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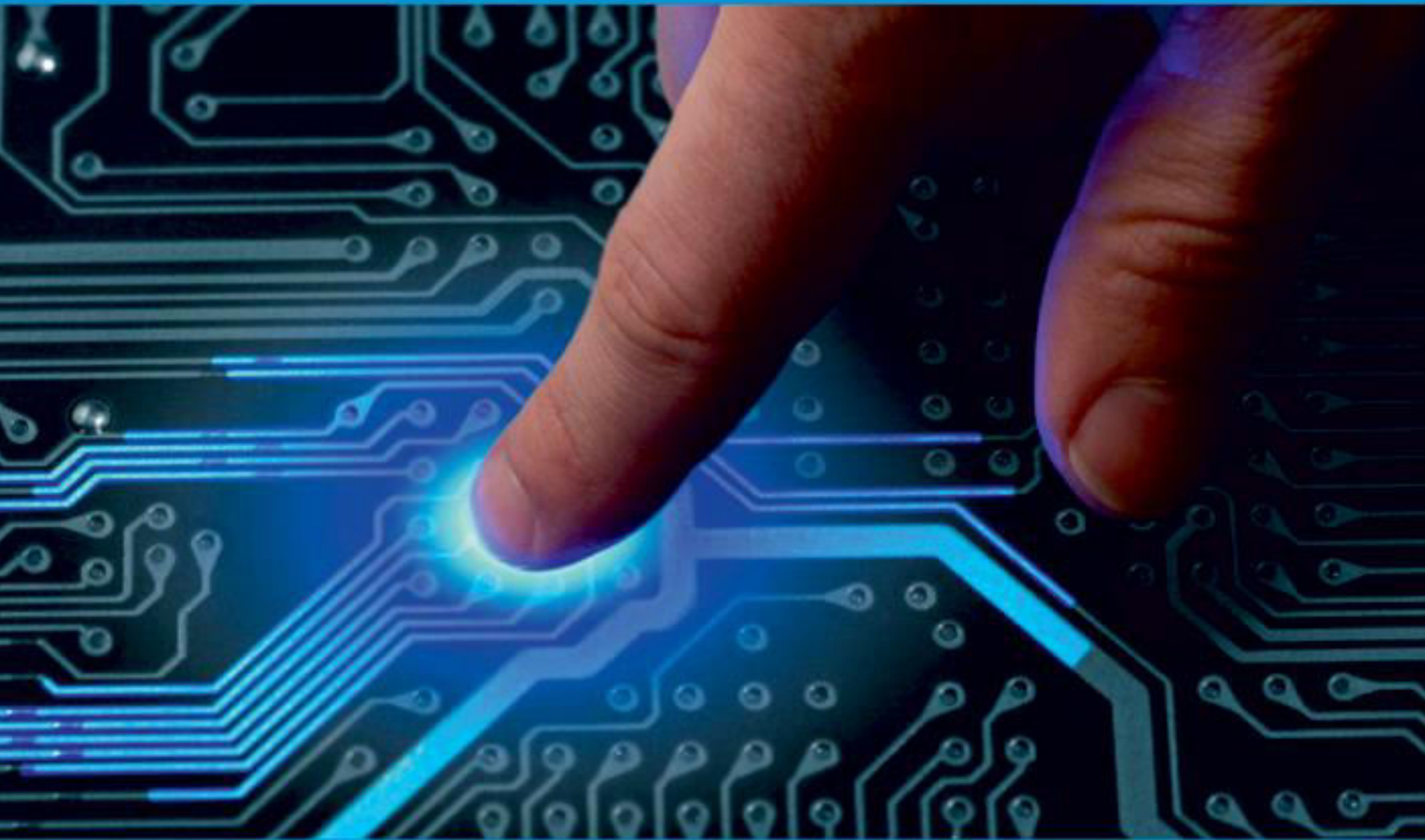

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IoT BASED SMART HELMET USING ARDUINO UNO ATMEGA328P

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ABSTRACT Traffic accidents are a common problem and governments have implemented laws to prevent them. However, accidents still occur frequently especially with motorcycles. Wearing helmets and driving responsibly can reduce the risk. To improve safety, intelligent helmet systems have been created by leveraging Internet of Things (IoT) technology. These systems detect accidents restore GPS (Global Positioning System) positions, and improve understanding of IoT technologies. Components like Arduino UNO and IR (Infrared Radiation sensor) sensors are used to ensure the person wearing the helmet before starting the bike. RF (Radio Frequency) modules facilitate wireless communication between both helmet and bike units. The system also includes fall detection using ADXL (Analog Devices Accelerometer) sensors and Global System for Mobile Communications (GSM)/GPS modules to track incident locations and send SMS alerts. Intelligent helmet systems greatly enhance accident finding and motorcycle safety.

KEYWORDS: MQ-3 Alcohol Sensor, RF Receiver, IR Sensor, ADXL, LCD Display, Buzzer, RF Transmitter, Arduino Uno, GPS, GSM, Motor driver, Motor.

I. INTRODUCTION

This work addresses the increasing issue of road accidents by introducing an intelligent helmet system. That prioritizes rider safety. Despite existing regulations, accidents, especially among two-wheeler riders, continue to rise. The work seeks to avoid accidents, detect them quickly, and provide immediate assistance using advanced technologies. It tackles the problem of high accident rates, emphasizing the importance of helmet usage and responsible riding. The intelligent helmet system ensures the bike's engine starts only after the helmet is worn correctly. The system also includes a fall detection feature for prompt assistance in case of accidents. By utilizing IoT technology, advanced sensors, and communication modules, the intelligent helmet system offers a comprehensive solution to enhance rider safety.

II. RELATED WORK

In [1] Mohd Afiq et al. proposed this work and this work focuses on improving motorcycle rider safety by developing a smart helmet with sensors. It includes a FSR (Force Sensing Resistor) and a BLDC Fan for detecting the rider's head and motorcycle speed each. A wireless communication system using a Radio Frequency 315 MHz Module is implemented. The microcontroller PIC16F84a controls the system, allowing the engine to start only after the rider wears the helmet. Additionally, an LED flashes when the motor speed tops 100 km/hour. In [2] Sudharsana et al. developed an intelligent helmet to address the issues of helmet non-compliance and drunk driving, a smart helmet system is proposed. It contains of IR (Infrared Radiation), PIR (Passive Infrared radiation), and MQ-3(Methane Gas Sensor) alcohol sensors to sense the helmet and alcohol consumption. A sensor called an accelerometer is employed to limit bike speed and detect falls. If in case an accident occurs, a GSM module sends a message to the rider's family. The system incorporates ADXL335 accelerometer and GSM technology for these functionalities. In [3] Nitin Agarwal et al. established smart helmet using iot technology. The telemetry system includes a pressure sensor that activates when the rider wears the helmet. Upon activation, the sensor sends a control signal to the receiver circuit, which then activates the relay connected to the bike's ignition circuit. In the prototype, a dPDT electromechanical relay is used, but state relays can be utilized for faster response and improved performance on a larger scale. In [4] Ajay and Vishnu were created an intelligent helmet system that spots accidents using pressure sensors and notifies them through Global Positioning System and Global System for Mobile Communications. The system tracks the current location using Global Positioning System and sends it to emergency contacts. It also incorporates a direction finding system using

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Google Maps and voice readout through helmet speakers to provide the most efficient route to the location. These features of location tracking and accident notification are highly beneficial. In [5], S. Tapadar et al. devised a system that employs two sets of control systems, one for the rider and the other for the motorcycle's operation. These systems communicate wirelessly through Bluetooth from the helmet to the motorcycle control device. If the helmet detects the presence of alcohol in the air, the motorcycle will be prevented from starting. However, this design does not ensure that the rider is wearing a helmet. In [6] Jesudoos A et al. utilized sensors such as IR sensor, vibration sensor, and MQ-3 sensor to enhance helmet functionality. The gas sensor detects alcohol consumption through breath analysis, while the vibration sensor detects accidents. Load checker identifies vehicle load, and all sensors are connected to a PIC (Programmable Integrated Circuit.) microcontroller. The system displays alcohol detection on an LED display, sends accident information via GPS to the hospital, and tracks rash driving through a MEME (Multimedia Extension to the Internet Mail) sensor. The IR sensor ensures helmet usage, and automatic ambulance booking is based on the rider's location. In [7] S. J. Swathi et al. developed a safety framework that combines a smart helmet with a bike to mitigate the risks associated with two-wheeler accidents, bike theft, and drunk driving. The framework incorporates RFID (Radio Frequency Identification) technology, password authentication, and many sensors including a MQ-3 sensor and proximity sensor. The bike's operation is restricted by the proximity sensor when the helmet is not worn, and the gas sensor detects alcohol consumption. In the presence of alcohol, the ignition system is automatically disabled. In [8] Ehsanul Alim et al. proposed an approach that utilizes Arduino NANO and Arduino Mega-2560 microcontrollers to control the components of the system. Communication between the sender and receiver is achieved using two 2.4 GHz nRF24L01 modules. The system incorporates an MQ-3 alcohol sensor to sense whether the motorcycle rider has consumed alcohol. If alcohol is detected, the engine is turned off. A Sharp IR sensor is employed to notice the rider's head within a specific range, and the bike's engine starts only when the rider wears a helmet. The Global Positioning System and Global System for Mobile Communications technologies are utilized to find the rider's location and send text messages to their family members in the event of an accident. In [9] Dr. Y MohanaRoopa et al. established a smart helmet incorporating three key components: Alcohol Sensor, Accident Switch with GSM, and GPS. Initially, only the Alcohol Sensor and Accident Switch were integrated, but the authors propose mixing all three components into a single helmet. The Alcohol Sensor detects alcohol consumption by the motorist while driving, triggering an alarm message if alcohol is detected. The Accident Switch, also known as a Bump switch, sends emergency SMS alerts to the victim's contacts and nearby hospitals. In [10] A. Siri Pallavi K et al. proposes an IoT-based ignition interlock device (IID) aimed at preventing drunk driving by disabling a vehicle's ignition if the driver's blood alcohol concentration (BAC) exceeds the legal limit. The system incorporates a breathalyzer sensor to measure the driver's BAC, with the data transmitted to an IoT platform for analysis and processing. In case of high BAC levels or attempts to circumvent the system, alerts can be sent to a designated mobile phone number. The integration of IoT technology ensures the system's reliability, scalability, and accessibility, making it an effective solution for combating drunk driving and reducing associated accidents.

III. PROBLEM STATEMENT

The work aims to solve the problem of increasing road accidents, particularly among two-wheeler riders. Despite existing laws and regulations, accidents persist, leading to injuries and fatalities. The work focuses on three key issues.

1. **Not wearing helmet**: Many riders either don't wear helmets or wear them incorrectly, increasing the risk of head injuries during accidents.
2. **Drunken Drive:** Driving with consumption of alcohol is extremely dangerous and puts both the driver and others on the way at risk. Deliberately increasing the likelihood of accidents risks the safety of everyone involved.
3. **Location finding problem:** In case of an accident, determining the precise site of the rider can be challenging making it difficult to provide timely medical assistance.

The project suggests using a smart helmet system that incorporates IoT technology to encourage wearing helmets correctly and send quick emergency notifications. The work aims to enhance rider safety and reduce accidents by allowing the bike's engine to start only after the helmet is worn correctly. The system also includes features like fall detection and Global System for Mobile Communications, Global Positioning System modules, allowing for swift medical assistance and faster response times.

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i. Existing System

Accidents keep happening despite the government's efforts to prevent them. Bikes and other two wheeler vehicles are especially prone to accidents. Staying safe requires wearing a helmet and practicing careful riding. That is why a smart helmet is created using IoT technology. It has devices and sensors to make sure the bike's engine starts only after the rider wears the helmet. The helmet can also spot if the rider falls and GPS (Global Positioning System) system to find them quickly in emergencies. This smart helmet aims to protect riders and make two-wheeler travel safer.

ii. Proposed System

The proposed system addresses the issues of helmet compliance drunken driving detection and awareness of approaching vehicles. It utilizes IR (Infrared Radiation) and MQ-3(Gas) sensors to ensure proper helmet usage and detect alcohol consumption. Wireless communication is established between the helmet and bike units using an RF (Radio Frequency) module. In the event of an accident, GSM (Global System for Mobile Communications) and GPS (Global Positioning System) modules are employed to transmit the site to emergency contacts. The system includes an Arduino UNO in the helmet unit and another Arduino UNO, GSM, and GPS Neo in the bike unit. The main goal is to enhance rider safety and minimize response time for medical assistance.

IV. METHODOLOGY

The methodology of this work tells that system involves two interconnected units, namely the Helmet Unit and the Bike Unit (both units have microcontroller), which communicate wirelessly using the RF (Radio Frequency) Transmitter & Receiver Module. The system verifies that the engine of the two-wheeler remains inactive unless the rider wears the helmet correctly, sensed through an IR sensor. Also, the rider must pass an alcohol test using an MQ-3 sensor to prevent drink and drive incidents. Then it includes GPS for detecting the accident and site tracking. In case of an accident or Alcohol detected, the system sends SMS alerts to emergency contacts using the GSM (Global System for Mobile Communications) module. The system contains these modules Helmet detection, Alcohol detection and Accident and fall detection.

V. ALGORITHM

i. Algorithm for Helmet Unit

Step 1: Start.
Step 2: Initialize the Arduino Uno and necessary pins for communication.
Step 3: Set up the RF transmitter for wireless communication.
Step 4: Configure the IR sensors and MQ3 sensors.
Step 5: Check if the helmet is noticed by monitoring the status of the IR sensors.
Step 6: If helmet is not being detected, send a signal thru RF transmitter to disable the engine.
Step 7: Check the MQ3 sensor for alcohol detection.
Step 8: If alcohol is detected, send a signal through RF transmitter to disable the engine.
Step 9: Activate the buzzer to provide an audible alert if the helmet or alcohol is not in compliance.
Step 10: Display relevant information on the LCD display, such as helmet status and alcohol detection.
Step 11: Repeat steps 4-9 in a loop for continuous monitoring.
Step 12: End.

ii. Algorithm explanation for Helmet Unit

The provided algorithm outlines the step-by-step process of a smart helmet system designed to develop rider safety by ensuring helmet compliance and preventing drunk driving. It begins by initializing the Arduino Uno microcontroller and setting up communication pins. The RF transmitter is configured for wireless data exchange with the bike module. IR and MQ3 sensors are working to detect the presence of the helmet and alcohol consumption, respectively. The system continuously monitors the helmet's status through the IR sensors, and if the helmet is not detected, it sends a signal to disable the engine using the RF transmitter. Similarly, the MQ3 sensor checks for alcohol levels, and if alcohol is detected, it again signals the bike module to prevent engine ignition. To alert the rider, a buzzer is activated in case the helmet or alcohol is not in compliance. The LCD display shows relevant information for the

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rider's awareness. The algorithm operates in a loop, continually evaluating helmet and alcohol status for continuous monitoring during the rider's journey, thereby enhancing safety and responsible driving practices.

iii. Algorithm for Bike Unit

Step 1: Start.
Step 2: Initialize the Arduino Uno and necessary pins for communication.
Step 3: Set up the RF receiver for wireless communication.
Step 4: Configure the ADXL accelerometer.
Step 5: Continuously monitor the acceleration values from the ADXL.
Step 6: If the acceleration exceeds a predefined threshold, it indicates a potential fall or accident.
Step 7: Activate the GPS Neo module to obtain the present site of the bike.
Step 8: Send an SMS alert to designated emergency contacts, including the GPS location, using the GSM module.
Step 9: Control the motor driver to start or stop the engine based on signals received from the RF receiver.
Step 10: Display relevant information on the LCD display, such as bike status and GPS location.
Step 11: Repeat steps 4-9 in a loop for continuous monitoring and response.
Step 12: End.

iv. Algorithm explanation for Bike Unit

The algorithm describes the functioning of an IoT-based smart helmet system for a bike. It begins by initializing the Arduino Uno and setting up communication pins for data exchange. The RF receiver is configured for wireless communication with the helmet unit. The ADXL accelerometer is then set up to monitor the bike's acceleration continuously. If the acceleration surpasses a predefined threshold, it indicates a potential fall or accident. In the event of an accident, the GPS module is activated to obtain the bike's current location. An SMS alert containing the GPS location is sent to designated emergency contacts through the GSM module, informing them about the incident. To control the bike's engine, the motor driver receives signals from the RF receiver, allowing the system to start or stop the engine remotely. The LCD display provides real-time information about the bike's status and the GPS location for the rider's awareness. The algorithm operates in a loop, continually monitoring the bike's acceleration and responding accordingly. It ensures prompt actions in the event of an accident, providing valuable information to emergency contacts for quick assistance. The system enhances safety by integrating smart features to prevent accidents and facilitate immediate response in case of emergencies.

VI. FLOW CHART

i. Flow chart for Bike Unit

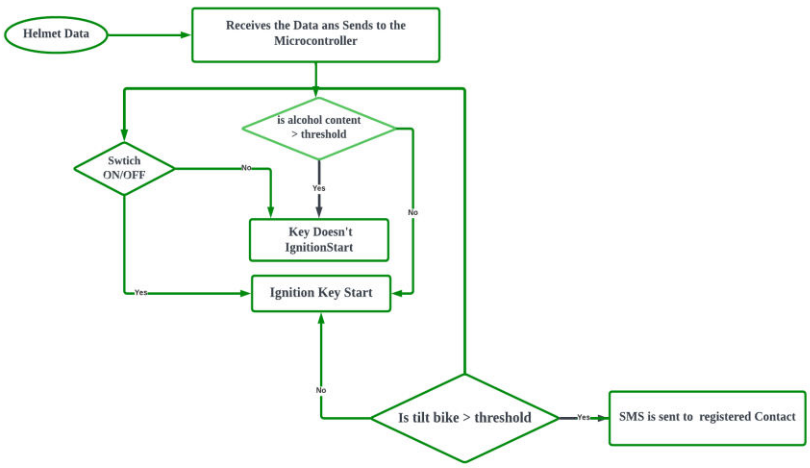

Fig-1: Flow diagram for the Bike Unit

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In the above Fig-1 the helmet has a transmitter and the bike has a receiver for wireless communication. When the rider wears the helmet a switch is activated. If the alcohol sensor in the helmet detects alcohol above the threshold the bike's ignition remains off. The bike's accelerometer measures its tilt, and the microcontroller processes the data. The managed data is then sent SMS to registered Contact number.

ii. Flow chart for Helmet Unit

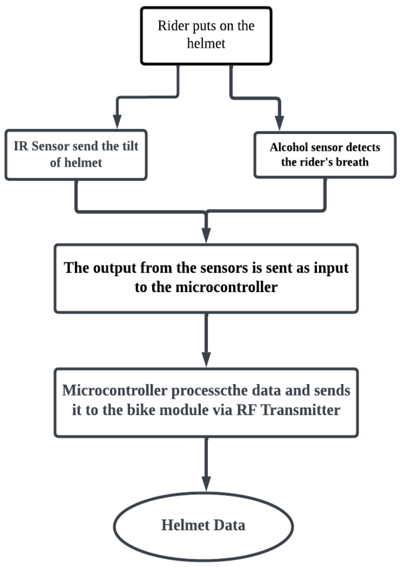

Fig-2: Flow diagram for the Helmet Unit

In the above Fig-2 the helmet section contains a transmitter, while the bike section contains a receiver, facilitating wireless communication between the two modules. When the rider wears the helmet, a sensor detects the helmet's wearing status. Additionally, an alcohol sensor within the helmet analyses the rider's breath for the presence of alcohol. If the alcohol sensor detects intoxication beyond the threshold value, the bike's ignition is disabled. The helmet's embedded accelerometer monitors its tilt and movement. The outputs of these components serve as inputs for the microcontroller, which procedures the data and generates processed output. The microcontroller's output is then transmitted to the bike module via the RF transmitter, establishing communication between the two modules.

A. HELMET MODULE COMPONENTS

The helmet module consists of numerous key components that work composed to enhance safety and provide important functionalities. These components contain the MQ-3 alcohol sensor, RF transmitter, IR sensor, Arduino Uno and power supply.

Fig-3: MQ-3 Alcohol Sensor Fig-4: RF Transmitter Fig-5: IR Sensor

The Above Fig-3 the MQ-3 sensor is responsible for sensing the presence of alcohol vapour in the rider's respiration. It measures the alcohol level and provides this data to the microcontroller for additional processing. In the

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following Fig-4 the RF transmitter enables wireless communication between the both helmet and the bike module. It transmits important data and signals, such as helmet status and alcohol detection, to the bike module for further actions or notifications. The above Fig-5 the IR sensor is used to sense the presence of the rider's head within the helmet. It ensures that the helmet is being worn properly before allowing the bike's ignition to start.

B. BIKE MODULE COMPONENTS

The bike module integrates various components to enhance functionality and safety. These components include the ADXL accelerometer, LCD display, Potentiometer, buzzer, RF receiver, Arduino Uno microcontroller, GPS module, and GSM module. Together, they enable features such as motion detection, data display, alert notifications, wireless communication, and location tracking within the bike module.

Fig-6: ADXL

Fig-7: LCD Display

The above Fig-6 the ADXL measures the acceleration and tilt of the bike module. It detects any changes in motion or orientation, allowing for features like fall detection and determining the bike's position. The following Fig-7 the LCD display provides visual feedback and information to the user. It can show important data such as system status, enhancing the user's interaction with the bike module.

Fig-8: Buzzer

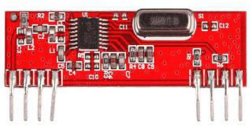

Fig-9: RF Transmitter

The following Fig-8 the buzzer produces audible alerts or warning signals. It c used to notify the rider of critical events such as not wearing helmet or Alcohol detection. The above Fig-9 the RF receiver receives signals transmitted from the helmet module. It allows for wireless communication between the helmet and bike modules, enabling the transfer of data related to helmet status, alcohol detection, or other important information.

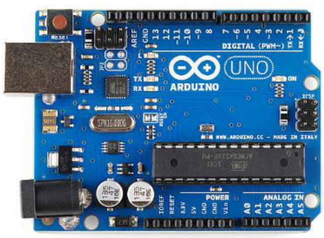

Fig-10: Arduino Uno

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The following Fig-10 the Arduino Uno acts as the brain of the bike module, controlling and coordinating the operation of various components. It processes input data, executes programmed logic, and provides output signals to control different functionalities of the bike module.

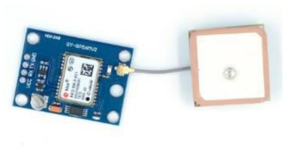

Fig-11: GPS

Fig-12: GSM

The Following Fig-11 the GPS Neo module provides accurate positioning and navigation capabilities. It accepts signals from GPS satellites to regulate the bike's exact location, allowing for features such as real-time tracking, route planning, and geo-fencing. The above Fig-12 the GSM module enables communication via the cellular network. It is used to send SMS notifications or make emergency calls in case of accidents, ensuring that relevant parties are alerted and prompt assistance can be provided.

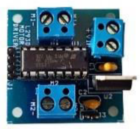

Fig-14: Motor driver

Fig-15: Motor

The above Fig-14 the motor driver plays a crucial role in the smart helmet project by enabling precise control over the motor's movement in the bike module. The following Fig-15 the motor in the smart helmet work is used to control the ignition system of the bike.

VII. RESULTS

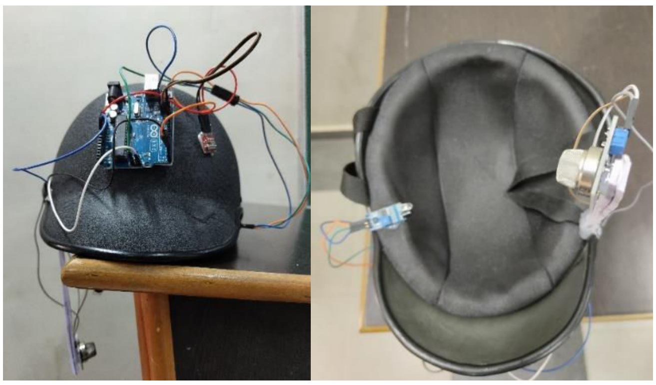

Fig-16: Helmet Section

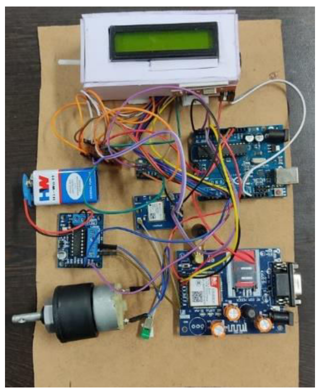

Fig-17: Bike Section

The above Fig-16 the helmet section of the smart helmet system includes the MQ-3 alcohol sensor, RF transmitter, and IR sensor. These components detect alcohol consumption, enable wireless communication, and ensure helmet compliance. The Arduino Uno microcontroller controls the system.

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In the following Fig-17 the bike section of the smart helmet system includes various components, including the ADXL, LCD display, buzzer, RF receiver, Arduino Uno, GPS module, GSM module, and potentiometer. The accelerometer detects the bike's tilt or movement, while the LCD display and buzzer provide necessary feedback and alerts. The RF receiver receives data transmitted from the helmet section, which is then processed by the Arduino Uno. The GPS module tracks the bike's location, and the GSM module enables communication for emergency alerts. Lastly, the potentiometer is utilized for input control or adjustment purposes

Fig-18: Alert Messages

The following Fig-18 shows alert message on Smartphone. It will shows Alcohol, helmet status and accident detection with location.

VIII. CONCLUSION

IoT based Smart Helmet using Arduino Uno is been developed with the aim of enhancing rider safety and preventing accidents. By integrating advanced technologies such as IoT, sensors, and communication modules, the work addresses key issues such as no helmet usage and drunken drive. The smart helmet system ensures that the bike's engine starts only after the rider wears the helmet correctly, promoting helmet usage. In situation of an accident, the system includes fall detection sensors and GPS/GSM modules to quickly notify emergency services and transmit the rider's location for registered contact number. The work offers a comprehensive solution for improving rider safety, reducing accidents, and improving response times during emergencies. By leveraging the power of IoT technology, the smart helmet project aims to create a safer environment for riders and contribute to overall road safety.

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