VISVESVARAYA TECHNOLOGICAL UNIVERSITY

Jnana Sangama, Belagavi,Karnataka - 590 018

Project/Seminar report on

Design and Implementation of IoT-Based Smart Helmet for Road Accident Detection

Submitted to

Visvesveraya Technological University, Belagavi

In partial fulfillment for award of the degree of

Bachelor of Engineering (BE)

in

Computer Science and Engineering

Submitted by

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Under the Guidance of

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2025

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CERTIFICATE

This is to certify that the major project work entitled **"Design and Implementation of IoT-Based Smart Helmet for Road Accident Detection"**, carried out by **Ms. Bhagya Golasangi (2BL23CS402)**, is a bonafide student of **BLDEA'S V. P. Dr. P. G. Halakatti College of Engineering and Technology, Vijayapur**, Department of Computer Science and Engineering, has satisfactorily completed the project work.

The project report titled **"Design and Implementation of IoT-Based Smart Helmet for Road Accident Detection"** is submitted to **Visvesvaraya Technological University, Belagavi, Karnataka**, in partial fulfilment of the requirements for the award of the Bachelor of Engineering (B.E.) degree in Computer Science and Engineering under VTU, Belagavi, for the year 2025.

Guide	H.O.D	Principal
Dr. Veena .A. Patil	**Dr. Anil Kannur**	**Dr. Manjunath P**

Name of the Examiners Signature with Date

1. Prof.
2. Prof.

DECLARATION

I,student of the seventh-semester B.E. program in the Department of Computer Science and Engineering, hereby declare that the Major Project entitled **"Design and Implementation of IoT-Based Smart Helmet for Road Accident Detection"** embodies the report of my project work carried out by me under the guidance of **Dr. Veena A. Patil**.

I also declare that, to the best of my knowledge and belief, the work presented in this report does not form part of any other project report or dissertation on the basis of which a degree or award has been conferred previously on any student.

Bhagya Golasangi 2BL23CS402

ACKNOWLEDGMENT

After completing this research study, I feel that words fall short of conveying my gratitude to everyone who supported me in achieving my objectives. I am genuinely grateful to God for His grace, strength, support, and, most importantly, His love throughout my academic journey. His kindness has enabled me to succeed and progress in all my academic endeavors.

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I also extend my deepest gratitude to the project coordinators as well as **Dr. Manjunath P**, Head of the Institute, and other institute heads for their constant support and insightful guidance, which have been instrumental in the completion of this project.

Bhagya Golasangi

ABSTRACT

The Smart Helmet for Two-Wheelers is an innovative safety system designed to reduce road accidents and ensure rider safety using IoT technology. The system is built around the ESP8266 microcontroller, which serves as the brain of the entire setup. An IR sensor is used to detect whether the rider is wearing the helmet, while an alcohol sensor monitors the presence of alcohol in the rider's breath. The bike's ignition, represented by a relay module, will only activate if the helmet is worn and no alcohol is detected. Once the bike is turned on, the accident detection system using the MPU6050 sensor continuously monitors the rider's motion. In case of an accident, the system triggers a buzzer, fetches the live location from a GPS module, and updates the accident details, including location and alert status, to the ThingSpeak cloud platform. Additionally, an LCD display provides real-time updates of system status to the rider. This smart helmet aims to enforce safe driving practices, enable quick accident response, and provide real-time monitoring through IoT, ultimately contributing to the reduction of road fatalities and promoting responsible riding behavior among two-wheeler users.

The rapid increase in road accidents, especially among two-wheeler riders, has highlighted the need for intelligent safety solutions. This project presents the design and implementation of an IoT-based smart helmet aimed at enhancing rider safety by detecting accidents in real time and promptly notifying emergency contacts. The helmet integrates multiple sensors, including an IMU (Inertial Measurement Unit) for fall and impact detection, GPS for accurate location tracking, and wireless communication modules such as GSM/Wi-Fi for alert transmission. Embedded microcontroller-based logic ensures real-time monitoring and immediate response during accident events. Data is logged to a cloud platform for remote monitoring and analytics. The system is developed using low-cost, lightweight components to maintain comfort and usability. Field testing demonstrates the effectiveness of the prototype in detecting accidents accurately, reducing emergency response time, and potentially saving lives. This work provides a practical framework for IoT-enabled rider safety solutions and future smart transport applications.

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Chapter 1 INTRODUCTION

1.1 Introduction

Road accidents of two-wheelers are one of the major causes of injury and death among people around the world. Most of these accidents are due to unhelmeted riders or driving in an intoxicated state. In order to make roads safer, the Smart Helmet for Two-Wheelers incorporates modern sensor technology along with IoT concepts into a single safety system. This project will ensure that riders adhere to basic safety measures while providing automatic accident detection and alert mechanisms. The ESP8266 microcontroller controls the whole system and synchronizes the operation of all sensors and modules connected to it. Inside the helmet, an IR sensor is installed that detects whether the rider is wearing it properly or not. At the same time, the alcohol sensor checks for alcohol consumption. In case of failure to wear the helmet or being under the influence of alcohol, the system does not allow the bike to start: it switches off the relay module, which plays the role of the switch for the ignition system. The bike may be started, and the accident detection system will be turned on once the rider has fulfilled both safety requirements. The MPU6050 sensor detects accidents based on sudden movements or forces of impact. In an accident condition, the system triggers a buzzer, acquires the rider's GPS location, and sends the information to a ThingSpeak cloud for real-time monitoring and alert. The system then activates an accident alert indicator on the cloud and displays relevant information on an LCD display. This Smart Helmet project ensures that riders follow basic safety requirements and provides immediate accident alerts and location tracking for quicker emergency responses. It is an example of how IoT can be employed in an efficient manner to make the roads safer and help save lives.

1.2 Background

Two-wheeler riders are highly vulnerable to severe injuries and fatalities during road ac cidents, mainly due to the lack of protective equipment and unsafe riding practices such as not wearing helmets or driving under the inuence of alcohol. Traditional helmets o er only physical protection and cannot detect unsafe behavior or provide emergency assistance. With the growth of IoT and embedded sensor technologies, it has become possible to design smart helmets that actively monitor rider safety conditions. By inte grating sensors such as IR for helmet detection, MQ-3 for alcohol sensing, and MPU6050 for accident detection, along with GPS and IoT communication modules, a smart helmet can enforce safety rules, block vehicle ignition when conditions are unsafe, and automat ically send accident alerts with the rider's live location. These advancements address major shortcomings in existing systems by ensuring safety compliance, reducing emer gency response time, and improving overall road safety through intelligent, automated monitoring. This background highlights the need for a modern IoT-based smart hel met capable of supporting real-time accident detection and promoting responsible riding behavior.

1.3 Need for an IoT-Based Smart Helmet

Two-wheeler accidents frequently go unreported in time, especially in rural areas. In many cases, injured riders are unable to call for help, leading to delayed medical treatment and severe consequences. An IoT-based smart helmet addresses this issue by:

- Many two-wheeler riders do not wear helmets. ˆ
- Drunk driving causes frequent accidents. ˆ
- Normal helmets cannot detect accidents or send alerts. ˆ
- Delayed emergency response increases fatalities. ˆ
- Asmart system is needed to ensure safety and give real-time accident alerts

1.4 Challenges in Designing an IoT-Based Smart Helmet

Despite its advantages, developing an e cient smart helmet system comes with challenges:

1. Difficult to detect accidents accurately without false alarms.
2. Alcohol and motion sensors may give inaccurate readings due to environment.
3. Requires stable power supply and increases helmet weight.
4. GPS and cloud alerts depend on network connectivity.
5. Sensors need regular calibration and maintenance.
6. Privacy concerns due to continuous location tracking.
7. Users may resist technology that blocks ignition or monitors behavior

1.5 Motivation to Carry Out Research Work

The motivation behind this research is to address the rising number of two-wheeler accidents caused by not wearing helmets, drunk driving, and the lack of immediate accident reporting systems. Many accident victims do not receive timely medical help because there is no automatic way to detect crashes or share their location. By integrating IoT technology with sensors such as helmet detection, alcohol monitoring, and accident detection, this smart helmet aims to improve rider safety and reduce fatalities. This research is driven by the need for a low-cost, automated, and reliable system that ensures safety compliance and enables quick emergency response, ultimately promoting responsible riding and saving lives.

1.6 Research Objectives

The primary objectives of this project include:

- To ensure that the rider wears the helmet before starting the vehicle. ^
- To prevent bike ignition when alcohol is detected using an alcohol sensor. ^
- To automatically detect accidents using the MPU6050 motion and impact sensor.
- To send real-time accident alerts and GPS location to the ThingSpeak cloud platform. ^
- To display system status and messages on an LCD for rider awareness. ^
- To create an integrated, IoT-based safety system that enhances rider protection. ^
- To reduce emergency response time and improve overall road safety.

1.7 Project Report Outline

The remaining chapters of this report are organized as follows: ^

- Chapter 2 presents a literature review of existing smart helmet systems.
- Chapter 3 explains the system design, architecture, and components.
- Chapter 4 describes implementation details and hardware integration.

- Chapter 5 presents the results, testing, and performance evaluation.
- Chapter 6 concludes the work and provides suggestions for future improvements

1.8 Summary

In this chapter, the fundamental concept and motivation behind the IoT-Based Smart Helmet system were discussed. The increasing number of two-wheeler accidents, often caused by not wearing helmets and drunk driving, highlights the need for an intelligent safety solution. Traditional helmets only provide physical protection, whereas the proposed smart helmet integrates IoT technology to actively monitor rider behavior and riding conditions.

The chapter detailed how various sensors—such as the IR sensor for helmet detection, the MQ-3 alcohol sensor for sobriety checks, and the MPU6050 for accident detection—work together under the control of the ESP8266 microcontroller. Additional modules like the GPS and cloud services ensure fast accident reporting and real-time location tracking. The background, need, challenges, applications, motivation, and objectives were also presented to establish a clear understanding of the system's purpose and scope. Overall, this chapter sets the foundation for the design and development of a reliable, automated smart helmet system aimed at improving rider safety and reducing accident fatalities.

Chapter 2 LITERATURE SURVEY

2.1 Introduction

This chapter presents a comprehensive survey of existing research related to smart helmets, accident detection systems, alcohol sensing mechanisms, and IoT-based safety technologies for two-wheeler riders. With the increasing number of road accidents involving motorcyclists, researchers have focused on integrating sensors, microcontrollers, wireless communication, and cloud platforms to design intelligent helmets that enhance rider safety. The following sections summarize major contributions, identify limitations, and highlight research gaps that motivated the development of the proposed IoT-based Smart Helmet system.

Paper 1

Title: An Approach Towards Intelligent Accident Detection, Location Tracking and Notification System

Authors: Mohammad Nazmus Sakib, Supriya Sarker, Md. Sajedur Rahman (2020)

Description: This paper presents an intelligent accident detection and notification system designed to reduce emergency response time after road accidents. The system employs accelerometer and vibration sensors to continuously monitor sudden changes in motion and impact intensity. When an accident is detected, a GPS module retrieves the exact location of the incident and a GSM module sends alert messages to predefined emergency contacts.

The proposed system operates automatically without human intervention, ensuring timely medical assistance. Although the system is effective in accident detection and alert transmission, it does not include preventive safety features such as helmet usage verification or alcohol detection, which limits its overall safety coverage.

Paper 2

Title: Automatic Accident Detection and Reporting System

Authors: M. S. Amin and J. Jalil (2012)

Description: This research proposes an automatic accident detection and reporting system using GPS, GSM, and GPRS technologies. The system detects accidents by monitoring sudden deceleration and abnormal vehicle behavior. Upon detecting an accident, the GPS module captures the location details and transmits them to a remote monitoring center.

The system demonstrates the effectiveness of wireless communication technologies in emergency alert applications. However, the solution is vehicle-mounted and does not consider rider-related safety aspects such as helmet usage or alcohol consumption.

Paper 3

Title: Real-Time Crash Detection Using Tri-Axial Accelerometer
Authors: B. N. Narayanan and R. S. Moni (2014)

Description: This paper presents a real-time crash detection system based on tri-axial accelerometer data. The system analyzes acceleration values along three axes to identify sudden shocks, rollovers, and abnormal vehicle orientation. By combining impact force and tilt angle analysis, the system reduces false accident detection.

While the approach improves detection accuracy, it requires precise threshold calibration and does not provide real-time alert transmission or cloud-based data storage.

Paper 4

Title: GSM-Based Motorcycle Accident Reporting System
Authors: A. K. Sharma and P. Singh (2016)

Description: This paper proposes a low-cost GSM-based motorcycle accident reporting system. The system detects severe impacts and automatically sends alert messages to nearby hospitals or emergency services. The design emphasizes simplicity and affordability, making it suitable for large-scale deployment.

However, the system focuses only on post-accident reporting and does not include preventive safety mechanisms such as alcohol detection or helmet enforcement.

Paper 5

Title: IoT-Based Vehicle Monitoring and Accident Detection System
Authors: R. K. Kodali and S. Sahu (2017)

Description: This research introduces an IoT-based accident detection and vehicle monitoring system using the ESP8266 Wi-Fi module. Sensor data related to vehicle motion is uploaded to a cloud server, enabling real-time monitoring and future data analysis.

Although cloud integration improves scalability and accessibility, the system depends on continuous internet connectivity and experiences higher power consumption.

Paper 6

Title: Smart Helmet for Two-Wheeler Safety Using Alcohol Detection

Authors: J. Varma, P. G. Rao and S. Babu (2018)

Description: This paper presents a smart helmet system that ensures helmet usage and prevents drunk driving. Pressure sensors verify helmet wearing, while an alcohol sensor checks the rider's breath before allowing vehicle ignition.

The system effectively enforces safety compliance but lacks accident detection and emergency alert features.

Paper 7

Title: Multi-Sensor Based Accident Detection System

Authors: N. A. Patel and D. P. Mehta (2019)

Description: This paper proposes a multi-sensor accident detection system using accelerometers, gyroscopes, and ultrasonic sensors. Sensor fusion improves detection accuracy and reduces false alarms. However, increased hardware complexity and power consumption make the system less suitable for helmet-based applications.

Paper 8

Title: AI-Based Accident Detection Using Machine Learning

Authors: S. Mahmud, M. Hossain and T. Chakraborty (2020)

Description: This paper introduces an AI-based accident detection system using machine learning models trained on accelerometer data. The system differentiates between normal riding conditions and accidents with high accuracy. However, it requires large datasets and higher computational resources, making real-time embedded implementation challenging.

Paper 9

Title: Smart Helmet with Accident Detection and GPS Alert System

Authors: P. K. Raj and S. D. Kale (2021)

Description: This paper presents a smart helmet system integrating accident detection and GPS-based emergency alerts. Impact sensors detect accidents and GSM communication sends location details to emergency contacts. The system improves emergency response but lacks cloud connectivity and preventive safety features.

Paper 10

Title: Next-Generation IoT-Based Accident Detection Using NB-IoT

Authors: R. Ahmad, M. A. Rahman and K. Islam (2022)

Description: This paper proposes a next-generation IoT-based accident detection framework using NB-IoT and cloud services. The system enables real-time tracking, accident detection, and emergency communication with improved coverage and reliability. However, high deployment cost and infrastructure dependency limit its practical adoption.

2.2 Summary

This chapter reviewed advancements in smart helmet technologies, accident detection, alcohol sensing, and IoT-based alert systems. While many studies propose individual safety features, integrated multi-sensor safety systems are still limited. These gaps motivated the development of the proposed IoT-based Smart Helmet that combines helmet usage verification, alcohol detection, accident detection using an MPU6050 sensor, and real-time GPS alert transmission through ThingSpeak for enhanced rider safety.

Chapter 3 METHODOLOGY

3.1 Introduction

This chapter explains the methodology adopted for designing and implementing the IoT-Based Smart Helmet for Road Accident Detection. The methodology includes system architecture, component integration, software flow, and the overall working principle. The approach ensures rider safety through continuous monitoring and automated emergency response.

3.2 Design Methodology and Working

The Smart Helmet for Two-Wheelers is designed using an integrated IoT-based approach to ensure rider safety through continuous monitoring and intelligent control. The system's core component, the ESP8266 microcontroller, coordinates all sensor inputs and decision-making processes. An IR sensor is embedded inside the helmet to detect whether the rider is wearing it. Simultaneously, an alcohol sensor monitors the rider's breath to check for alcohol consumption. The ignition system of the bike, controlled through a relay module, will only activate when the helmet is properly worn and no alcohol is detected, thereby enforcing safety compliance before riding. Once the bike is operational, an MPU6050 sensor continuously monitors the rider's motion and orientation to detect any abnormal movements or accidents. In the event of an accident, the system automatically triggers a buzzer to alert nearby individuals and activates the GPS module to fetch the live location of the incident. This information, including the accident alert and coordinates, is uploaded to the ThingSpeak cloud platform for real-time monitoring and emergency response. An LCD display is included to show the system's current status, such as helmet detection, alcohol test results, and connectivity updates. This design ensures that all safety conditions are verified before vehicle operation and provides immediate assistance during emergencies, thus enhancing road safety and promoting responsible driving behavior.

3.3 Block diagram

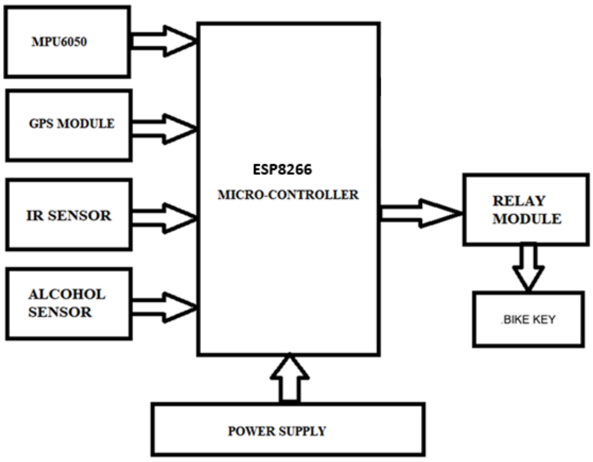

Figure 3.1: Block Diagram

Block diagram explanation

- ESP8266 microcontroller : this microcontroller is the brain of the entire system which collects the sensor data and makes the certain action
- GPS module : GPS module is used to fetch the live location of the bike rider when accident takes place
- IR sensor : IR sensor is used to detect the helmet is wearied by the driver or not
- Alcohol sensor : alcohol sensor is used to detect the alcohol drunk by the driver or not
- MPU6050 : this sensor is used to detect the sudden change in the G-Force when accident takes place
- Relay module : when the helmet is worn and the alcohol is not consumed by the bike rider the relay will turn on indicating the bike turn on

3.4 Summary

In this chapter, the complete methodology behind the development of the IoT-Based Smart Helmet was presented. The system integrates multiple sensors and modules—such as the IR sensor, MQ-3 alcohol sensor, MPU6050 accelerometer–gyroscope, GPS module, and relay module—under the control of the ESP8266 microcontroller. The methodology ensures that the rider cannot start the vehicle unless the helmet is worn and no alcohol is detected, thereby enforcing essential safety measures before riding.

The working principle highlights real-time monitoring of rider behavior and vehicle conditions. Accident detection is achieved through the MPU6050 sensor, after which the system automatically activates an alarm and sends the live location to the cloud platform for emergency alerts. The block diagram and its explanation illustrate the functional flow of data between different components. Overall, the methodology ensures seamless integration of hardware and software to create a reliable, automated safety system aimed at reducing road accidents and enhancing rider protection.

Chapter 4 HARDWARE COMPONENTS

4.1 Introduction

This chapter presents the various hardware components used in the development of the smart helmet system. Each component plays a critical role in ensuring accurate sensing, reliable processing, and effective communication of safety-related data.

4.2 Hardware Requirements

- ESP8266 NodeMCU Microcontroller – Central control and Wi-Fi communication.
- IR Sensor – Detects helmet wearing status.
- MQ-3 Alcohol Sensor – Detects alcohol level in rider's breath.
- MPU6050 Sensor – Accelerometer and gyroscope for motion and accident detection.
- GPS Module (NEO-6M) – Provides real-time location coordinates.
- Relay Module – Controls ignition system (bike start/stop).
- Buzzer – Provides audible alert during accidents.
- 16×2 LCD Display – Shows system status and alerts.
- Power Supply / Battery Pack – Powers all components.
- Helmet Shell and Wiring – Mounts sensors and circuit safely.
- Solar Panel - A solar panel is a device that converts sunlight into electrical energy

4.3 Hardware Components Description

4.3.1 MQ-3 Alcohol Detector Gas Sensor Module

Figure 4.1: Alchol Sensor

- Detects alcohol vapors in the air using its sensitive oxide semiconductor layer.
- Changes its electrical resistance when alcohol molecules come in contact with the sensing surface.
- Converts this resistance change into a voltage output through its onboard circuitry.
- Outputs both analog (variable voltage) and digital (threshold-based) signals.
- The analog output increases as alcohol concentration increases.
- The digital output activates when the gas level crosses a set threshold (adjustable via onboard potentiometer).

4.3.2 ESP8266 / NODE MCU microcontroller

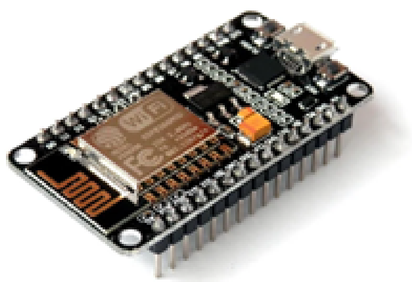

Figure 4.2: NODE MCU microcontroller

- Acts as a Wi-Fi-enabled microcontroller, able to connect to the internet or local networks.
- Works as a web server or client, allowing devices to send and receive data wirelessly.
- Reads inputs from sensors using its GPIO pins and processes the data.
- Controls output devices like LEDs, relays, and motors based on programmed instructions.
- Communicates with other modules through I^2C, SPI, and UART protocols.
- Executes user-written programs (Arduino, MicroPython, Lua) to automate tasks.
- Can operate in station mode, access point mode, or both, enabling flexible networking.

4.3.3 MPU-6050 3-Axis Accelerometer and Gyro Sensor

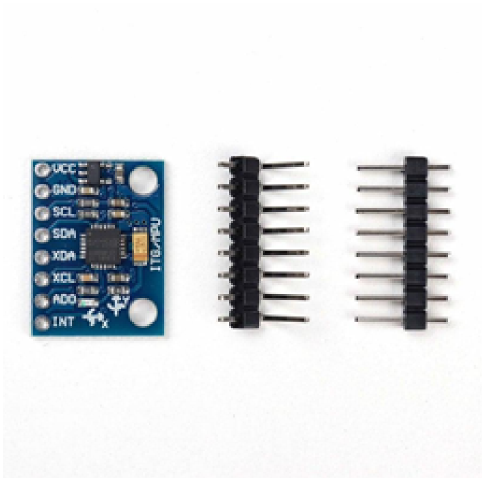

Figure 4.3: Accelerometer and Gyro Sensor

Accelerometer (3-axis)

- Measures linear acceleration in X, Y, Z directions.
- Detects tilt, vibration, and movement.

Gyroscope (3-axis)

- Measures rotation around X, Y, Z axes.
- Detects angular movement such as turning or spinning.

4.3.4 IR Sensor

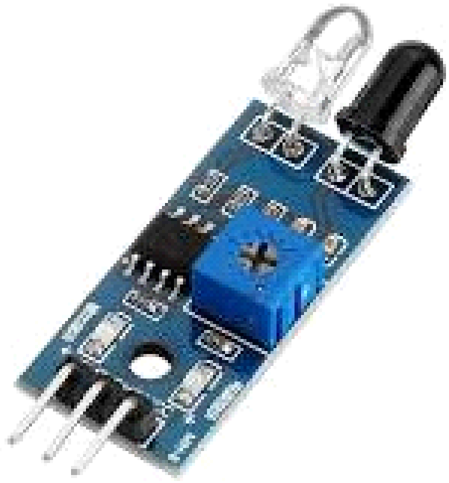

Figure 4.4: IR Sensor

- The IR sensor emits infrared light inside the helmet.
- When the rider wears the helmet, the IR light reflects from the rider's head/face.
- The reflected IR light is detected by the sensor, confirming helmet is worn.
- If the IR sensor detects the rider's presence, it sends a signal to the microcontroller.
- The microcontroller then allows the bike ignition system to start the vehicle.
- If the helmet is not worn, the IR light does not reflect back, and the system prevents ignition.

4.3.5 NEO-6M GPS Module with EPROM

Figure 4.5: GPS Module

- Receives GPS signals from satellites via the helmet's antenna.
- Calculates position: latitude, longitude, altitude, speed, and time.
- EPROM stores satellite data and last position for fast startup.
- Sends data to the helmet's processor or smartphone via UART/I2C/SPI.
- Navigation: provides real-time location for maps or HUD.
- Safety: can send location in emergencies or accidents.
- Ride tracking: logs routes, speed, and travel time.

4.3.6 Battery

Figure 4.6: Battery

- Primary Power Supply – Provides energy to run all electronic components of the smart helmet, such as sensors, Bluetooth modules, and LED lights.
- Sensor Operation – Powers impact, motion, or position sensors that detect accidents or falls.
- Connectivity – Supplies energy to communication modules (Bluetooth/Wi-Fi) for connecting with smartphones or other devices.
- Indicator Systems – Powers LED indicators, displays, or alert systems for battery status or helmet notifications.
- Rechargeable Energy Storage – Being lithium-ion, it stores energy efficiently and can be recharged multiple times for repeated use.

- Backup in Safety Features – Ensures safety features like SOS alerts or emergency calls remain operational even if other sources fail.
- Lightweight and Compact – Its cylindrical form factor allows integration without making the helmet bulky or heavy.

4.3.7 Buzzer

Figure 4.7: Buzzer

- Provides audible alerts in the event of an accident detection.
- Can also be used for warning signals or confirmation of actions like alert sent.

4.3.8 Jumper Wire

Figure 4.8: Jumper Wire

- Connect different components on the breadboard or to the Arduino.
- Ensure flexible and reusable wiring during prototyping.

4.3.9 Solar Panel

Figure 4.9: Solar panel

- Converts sunlight into electrical energy.
- Provides power to circuits and rechargeable batteries.

4.4 Summary

This chapter presented the detailed hardware components used in the development of the Smart Helmet system. Each component plays a vital role in ensuring rider safety, system reliability, and functional efficiency. The ESP8266 NodeMCU microcontroller acts as the central control unit, processing sensor data and managing communication. Essential detection modules such as the MQ-3 alcohol sensor, IR sensor, and MPU6050 accelerometer–gyro module help determine helmet usage, alcohol consumption, and accident events. The NEO-6M GPS module provides accurate real-time location tracking during emergencies, while the relay module controls the ignition system based on safety conditions.

Supporting elements like the buzzer, LCD display, and battery ensure immediate alerts, system feedback, and uninterrupted power supply. Together, these hardware components form an integrated ecosystem that enhances rider safety, provides responsive risk detection, and ensures automated emergency reporting. The efficient combination of sensing, processing, communication, and power management technologies makes the smart helmet a reliable and intelligent safety solution.

Chapter 5 SOFTWARE COMPONENTS

5.1 Introduction

This chapter explains the software components used in the development and implementation of the IoT-Based Smart Helmet for Road Accident Detection. These components provide program logic, cloud integration, data monitoring, and communication between hardware modules.

5.2 Software Requirements

- Arduino IDE – Programming and uploading code to the ESP8266 microcontroller.
- ThingSpeak IoT Platform – Cloud dashboard for data logging and monitoring.

5.3 Software Description

Procedure to Install Arduino Software (IDE)

Step 1: First we must have an Arduino board and a USB cable. In case we use Arduino UNO, Arduino Duemilanove, Nano, Arduino Mega 2560, or Diecimila, we will need a standard USB cable (A plug to B plug), the kind we would connect to a USB printer as shown in Fig. In case we use Arduino Nano, we will need an A to Mini-B cable instead as shown in Fig.

Figure 5.1: A to Mini-B Cable

Step 2 : Download Arduino IDE Software.

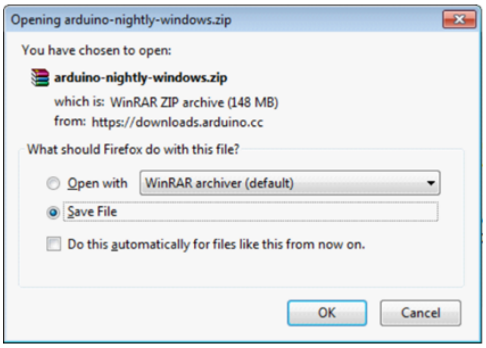

Figure 5.2: Downloading Arduino IDE

One can get different versions of Arduino IDE from the Download page on the Arduino Official website. We must select our software, which is compatible with our operating system (Windows, IOS, or Linux). Unzip the file, after downloading it completely.

Step 3 : Power up your board.

The Arduino Uno, Mega, Duemilanove and Arduino Nano automatically draw power from either, the USB connection to the computer or an external power supply. If you are using an Arduino Diecimila, you have to make sure that the board is configured to draw power from the USB connection. The power source is selected with a jumper, a small piece of

plastic that fits onto two of the three pins between the USB and power jacks. Check that it is on the two pins closest to the USB port. Connect the Arduino board to computer using the USB cable. The green power LED (labeled PWR) should glow.

Step 4 : Launch Arduino IDE.

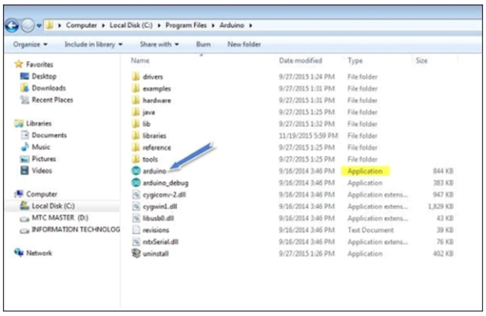

Figure 5.3: Launching Arduino IDE

After your Arduino IDE software is downloaded, you need to unzip the folder. Inside the folder, you can find the application icon with an infinity label (application.exe). Double-click the icon to start the IDE.

Step 5 : Open your first project. Once the software starts, we have two options:

- Create a new project.

  To create a new project, select File →New, as shown in Fig. 5.4 (a).

- Open an existing project example.

  To open an existing project example, select File → Example → Basics → Blink, as shown in Fig. 5.4 (b).

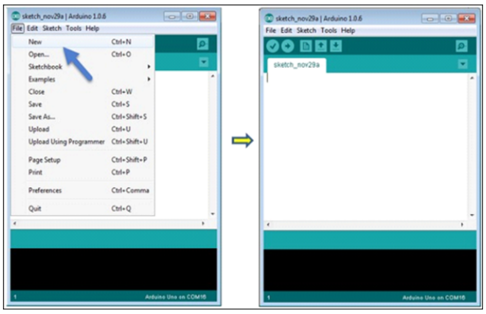

Figure 5.4: (a)Creating a New Project

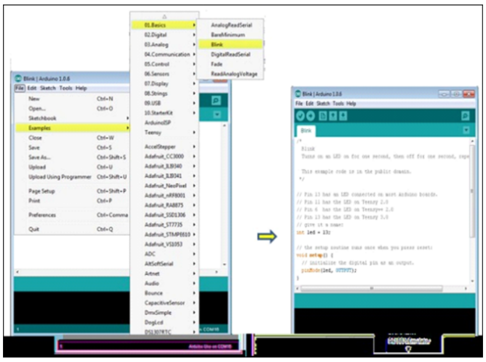

Figure 5.5: (b)Opening an Existing Project

Here, we are selecting just one of the examples with the name Blink. It turns the LED on and off with some time delay. We can select any example from the list.

Step 6 : Select the respective Arduino board.

To avoid any error while uploading our program to the board, we must select the correct Arduino board name, which matches with the board connected to our computer.

Go to Tools → Board and select the board.

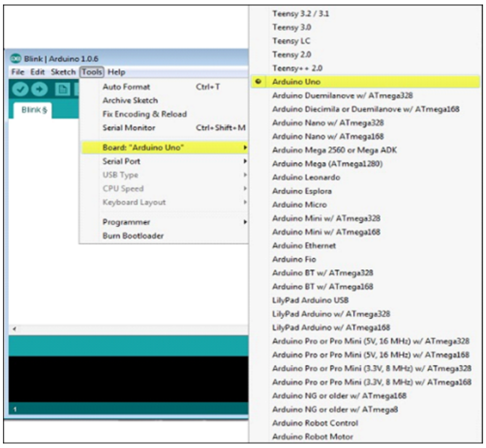

Figure 5.6: Selecting the Arduino Board

Step 7 : Select the serial port. Select the serial device of the Arduino board. Go to Tools → Serial Port menu.

This is likely to be COM3 or higher (COM1 and COM2 are usually reserved for hardware serial ports). To find out, you can disconnect your Arduino board and re-open the menu, the entry that disappears should be of the Arduino board. Reconnect the board and select that serial port.

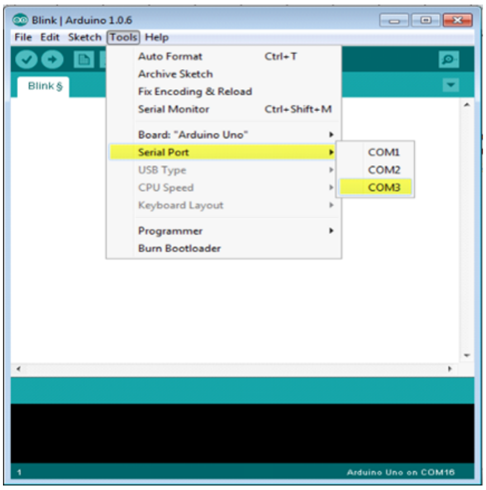

Figure 5.7: Selecting the Serial Port

Step 8 : Upload the program to the board.

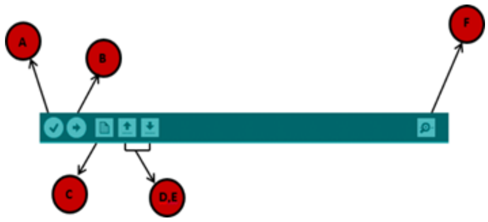

Figure 5.8: Arduino IDE Toolbar

Before explaining how to upload our program to the board, we should know the function of each symbol appearing in the Arduino IDE toolbar. A : Used to check if there is any compilation error. B : Used to upload a program to the Arduino board. C : Shortcut used to create a new sketch.

D : Used to directly open one of the example sketch. E : Used to save your sketch. F : Serial monitor used to send and receive the serial data from the board.

Now, simply click the "Upload" button in the environment. Wait few seconds; we will see the RX and TX LEDs on the board, flashing. If the upload is successful, the message "Done uploading" will appear in the status bar.

5.4 Summary

Chapter 5 briefly outlined the software components used in the IoT-Based Smart Helmet system. It explained how the ESP8266 is programmed using the Arduino IDE and how various libraries are employed to read sensor data, process inputs, and control outputs. The chapter also highlighted the role of Wi-Fi connectivity and cloud communication in sending accident alerts and location data. Overall, the software components ensure smooth coordination between hardware units and enable intelligent, automated safety functions in the helmet.

Chapter 6 RESULTS AND DISCUSSION

6.1 Introduction

This chapter presents the experimental results obtained after developing and testing the IoT-Based Smart Helmet for Road Accident Detection. The system was tested under multiple real-world scenarios to validate its accuracy, reliability, and responsiveness.

6.2 Result

The figure below shows the hardware connections and prototype of the project.

- **Project prototype**

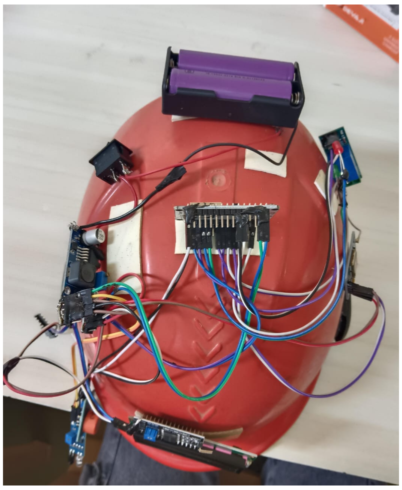

Figure 6.1: helmet

- Power on the IoT-based smart helmet, which is now ready for automatic road accident detection and location tracking using the GPS module.

Figure 6.2: Power Supply

- **For accidental display in LCD.**

Figure 6.3: Accident Detection

- **For accidental location tracking.**

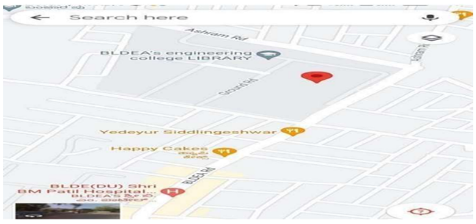

Figure 6.4: Location Tracking

- **The solar panel charges the battery.**

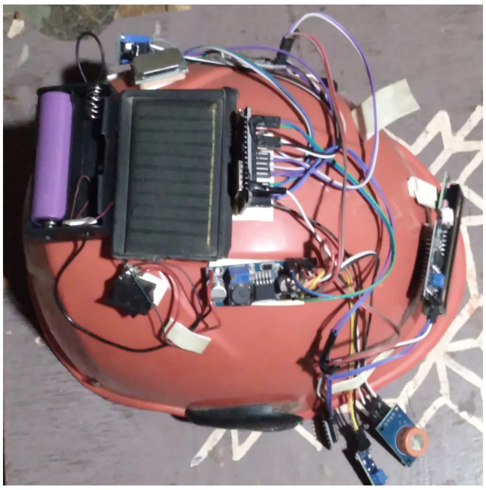

Figure 6.5: Solar-powered smart helmet circuit setup

6.3 Summary

This chapter presented the working results of the Smart Helmet system and showed that it successfully detected accidents, monitored safety conditions, and sent alert notifications with location data. The discussion highlighted the system's performance, reliability, and limitations observed during testing.

Chapter 7 ADVANTAGES AND DISADVANTAGES

7.1 Introduction

This chapter highlights the major advantages of the IoT-Based Smart Helmet for Road Accident Detection. The system integrates safety, automation, and real-time monitoring to improve the overall riding experience and ensure rider protection.

7.1.1 Advantages

- Proactive accident response — faster help via automatic GPS alerts.
- Behavioral enforcement — prevents drunk riding and enforces helmet use at source.
- Low human error — automated detection reduces reliance on bystander reporting.
- Data collection — useful telemetry for safety analytics and research.
- Cost-effective components — ESP8266, MPU6050, alcohol sensors and GPS are low-cost and widely available.
- Scalable — same design can be adapted to fleets and paired with cloud dashboards.
- Customizable thresholds — sensitivity for accident detection and sobriety checks can be tuned.
- Improved survivability — audible alerts and immediate location sharing can reduce time-to-rescue.
- User feedback — on-helmet LCD or smartphone alerts encourage safer behavior.
- Integration-friendly — easily connects to IoT platforms (ThingSpeak, MQTT, custom servers).

7.1.2 Disadvantages

- 1. False positives/negatives — MPU6050 thresholds or breath-sensor noise can misclassify events.

- Privacy concerns — continuous location and behavior logging raises user privacy issues.
- Sensor reliability — alcohol sensors can be slow, degrade, or be spoofed (environmental alcohol).
- Power/weight — added electronics require battery power and may increase helmet weight.
- Environmental factors — rain, extreme temperatures, or vibration may affect sensors/GPS reception.
- User acceptance — riders may resist systems that prevent ignition or that log behavior.
- Connectivity dependency — cloud alerts require network access; offline behavior must be handled.
- Maintenance and calibration — sensors (alcohol, IMU) require periodic calibration.
- Legal and liability questions — who's responsible for failed alerts or incorrect blocking of ignition.
- Cost barrier for low-income riders — even low-cost add-ons may be unaffordable at scale.

7.2 Summary

In this chapter, we studied the IoT-Based Smart Helmet for Road Accident Detection. The system improves road safety by providing automated accident alerts, real-time monitoring, and behavioral enforcement. Its main advantages include faster emergency response, cost-effective components, and scalability, while disadvantages involve sensor reliability, privacy concerns, power requirements, and user acceptance. Overall, the chapter highlights both the benefits and challenges of implementing the smart helmet system.

Chapter 8 APPLICATIONS

8.1 Introduction

This chapter highlights the practical applications of the IoT-Based Smart Helmet for Road Accident Detection. The system can be applied in various real-world scenarios to enhance rider safety and optimize traffic management.

8.1.1 Applications

- Pre-ride safety enforcement — allow vehicle ignition only when helmet is worn and rider passes sobriety check.
- Real-time accident detection and automatic emergency alerting (location + notifications).
- Rider health monitoring — detect falls, loss of consciousness, abnormal vitals (if sensors added).
- Fleet management — monitor compliance and incidents across delivery or courier fleets.
- Urban traffic-safety analytics — aggregate anonymized crash and helmet-wearing data for city planning.
- Insurance telematics — provide verified incident data for claims and risk-based premiums.
- Rider coaching and training — log unsafe behaviour (sudden turns, hard braking) for feedback.
- Worksite/industrial safety — helmet usage and impact logging for construction/mining.
- Law enforcement / automated helmet-violation detection (camera + sensors or networked alerts).
- Augmented capabilities (HUD, navigation, rear-camera feed) when combined with AR and connectivity.

8.2 Summary

The IoT-Based Smart Helmet finds applications in emergency services, fleet management, traffic safety analysis, insurance, and smart city initiatives. Its practical use enhances rider safety, supports data-driven decision making, and promotes responsible behavior on the road.

Chapter 9 Future Scope

9.1 Introduction

The Future Scope chapter presents the potential advancements and improvements that can be added to the IoT-Based Smart Helmet for Road Accident Detection. It outlines how emerging technologies and new features can enhance the system's efficiency, accuracy, and usefulness in real-world applications.

9.1.1 Future Scope

The Smart Helmet system can be further enhanced with advanced technologies to make it more intelligent and user-friendly. Future versions can integrate machine learning algorithms to improve accident detection accuracy by analyzing motion patterns and classifying the severity of impacts. Voice recognition and gesture control features can be added to allow hands-free operation of calls, music, or navigation. Integration with smartphones through a dedicated mobile application can provide real-time notifications, riding analytics, and emergency contact updates. The system can also be expanded to include biometric sensors to monitor the rider's heart rate and fatigue level, alerting the user in case of abnormal conditions. Future work may explore solar-powered helmets for energy self-sufficiency and LoRa or 5G connectivity for broader communication range and lower latency. Additionally, collaboration with insurance companies and law enforcement can help promote responsible driving and facilitate accident investigation through data logging.

9.2 summary

This chapter discussed various enhancements that can be implemented in future versions of the Smart Helmet, such as machine learning integration, biometric monitoring, mobile app connectivity, renewable power options, and advanced communication systems. These improvements aim to make the Smart Helmet more intelligent, reliable, and beneficial for rider safety and accident management.

Chapter 10 CONCLUSION

The Smart Helmet for Two-Wheelers successfully integrates multiple sensors and IoT technology to create a proactive safety system for riders. By ensuring that the bike ignition activates only when the helmet is worn and the rider is sober, the system enforces essential safety compliance before riding. The inclusion of accident detection using the MPU6050 sensor and automated GPS-based alert transmission to the ThingSpeak cloud provides rapid emergency response, potentially saving lives. The LCD display and buzzer enhance user awareness and feedback. This project demonstrates how low-cost microcontrollers and IoT connectivity can be utilized to design an efficient, real-time safety solution for two-wheelers. It contributes to safer roads by promoting responsible driving habits and enabling intelligent accident management, marking a step toward smarter and safer transportation systems.

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