



Smart Helmet for Motorcyclists with GPS Navigation and Alerts for Emergencies

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Abstract: This project introduces an IoT-enabled smart helmet system aimed at improving rider safety through accident detection and helmet usage monitoring. A NodeMCU the microcontroller, gyro sensor for detecting accidents, and a push button sensor to verify if the helmet is being worn make up the system. The system automatically turns on a buzzer to alert people right away and turns the vehicle motor on or off for safety if the goggles is not worn or an accident is detected. At the same time, the Blynk IoT platform sends real-time notifications to the user's phone. This system makes sure that people respond quickly in case of an accident, makes sure that helmets are worn, and lets people watch from afar for better safety.

I. INTRODUCTION

Road accidents involving two-wheelers have become a major concern due to the increasing number of motorcycles on roads and the lack of proper safety measures. Motorcyclists are more vulnerable to severe injuries compared to other vehicle users, especially when safety equipment such as helmets is not used properly. Many accidents result in serious consequences due to delayed medical assistance and the absence of immediate alert systems.

Traditional helmets provide basic head protection but do not offer any intelligent features to monitor rider safety or respond automatically during emergencies. In many cases, accidents go unnoticed for a long time, which delays rescue operations and increases the risk of fatal injuries. Additionally, riders often neglect wearing helmets, despite safety regulations, leading to a higher number of injuries and fatalities.

With the advancement of Internet of Things (IoT) technology, smart wearable devices can be developed to improve rider safety through real-time monitoring and automated response systems. IoT enables the integration of sensors, microcontrollers, and communication platforms to detect critical situations and instantly notify concerned authorities or users. Smart helmet systems leverage these technologies to enhance accident detection, ensure helmet usage, and provide timely alerts.

The Smart Helmet for Motorcyclist with GPS Navigation and Emergency Alerts is designed to improve rider safety by integrating sensors and IoT-based communication. The system uses a gyro sensor to detect accidents and a button sensor to verify whether the helmet is properly worn. If unsafe conditions are detected, such as riding without wearing the helmet or the occurrence of an accident, the system activates a buzzer for immediate warning and controls the vehicle motor to enhance safety.

Furthermore, the NodeMCU microcontroller enables real-time communication with the Blynk IoT platform, allowing notifications to be sent instantly to the user's mobile phone. This ensures quick response during emergencies and enables remote monitoring of rider safety. Overall, the proposed smart helmet system provides an effective, reliable, and intelligent solution to enhance motorcyclist safety and reduce accident-related risks.

II. RELATED WORK

“Advanced Smart Safety Helmet for Motor Cycles using Real-Time Sensor Data”

This paper is all about the importance of development of a smart helmet that aims to enhance the safety of two wheeler riders with the help of contemporary technologies. The system, which we have termed as the "Advanced Smart Helmet", includes major safety requirements like helmet compliance verification, alcohol level verification, and accident verification, with the facility to fine communication with emergency units. The helmet includes an IR sensor to verify proper use, an MQ3 alcohol sensor to verify drunkenness, and a vibration sensor to verify accidents. These are interfaced with a GPS and GSM module to alert emergency units to the rider's location in case of emergencies. Sensor data processing is done through an ESP32 microcontroller, while wireless communication between the motorbike and helmet is done without wires through Wi-Fi. The motorbike's ignition system is controlled through a motor driver IC, such that the motorbike can be started only when all the safety requirements are fulfilled. In contrast to existing systems lacking an end-to-end mechanism of rider safety, this smart helmet integrates multiple safety requirements in a single IoT-based solution. Mass-producible, this smart helmet not only avoids accidents but also responds immediately during emergencies, offering a scalable and innovative safety product in the automotive industry..

"IoT based Smart Helmet System for Accident Prevention"

The smart helmet's purpose is to provide features for detecting and reporting whether a person has drunk alcohol while wearing a helmet. Because riders don't wear helmets and drink alcohol, road accidents are on the rise. Thousands of people die every year in vehicle accidents in today's world. Accidents can often be reduced by using a smart helmet. The project's main goal is to build a practical helmet that can prevent accidents without the use of a helmet and detect alcohol. The touch sensor identifies whether the user is wearing a helmet. The Gas sensor detects the presence of alcohol in the rider's breath. The bike will not start if the rider is not wearing a helmet or has consumed alcohol. The bike can only be started if there are no signs of intoxication and a helmet is worn. Sensor operations are used to construct the system.

"Vehicle Accident Detection and Alerting System"

In this paper, we proposed a system to detect vehicle accident and alert to the family member as well as

nearby police control rooms and hospitals. The numbers of accidents happening in our country are increasing rapidly everyday and existing systems for a person who meets with an accident are weak as per the ratio. Also the existing systems are focusing mostly on prevention of accident rather than taking immediate actions after an accident; so that the person could be save. The aim of the project is to detect the road accidents and to provide immediate help for needy which avoids the loss of valuable human life. **Keywords:** RF transmitter and receiver, LCD, Atmega 328 Microcontroller, Vibration Sensor, Regulator GSM module.

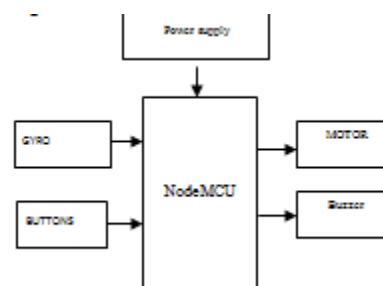
"IoT Based Smart Helmet for Rider Safety" – Sharma, R.

This paper presents a smart helmet system that integrates IoT technology to enforce helmet usage and detect accidents. The authors propose using sensors to monitor helmet wear and accident conditions, with alerts sent via mobile applications. The study emphasizes the importance of real-time monitoring and emergency response, showing how IoT can reduce fatalities and improve rider safety.

III. IMPLEMENTATION

The proposed system integrates NodeMCU with a gyro sensor to detect sudden impacts (accidents) and a button sensor to detect whether the helmet is being worn. When abnormal activity or non-usage is detected, the system activates a buzzer and controls the vehicle motor to prevent unsafe operation. At the same time, the NodeMCU sends alerts and sensor data to the user's mobile phone through the Blynk IoT application. This approach ensures automatic accident detection, enforces helmet usage, and provides real-time monitoring for enhanced rider safety.

Block diagram:



Working

The Smart Helmet system works by integrating IoT technology with safety-focused sensors and controls to protect motorcyclists. A NodeMCU microcontroller serves as the core, connected to a gyro sensor that detects accidents and a button sensor that ensures the helmet is worn. If the rider neglects to wear the helmet or an accident is detected, the system immediately activates a buzzer and controls the vehicle motor by switching it ON or OFF to prevent unsafe riding. At the same time, real-time alerts are sent to the rider's mobile phone via the Blynk IoT platform, enabling quick response and remote monitoring. This combination enforces helmet usage, provides accident detection, and enhances overall rider safety through automated emergency alerts.

HARDWARE REQUIREMENTS

Node MCU

Technically speaking NodeMCU is a firmware for ESP8266 developed using C Programming Language, Espressif NON-OS SDK and Lua scripting language. Traditionally, we write code for our Microcontrollers like Arduino, STM32, 8051 etc., either in C or C++ and compile it with a set of tools and generate a binary file. This binary file is then uploaded into the flash memory of the microcontroller and it gets executed. Things are quite different with NodeMCU. You can consider the NodeMCU firmware as an interpreter for Lua Scripts. So, if your ESP8266 is loaded with NodeMCU Firmware, you can simply write your application in Lua and send it to the ESP8266. NodeMCU Firmware will interpret the byte code and executes the commands. There is no compilation, no binary file etc. Just write a script and run it the team which developed NodeMCU Firmware also developed a breakout board for ESP-12E module called the NodeMCU Devkit. So, many of us are actually using the board called NodeMCU and programming it with Arduino IDE and not the Lua Scripts.



IMPORTANT NOTE: Only one firmware can exist on the ESP8266. It can be either AT Commands Firmware, NodeMCU Firmware or Arduino based code. Once you upload an Arduino sketch, the NodeMCU firmware gets erased. If you want to work with Lua Scripts and NodeMCU, then you have to flash the NodeMCU Firmware.

ESP-01 vs. NodeMCU (ESP-12E)

As mentioned earlier, the NodeMCU Devkit is actually a Breakout Board for the ESP-12E Module. The ESP-01 is the vanilla version of the ESP8266 Wi-Fi SoC made by Ai-Thinker, a third part module manufacturer for ESP8266.

Brief about NodeMCU ESP8266

The **NodeMCU ESP8266 development board** comes with the ESP-12E module containing the ESP8266 chip having Tensilica Xtensa 32-bit LX106 RISC microprocessor. This microprocessor supports RTOS and operates at 80MHz to 160 MHz adjustable clock frequency. NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs. Its high processing power with in-built Wi-Fi / Bluetooth and Deep Sleep Operating features make it ideal for IoT projects.

NodeMCU can be powered using a Micro USB jack and VIN pin (External Supply Pin). It supports UART, SPI, and I2C interface.

- **ESP8266 Chip:** The core of the NodeMCU module is the ESP8266 chip, which provides Wi-Fi connectivity and microcontroller functionality.

There is one analog input pin available, allowing for the connection of analog sensors. This pin can read voltage levels and convert them into digital values for processing.

UARTs: 1

The module includes one UART (Universal Asynchronous Receiver/Transmitter) for serial communication, which is essential for debugging and connecting to other serial devices.

SPIs: 1

One SPI (Serial Peripheral Interface) is available, providing high-speed communication with devices like SD cards, displays, and other SPI peripherals.

I2Cs: 1

The I2C (Inter-Integrated Circuit) bus allows for communication with multiple I2C devices using only two wires, making it ideal for connecting sensors and modules that support I2C communication.

Flash Memory: 4 MB

The NodeMCU is equipped with 4 MB of flash memory for storing the firmware and user programs. This ample storage space allows for the development of complex applications and features.

SRAM: 64 KB

It includes 64 KB of SRAM (Static Random Access Memory) for data storage and processing during runtime. This memory is used for variables, data buffers, and program execution.

Clock Speed: 80 MHz

The microcontroller operates at a clock speed of 80 MHz, providing sufficient processing power for handling various tasks efficiently and in real-time.

USB-TTL based on CP2102:

The onboard CP2102 USB-to-TTL converter allows for easy programming and serial communication over USB. It enables plug-and-play functionality, simplifying the setup and development process.

PCB Antenna:

The NodeMCU features an integrated PCB antenna, which provides reliable Wi-Fi connectivity without

the need for an external antenna. This design keeps the module compact and easy to use.

Compact Size:

The small form factor of the NodeMCU module makes it ideal for integration into IoT projects, where space is often limited. Its compact size allows it to fit seamlessly into a wide range of applications, from home automation to wearable devices.

PUSH BUTTON

Push Buttons are normally-open tactile switches. Push buttons allow us to power the circuit or make any particular connection only when we press the button. Simply, it makes the circuit connected when pressed and breaks when released. A push button is also used for triggering of the SCR by gate terminal.

A push button switch is a mechanical device to control an electrical circuit by a manual operation to energize the internal switching mechanism. Push button switches are electrical actuators this switch will close or open an electrical circuit by pressing the switch. Push button switches control a wide range of electronic circuits. These switches are in the form of a button or a key. These switches can be either momentary or maintained. But, the push button is the frequent sort of momentary switch. Generally, A closed push button switch is known as a push-to-break switch. An open push button switch is known as a push-to-make switch. The maintained push button is connected to a mechanism that holds and releases between successive alternate pushes. Push buttons technically consist of two states or more, but, a push button having more than two states is not a common option. These push buttons are available in a variety of shapes, sizes, and configurations, depending on the design requirements.



Fig: push button

GYRO SENSOR

Gyroscope sensor is a device that can measure and maintain the orientation and angular velocity of an

object. These are more advanced than accelerometers. These can measure the tilt and lateral orientation of the object whereas accelerometer can only measure the linear motion.

Gyroscope sensors are also called as Angular Rate Sensor or Angular Velocity Sensors. These sensors are installed in the applications where the orientation of the object is difficult to sense by humans.

Measured in degrees per second, angular velocity is the change in the rotational angle of the object per unit of time.



Gyroscope Sensor

L298N MOTOR DRIVER IC

There are multiple kinds of motion we face in our daily life some are linear some are rotatory motion. Both motions have their importance in machines and our life. In the 19th century, the scientist started discovering/inventing some ways of producing current and motions when British physicist John Ambrose Fleming invented the right-hand rule.

L298N IC is known as a motor driver. It is a low voltage operating device like other ICs. The other ICs could have the same functions like L298N but they cannot provide the high voltage to the motor. L298N provides the continuous bidirectional Direct Current to the Motor. The Polarity

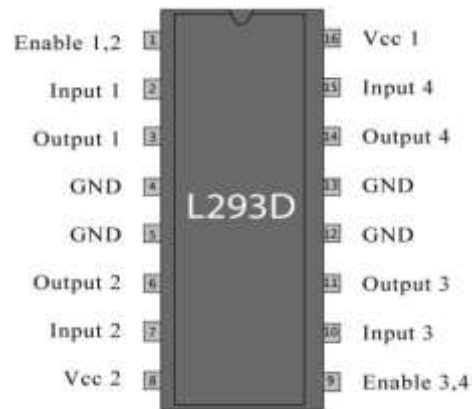
of current can change at any time without affecting the whole IC or any other device in the circuit. L298N has an internal H-bridge installed for two motors.

H-Bridge is an electrical circuit that enables the load in a bidirectional way. L298N Bridge is controlled by external low voltage signals. It may be small in size, but its power output capacity is higher than our expectation. It could control any DC motor speed and

direction with a voltage range of 4.5 – 36 Volts. Its diodes also save the controlling device and IC from back EMF. To control the max 600mA amount of current an internal “Darlington transistor sink” installed in it, which could be used to control a large amount of current by providing a small amount of current. It has also internal “pseudo-Darlington source” which amplifies the input signal to control the high voltage DC motor without any interception.



L298N pin out



DC MOTOR

DC Motor is an electrical machine which, when provided with direct current electrical energy, converts it into mechanical energy. It is based on electromagnetic induction, where a conductor carrying current (normally a coil of wire) placed in a magnetic field experiences force to rotate. This rotation is used to perform mechanical work.

There are many applications for DC motors, they can be used in robotics; electric vehicles, and some

industrial machinery as well as household devices. DC motor can be used at such places where speed control is required. That is why DC motors are often used in trolleys, electric train production systems, elevators, etc.



Fig: DC motor

BUZZER

An audio signalling device like a beeper or buzzer may be electromechanical or piezoelectric or mechanical type. The main function of this is to convert the signal from audio to sound. Generally, it is powered through DC voltage and used in timers, alarm devices, printers, alarms, computers, etc. Based on the various designs, it can generate different sounds like alarm, music, bell & siren.



Buzzer Pin Configuration

The **pin configuration of the buzzer** is shown below. It includes two pins namely positive and negative. The positive terminal of this is represented with the '+' symbol or a longer terminal. This terminal is powered through 6Volts whereas the negative terminal is represented with the '-' symbol or short terminal and it is connected to the GND terminal.

IV. RESULT ANALYSIS



Fig1: project kit



Fig2: IOT connectivity



Fig3: helmet status

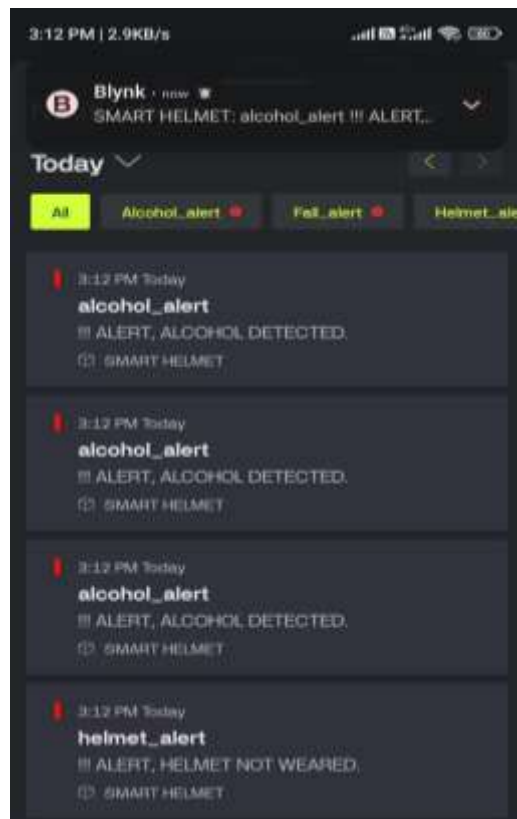


Fig4: notifications to the device owner

V. CONCLUSION

an effective IoT-based solution to enhance rider safety and reduce the risks associated with motorcycle accidents. By integrating sensors, automation, and real-time communication, the proposed system addresses critical issues such as accident detection, helmet usage enforcement, and delayed emergency response.

The use of a gyro sensor enables reliable detection of accidents, while the button sensor ensures that the helmet is properly worn before the vehicle can operate. In unsafe situations, the system activates a buzzer to provide immediate alerts and controls the vehicle motor by turning it ON or OFF to enhance rider safety. The NodeMCU microcontroller efficiently manages sensor data and communication, ensuring smooth system operation.

Real-time notifications sent through the Blynk IoT platform allow instant alerts to the rider or concerned individuals, enabling quicker response during emergencies. This reduces the time required for

assistance and increases the chances of minimizing injury severity. The system also promotes responsible riding behavior by enforcing helmet usage.

In conclusion, the proposed smart helmet system demonstrates how IoT technology can significantly improve road safety for motorcyclists. With further enhancements such as GPS location sharing, emergency contact integration, and advanced accident analysis, the system can be developed into a comprehensive safety solution suitable for real-world deployment and smart transportation systems.

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