

IOT-ENABLED SMART HELMET FOR ACCIDENT DETECTION AND RIDER DROWSINESS MONITORING

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Abstract—Mostly, road accidents occur due to the negligence of the rider and fatigue during riding. Hence, this project proposes an IoT-based Smart Helmet for Accident Detection and Rider Drowsiness Detection to increase the safety of the rider. This smart helmet is equipped with a vibration sensor that detects accidents. In the case of an accident, the system will send an emergency message containing the position of the rider to his/her family members or emergency departments. The helmet will also be equipped with an eye-blinking sensor that detects the drowsiness of the rider. If the rider is feeling sleepy, then the system sends a warning signal. This smart helmet not only reduces the rate of road accidents but also provides emergency assistance at a faster pace.

Keywords: IoT, Smart Helmet, Accident Detection, Drowsiness Detection, ESP32, GPS, GSM, Rider Safety.

I. INTRODUCTION

Road accidents have been one of the biggest threats in the world, causing a huge loss of life every year. One of the factors that leads to road accidents is the lack of awareness on the part of drivers or the rider of any vehicle about their state of sleepiness. Conventional systems have been quite ineffective when it comes to detecting accidents and monitoring the health conditions of the rider. Therefore, a new and improved system for safety purposes has to be designed.

This paper presents a safety helmet, which includes accident detection and rider alertness monitoring. This system employs devices like accelerometer to sense accidents, and eye blink detector sensors to check the rider's alertness level. In the event of an accident, the rider is automatically informed by sending an alert message to him/her along with their coordinates using the GPS and GSM sensors.

II. STATEMENT OF THE PROBLEM

Road accidents continue to be a very pressing problem around the world; however, many fatalities are caused as a result of slow reaction from emergency services as well as the lack of immediate medical attention to the injured party. One of the biggest contributors to these deaths is drowsiness among the riders, which impairs their ability to react. Moreover, during many incidents, victims are usually unable to communicate where they are to send a signal for help.

The current safety solutions have very narrow functions, which include accident detection but fail to tackle the underlying problem or do not offer any immediate communication. Thus, there is a need for a more comprehensive solution, which will not only detect any potential accidents or signs of sleepiness in the rider, but also be capable of reacting immediately in case an incident occurs.

This research project, therefore, will seek to create a smart helmet, using IoT technologies, which will monitor the rider, detect accidents, and send a notification regarding location of the victim to preset contacts.

III. OBJECTIVES

1. To design and develop a system for the IoT-based smart helmet, which increases safety through accident detection and drowsiness monitoring.
2. To monitor rider drowsiness
3. To alert the rider instantly
4. To alert the rider instantly
5. To track rider location instantly
6. To alert emergency services instantly
7. To make the system affordable and portable
8. To reduce response time during accidents

IV. LITERATURE SURVEY

Latest developments in smart helmets have made valuable contributions towards the advancement of road safety due to the incorporation of Internet of Things (IoT) technology. Different studies have explored accident detection, alert systems, and rider safety improvement through sensors and communication modules.

1. S. Rajesh, M. Kumar, and P. Karthik introduced an intelligent smart helmet concept that includes accident detection, sleepiness, and alcohol detectors. Vibration and microelectromechanical systems (MEMS) are utilized for accident detection while the camera is applied for detecting rider's sleepiness. In addition, global positioning system (GPS) and general system mobile (GSM) modules are used for alerting emergency contacts instantly.
2. A. Sharma and R. Singh designed an accident detection system based on a smart helmet wherein accelerometers play a crucial role in detecting accidents. GSM modules are utilized for sending emergency messages together with the rider's current location. The system has been found effective in reducing response time during accidents but lacks sleepiness detection capabilities.
3. Similarly, K. Priyanka and S. Balamurugan proposed an IoT-enabled smart helmet for detecting accidents through the use of GPS and communication modules. The research highlights the importance of real-time tracking and alerting in reducing deaths caused due to accidents. Yet, the helmet is unable to incorporate the status of the rider, such as drowsiness.
4. A review conducted by R. Kumar and D. Gupta highlighted different smart helmet systems and noted that most of the systems available are limited to accident detection and alerting. The research proposes that adding other functions, such as drowsiness detection, would increase the efficiency of the system.

As seen from the above literature review, it is clear that the current available technologies are able to detect accidents, but none of them can integrate accident detection and rider drowsiness detection at once. In order to bridge this gap, the current project aims to design an IoT-based smart helmet that can detect accidents, drowsiness, and notify the authorities instantly.

V. EXISTING SYSTEM

The existing intelligent motorcycle helmets concentrate primarily on detecting any accident with the help of sensors, such as acceleration and vibration sensors.

These sensors detect sudden shocks and accident situations.

GPS sensor helps to track the position of the rider.

GSM sensor sends out warning messages to predetermined contacts.

There are also functionalities, such as drunk alerting and helmet usage sensing.

However, these systems are oriented towards post-accident solutions and do not have any pre-accident solutions.

Moreover, they do not have drowsiness monitoring functionality.

Shortcomings of the Current System:

- Primarily designed to detect accidents and not prevent them.
- Does not incorporate rider drowsiness detection feature.
- Requires Internet connectivity to transmit alerts.
- Risk of faulty detection due to inaccurate sensors
- No provision for incorporating different safety measures.
- High cost and complexity involved in some designs.
- Ineffective in providing full rider safety assurance.

VI. PROPOSED SYSTEM

- Utilizes Internet of Things to develop smart helmet for rider safety and drowsiness monitoring system
- Uses acceleration and vibration sensor for accident detection
- Detects rider’s drowsiness by using eye-blink sensor
- Gives instantaneous alert to the rider via buzzer/LED
- Locates the rider in real-time using GPS module
- Sends emergency notifications via GSM/Wi-Fi to pre-defined contacts.

Key Components:

Microcontroller (ESP32/Arduino): Functions as the central processing unit of the system and analyses all sensor information

Accelerometer (MPU6050): Senses any abrupt movements, tilts, and impacts to detect accidents

Vibration Detector: Helps detect strong vibrations during accidents

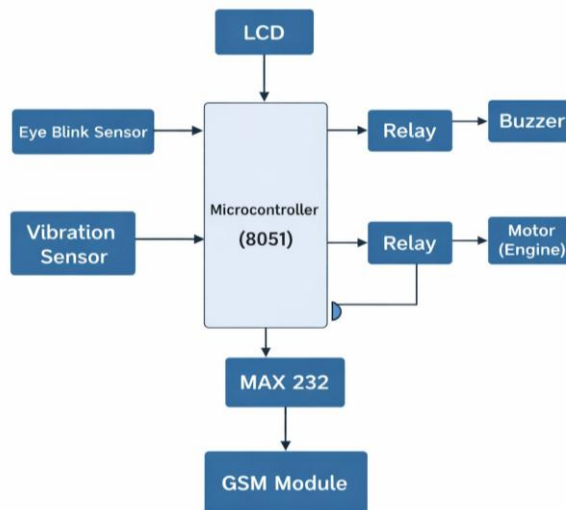
Eye-Blinking Detector (IR Detector): Monitors blinking and detects any signs of sleepiness in the driver

GPS Tracker: Offers real-time location updates in emergency situations

GSM/Wi-Fi Network: Sends notification along with the location information to emergency contacts

Buzzer and LED: Notifies driver about their drowsiness

Source of Energy (Battery): Sources energy for all the parts.



VII. TOOLS & METHODOLOGY

Hardware Tools

Microcontroller (ESP32/Arduino):

Serves as the primary processor to control all other elements.

Accelerometer (MPU6050):

Detects any sudden movements, tilt, and impact to detect accidents.

Vibration Sensor:

Detects any sudden jolts to ascertain accidents.

Eye Blinking Sensor (IR Sensor):

Measures eye blinking to detect the sleepiness of the rider.

GPS Module (Neo-6M):

Gives location information in case of emergencies.

GSM Module (Sim8001):

Sends emergency messages along with location information.

Buzzer:

Makes a sound alert when the rider is sleepy.

LED Indicator:

Provides light alert for drowsiness and system operation.

Battery (Source of Power):

Provides power to the whole system.

Software Tools

Arduino IDE:

Tool used for coding and uploading codes to the controller.

Embedded C:

Tool used for programming the logic of the system.

Proteus (Optional Simulation Tool)

Tool used for circuit design and simulation (Optional)

Tinkercad

Circuit simulator and tester

ThingSpeak / IoT Platform (Optional)

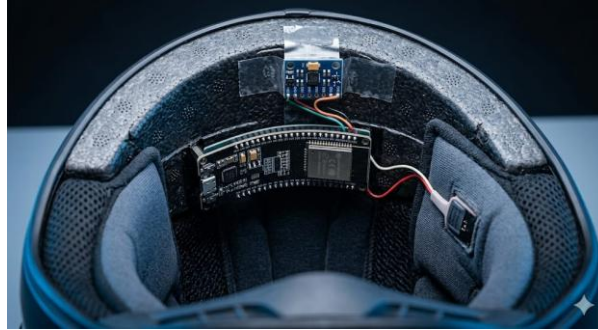
Data logger and Cloud Storage

Draw.io & PowerPoint

Tools used for designing block diagrams and flow charts

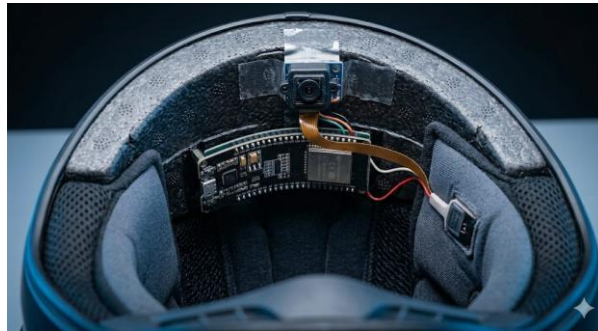
VIII. PROPOSED METHODOLOGY

Step1: Core sensor integration



This proposed system will help increase the safety of the rider by implementing accident detection as well as the monitoring of drowsiness through IoT. This system comprises of a microcontroller, which will control various sensors and modules.

Step2: Drowsiness Monitoring Setup (the eyeblink sensor)



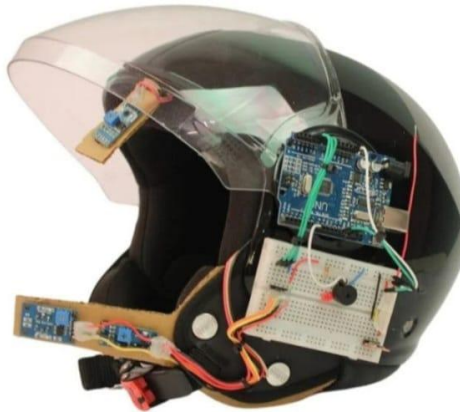
Firstly, initialization takes place for all the elements, including the accelerometer, vibration sensor, eye-blink sensor, GPS module, as well as GSM/Wi-Fi module. The system constantly monitors the data coming from the sensors in real time. Using the information provided by the accelerometer and vibration sensors, the system detects any sudden impact or any unusual movement to ascertain the condition of an accident based on certain threshold values.

Step3: Wireless communication and GPS integration



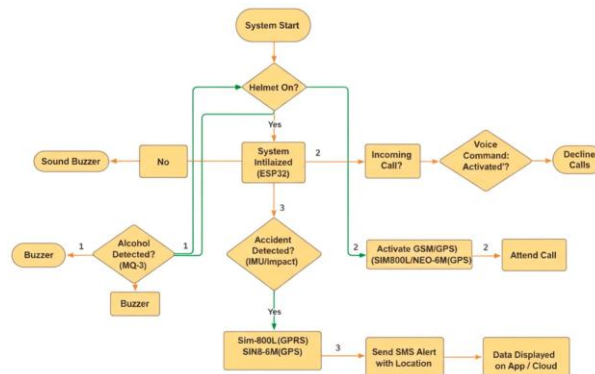
While doing this, the eye-blink sensor monitors the rider's eyes in order to detect any signs of drowsiness.

Step4: The Operational Dashboard and Alert System

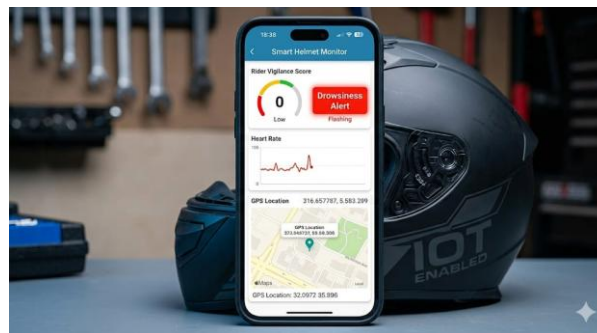


Upon detecting drowsiness, the rider will be warned through the buzzer/LED system. In case of an accident, the GPS module gets the real-time location, and the GSM/Wi-Fi module will send out an emergency message to designated contacts.

IX. FLOW CHART



X. RESULT & DISCUSSION



The proposed system was subjected to different tests to test its efficacy in detecting accidents and rider drowsiness. The accelerometer and vibration sensors were capable of detecting sudden impact and abnormal movement in a way that indicated accidents. Eye blink sensor also performed well in detecting drowsiness through prolonged closing of eyes and abnormal blinking pattern.

GPS module provided precise information about the location while GSM/Wi-Fi modules were effective in sending emergency messages to pre-designated contacts. Alert system composed of buzzer and LED proved effective in drowsiness situation.

In conclusion, the system worked efficiently in practical situations with increased accuracy and faster response than previous systems. In addition, the combined effectiveness of all features made the system superior to other available systems.

XI. FUTURE SCOPE

Linking up with a mobile app for live tracking and notifications

Using AI to detect drowsiness through camera technology and images

Cloud computing to help analyze data and keep track of accidents

Installation of sensors that monitor other health factors such as heartbeat

Connecting with emergency services to ensure automatic ambulance notifications

Improving battery performance to maximize the use of the device

Using high-speed internet services like 5G for quicker data transfer.

XII. CONCLUSION

The smart helmet system proposed here serves as a very effective solution that can be used to enhance rider safety through the inclusion of accident detection as well as drowsiness detection. By continuously monitoring the condition of the rider using various sensors, the system sends alerts as soon as drowsiness is detected in order to ensure prevention of an accident. In case an accident occurs, the system sends an alert together with the current location of the rider.

In comparison to other existing devices, the one that has been developed here is more advanced since it incorporates two features in one device; preventive and responsive safety measures. The use of different sensors, GPS technology, and communication components makes the system very accurate and efficient. Overall, the system is affordable and practical and can serve a very great purpose.

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