WIRELESS INTELLIGENT MULTI-SENSOR HELMET FOR CRASH DETECTION, DRIVER SAFETY AND ENGINE LOCKING

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Keywords:

Smart Helmet, Alcohol Detection, Drowsiness Detection, Accident Alert, Wireless Engine Locking.

Introduction:

1. Road accidents are one of the leading causes of death worldwide, especially among two-wheeler riders. Lack of helmet usage, drunk driving, and rider drowsiness are major contributors to fatal accidents. Traditional safety systems are passive and fail to prevent accidents proactively.
2. To overcome these issues, this project proposes a **wireless intelligent multi-sensor helmet system** that ensures rider safety through real-time monitoring and control. The system integrates multiple sensors such as alcohol detection, eye-blink monitoring, helmet detection, and crash detection to continuously analyze the rider's condition.
3. The helmet communicates wirelessly with the bike unit using HC-12 communication. If unsafe conditions are detected, the system prevents engine ignition or locks it, thereby enforcing safety rules automatically.
4. Additionally, in case of an accident, the system sends an emergency alert with GPS location to a predefined contact using GSM technology. This significantly reduces response time and improves survival chances.
5. This project combines embedded systems, IoT, and safety automation to provide a smart and reliable solution for reducing road accidents and improving rider safety.

Objectives:

1. To develop a smart helmet integrated with multiple sensors (helmet detection, alcohol sensor, eye-blink/drowsiness sensor, crash detection sensor) for continuous monitoring of rider safety conditions.
2. To establish wireless communication between the helmet unit and the bike unit using the HC-12 module for real-time transmission of safety data.
3. To implement an engine locking mechanism in the bike unit that prevents the engine from starting when unsafe conditions such as no-helmet, alcohol consumption, or drowsiness are detected.
4. To detect crash or impact events using an MPU-6050 accelerometer/gyroscope and trigger emergency protocols when a severe accident occurs.

5. To integrate GPS and GSM modules for sending automated SMS alerts with real-time location coordinates (Google Maps link) to a registered emergency contact during a crash.
6. To provide immediate visual and audio alerts (LED indicators and buzzer) to notify the rider of any unsafe condition before engine locking or emergency action is taken.

Methodology:

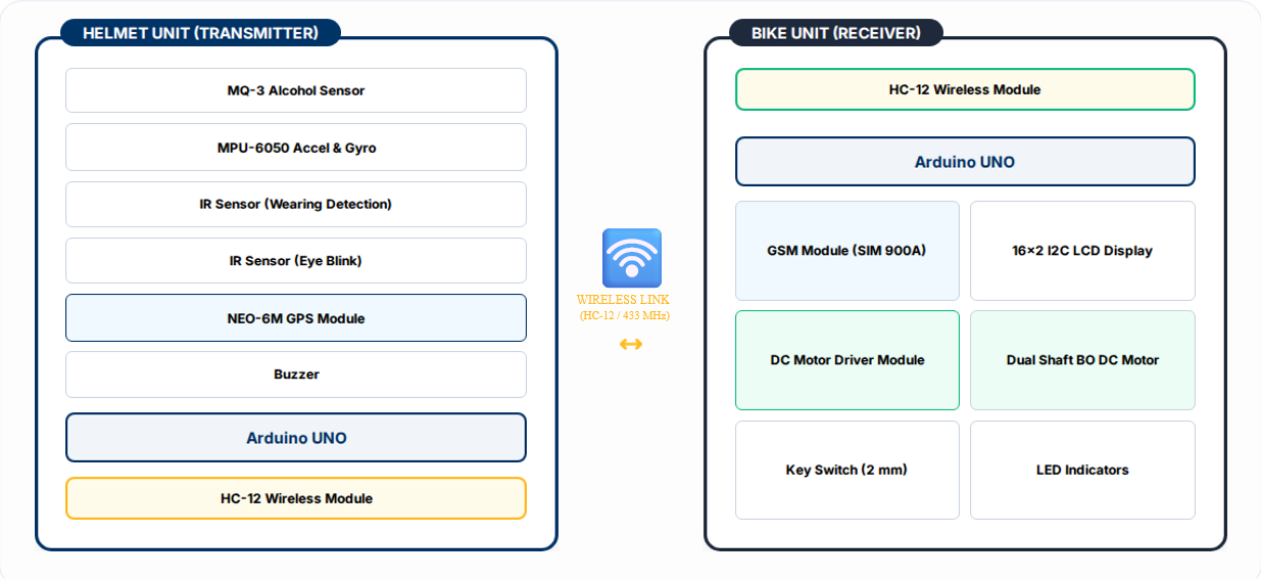

Figure 1: Block Diagram

1. The system consists of two main units: a helmet-mounted transmitter unit and a vehicle-mounted receiver unit.
2. In the helmet unit, various sensors are used to monitor rider conditions. An IR sensor detects whether the helmet is worn properly. A TCRT5000 sensor monitors eye blinking to detect drowsiness. An MQ-3 sensor is used for alcohol detection. An MPU6050 accelerometer and gyroscope detect crash or impact events.
3. All sensor data is processed using an Arduino microcontroller. The processed data is transmitted wirelessly to the bike unit using the HC-12 module.
4. In the vehicle unit, another Arduino receives the transmitted data. The system checks safety conditions when the ignition is turned ON. If all conditions are safe, the engine is allowed to start using a motor driver. If unsafe conditions are detected, the engine is locked and warning indications are given through LEDs and buzzer.
5. In case of a crash, the GPS module obtains the location, and the GSM module sends an SMS alert with location coordinates to emergency contacts.
6. This methodology ensures real-time monitoring, automatic safety enforcement, and quick emergency response.

Result and Conclusion:

The developed system successfully detects unsafe riding conditions such as absence of helmet, alcohol consumption, and drowsiness. It effectively prevents the engine from starting under unsafe conditions, ensuring compliance with safety measures.

Figure 2: Testing of Helmet Wearable Feature

The crash detection mechanism accurately identifies accident scenarios and triggers emergency alerts with location details. The GPS and GSM modules function reliably in sending real-time information.

The wireless communication between helmet and vehicle is stable and efficient, ensuring continuous monitoring.

Overall, the project demonstrates a practical and cost-effective solution to improve rider safety. It reduces dependency on manual enforcement and promotes disciplined riding behavior.

Thus, the system proves to be an efficient safety enhancement tool for two-wheeler riders.

Project Outcome & Industry Relevance

This project has strong relevance in the automobile and safety industry. It can be implemented in two-wheelers as a standard safety feature to reduce accidents.

It contributes to smart transportation systems and IoT-based safety solutions. The system can be used by bike manufacturers, traffic authorities, and safety organizations.

It also supports government initiatives for road safety and accident reduction. The product has potential for commercialization and large-scale deployment.

Working Model vs Simulation

This project involves a working hardware model consisting of a smart helmet unit and a vehicle control unit.

Project Outcomes and Learnings

Through this project, we gained knowledge in embedded systems, sensor integration, wireless communication, and IoT applications.

We learned how to design real-time safety systems, integrate multiple hardware modules, and develop reliable communication between devices.
The project also enhanced our skills in problem-solving, teamwork, and practical implementation of theoretical concepts.

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Future Scope:

The future scope of this project includes:

1. The system can be further enhanced by integrating mobile applications for real-time monitoring and alerts. Cloud connectivity can be added for data storage and analysis.
2. Advanced sensors such as heart-rate monitoring and fatigue detection can improve safety further. AI-based accident prediction systems can also be implemented.
3. The design can be miniaturized for better comfort and usability. Integration with smart city infrastructure and traffic control systems is also possible.