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Real-Time Accident Detection and Alcohol Monitoring using a Smart Helmet

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***Abstract*—Road accidents and alcohol-impaired driving are major contributors to traffic fatalities. This paper proposes a smart helmet system designed to detect alcohol consumption, identify accidents, and automatically send emergency alerts using GPS and GSM modules. An alcohol sensor prevents ignition if alcohol is detected. The system also senses collisions using a vibration sensor and transmits location information via SMS. This proactive safety system aims to reduce delays in emergency response and discourage drunk driving.**

***Index Terms*—Smart Helmet, IoT, NodeMCU, Alcohol Detection, Accident Alert, Safety System, Vehicle Control**

I. INTRODUCTION

The growing number of road accidents due to drunk driving and delayed emergency responses highlights the need for intelligent safety mechanisms. Helmets, though mandatory, offer no active safety functions. The proposed smart helmet integrates alcohol detection and accident alerting mechanisms to improve user safety and ensure prompt communication with emergency services.

II. LITERATURE REVIEW

Various smart helmet designs have emerged focusing on safety automation. Systems using GSM and GPS modules have proven effective in accident alerts. Recent works integrate alcohol sensors, pressure sensors, and wireless communication for proactive safety features. However, many systems rely on Arduino-based platforms. This work enhances connectivity by using NodeMCU, which offers built-in Wi-Fi for seamless IoT integration.

III. SYSTEM DESIGN

The block diagram consists of:

- Helmet Unit: Alcohol sensor, pressure sensor, vibration sensor, and NodeMCU.
- Vehicle Unit: Ignition lock controlled by the NodeMCU based on sensor data.
- Cloud and Alert Unit: Sends real-time alerts via IoT (e.g., Blynk).

IV. HARDWARE COMPONENTS

V. COMPONENTS REQUIRED

– Node MCU - A development board with Wi-Fi capabilities, used to control and process sensor data.

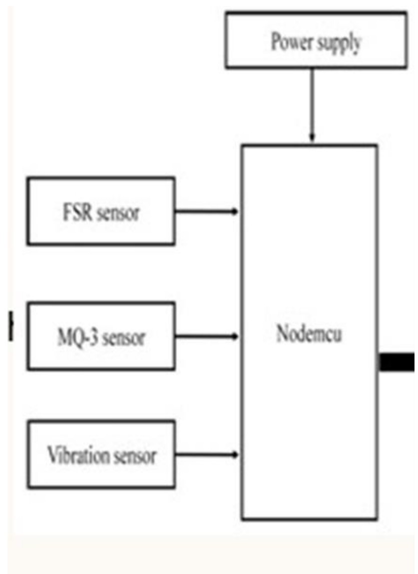

Fig. 1. Block Diagram of Helmet Unit

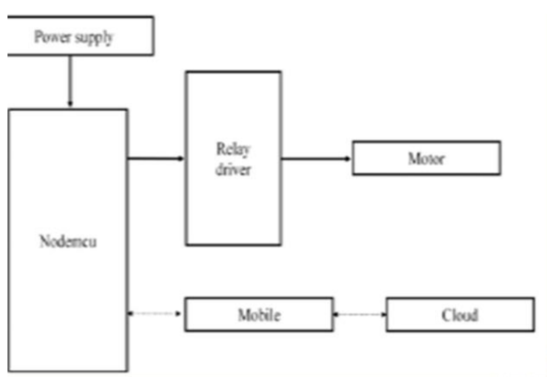

Fig. 2. Block Diagram of Bike Unit

– MQ-3 Alcohol Sensor – Detects presence of alcohol in the user's breath.
– Vibration Sensor – Detects impact or fall.
– FSR (Force Sensing Resistor) - Measures applied pressure or force by changing its resistance.
– Buck Converter - it is used to convert 12V to 5V

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Fig. 3. NodeMCU

Fig. 4. MQ3 Sensor

Fig. 5. Vibration Sensor

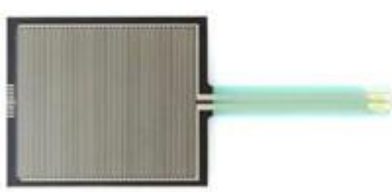

Fig. 6. FSR for the working of node MCU

Fig. 7. Buck Converter

– Relay Module: Controls ignition based on sensor inputs.
– GPS Module: Captures location data in case of an accident.
– Blynk IoT Platform: Used for mobile alerts.

VI. SOFTWARE IMPLEMENTATION

The firmware was developed in Arduino IDE using C/C++ for the NodeMCU. Blynk libraries were used for IoT communication. Sensor values are continuously monitored. If conditions violate safety (alcohol detected, helmet not worn), the relay disables the ignition. In case of a crash (vibration), an alert with GPS location is sent via Blynk.

VII. WORKING

NodeMCU (ESP32) is configured to connect to a Wi-Fi network using the SSID and password that you provided in the code. This allows the system to send data to the Blynk app. Several sensors are connected to the NodeMCU.Force Sensor (Analog Pin) detects physical pressure or force on the helmet (e.g., a crash or impact).MQ-2 Gas Sensor (Analog Pin and Digital Pin) detects harmful gases like alcohol fumes or smoke.Vibration Sensor (Digital Pin) detects vibrations, such as from a crash or sudden movement. A vibration motor is connected via a transistor (GPIO pin). The motor simulates a vibration alert when the system detects a crash or a specific event.The motor operates based on the readings from the Force Sensor. When the Force Sensor detects a force above a predefined threshold (indicating a crash or heavy impact), the system activates the vibration motor (full speed). When the sensor value exceeds a threshold (indicating a crash), the motor turns on to alert the rider. The system periodically reads the values of the sensors (Force Sensor, MQ-2 Gas Sensor and Vibration Sensor) and sends these data to the Blynk app using virtual pins. This allows you to view sensor data and monitor the system status in real-time on the Blynk app. It also sends a notification to the Blynk app (Motor ON).If no crash is detected, the motor remains off.The program also allows the user to manually control the motor's speed via a slider in the Blynk app. This slider sends a PWM value (0 to 255) to control the motor's speed using virtual pin.The program runs continuously, checking sensor values and updating the Blynk app every second. It keeps sending the sensor data to the app for monitoring.

VIII. RESULTS

The prototype was tested in real-time scenarios. It successfully prevented vehicle ignition without helmet and upon detecting alcohol. Alerts were sent to the configured mobile device within seconds of a simulated crash.

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IX. CONCLUSION

This paper proposes a smart helmet system that ensures safety by checking helmet use and sobriety and provides crash alerts. Using NodeMCU enables easy cloud integration and real-time communication. Future enhancements include fall detection using gyroscopes and machine learning for behavior prediction.

X. FUTURE SCOPE

The system can be extended to:

- Include gyroscopes for accurate fall detection.
- Add camera modules for live streaming after accidents.
- Integrate with emergency services via APIs.

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