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Helmet Based Accident Alerting Device

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ABSTRACT
This project involves the design and development of a helmet-based accident alerting device to enhance road safety for motorcyclists. The device, powered by an ESP8266 Module, integrates a GPS module (Neo-6M) for real-time location tracking and a GSM module (SIM900A) for communication. In the event of an accident, detected through the device's sensors, the system automatically sends an SMS alert containing the rider's location to predefined emergency contacts. Additionally, the device has the capability to initiate voice calls if necessary. The system provides a rapid response mechanism, ensuring prompt assistance in emergencies, potentially reducing response time and improving survival rates. Compact and cost effective, this device contributes to safer riding conditions by combining location tracking, automated messaging, and call functionality within a wearable device, specifically suited for motorcycle helmets.

Keywords: Esp8266 module, Neo 6m GPS module, Sim 900A GSM module, Accelerometer MPU6050, Ultrasonic sensor HC-SR04.

1. INTRODUCTION

In recent years, road safety has become a critical concern, especially for two-wheeler riders. Many accidents occur due to the negligence of wearing helmets, and in the event of an accident, timely medical assistance is crucial. The Smart Helmet project is designed to enhance rider safety by integrating advanced sensors and communication technology.

This Smart Helmet incorporates features such as an accident detection system, GPS tracking, and SOS alert system. It ensures that the rider wears the helmet before starting the bike using a VL53L0X laser ranging sensor. Additionally, the system detects sudden impacts using an accelerometer and magnetometer and sends an emergency alert with the GPS location to a predefined contact via a GSM module.

By utilizing IoT-based real-time monitoring, this project aims to minimize accidentrelated fatalities by ensuring immediate assistance in emergencies. The helmet's ability to detect head impact, sudden motion changes, and non-compliance with helmet-wearing rules makes it a reliable safety device for motorcyclists.

2. LITERATURE REVIEW

Smart helmets have been the focus of extensive research and development, integrating various technologies to enhance rider safety, accident prevention, and emergency response. This section explores previous studies, innovations, and advancements in smart helmet systems.

2.1 Accident Prevention and Detection

Several studies emphasize the importance of accident detection mechanisms in smart helmets. Researchers have integrated sensors such as accelerometers, gyroscopes, and magnetometers to detect sudden impacts or falls. For instance, studies have demonstrated that combining an accelerometer and GPS module can help detect accidents and send alerts via GSM or IoT-based communication systems. The use of machine learning algorithms to analyze motion patterns has also been explored to enhance accuracy in accident detection.

2.2 IoT and Communication Technologies in Smart Helmets

Advancements in the Internet of Things (IoT) have enabled real- time monitoring and alert systems in smart helmets. Various studies propose using GSM, GPS, and Bluetooth modules to transmit accident alerts to emergency contacts. Some research also explores LoRa and NB-IoT technologies for long-range communication, ensuring better connectivity even in remote areas. Additionally, integration with mobile applications has been widely studied, allowing users to track their rides, receive notifications, and access emergency assistance.

2.3 Safety Features and Compliance with Standards

Helmet safety standards such as DOT (Department of Transportation), IS (Indian Standards), and ECE (Economic Commission for Europe) certification have been referenced in several studies. Researchers emphasize the need for lightweight, impact-resistant materials while integrating electronic components.

3. EXISTING METHOD

Helmet-based accident alerting devices are designed to improve rider safety by detecting crashes and sending immediate alerts to emergency contacts or services. These devices rely on sensors integrated into the helmet to monitor the rider’s movements, impacts, and environmental conditions. Here's a detailed look at how existing methods for helmet-based accident alerting devices work.

3.1 Livall BH51M Smart Helmet

This helmet is equipped with built-in crash detection sensors that can detect impact and send an automatic emergency alert with location details to a pre-programmed contact list via a mobile app.

The helmet also features Bluetooth for hands-free calling and music streaming, along with a built-in walkie-talkie feature for communication with other riders.

3.2 Sena 50S Motorcycle Communication System

A communication helmet that integrates crash detection with emergency alert features. In the event of a crash, it sends real-time alerts to emergency contacts along with the rider's GPS location, while also providing communication between riders through Bluetooth.

3.3 Nexx XWED-2 Smart Helmet

The Nexx XWED-2 integrates a crash detection system that automatically triggers an emergency alert to a mobile app, which then contacts emergency responders or designated contacts. It also includes a GPS system to relay the rider's location accurately.

3.4 Helite Airbag Helmet

A more advanced solution that combines an airbag system with crash detection. The airbag inflates upon

detecting a collision, providing additional neck and head protection. The helmet sends an alert to emergency services along with the rider's location, providing enhanced safety.

3.5 SmartCap Technology

Used in some helmets for work environments (like construction or mining), SmartCap is a fatigue and impact monitoring system. It not only detects when a worker falls or has an accident but also monitors fatigue levels to reduce the risk of accidents caused by drowsiness

4. PROPOSED SOLUTION

The helmet-based accident alerting device aims to significantly improve rider and worker safety by providing immediate detection and response in the event of an accident. The device is equipped with a variety of sensors, including accelerometers, gyroscopes, and pressure sensors, to monitor impacts, falls, and sudden changes in movement or velocity. Upon detecting a severe impact or unusual inactivity, the system automatically sends a distress signal, along with the user's GPS location, to designated emergency contacts or services via Bluetooth or GSM. The helmet is lightweight, comfortable, and integrates seamlessly with the existing structure, ensuring it doesn't compromise the user's experience. Additional features like an SOS button, voice activation, and real-time tracking add layers of security.

Fig.4.1.1: Block Diagram

5. HARDWARE COMPONENTS

5.1 Esp8266 Wifi module

The ESP8266 module is a compact,low-cost Wi-Fi microchip that enables devices to connect to the internet. It is widely used in IoT (Internet of Things) applications due to its small size and affordability. The module features a built-in TCP/IP stack, making it easy to implement wireless communication in projects.

5.2 Neo 6M Gps module

The GPS Neo-6M module is a compact and affordable GPS receiver that provides accurate location data for various applications. It uses the U-blox Neo-6M chipset to track satellite signals and output coordinates, speed, and time information via serial communication.

5.3 Ultrasonic Sensor

It is used to detect the distance of an object by using ultrasonic waves. It consists of 4 pins (Vcc, Gnd, Trigger, Echo). Trigger pin is used to send the ultrasonic waves as input, Echo pin is used to detect the echo signals which are reflected back from the object. It will detect the distance by converting the time taken for sending and receiving the echo's of ultrasonic waves.

5.4 GSM Module

It is used to communicate b/w electronic devices using cellular networks. In this module we are mainly using 4 pins (Tx, Rx, Vcc, Gnd), Sim holder and Antenna for transmitting/receiving signals.

5.5 Led

It is a light emitting diode which emits light by applying voltage. In our project we using this component to represent the Lights present in the railway station.

5.6 Accelerometer MPU6050

The MPU6050 Accelerometer and Gyroscope Module is a widely used sensor module that integrates a 3-axis accelerometer and a 3-axis gyroscope into a single compact device. This module can measure both linear acceleration and rotational motion, making it ideal for motion-sensing applications.

5.7 Push Button

A **push-button** (also spelled **pushbutton**) or simply **button** is a simple switch mechanism to control some aspect of a machine or a process.

6. SOFTWARE

6.1 Installation of ARDUINO

Step-1: Download And Extract Arduino IDE Software.

Step-2: : Launch Arduino IDE, Open the Arduino IDE from the desktop icon click next to install then click on icon to open the software.

6.2 ARDUINO Code Dumping

Step-1: Open your first project.

Step-2: Select your Arduino board then, Go to Tools > Arduino nano Boards > Boards Manager.

Step-3: Select your Arduino board Processor then, Go to Tools > Processor > ESP32..

Step-4: Edit Code on Editor Window then, Click on File tab and then open preferences

Step-5: Compile code.

Step-6: Upload Code into Arduino Board.

7 ADVANTAGES

7.1 Accident Detection & Emergency Alerts

The MPU6050 accelerometer detects sudden impacts or falls, ensuring quick response.

The NEO-6M GPS module provides accurate rider location in case of an accident.

Sends an SMS alert with location coordinates to emergency contacts for immediate assistance.

7.2 Enhanced Rider Safety

Helmet Usage Detection: Ensures that the rider wears the helmet before the vehicle starts using a proximity sensor.

Detects abnormal helmet orientation, indicating possible unconsciousness or a crash.

Prevents drunk driving by detecting alcohol levels and disabling the vehicle ignition if necessary.

8 APPLICATIONS

8.1 Road Safety and Motorcyclist Protection

Helps in quick response during accidents by sending SMS alerts with GPS location.

8.2 Industrial and Construction Safety

Alerts safety teams in case of falls or unconsciousness in construction, mining, and manufacturing industries.

8.3 Military and Defense Applications

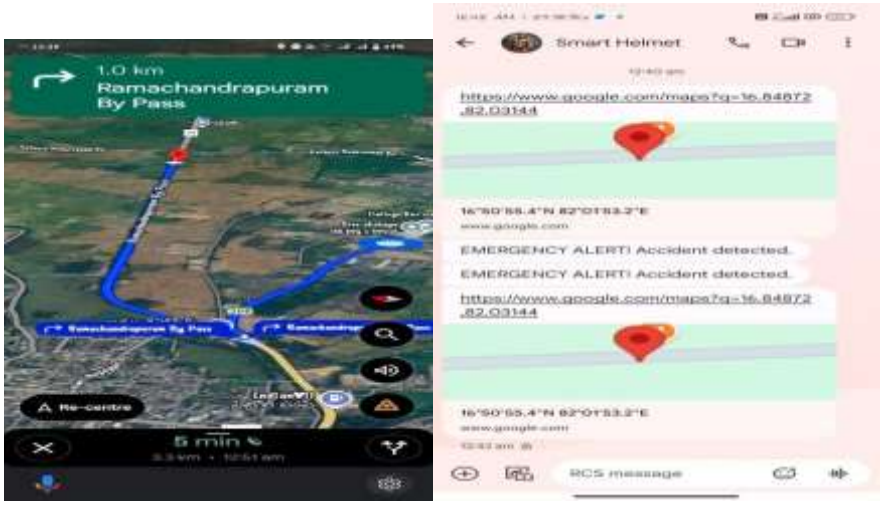
Identifies injuries and unconsciousness of soldiers, enabling immediate assistance.

8.4 Sports and Adventure Safety

Helps monitor high-speed crashes in sports like bike racing and mountain biking.

9 EXPERIMENTAL RESULTS

The result obtained after completion the project is whenever An accident is detected through the device's sensors, the system automatically sends an SMS alert containing the Riders location to predefined emergency contacts. Additionally device has the capability to initiate calls if necessary. The system provides a rapid response mechanism, ensuring prompt assistance in emergencies, potentially reducing response time and improving survival rates.



10 FUTURE SCOPE

The Smart Helmet has immense potential for future advancements, integrating cutting-edge technologies to enhance safety and usability. The following are key areas for improvement: AI- Based Accident Detection – Machine learning algorithms can be used to analyze motion patterns and predict accidents, reducing false alerts. Biometric Authentication – Features like fingerprint scanning and facial recognition can prevent unauthorized helmet use and improve security. Health Monitoring Sensors – Integration of heart rate, temperature, and fatigue detection sensors can alert riders and emergency services in case of health-related risks. Augmented Reality (AR) & Heads-Up Display (HUD) – Smart displays inside the helmet can provide real-time navigation, speed monitoring, and traffic updates without distracting the rider. IoT & Smart City Integration – The helmet can communicate with smart traffic systems to enhance safety, detect helmet violations, and send emergency alerts more efficiently

11 CONCLUSION

The Smart Helmet is a revolutionary safety device designed to prevent accidents, detect crashes, and provide real-time emergency alerts. By integrating sensors like MPU6050 (accelerometer), NEO-6M GPS, SIM800L (GSM), and alcohol detection modules, it ensures rider safety and compliance with traffic regulations. The helmet's ability to send automatic SMS alerts with GPS coordinates, monitor head movements, and prevent drunk driving significantly reduces the risk of fatal accidents.

In addition, the future scope of the project includes AI-based accident prediction, biometric authentication, augmented reality (HUD), and IoT connectivity, which will further enhance its usability and effectiveness. With continuous advancements, the Smart Helmet will become an essential tool in road safety, industrial protection, and military applications, ensuring faster emergency response and saving lives.

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8. These references provide valuable insights into helmet safety systems, IoT applications, and sensor integration, supporting the Smart Helmet project's development. Let me know if you need additional sources