

IOT BASED RIDER HEALTH MONITORING SYSTEM FOR SAFETY AND SECURITY

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Keywords:

RFID Authentication, Health Monitoring (BP), Alcohol Detection (MQ3 Sensor), Accident Detection, ESP32 and Arduino UNO

Introduction/Background:

- The proposed system ensures that only the authorized owner can access and start the bike by verifying an RFID tag embedded in the rider's bike. Additionally, it enforces helmet usage and monitors the rider's health conditions—including blood pressure, and alcohol levels—before unlocking the ignition. The engine starts only if all predefined safety conditions are met, ensuring the rider is fit to drive.
- To further enhance safety, the system continuously monitors the rider's vitals during the journey. If abnormal readings, such as high blood pressure, are detected, the system alerts the rider to stop. If the rider fails to respond, the bike gradually slows down and stops to prevent potential accidents. In case of a crash, the built-in GPS module automatically sends location details and emergency alerts to registered contacts, guardians, and nearby hospitals, ensuring timely assistance.
- By integrating RFID-based authentication, real-time health monitoring, and emergency response mechanisms, this system significantly enhances rider safety and reduces the risk of accidents caused by health issues or unauthorized access.

Objectives:

- Ensure the authenticity & identity of vehicle owner/rider of the bike via security system installed at the bike to unlock the key.

- Monitors the health safety of the rider (wearing helmet, alcohol level, and blood pressure check). Allows the lock of the ignition if all the health safety conditions are met.
- During ride if any anomalies found in health conditions, issue warning signal and reduce the speed of the engine to halt the vehicle for the safety and health of a rider.
- In case of accidents, send emergency alert notifications to the registered guardian.

Methodology:

- **RFID-Based Authentication (Helmet Check)**

An RFID reader is used to verify the unique ID embedded in the rider's helmet. This ensures that only the authorized owner can unlock the system.

- **Helmet Detection & Lock System**

The presence of the helmet is verified using the RFID tag. If the correct tag is detected, the system proceeds to evaluate health and safety conditions before unlocking the key (relay control) for the ignition system.

- **Health Monitoring**

BP sensor constantly monitor the rider's blood pressure.

If any abnormalities are detected beyond safe thresholds, the system sends a warning to the rider. If the rider's condition is unsuitable for riding, the ignition will remain locked.

- **Alcohol Detection**

An MQ-3 alcohol sensor checks the rider's breath for alcohol content. If alcohol is detected above the limit, the relay does not activate, preventing ignition.

Ignition Control via Relay Module

Only when all safety conditions (helmet detected, alcohol-free, healthy vitals) are met, the relay module is activated to power the ignition system. This allows the rider to start the vehicle.

- **Real-Time Monitoring During Ride**

The system continues to monitor the rider's bp level using the pulse sensor during the ride. If vitals spike to dangerous levels, a buzzer sounds to alert the rider.

The system uses the motor control module to gradually slow down and stop the vehicle by cutting off the ignition relay.

- GPS Tracking and Emergency Alerts

In case of an accident occurred:

The GPS module (e.g., NEO-6M) transmits the rider's current location.

The system sends this data via a communication module (like GSM or IoT-based cloud) to registered emergency contacts.

- Display Interface (LCD)

A 16x2 LCD screen shows real-time data such as rider vitals, helmet status, alcohol level. It helps the rider get immediate feedback on their condition and system status.

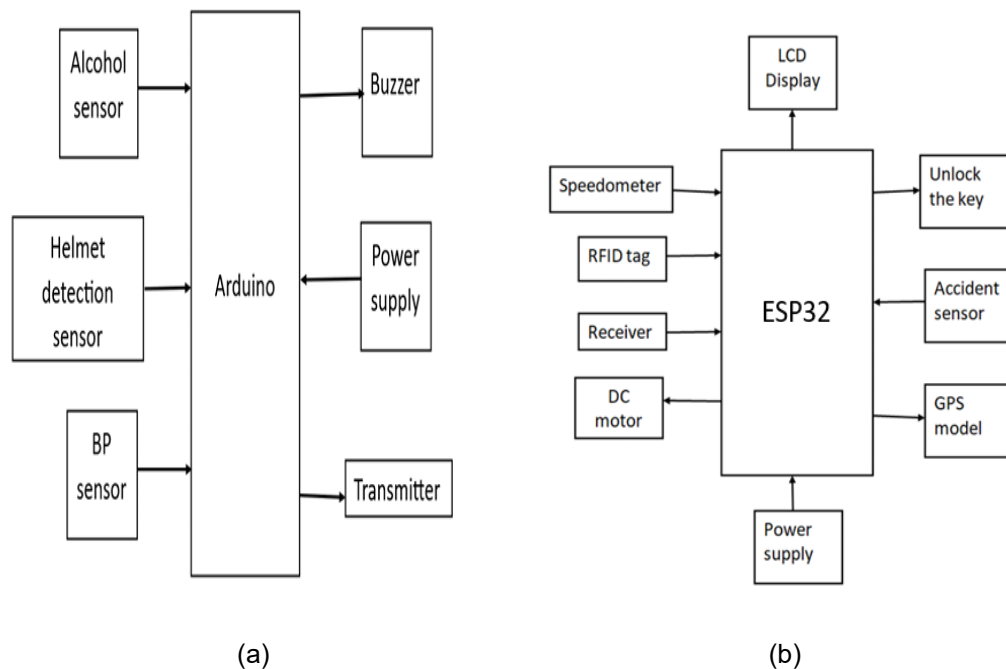


Figure 1: (a) Helmet module and (b) Bike module

Results & Conclusions:

The Smart Helmet System is an innovative and intelligent solution designed to enhance rider safety by integrating helmet detection, alcohol detection, BP rate monitoring, RFID authentication, and accident detection. The system ensures that the vehicle does not start unless the rider is wearing a helmet, unless the BP level is normal and prevents drunk driving by disabling ignition if alcohol is detected, and sends real-time alerts and location in case of an accident. By leveraging wireless Zigbee

communication and IoT-based Telegram alerts, the system provides an automated and real-time response mechanism for emergency situations.

In conclusion, With increasing concerns over road safety, this system has the potential to significantly reduce motorcycle-related fatalities and injuries. The project not only promotes safe driving habits but also integrates cutting-edge technology for enhanced security and monitoring. Future developments can make this system even more robust, scalable, and intelligent, paving the way for smart transportation solutions that prioritize rider safety and accident prevention.

Project Outcome:

- **Helmet enforcement:** The bike will not start unless the rider wears a helmet, no alcohol detected and normal BP levels.
- **Prevention of drunk driving:** If alcohol is detected, the ignition is disabled, and an alert is sent.
- **Monitoring BP level:** If the BP level is not suitable for driving and while driving the BP level fluctuates then the ignition is disabled and an alert is sent.
- **Accident response system:** If an accident occurs, an emergency alert with location is sent via Telegram.
- **User authentication:** Unauthorized users cannot start the bike without RFID authentication.
- **Wireless communication:** Real-time data transmission using Zigbee ensures efficient operation.

Industry Relevance:

- Improves road safety by allowing only authorized users to drive the vehicle.
- Merges health monitoring, which is crucial in minimizing accidents caused by medical emergencies.
- Alcohol detection prevents drunk driving, conforming to international traffic safety standards.
- Helmet authentication prevents helmet law violations, minimizing head injury risks.
- Real-time monitoring of vitals and automatic intervention provide an added layer of proactive safety.

- GPS integration facilitates instant sharing of accident locations for quicker emergency response.
- Provides possibility for integration with smart city traffic management systems and IoT platforms.

Working Model vs. Simulation/Study: Working Model

Project Outcomes and Learnings:

- We successfully developed a smart bike system that ensures rider safety using real-time health and authentication checks.
- The system accurately detects helmet usage with RFID and verifies the rider's identity.
- Health parameters like Blood pressure rate and alcohol levels were monitored using sensors.
- We implemented automatic ignition control to prevent unsafe riding conditions.
- GPS integration allowed real-time location tracking during emergencies.
- We learned how to interface multiple sensors and modules with microcontrollers.
- We gained experience in circuit design, embedded programming, and real-world problem-solving.
- Debugging sensor data and optimizing performance taught us patience and attention to detail.
- We understood the importance of safety automation in reducing road accidents.

Future Scope:

- Cloud storage can log accident reports, alcohol levels, and ride stats for analysis by authorities and insurers.
- Advanced health sensors like SpO₂ and heart monitors can offer complete rider diagnostics.
- Voice command features can let riders control navigation, calls, and bike functions hands-free.
- AI can analyze real-time data to predict accidents and alert riders early.
- Solar panels on helmets can improve energy efficiency and reduce reliance on charging.

- The system can auto-call emergency contacts with GPS location if the rider is unresponsive after a crash.
- 5G connectivity can boost communication speed between helmet, bike, and cloud systems.
- AR displays in helmets can show speed, navigation, and alerts for a smarter riding experience.
- The system supports large-scale enforcement of helmet rules and anti-drunk-driving laws.
- These innovations make biking safer, smarter, and more connected for the future.