IOT BASED SMART HELMET TO ENHANCE RIDER SAFETY

A PROJECT REPORT

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BONAFIDE CERTIFICATE

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EXAMINER 1 EXAMINER 2

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We would like to express my wholehearted gratitude to the Almighty, who showered us all with blessings. I wish to offer my humble greetings at the lotus feet of her holiness MATA AMRITANANDAMAYI DEVI, Chancellor of Amrita Vishwa Vidyapeetham for her divine blessings.

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ABSTRACT

Motorcycles offer an exciting and fuel-efficient mode of transportation, but they inherently lack the safety features of enclosed vehicles. This project proposes an IoT-based smart helmet system designed to significantly improve rider safety by leveraging a combination of advanced sensors, real-time communication, and intelligent functionalities.

The system prioritizes responsible riding habits by monitoring helmet usage and detecting rider impairment through alcohol sensors. Integration with Bluetooth connectivity allows for hands-free communication, minimizing distractions on the road. In the event of an accident, the smart helmet automatically activates emergency services by transmitting the rider's location data. Additionally, a manual deactivation button allows for cancelling false alarms. An LCD display keeps the rider informed about the system's status, battery level, GPS location, and any critical alerts. Finally, the user interface is designed for ease of use, providing visual and'auditory feedback to ensure the rider stays informed and focused on the road.

In conclusion, this project presents a compelling vision for the future of motorcycle safety. The proposed IoT-based smart helmet leverages cutting-edge technology to address critical safety concerns, promote responsible riding practices, and empower riders with increased situational awareness. While challenges exist in design and user experience, overcoming these hurdles will pave the way for a future where motorcycle travel is demonstrably safer and more enjoyable for riders of all experience levels.

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CHAPTER-1

INTRODUCTION

The thrill of riding a motorcycle is undeniable, but the inherent lack of protection compared to enclosed vehicles makes it a risky proposition. Statistics paint a grim picture – motorcycle accidents are a leading cause of serious injuries and fatalities. One of the most devastating consequences of these accidents is Traumatic Brain Injury (TBI). TBIs occur when a forceful blow to the head disrupts the normal function of the brain. Even seemingly minor accidents can cause TBIs, leading to a range of physical, cognitive, and emotional challenges.

This is where our project, the development of an IoT-based smart helmet, comes in. By integrating advanced technology, we aim to significantly reduce the risk and impact of motorcycle accidents, particularly those causing TBIs. Our smart helmet goes beyond basic protection; it becomes a proactive guardian, using sensors and communication to enhance rider safety and potentially prevent accidents altogether.

This introduction delves into the exciting world of IoT-based smart helmets. We will explore the core functionalities that enhance rider safety, from automated emergency response to blind-spot detection. We will examine the communication aspects that keep riders connected, ensuring seamless data exchange and real-time updates. Finally, we will unveil the potential benefits of these smart helmets, including a significant reduction in accident rates and fatalities, a heightened sense of rider awareness, and the promotion of responsible riding habits.

As research and development in this field accelerate, IoT-based smart helmets have the potential to become an indispensable safety feature for every motorcycle rider. Imagine a future where these intelligent companions transform motorcycle travel into a demonstrably safer and more enjoyable experience, empowering riders to navigate the roads with confidence and peace of mind. This introduction paves the way for a deeper exploration of this transformative technology, offering a glimpse into a future where motorcycle safety takes a monumental leap forward.

In conclusion, this introduction has highlighted the limitations of traditional motorcycle helmets in terms of safety. It then introduced the concept of smart helmets – high-tech helmets equipped with sensors and communication features – as a potential solution. By exploring their functionalities and potential benefits, this introduction piques the reader’s interest in learning more about how smart helmets can revolutionize motorcycle safety and create a more enjoyable riding experience.

MOTIVATION

The motivation behind the IoT based Smart Helmet to Enhance Rider Safety is rooted in the desire to address the motor cycle accidents which are concerned globally, with high rate of injuries and fatalities. Traditional helmets offer passive protection but lack advanced features to actively prevent accidents or provide post-accident assistance. Several key factors drive the motivation for this project:

1. **Inadequate Emergency Response:**

   In many accidents, timely medical assistance can make the difference between life and death. However, riders often struggle to communicate their exact location or condition following an accident, leading to delayed response times. This helmet can actively contribute to reducing accidents by providing real-time alerts and monitoring rider behavior.

2. **Hands Free Communication**:

   Bluetooth connectivity enables riders to make and receive phone calls hands-free, minimizing distractions and allowing them to keep their hands on the handlebars and their eyes on the road. This enhances safety by reducing the risk of accidents caused by using mobile devices while riding.

3. **Accurate Location Tracking**:

   GPS integration provides precise location data to emergency responders. In the event of an accident, this ensures that help arrives at the exact location quickly, minimizing delays that can worsen the rider’s condition.

4. **Enhanced Post Accident Communication**:

   The helmet can automatically log data such as the time, location, and severity of the impact. This information is valuable for medical personnel, insurance claims, and legal purposes, facilitating smoother post-accident processes and reducing stress for the rider. The motivation behind this project is to enhance post-accident communication without using smart phones.

5. **Navigation Assistance to Prevent Road Accidents**:

   Real-time GPS navigation integrated into the helmet helps riders avoid getting lost or taking dangerous routes. Accurate, up-to-date navigation instructions can prevent riders from entering hazardous areas, contributing to their overall safety. This helps in easy navigation in unknown routes.

6. **Simplicity and Ease of Use**:

   In stressful situations, accessing a phone and dialing for help can be difficult. An SOS button offers a simple, one-touch solution that can be easily activated even if the rider is disoriented or injured. This SOS button helps in calling for emergency services when the rider feels danger.

7. **Prevention of Drunk Driving**:

   Drunk riding is a major cause of motorcycle accidents, often leading to severe injuries or fatalities. An alcohol detection system in the helmet can prevent intoxicated riders from starting their journey, significantly reducing the risk of accidents caused by impaired judgment and coordination.

8. **Critical Protection for Brain:**

   The primary purpose of a helmet is to protect the rider's brain, which is highly vulnerable during motorcycle accidents. By integrating advanced impact detection and mitigation technologies, the helmet can better protect the brain from traumatic injuries.

In summary, the motivation for developing is rooted in the principles of real-time accident detection, prevention of drunk and drive cases, usage of SOS button in case of emergency, easy post-accident communication and leveraging technology to provide extra safety measures for solo riders

OBJECTIVES

- To develop a wearable technologically advanced helmet to improve rider's safety.
- To address key factors such as helmet usage, alcohol intoxication and emergency response.

SUB-OBJECTIVES

- **Helmet Usage Monitoring**: Sensor-based system prevents bike start if the helmet or chin-strap is not secured.
- **Alcohol Detection**: Integrated alcohol detection prevents bike start if the rider is intoxicated.
- **Speaker Availability**: Hands-free communication with priority call filtering.
- **Emergency Services Activation and De-activation**: Automatic accident alerts with manual false alarm deactivation.
- **LCD Display**: Displays system status, conditions, and helmet location (latitude and longitude).
- **User Interface and Feedback**: User-friendly interface with visual and auditory alerts.

CHAPTER-2

LITERATURE SURVEY

Paper1 Title:

M. A. Rahman, S. M. Ahsanuzzaman, I. Rahman, T. Ahmed and A. Ahsan, "IoT Based Smart Helmet and Accident Identification System," 2020 IEEE Region 10 Symposium (TENSYMP), Dhaka, Bangladesh, 2020, pp. 14-17, doi: 10.1109/TENSYMP50017.2020.9230823.

Objectives:

- Enhance rider safety: To ensure helmet and chin-strap are properly worn before allowing bike engine start.
- To prevent riding under the influence of alcohol.
- Enable Effective Communication: To provide hands-free communication with prioritization of important calls.
- Improve Emergency Response: To automatically notify emergency services in case of an accident, provide accurate location details to emergency responders and include a manual override to deactivate false alarms.
- Provide Real-Time Monitoring: To display system status, conditions, and location data on an LCD screen.
- User-Friendly Interaction: To design an intuitive interface for easy interaction and feedback.

Methodology used:

1) System Design:

Helmet Usage Monitoring:

- Equip the helmet with pressure sensors and strap sensors to detect proper wearing and chin-strap fastening. Connect these sensors to the bike's ignition system to prevent engine start if criteria are not met.

Alcohol Detection:

- Integrate a breathalyzer sensor into the helmet that communicates with the bike's ignition system, preventing the engine from starting if alcohol is detected.

Speaker Availability:

- Install speakers and a microphone within the helmet for hands-free communication.
- Implement a filtering algorithm to prioritize important calls and minimize distractions.

Emergency Services Activation:

- Use accelerometers and gyroscopes to detect accidents.
- Program the system to send location data via GPS and a cellular network to emergency services.
- Include a manual button to deactivate alerts in case of false positives.

LCD Display:

- Implement a display panel on the helmet to show real-time system status, sensor conditions, and GPS coordinates.

User Interface and Feedback:

- Develop a user-friendly interface with both visual (LED indicators, LCD) and auditory feedback (speakers, alarms) to inform the rider of system status and alerts.

2) **Implementation:**
   - Develop firmware and software to manage sensor data and control bike ignition based on sensor inputs.
   - Integrate the hardware components (sensors, GPS module, LCD display, communication modules) into the helmet and bike.
   - Create a mobile or web application for additional user interaction and configuration.

3) **Testing and Validation:**
   - Conduct lab and field tests to validate sensor accuracy and system reliability.
   - Simulate accident scenarios to test emergency notification system.
   - Collect user feedback to refine the interface and functionality.

Block Diagram:

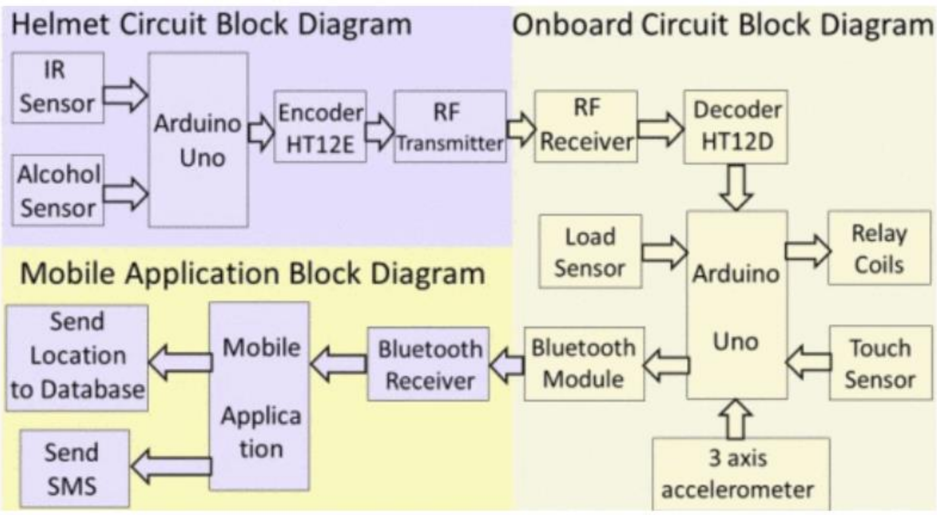

Fig 2.1: Helmet Circuit block diagram

Working principles:

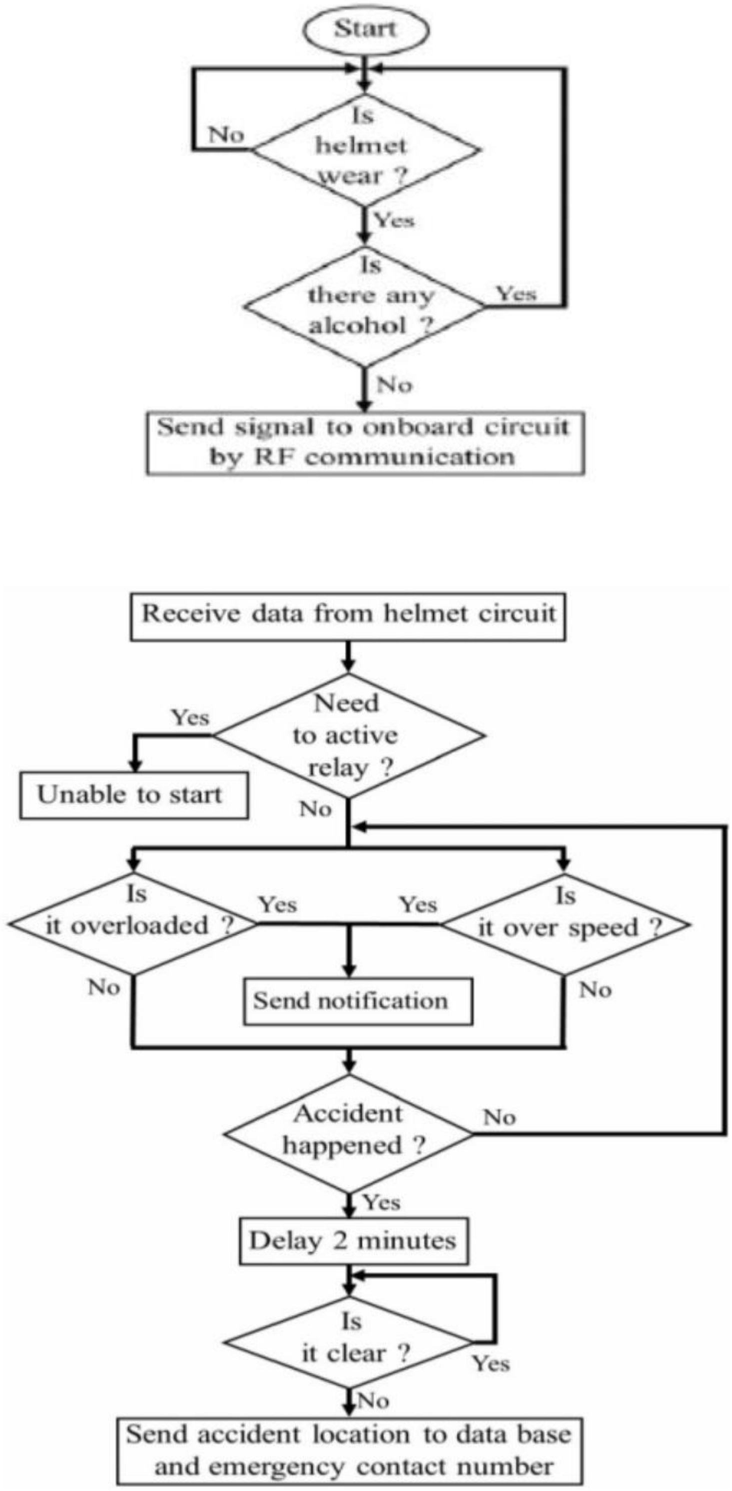

Fig2.2: Operational Workflow

User Interface application:

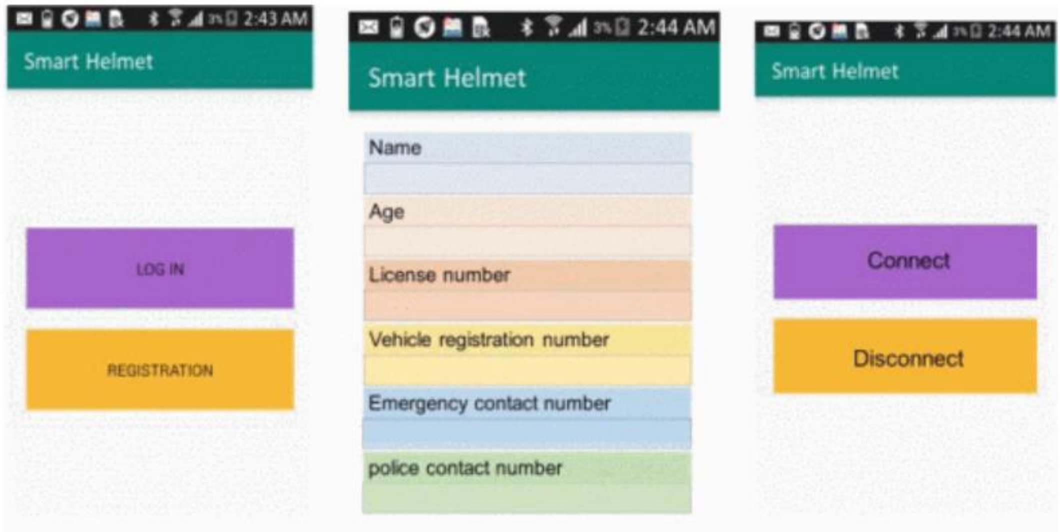

Fig 2.3: User Interface application

Conclusion:

In conclusion, the IoT-based smart helmet and accident identification system aims to significantly enhance rider safety through a multi-faceted approach. By ensuring the rider wears the helmet properly and is not under the influence of alcohol, the system promotes responsible riding habits. The integration of hands-free communication and automatic emergency notifications improves both rider convenience and safety.

Real-time monitoring and a user-friendly interface provide ongoing feedback to the rider, ensuring system transparency and reliability. The successful implementation and testing of this system demonstrate its potential to reduce accident-related injuries and fatalities, offering a valuable contribution to road safety technology.

Paper2 Title:

N. V. Joshi, S. P. Joshi, M. S. Jojare, N. S. Joshi and A. R. Askhedkar, "Design and Finite Element Analysis of IoT based Smart Helmet," 2020 IEEE International IOT, Electronics and Mechatronics Conference (IEMTRONICS), Vancouver, BC, Canada, 2020, pp. 1-8, doi: 10.1109/IEMTRONICS51293.2020.9216393.

Objectives:

- Develop an Innovative Safety Helmet: Design a helmet incorporating IoT technology to enhance rider safety. Integrate sensors for helmet usage, alcohol detection, and accident identification.
- Ensure Structural Integrity: Conduct Finite Element Analysis (FEA) to evaluate the helmet's structural performance under various conditions. Optimize the helmet design to withstand impact forces during accidents.
- Implement Real-Time Monitoring and Feedback Systems: Incorporate LCD displays and communication modules for real-time status updates and alerts. Design a user-friendly interface for rider interaction.
- Enhance Emergency Response Capabilities: Develop systems for automatic accident detection and notification to emergency services. Ensure accurate location tracking and quick response times.

Methodology used:

1) **Design Phase:**
    - **Helmet Design:** Use CAD software to design the helmet, ensuring it accommodates all necessary sensors and electronic components without compromising comfort and aerodynamics.

- **Sensor Integration:** Design the placement and integration of pressure sensors, alcohol sensors, accelerometers, gyroscopes, GPS modules, LCD display, and communication modules.

2) Finite Element Analysis (FEA):

- **Material Selection:** Choose materials that provide optimal strength, durability, and weight for the helmet shell and inner padding.
- **Modeling:** Create a finite element model of the helmet using appropriate meshing techniques.
- **Loading Conditions:** Define impact scenarios such as frontal, side, and rear collisions to simulate real-world accident conditions.
- **Simulation:** Perform FEA simulations to assess the stress distribution, deformation, and potential failure points of the helmet.
- **Optimization:** Based on FEA results, iterate the design to improve structural integrity, reduce stress concentrations, and enhance impact absorption.

3) System Integration:

- **Electronics Assembly:** Integrate sensors and electronic components within the helmet, ensuring secure and efficient wiring and connectivity.
- **Software Development:** Develop firmware and software for sensor data processing, real-time monitoring, and user interface.
- **Communication Protocols:** Implement communication protocols for data transmission to mobile devices or cloud services.

4) Prototyping and Testing:

- **Prototype Fabrication:** Manufacture a prototype of the smart helmet incorporating all design features and electronic components.
- **Lab Testing:** Conduct controlled laboratory tests to validate sensor functionality, system integration, and structural performance.
- **Field Testing:** Perform field tests with actual riders to evaluate real-world performance, user interaction, and reliability.

5) Validation and Refinement:

- **User Feedback:** Collect feedback from test riders to identify any usability issues or design improvements.
- **System Calibration:** Calibrate sensors and refine software algorithms based on testing results to enhance accuracy and responsiveness.

Sensor and Module replacement view:

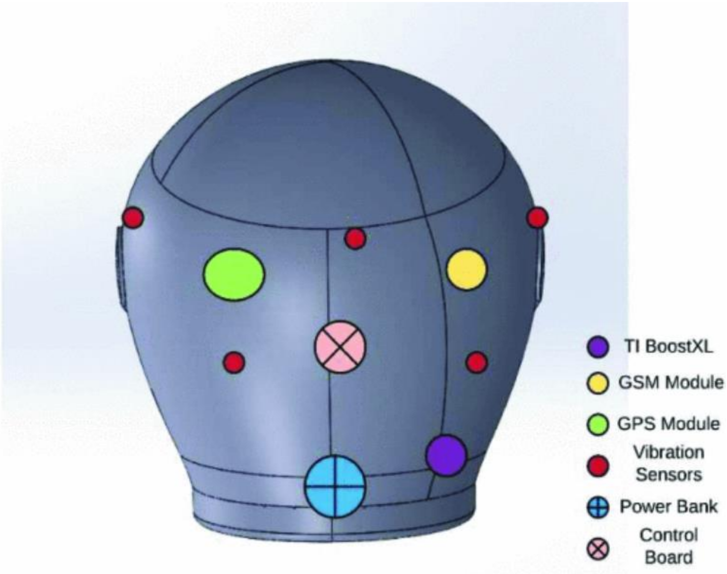

Fig 2.4: Sensor and Module replacement view

Circuit Diagram:

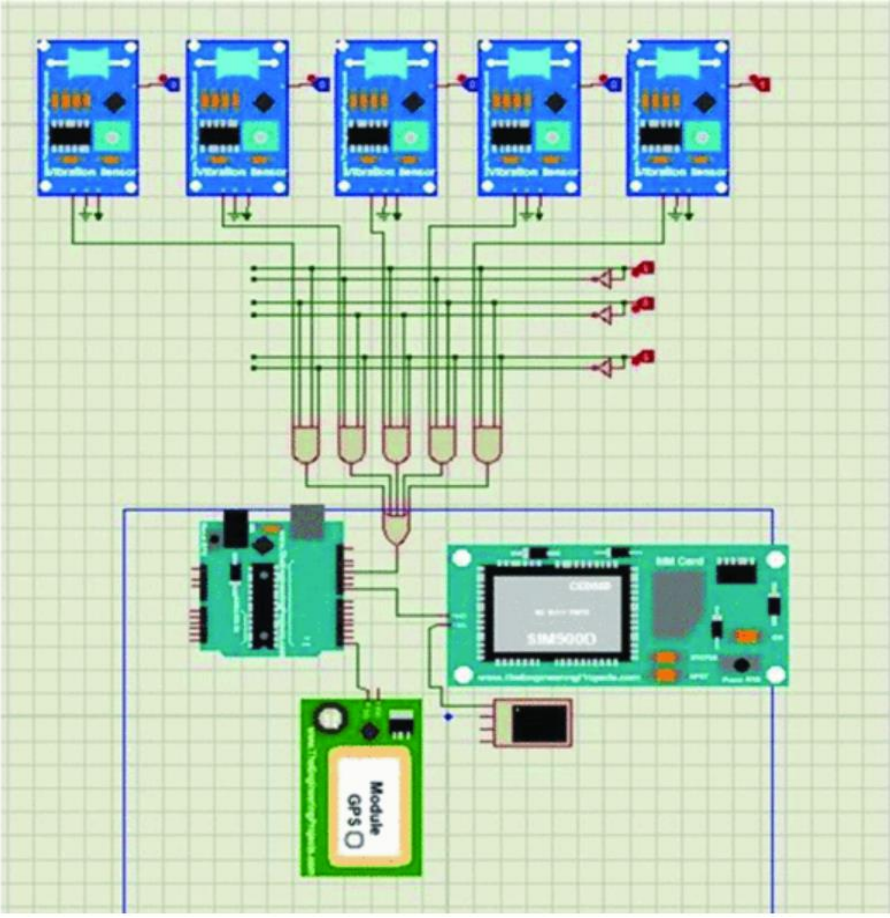

Fig 2.5: Circuit diagram of literature paper

Flowchart of code:

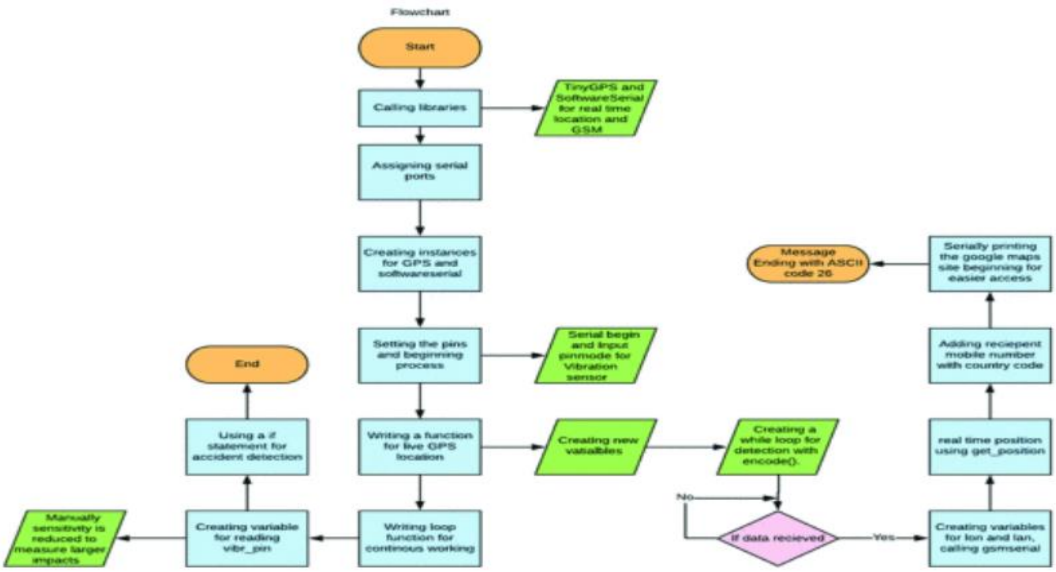

Fig 2.6: Flowchart of code

Conclusion:

The design and FEA of an IoT-based smart helmet demonstrate the feasibility and effectiveness of integrating advanced safety features into motorcycle helmets. The detailed design process ensures that all necessary sensors and electronic components are seamlessly incorporated without compromising comfort or aerodynamics. FEA simulations validate the helmet's structural integrity under various impact conditions, guiding design optimizations for improved safety performance.

System integration and testing phases confirm the functionality and reliability of real-time monitoring, user feedback mechanisms, and emergency response capabilities. The resulting smart helmet provides a comprehensive safety solution, enhancing rider protection through innovative technology and robust design. User feedback and testing further refine the system, ensuring a user-friendly and effective safety device. Overall, this study showcases the potential of IoT technology in improving motorcycle safety, offering a valuable contribution to the development of next-generation safety helmets.

Paper3 Title:

M. E. Alim, S. Ahmad, M. N. Dorabati and I. Hassoun, "Design & Implementation of IoT Based Smart Helmet for Road Accident Detection," 2020 11th IEEE Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON), Vancouver, BC, Canada, 2020, pp. 0576-0581, doi: 10.1109/IEMCON51383.2020.9284820.

Objectives:

- **Develop a Smart Helmet for Enhanced Rider Safety:** Design a helmet that integrates IoT technology to detect road accidents. Ensure the helmet can monitor critical safety parameters such as helmet usage and rider sobriety.
- **Implement Real-Time Accident Detection:** Equip the helmet with sensors to accurately detect accidents. Develop a system to automatically notify emergency services with the rider's location.
- **Provide Real-Time Feedback and Monitoring:** Display real-time system status and safety conditions on an LCD. Create a user-friendly interface for easy interaction and status updates.
- **Enhance Communication and Emergency Response:** Enable hands-free communication for the rider. Ensure quick and accurate transmission of emergency alerts and location data.

Methodology:

1) **System Design:**
   - **Helmet Design:** Utilize CAD software to design the helmet structure, ensuring it accommodates sensors and electronics while maintaining comfort and aerodynamics.
   - **Sensor Integration:** Plan the placement and integration of sensors including accelerometers, gyroscopes, pressure sensors, alcohol sensors, GPS modules, and an LCD display.

2) Hardware and Software Development:

- **Hardware Components:** Select appropriate sensors and electronic components for accurate data collection and reliable performance.
- **Sensor Network:** Develop a network of sensors within the helmet to monitor impact forces, helmet usage, and rider sobriety.
- **Microcontroller Programming:** Program the microcontroller to process sensor data, detect accidents, and manage communication with emergency services.
- **Communication Modules:** Integrate GSM/GPRS or other communication modules to enable real-time data transmission and emergency alerts.

3) Accident Detection Algorithm:

- **Data Collection:** Collect data from accelerometers and gyroscopes to identify patterns associated with accidents.
- **Algorithm Development:** Develop algorithms to differentiate between normal riding conditions and accident scenarios.
- **Threshold Setting:** Establish threshold values for impact forces and motion changes to trigger accident alerts.

4) Real-Time Monitoring and Feedback:

- **LCD Display:** Implement an LCD to show real-time status of the helmet, including safety conditions and GPS coordinates.
- **User Interface:** Design a user-friendly interface for easy interaction, providing both visual and auditory feedback.

5) Emergency Notification System:

Automatic Alerts: Configure the system to automatically send alerts to emergency services with the rider’s location upon accident detection.

- **Manual Deactivation:** Include a manual override button to cancel false alarms and prevent unnecessary emergency responses.

6) Prototyping and Testing:

- **Prototype Development:** Build a prototype incorporating all design features and electronic components.
- **Lab Testing:** Conduct controlled tests to validate sensor accuracy, algorithm performance, and system integration.
- **Field Testing:** Perform real-world tests with actual riders to evaluate the system's reliability and usability in practical scenarios.

Results:

Fig 2.7: Implemented helmet module

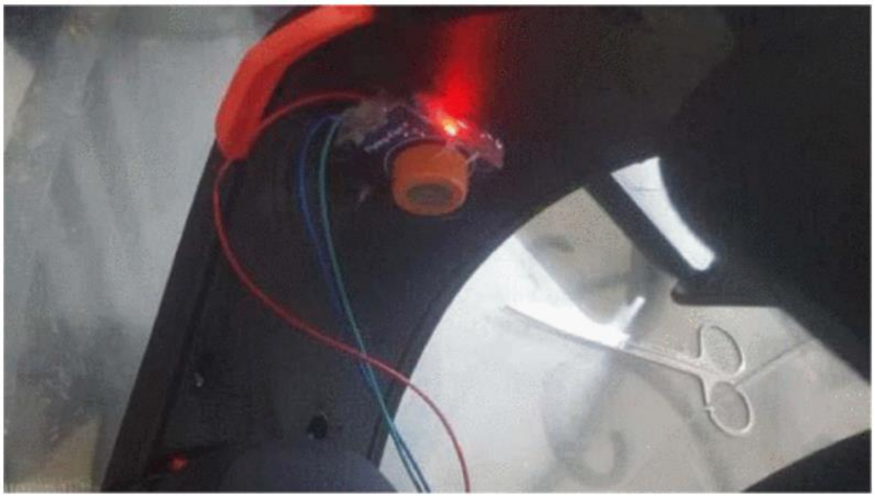

Fig 2.8: Alcohol sensor installment

Conclusion:

The design and implementation of an IoT-based smart helmet for road accident detection successfully demonstrate the potential of integrating advanced safety technologies into motorcycle helmets. The detailed design process ensures that all necessary sensors and electronic components are seamlessly integrated without compromising the helmet's comfort or aerodynamics.

The developed accident detection algorithm and emergency notification system effectively identify accidents and promptly alert emergency services, providing a critical safety feature for riders. Real-time monitoring, user-friendly interface, and hands-free communication enhance the overall user experience and ensure ongoing safety awareness. Testing and validation confirm the system's accuracy, reliability, and usability in both controlled and real-world conditions. User feedback and iterative refinement further improve the system, ensuring it meets the practical needs of riders. Overall, this study showcases the feasibility and benefits of IoT technology in enhancing motorcycle safety, offering a valuable contribution to the development of intelligent safety devices for road users.

CHAPTER-3

DESIGN

Developing an IoT based Smart Helmet to Enhance Rider Safety involves a systematic approach that encompasses design, data collection, training and testing. Here is the step-by-step methodology for creating such a model:

1) System Design

- Helmet Section:

    - Main Controller: Arduino UNO microcontroller.
    - Power Supply: Battery-powered system.
    - Sensors and Modules:

        Helmet Detection Switch: Checks if the helmet is worn.

        Alcohol Sensor: Monitors alcohol levels around the rider.

        Accident Sensor: Detects sudden impacts or falls.

        GPS Module: Tracks the location of the helmet wearer.

        GSM Module: Sends SMS alerts or makes calls in emergencies.

        RF Transmitter: Communicates with the vehicle.

        LCD Display: Shows system status and messages.

        Buzzer: Provides audible alerts.

        ESP8266 Wi-Fi Module: Enables internet connectivity.

        Limit Switch: Additional input for system control.

        SOS Switch: Allows manual emergency alerts.

Accident Disable Switch: Cancels false accident alerts.

- Vehicle Section:
  - RF Receiver: Receives signals from the helmet's RF transmitter.
  - Vehicle Control System: Interfaces with the RF receiver to control vehicle functions.

2) Operational Workflow:

- Helmet Usage Detection:
  - The helmet detection switch checks if the helmet is worn.
  - If the helmet is not worn, a message is displayed on the LCD: "Please wear a helmet."
- Alcohol Monitoring:
  - The alcohol sensor continuously monitors alcohol levels.
  - If alcohol is detected, an audible alert is given via the buzzer.
  - If no alcohol is detected, the RF transmitter triggers the vehicle to start.
- Accident Detection and Response:
  - The accident sensor detects sudden impacts or falls.
  - In case of an accident, the system sends an alert SMS/CALL to predefined contacts.
  - The buzzer is activated for alerts.
  - The SOS switch allows the rider to manually trigger emergency alerts.

- Location Tracking:
    - The GPS module tracks the helmet wearer’s location.
    - The location data (latitude and longitude) and accident notifications are sent to the Blynk app.
- Emergency Communication:
    - The GSM module sends SMS alerts or makes calls to predefined contacts during emergencies.
    - It answers automatically when a user calls.
- System Feedback:
    - The status of the system is displayed on the LCD.
- RF Communication:
    - The RF transmitter on the helmet communicates wirelessly with the RF receiver on the vehicle.
    - RF communication ranges between 30 KHz to 300 GHz and works by creating and detecting electromagnetic waves.
    - The wavelength of the electromagnetic signal is inversely proportional to the frequency; higher frequency means shorter wavelength.

3) Programming:

- Embedded C: The system's instructions are programmed using Embedded C.
- Microcontroller Firmware: Developed using Embedded C to manage sensor data, control the vehicle, and handle communication protocols.

Choice of Material:

- Battery power supply.
- Arduino UNO Microcontroller.
- SOS Switch.
- Switch to disable Accident.
- RF TX, RX Module.
- Alcohol sensor.
- Accident sensor.
- GPS.
- GSM.
- LCD display.
- Buzzer.
- ESP8266 WI-FI Module.
- Limit switch.

Arduino Uno:

The ATmega328 from the AVR family is the microcontroller board found on the Arduino Uno. In addition to a 16MHz ceramic resonator, there are 6 analog pins and 14 digital input/output pins. There is a reset button, a power jack, and a USB connection. Numerous libraries are available to assist its applications, which simplifies programming.

Microcontroller's advantages are:

Low price

Easy to use

Readily accessible in the marketplace

Reprogrammable up to a thousand times.

Reduced use of energy.

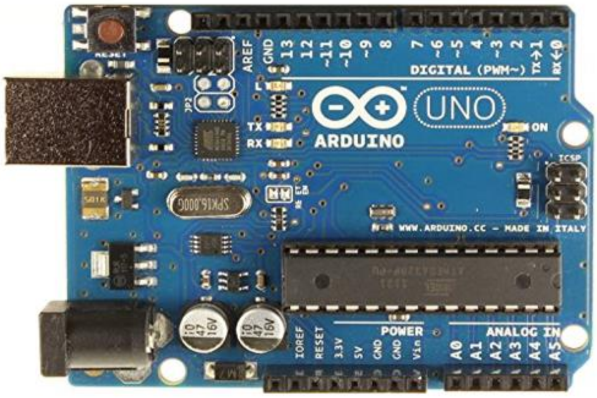

Fig 3.1: Arduino UNO

Alcohol sensor:

This module is built with the MQ3 Alcohol Gas Sensor. It is a cheap semiconductor sensor that can identify alcohol gasses at concentrations between 0.05 and 10 mg/L. Similar to a standard breathalyzer, this alcohol sensor can identify the amount of alcohol in your breath. It responds quickly and with great sensitivity. Based on the amount of alcohol present, the sensor outputs an analog resistive. One resistor is all that is required for the extremely basic drive circuit. A 0-3.3V ADC could be used as a basic interface.

Fig 3.2: Alcohol sensor(MQ3 sensor)

ADXL345:

The ADXL345 Tripple Axis Accelerometer Board is a compact, thin, low-power, three-axis accelerometer that can measure up to ±16 grams with a high resolution (13-bit). The 16-bit twos complement format of digital output data can be accessed using either an In tilt-sensing applications, it measures the static acceleration of gravity in addition to the dynamic acceleration brought on by motion or shock. Its measurement of inclination changes less than 1.0° is made possible by its high resolution (4 mg/LSB). I2C digital interface or SPI (3- or 4-wire) interface.

Specifications:

- Supply Voltage: 3.3 V/ 5V.
- Interface Type: I^2C, SPI.
- Sensing Range: ±2g, ±4g, ±8g, ±16g.
- Sensitivity:
  - X: 28.6 LSB/g.
  - Y: 31.2 LSB/g.
  - Z: 34.5 LSB/g.
- Ultra Low Power: 40µA in measurement mode, 0.1µA in standby@ 2.5V.
- Free-Fall Detection.
- Tap/Double Tap Detection

Fig 3.3: Accelerometer(ADXL345)

GSM modem:

An internationally recognized standard for digital cellular communication is the Global System for Mobiles (GSM). A GSM modem is found within every GSM phone. We are also connecting our GSM modem to our microcontroller, just like we would with any other mobile phone. The SIM-900A GSM modem is the one utilized in this project. SIM900A is a dependable and incredibly small wireless module. With its SMT design and very potent single-chip CPU that integrates the AMR926EJ-S core, this complete GSM/GPRS module offers you cost-effective options and modest dimensions. details. 900/ 1800 MHz dual-band.

Fig 3.4: GSM module

RF transmitter and RF receiver:

RF transmitter is an electronic device which uses radio waves for transmitting the signal. RF receiver is an electronic device which receives the data present in the radio waves and filters out unwanted data. It’s transmission channel: 434 MHz and range: 60 m.

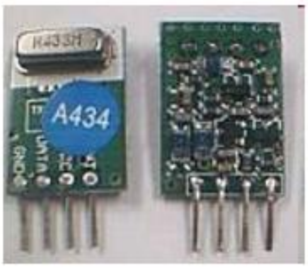

Fig 3.5: RF transmitter

Fig 3.6: RF receiver

Encoder and Decoder:

Encoder is used to generate the digital data which need to be transmitted. The encoder used in the project is HT12E. This encoder has 8-address lines and 4-data lines.

Fig 3.7: Encoder

Decoder is used to decode the required data from the received data. The decoder used in the project is HT12D. This decoder has 8-address lines and 4-data lines.

Fig 3.8: Decoder

Block Diagram:

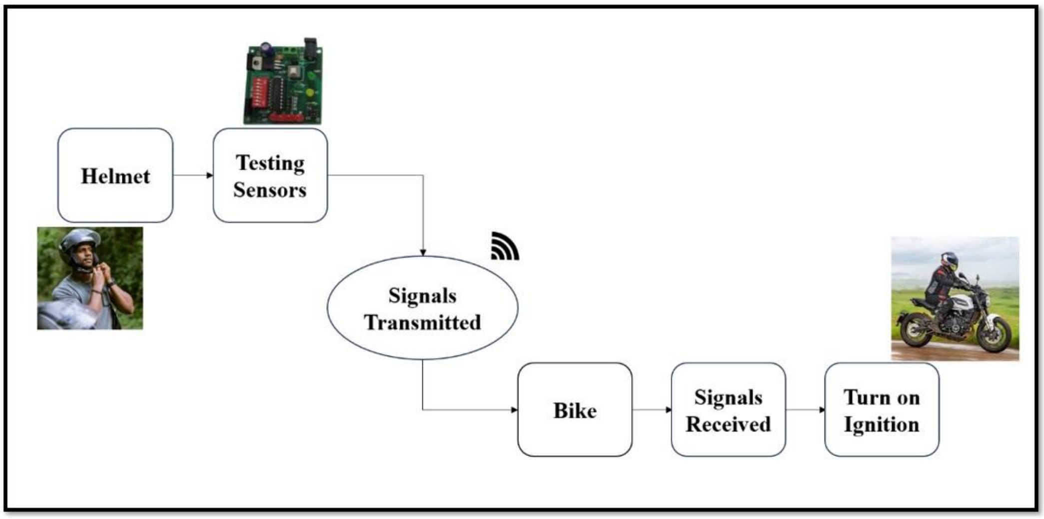

Fig 3.9: Block Diagram

Flowchart:

Helmet Module's Schematic Diagram:

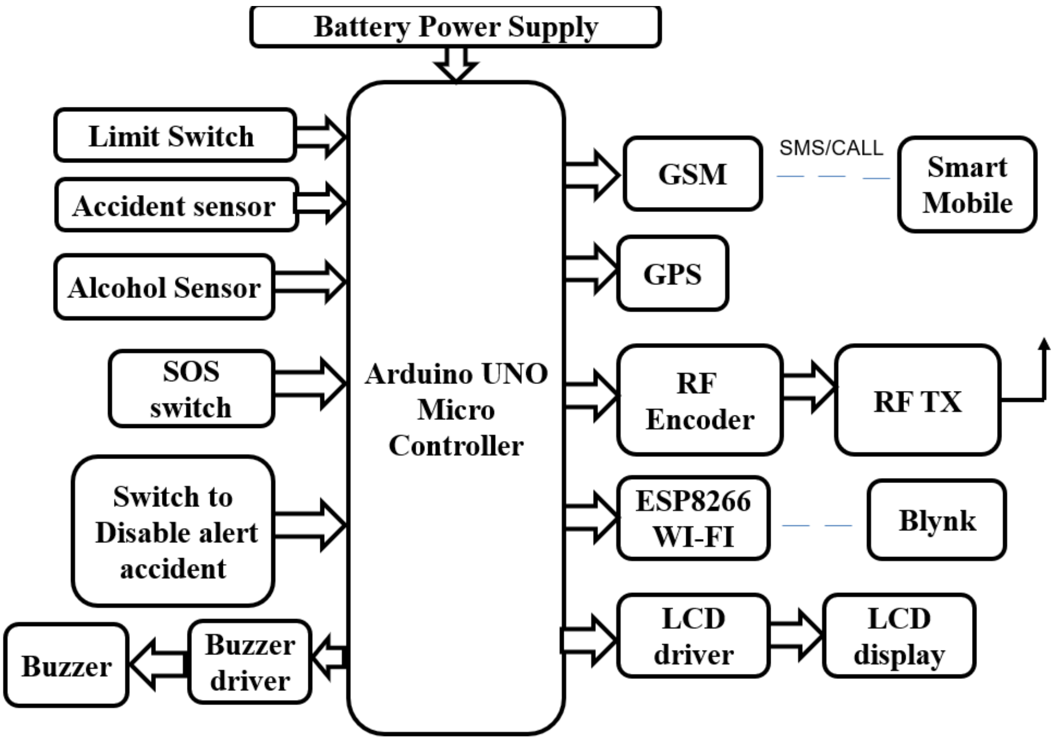

Fig 3.10: Schematic diagram of helmet

Vehicle Module's Schematic Diagram:

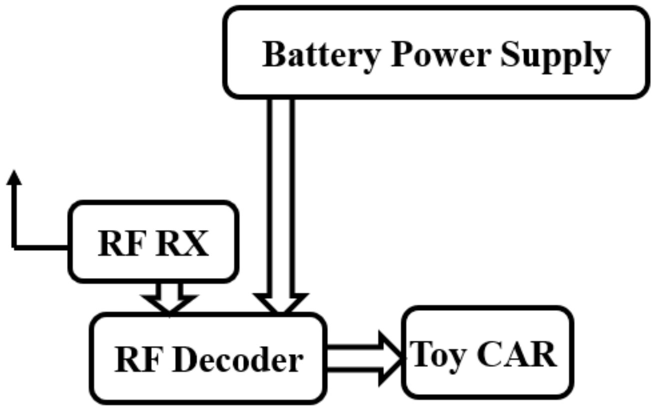

Fig 3.11: Schematic diagram of vehicle

Circuit Design:

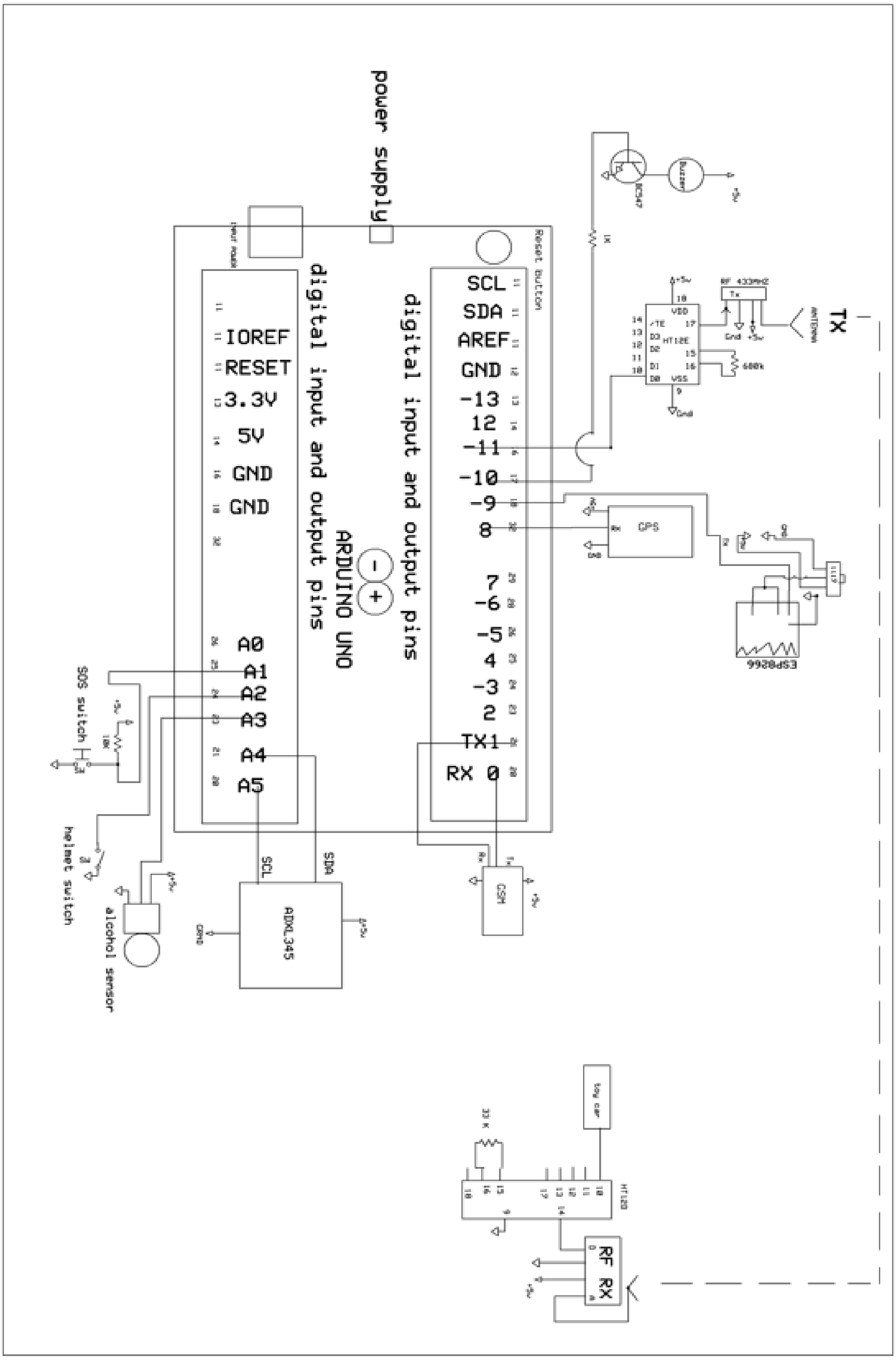

Fig 3.12: Circuit diagram

Design Implementation:

Fig 3.13: Helmet Module

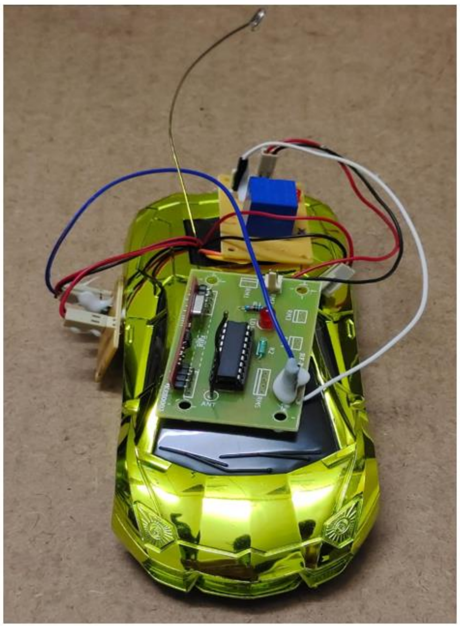

Fig 3.13: Vehicle Module

Code:

```
#include <Wire.h>
#include <Adafruit_Sensor.h>
#include <Adafruit_ADXL345_U.h>
Adafruit_ADXL345_Unified accel = Adafruit_ADXL345_Unified();
#include <TinyGPS++.h>
String phone_no1 = "+919390239329";
TinyGPSPlus gps;
#include <LiquidCrystal.h>
LiquidCrystal lcd(2,3,4,5,6,7);
#include <SoftwareSerial.h>
SoftwareSerial ss(8,9); // RX, TX pins for GSM module
#define em_sw A15
#define hel_sw A0
#define dis_sw A2
#define alcohol_sensor A3
#define rf 11
#define buzzer 10
float l,n;
int m;
int flag=0,count=0;
void setup()
{
  Serial.begin(9600);
  ss.begin(9600);
  lcd.begin(16,2);
  pinMode(rf,OUTPUT);
```

```
  pinMode(buzzer,OUTPUT);
  digitalWrite(rf,LOW);
  lcd.setCursor(0,0);
  lcd.print("Welcome To The   ");
  lcd.setCursor(0,1);
  lcd.print("Project          ");
  if(!accel.begin())
   {
     //Serial.println("No valid sensor found");
     while(1);
   }

  delay(1000);
  lcd.clear();
}
void loop()
{
  sensors_event_t event;
  accel.getEvent(&event);
  int x = event.acceleration.x;
  int y = event.acceleration.y;
  int a = analogRead(alcohol_sensor);
  int h = digitalRead(hel_sw);
  int d = digitalRead(dis_sw);
  int e = digitalRead(em_sw);
```

```
if(h==0)
{
  Serial.println("Helmet Worn     ");
  lcd.clear();
  delay(500);
  if(a<400)
  {
     lcd.clear();
     Serial.println("Alcohol Alert");
     lcd.setCursor(0, 0);
     lcd.print("Helmet Worn              ");
     lcd.setCursor(0, 1);
     lcd.print("Alcohol Alert            ");
     digitalWrite(rf,LOW);
     digitalWrite(buzzer,HIGH);
     delay(1000);
     digitalWrite(buzzer,LOW);
  }
  else
  {
    lcd.clear();
    Serial.println("Alcohol ok");
    lcd.setCursor(0, 0);
    lcd.print("Helmet Worn       ");
    lcd.setCursor(0, 1);
    lcd.print("No Alcohol         ");
    digitalWrite(rf,HIGH);
    delay(1000);
     lcd.clear();
      lcd.setCursor(0,0);
      lcd.print("lat:");
      lcd.print(gps.location.lat(), 6);
      lcd.setCursor(0,1);
      lcd.print("lon:");
      lcd.print(gps.location.lng(), 6);
    if((e==0)||(x<-5)||(x>5)||(y<-5)||(y>5))
    {
      flag=1;
      lcd.clear();
      lcd.setCursor(0,0);
      lcd.print("Emergency Alert    ");
        digitalWrite(rf,LOW);
        Serial.println("count"+String(count)+" ");
        digitalWrite(buzzer,HIGH);
        delay(1000);
        digitalWrite(buzzer,LOW);
        if(d==0)
        {
          lcd.clear();
          lcd.setCursor(0,0);
          lcd.print("Disable switch    ");
          lcd.setCursor(0,1);
```

```
            lcd.print("Activated               ");
            delay(500);
            count=0;
            flag=0;
          }
          if(flag==1)
          {
            count++;
          }
          if(count>10)
          {
            lcd.clear();
            lcd.setCursor(0,1);
            lcd.print("Sending SMS     ");
            sendSMS(phone_no1,"***Emergency Alert***\nLocation
            count=0;
            flag=0;
            MakeCall();
          }

      }
    }
  }
  else
  {
    digitalWrite(rf,LOW);
    lcd.clear();
    lcd.setCursor(0,0);
    lcd.print("Helmet Not Worn     ");
    lcd.setCursor(0,1);
    lcd.print("Please wear         ");
    delay(1000);
    lcd.clear();
    lcd.setCursor(0,0);
    lcd.print("lat:");
    lcd.print(gps.location.lat(), 6);
    lcd.setCursor(0,1);
    lcd.print("lon:");
    lcd.print(gps.location.lng(), 6);

  }
Serial.println("ATA\r\n");
ss.print(gps.location.lat(), 6);
ss.print(",");
ss.print(gps.location.lng(), 6);
ss.print(",");
ss.println(flag);
Serial.print(gps.location.lat(), 6);
Serial.print(",");
Serial.print(gps.location.lng(), 6);
Serial.print(",");
Serial.println(flag);
```

```
  delay(500);
}


void sendSMS(String number, String msg)
{
  Serial.println("AT+CMGF=1");    //Sets the GSM Module in Text Mode
  delay(1000);
  Serial.print("AT+CMGS=\""); Serial.print(number); Serial.println("\"\r\n")
  delay(1000);
  Serial.println(msg);
  delay(1000);
  Serial.println((char)26);
  delay(2000);
}

void MakeCall()
{
  Serial.println("AT+CLVL=1\r\n");
    delay(1000);

  Serial.println("AT+CRSL=1\r\n");
    delay(1000);

  Serial.println("ATD"+String(phone_no1)+";"); // ATDxxxxxxxxxx; --
  Serial.println("Calling  "); // print response over serial port
  delay(1000);
}

void displayInfo()
{
  if (gps.location.isValid())
  {
    l=gps.location.lat(), 6;
    n=gps.location.lng(), 6;
  }
  else
  {
    Serial.print(F("INVALID"));
  }

  Serial.println();
}
```

CHAPTER-4

RESULT

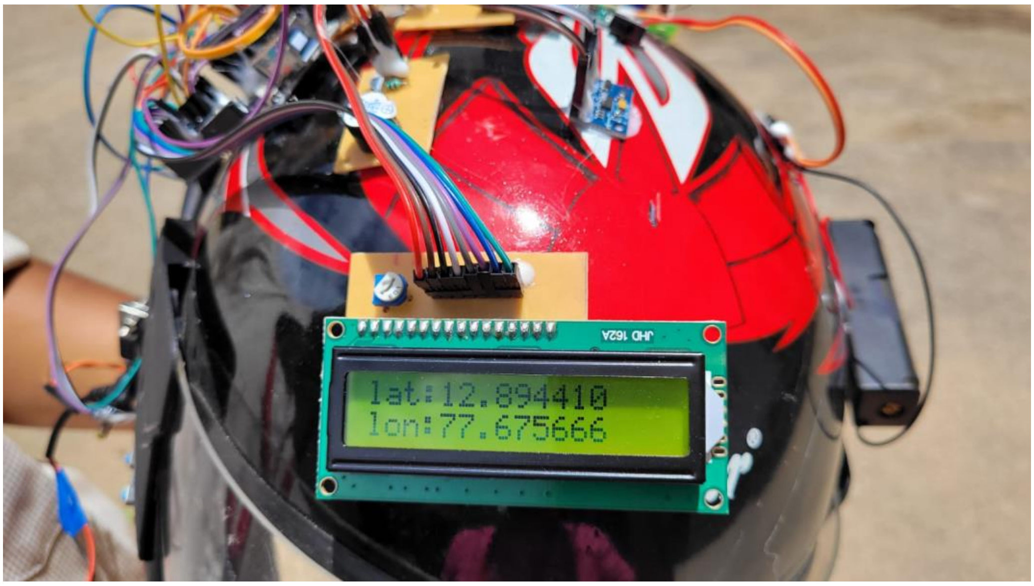

Fig 4.1: LCD display of latitude and longitude

Fig 4.2: LCD display of helmet detection

Fig 4.3: LCD display of helmet detection

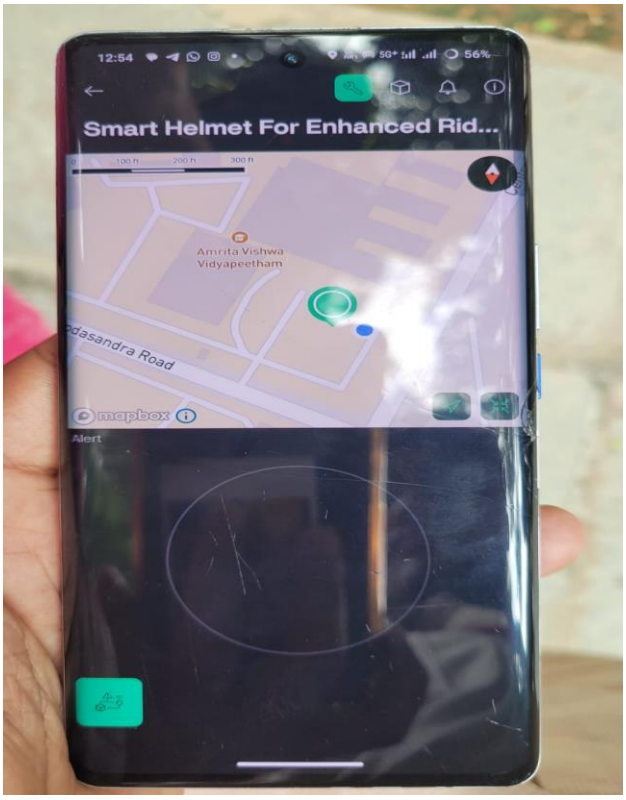

Fig 4.4: Live Location Tracking in Blynk app

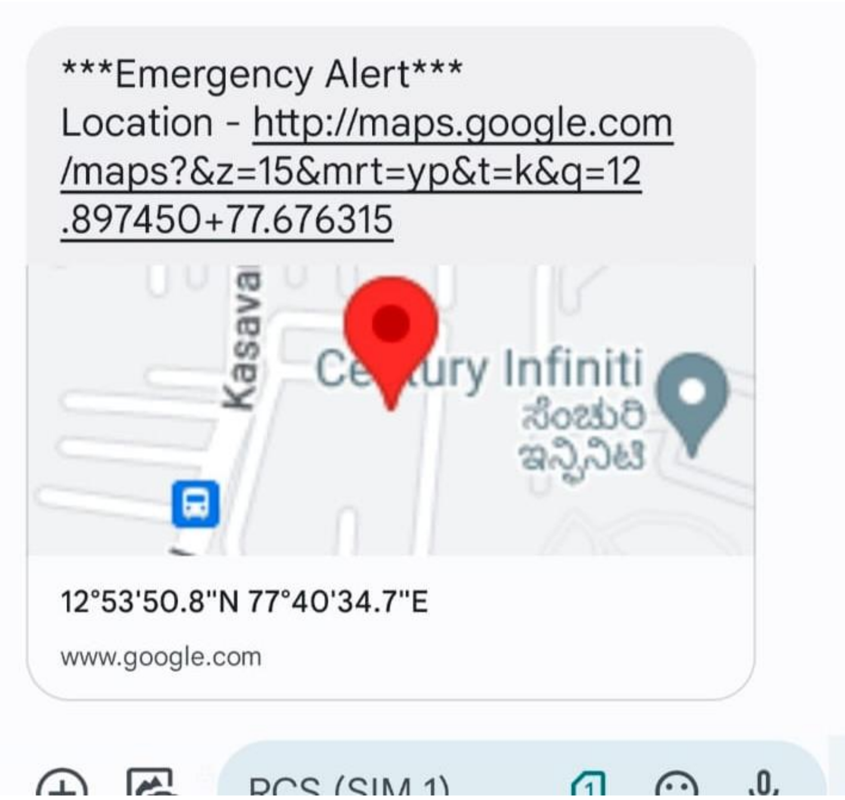

Fig 4.5: Emergency alert via SMS

ANALYSIS

The IoT-based smart helmet ensures safety by detecting helmet usage and alcohol levels, preventing vehicle ignition if necessary. It uses impact sensors for accident detection, sending automatic alerts with location data. Real-time feedback is provided through visual and auditory signals. RF communication integrates with the vehicle, and system performance is validated through testing. Efficient, secure software ensures reliable operation.

- Helmet Usage Detection: Ensure accurate and immediate detection of helmet usage. Prevent vehicle ignition if the helmet is not worn.

- Alcohol Monitoring: Accurately detect alcohol levels and prevent riding under the influence. Provide immediate audible alerts upon detection.
- Accident Detection: Reliably detect accidents using impact sensors. Send automatic alerts to emergency contacts with location data.
- Emergency Notification System: Ensure reliable and accurate communication of accident alerts. Include manual override options for false alarms.
- Real-Time Monitoring and Feedback: Provide clear visual and auditory feedback to the rider. Ensure usability of the interface and alerts.
- Vehicle Integration: Maintain reliable RF communication between helmet and vehicle. Control vehicle functions based on helmet status.
- System Integration and Testing: Validate system performance in real-world conditions. Incorporate user feedback and ensure reliability.
- Programming and Embedded System: Develop efficient and secure embedded software. Ensure real-time performance and robust error handling.

CHAPTER-5

APPLICATIONS

- Detects helmet usage and alcohol levels, preventing vehicle ignition if safety conditions are not met.
- Automatically alerts emergency contacts in case of accidents, providing location data.
- Enhances workplace safety by monitoring workers and detecting falls and impacts.
- Improves sports and recreational safety by detecting accidents and monitoring performance metrics.
- Enhances military and law enforcement safety with impact sensors and real-time tracking.
- Monitors patients in healthcare settings, detecting falls and sending alerts to caregivers.
- Ensures safety in hazardous environments like mining, tracking location and health status, and providing emergency alerts.

FUTURE SCOPE

- Enhanced Sensor Integration for health monitoring and hazard detection.
- Artificial Intelligence and Machine Learning for accident prediction and prevention.
- Augmented Reality (AR) for real-time information and situational awareness.
- Improved Connectivity for faster data transmission and emergency communication.
- Battery and Power Management for longer operation and sustainability.

- Expanded Safety Features like collision avoidance and voice controls.
- Smart City Integration for access to road data and efficient management.
- Customization and Comfort with modular designs and adjustable fit.
- Data Analytics for insights into rider behaviour and safety metrics.
- Regulatory Compliance for trust and widespread adoption.
- Emergency Response Enhancement with automatic incident recording and alerts.

CONCLUSION

- This system has the potential to improve rider safety by preventing them from riding by not turning on the engine when the helmet is not worn by the rider, chin strap is not secured and when alcohol consumption of the rider is more than the threshold value.
- The engine will turn ON only after the rider wears the helmet, chin-strap is secured and when the alcohol consumption level of the rider is below the threshold value.
- Once the engine turns ON, the accelerometer will keep track of the angle of tilt of the helmet, and when it exceeds the threshold limit, the GSM modem will send an SMS to the registered contacts and share the rider’s location.
- With the help of speaker we can connect the mobile to the helmet so that we can answer important calls because using mobile or earbuds is difficult and prone to cause accidents.
- With the help of SOS button, we can send a emergency signal to our registered contacts incase of any danger/threats.
- Emergency alerts can be de-activated with a buzzer incase of false alarms.

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