition).The Power Supply Module provides the necessary voltage and current to power all the connected components and the Arduino itself.Ensures stable and reliable operation of the system.Helmet signals (status and alcohol level) are received via RF. If conditions are met (helmet worn, no alcohol), the Arduino enables the DC motor to start the bike.GPS provides live location.If an accident occurs, the GSM module sends location- based alerts.The LCD display shows system updates to the rider.

4. Working Model

Figure 3: Helmet Unit



The microcontroller integrates necessary tests prior to starting the bike in order to prioritize rider safety. To determine if the rider is not wearing a helmet, it uses a sensor. The microprocessor turns off a switch to stop the bike from starting if either of the conditions is detected. A receiver is built within the helmet, and an infrared transmitter is mounted on the bike's dashboard for precise rider presence detection. This configuration confirms helmet use. As a safety measure, the bike is automatically deactivated if the receiver does not receive a signal, suggesting that a passenger is wearing the helmet instead. The accelerometer-gyroscope sensor promptly detects the impact in the event of an accident. The system retrieves information from the GPS module after identifying an accident [10].

Authorities and specified family members are then swiftly informed about the occurrence after receiving this information. They are able to react or offer the rider prompt support because of this proactive communication.

5. RESULT

Smart safety helmets for bike riders represent a significant technological advancement in personal protection and rider safety. These innovative helmets integrate multiple advanced features designed to enhance the overall cycling experience and minimize potential risks. By incorporating sophisticated sensors, impact detection systems, and emergency alert mechanisms, these helmets provide riders with an unprecedented level of protection.

The primary objective of smart safety helmets is to create a comprehensive safety ecosystem around the cyclist. Integrated technologies include Bluetooth connectivity for hands-free communication, GPS navigation with heads-up display capabilities, and automatic crash detection systems that can immediately alert emergency contacts in case of an accident. Advanced shock absorption technologies and lightweight, high-impact resistant materials ensure superior physical protection, while built-in LED lighting systems and visibility indicators significantly improve rider visibility during day and night cycling [11].

Whenever a drunk person tries to take control of vehicle, the alcohol sensor will detect the presence of alcohol and if presence of alcohol is detected by the sensor, it will shut down the bike ignition system and sound an alarm and incase of accident thereby alerting the nearby people and a message will be sent via GSM to specified mobile number with location using GPS.

6. CONCLUSION

The primary goal of this system's creation was to prevent motorbike accidents. The main goal of this system is to create an electronic smart helmet system because accidents are primarily caused by people not wearing helmets or by drinking alcohol. This method checks for drunk driving and helmet wear in turn.

We can decrease the number of head injuries that occur by putting this approach into place. It facilitates easy vehicle control for the driver. It is also very user-friendly and cost- effective. Thus, its authority in social aspects is good. A regrettable situation is preferable to prevention with an updated helmet. If there is an unlucky fall, the concerned parties will be notified.

These days, motorbikes are involved in the majority of accidents. The use of alcoholic beverages or the lack of a helmet increase the severity of those accidents. As part of our project, we plan to create an electronic smart helmet system that effectively detects drunk driving and helmet use.

A safe two-wheeler ride would be made feasible by putting this system into place, which would lower the number of head injuries sustained in collisions resulting from helmet failure and also lower the number of accidents brought on by drunk driving. To make this project successful, we often incorporate radio frequency wireless communications and sophisticated sensing approaches. Our method effectively screens for drunk driving and helmet use.

7. FUTURE SCOPE

The Smart Safety Helmet for Bike Riders holds significant potential for future development and integration into intelligent transportation systems. As technology advances, this system can be enhanced with real-time video surveillance and voice- controlled interfaces to improve rider convenience and monitoring. Integration with cloud-based platforms can allow for continuous data logging, enabling authorities or family members to track rider behavior, travel routes, and accident history.

The helmet can also support AI-powered crash prediction algorithms**,** capable of analyzing riding patterns and environmental conditions to alert riders before an accident occurs. Additionally, expanding the system to include health monitoring sensors (e.g., heart rate, temperature, and fatigue detection) could offer life-saving benefits in emergencies [12].

With the growth of vehicle-to-vehicle (V2V)and vehicle-to- infrastructure (V2I) communication, the smart helmet can also play a role in broader traffic ecosystems by sharing alerts with nearby vehicles or traffic signals. Ultimately, the smart helmet has the potential to evolve into a comprehensive, life- saving companion for riders, helping reduce accident fatalities, promoting responsible driving, and advancing the goals of smart and safe cities.

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