International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 04 | April - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Embedded Based Smart Helmet for Accident Detection

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ABSTRACT

Embedded-based smart helmet designed for real-time accident detection and prevention. The system integrates an accelerometer, gyroscope, and GPS to detect crashes and sudden impacts, while a microcontroller processes the data. Upon detecting an accident, the helmet sends an alert with real-time location details via GSM to emergency contacts. Additionally, an alcohol sensor ensures rider safety by preventing ignition if alcohol consumption is detected. This cost-effective and efficient system enhances road safety by enabling timely emergency response and reducing accident-related facilities.

KEYWORDS-

Microcontroller, IR sensor, IOT module.

I. INTRODUCTION

Road accidents are a leading cause of fatalities worldwide, often due to delayed emergency response. A smart helmet with embedded technology can significantly enhance rider safety by detecting accidents in real time and sending alerts for quick assistance. This system integrates sensors such as an accelerometer, gyroscope, and GPS to monitor impacts and sudden movements. A microcontroller processes the data and, in case of an accident, triggers an alert via GSM, sharing the rider's location with emergency contacts. Additionally, an alcohol sensor prevents intoxicated riding. This smart helmet provides a practical and efficient solution to reduce accident-related fatalities and improve road safety. This smart helmet integrates multiple sensors, including an accelerometer and gyroscope, to monitor sudden impacts and unusual motion patterns. A GPS module provides real-time location tracking, while a GSM module sends automatic alerts to emergency contacts upon detecting an accident. Additionally, the helmet features an alcohol sensor to prevent intoxicated riding and a helmet usage sensor to ensure compliance with safety protocols.

II. PROBLEM STATEMENT

Motorcycle accidents are a major cause of fatalities due to delayed medical response and lack of immediate accident detection. Many riders do not wear helmets, increasing injury severity. Additionally, drunk driving remains a significant risk factor. Existing safety measures are often ineffective in ensuring timely emergency assistance. Therefore, there is a need for a smart helmet with embedded technology that can automatically detect accidents, send real-time alerts with location details, and prevent drunk driving. This system aims to enhance road safety by reducing response time and promoting responsible riding behavior. To address these challenges, a smart helmet with embedded technology is proposed. This helmet will integrate various sensors to detect accidents, monitor the rider's condition, and ensure helmet usage. An alcohol detection system will also prevent drunk riding by restricting vehicle ignition. By implementing this smart helmet, accident-related fatalities can be reduced, emergency response times can be improved, and overall road safety can be enhanced.

III. METHODOLOGY

1.Sensor Integration: Accelerometer, Gyroscope, and GPS Detect crashes and track location.
2. Microcontroller Processing: Data from sensors is analyzed to identify accidents.
3. Accident Detection: Threshold-based impact analysis determines crash severity for accident detection .
4. Emergency Alert System : GSM module sends location-based alerts to emergency contacts.

5. Helmet & Alcohol Detection Ensures the bike starts only if the helmet is worn and no alcohol is detected.
6. Real-Time Safety Enhancement: Provides quick emergency response and promotes safe riding.

IV. BLOCK DIAGRAM

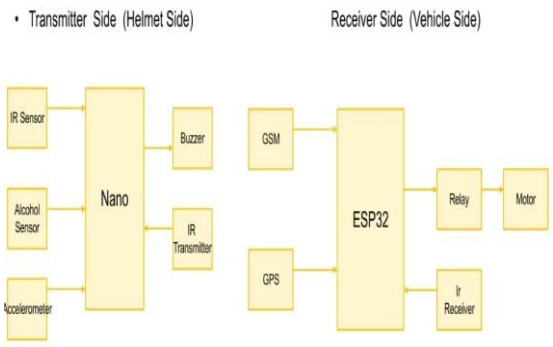


Fig: Block Diagram

V. COMPONENTS USED

1. ARDUINO NANO

The Arduino Nano is a compact, breadboard-friendly microcontroller based on the ATmega328P, similar to the Uno but smaller. It has 14 digital I/O pins (6 PWM), 8 analog inputs, 32KB flash memory, and operates at 16MHz. It supports UART, I2C, and SPI communication and can be powered via USB or VIN (6-12V). Ideal for robotics, IoT, and automation projects due to its small size and affordability. The Arduino Nano is a compact, breadboard-friendly microcontroller based on the ATmega328P. It operates at 5V, 16MHz and has 14 digital I/O (6 PWM), 8 analog inputs, 32KB flash memory, and supports UART, SPI, and I2C. Powered via USB or VIN (6-12V), it's ideal for robotics, IoT, and automation projects.

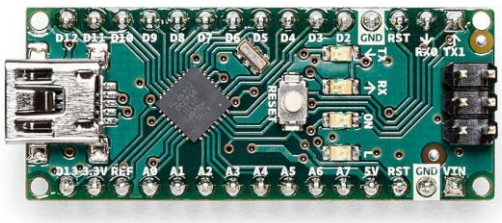


Fig: ARDUINO NANO

2. INFRARED SENSOR

An IR sensor (Infrared sensor) detects objects or motion using infrared light. It consists of an IR transmitter (LED) and an IR receiver (photodiode). Common types include active (emits and detects IR) and passive (PIR, detects heat). Used in obstacle detection, motion sensing, and remote controls. An IR sensor detects objects or motion using infrared light. It is used in obstacle detection, motion sensing, and remote controls.

Fig: INFRARED SENSOR

3. ALCHOAL SENSOR

An alcohol sensor detects the presence and concentration of alcohol, typically ethanol, in breath or other substances. Commonly used in breathalyzers, these sensors work by measuring changes in electrical properties (resistance or current) when alcohol vapor interacts with a sensor. There are two main types: semiconductor-based sensors, which are less accurate but inexpensive, and electrochemical sensors, which are more accurate and used in professional devices. Alcohol sensors are essential for applications like law enforcement, safety systems, and personal monitoring of alcohol consumption.

Fig: ALCHOAL SENSOR

4. ACCELEROMETER SENSOR

An accelerometer sensor measures acceleration forces in one or more directions. It detects changes in velocity or movement and can be used to determine orientation, vibration, and tilt. Commonly used in smartphones, fitness trackers, and vehicles, accelerometers are key components in applications like motion detection, step counting, and screen rotation. They work by sensing the force of gravity or changes in movement, converting them into electrical signals for analysis.

Fig: ACCELEROMETER SENSOR

5. BUZZER

A buzzer is an electronic device that emits sound when activated. It is commonly used for signaling, alerts, or notifications in various applications such as alarms, timers, and electronic devices. Buzzers can produce different tones or pitches and are typically powered by electricity. They work by vibrating a diaphragm or using piezoelectric materials to generate sound when an electric current passes through them.

Fig: DC MOTOR

6. IR TRANSMITTER

An IT transmitter is a device that sends data or signals from one point to another, typically over a network or wireless medium. In the context of information technology, transmitters are used to send data between devices, such as in wireless communication systems, radio frequency (RF) systems, or network connections. They convert data into a suitable signal (e.g., radio waves, infrared) for transmission and are essential components in communication systems like Wi-Fi, Bluetooth, or cellular networks.

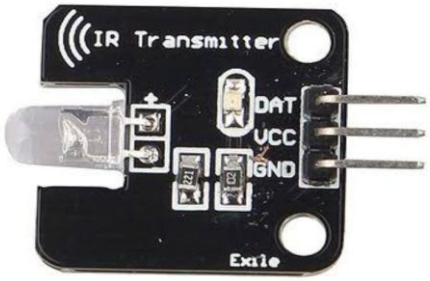


Fig: IR TRANSMITTER

7. GSM MODULE

A GSM (Global System for Mobile Communications) module is a device that allows microcontrollers or embedded systems to communicate over mobile networks. It enables functionalities such as sending and receiving SMS, making and receiving voice calls, and connecting to the internet via mobile data. GSM modules are widely used in various applications such as remote control systems, IoT devices, and home automation projects. They typically interface with microcontrollers through serial communication (UART) and can operate with SIM cards for network access.

Fig :GSM MODULE

8. GPS MODULE

A GPS (Global Positioning System) module is a device that allows a system to determine its geographic location (latitude, longitude, altitude) using signals from satellites. It provides accurate time and position data, which is widely used in navigation, tracking, and mapping applications. GPS modules typically

communicate with microcontrollers via serial interfaces and are used in projects like vehicle tracking systems, robotics, and location-based services. They require a clear line of sight to the sky to receive satellite signals effectively.

Fig: GPS MODULE

9. RELAY MODULE

A relay module is an electrically operated switch used to control high-voltage devices with low-voltage signals, such as from a microcontroller or a low-voltage system. It consists of an electromagnet (the relay), a switch, and a driver circuit to interface between the low-voltage control side and the high-voltage controlled side. When a low-voltage signal is applied to the relay's control input, the electromagnet activates the switch, allowing current to flow through the high-voltage circuit. Relay modules are commonly used in automation, home automation, and industrial applications for controlling devices like motors, lights, and appliances.

Fig: RELAY MODULE

10. IR RECEIVER

An IR (Infrared) receiver is a component that detects infrared light signals, typically used in remote control systems. It receives signals modulated at specific frequencies, which are transmitted by an IR LED in a remote control. The IR receiver decodes these signals into electrical data that can be processed by a microcontroller or other devices. It's commonly used in applications like TV remote controls, air conditioning units, and other consumer electronics. The receiver generally works by detecting the modulated light pattern and converting it into a digital signal for further processing.

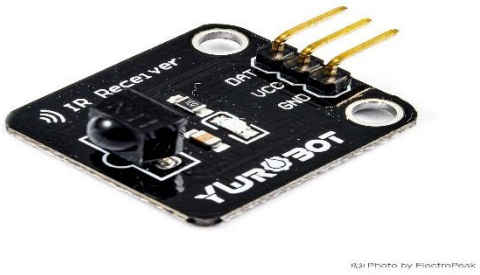
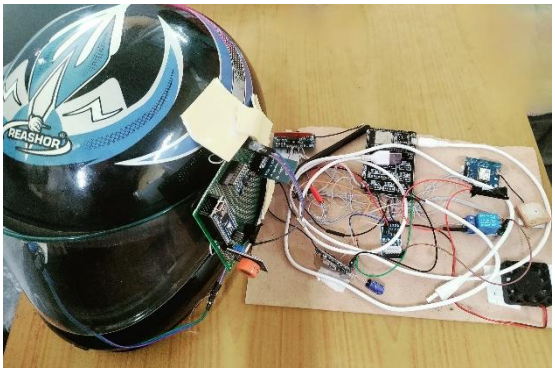


Fig: IR RECEIVER

RESULT :-



CONCLUSION :-

An embedded-based smart helmet for accident detection is a safety innovation that integrates sensors, microcontrollers, and communication technologies to monitor the rider's condition and detect accidents in real-time. When an impact or abnormal movement is detected, the system can trigger automatic alerts to emergency contacts or medical services, improving response time and enhancing rider safety. This technology can significantly reduce the consequences of accidents by enabling quicker assistance and helping to prevent serious injuries. It represents a promising advancement in wearable safety systems for motorcyclists and other riders.

REFERENCES :-

A good reference for an embedded-based smart helmet for accident detection would be:

"Design and Development of Smart Helmet for Accident Detection and Alert System" by S. S. R. Anjaneyulu, S. R. B. R. Krishna, and M. S. R. S. Murthy.

This paper discusses the integration of sensors (like accelerometers and gyroscopes) for accident detection in helmets, along with communication systems for alerting emergency contacts.

For further exploration, you can also refer to:

"Smart Helmet for Accident Detection and Prevention System Using IoT"

This article discusses the use of IoT technology combined with sensors in helmets for real-time accident detection and alert systems.

These references cover the use of embedded systems, sensors, and communication technologies to enhance rider safety and accident response time, making them valuable sources for research on the topic. You can find these papers in IEEE Xplore, ScienceDirect, or other academic research databases.