IOT-Based Smart Helmet With Alcohol And Motion Sensor

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Abstract—Two-wheelers are a commonly used form of transport but also come with high rates of road traffic accidents and deaths. In this paper, the safety of the two-wheeler rider in the nation is explored and enhanced by minimizing the increasing rates of road traffic accidents involving two wheelers due to the absence of a helmet and drunk driving. The work describes an IoT based smart helmet system, alcohol monitoring and motion/accident monitoring, and provide automated emergency notification with the key components of the smart helmet system. The key components are Arduino and MQ-3 sensor, MPU6050, GPS, and GSM. The overall objective of this research was to avoid the accident from happening and give prompt assistance in order to minimize casualties. The incidence of two-wheeled road accidents is a major public safety concern worldwide and is most often the result of particular behaviors, including the use of alcohol, helmet riding, and/or unsatisfied pillion and driver responsibilities. A neglected and critical concern is that the long waiting time for emergency medical treatment can complicate survivable injury into a considable fatalities. This paper outlines the design, implementation, and testing of an Internet of Things -based smart helmet system to preventatively minimize the risk of accident and responsively enable timely emergency response. A major factor contributing to fatalities in motorcycle accidents is the driver under the influence of alcohol.

Keywords: Smart Helmet, IoT, Alcohol Detection, Motion Sensor, Accident Detection, Road Safety, Embedded System

1.INTRODUCTION

The development of an iot-smart helmet incorporating alcohol and motion sensors fills an important gap in the marketplace. this is because of the statistics for two-wheeler accidents, where there is a disproportionate number of these that come from dangerous behavior and the delayed response of emergency services. [1], the project's foundation is a complex scenario that deals with both the human behavioral outcomes and technological limitations of current technology. continuously monitor cattle health parameters and shed conditions, and will notify farmers when preventative actions should be implemented. [2], two-wheeler riders are among the most exposed road users. for each mile traveled, motorcyclists are more than six times as likely to be killed in a crash as are users of other motor vehicles. [3], several of these crashes result from two of the most preventable factors: riding while under the influence of alcohol and failure to wear a helmet. traffic statistics globally conform to these assertions, with high levels of fatal consequences to motorcycle accidents with alcohol involvement in general, and head injury as the primary mode of death. [4], a namespace of intelligent helmet is full of practical elements of contemporary technology like sensors, real-time directions, and voice exchange. these play a role in safety, usability and functionality to the rider. [5], using technologies in the way of the internet of things (iot), artificial intelligence (ai).[6], it ensures sober individuals only can drive the car, which reduces the possibility of accidents due to alcohol. the objective of this r&d effort is to develop an alcohol detection smart helmet system with vehicle ignition control and other optional components such as gps tracking, bluetooth connectivity, and emergency call systems.[7],not only does this enhance rider safety, but also assists law enforcement and public health efforts in minimizing drunk driving accidents.

2 . LITERATURE SURVEY

Md.Atiqur Rahman,et.al[8]: Road traffic accidents contribute significantly to the global disease burden, especially in developing nations involving extensive two-wheeler penetration.A major proportion of road death globally is attributed to road traffic accidents and alcohol-impaired driving and riding without helmets.Worldwide, road traffic accidents have become widespread, contributing significantly to the global burden of disease. Research by the World Health Organization (WHO) indicates that the majority of road accidents involve alcohol-impaired driving and riding without helmets. The researchers and innovators thus responded by examining various technologies in enhancing the safety of the rider, especially sensor-centric and Internet of Things (IoT)-based solutions.

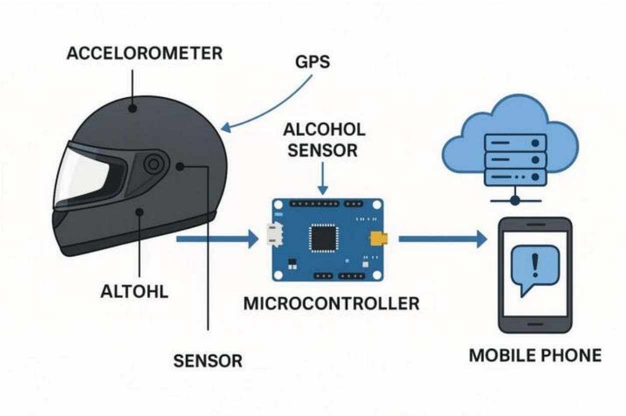


Fig-8:Road Safety Context

Chaudhary and Patel, et.al[9]: Suggested an IoT-enabled alcohol detection system with GSM and Arduino for alarming authorities and deactivating ignition. Such systems are primarily car-mounted, rather than wearable; thus inapplicable for two-wheelers. The present project proposes filling that void by integrating all such features in a low-cost, IoT-enabled smart helmet. It provides alcohol detection, helmet-wearing evidence verification, impact detection by vibration sensors, GPS-enabled location tracking, and real-time alarm transmission through GSM or Wi-Fi. By overcoming the many limitations of existing technologies, the project contributes to the development of intelligent transport systems and proposes a pragmatic solution.

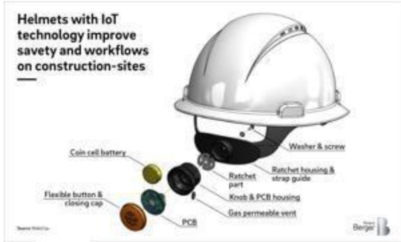


Fig-9:Existing Research on Alcohol Detection

Rao et al[10] : Created a smart helmet with motion and alcohol sensors, which identifies accidents and notifies contacts. IIT Roorkee Project: A smart helmet prototype that avoids ignition when the helmet is not being worn.Lack of GPS tracking, real-time IoT notifications, and complete system integration. Smart helmet research has also increased, with an interest in identifying helmet use and crash incidents. Rao et al. (2021) proposed mart helmet with motion sensors for accident detection and alerting emergency contacts. However, their system did not include alcohol detection and GPS tracking in real-time. On the commercial side,Sena and LIVALL provide helmets with Bluetooth connectivity and crash alert capabilities, but They are expensive and lack alcohol sensing or ignition control capabilities.

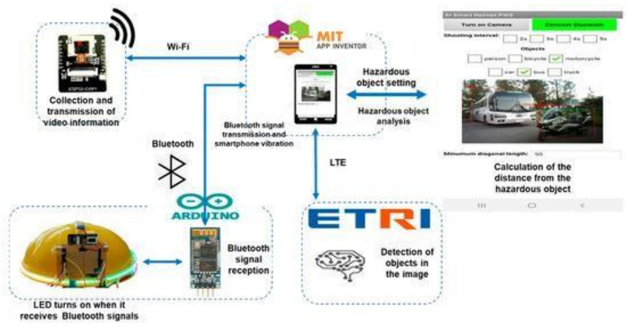


Fig-10:Smart Helmets with Sensors

shikha Gupta,et.al[11]:A two-wheeler often referred as motorbike or motorbike, that is most popular than another type of automobiles due to its affordability. But another point, this is the most dangerous car. The crash may occur due to speeding or alcohol driving. Safety and security while traveling in vehicles are an overriding concern for everyone. Due to the fast-paced urbanization and phenomenal expansion of transportation networks such as two-wheeler cars, road safety and bike security have become a unavoidable priority for us. It has increased the rate of accidents, which results in various damages with loss of life. In most situations, we cannot manage to identify the location of the accident. A helmet is a type of protective gear used to prevent injuries to the head. In more specific terms, the helmet supports the skull in order to protect the brain. A smart helmet can identify the location of accidents also save lives and makes riding a two-wheeler safer from earlier. This paper suggests a system of smart helmet to prevent the accident.

Piyush Mishra,et.al[12]: Traffic accident is the term used for any road accident that happens on public roads involving the presence of vehicles. They thus encompass car-pedestrian accident, car-animal accident, and car-obstacle accident. The road traffic [1] in the high-income nations accidents already rank in the top ten of the major disease burden causes in 1998 in measure terms DALYs (disability- adjusted life years). Road traffic accidents in less developed nations remained the leading cause of injury and the eleventh most important lost years of healthy life cause. Widening of the road is not the alternate solution to escape traffic in such cities [2] in Indian road network. The shortcomings in the state systems of controlling drunk driving can be rectified in several fashions.

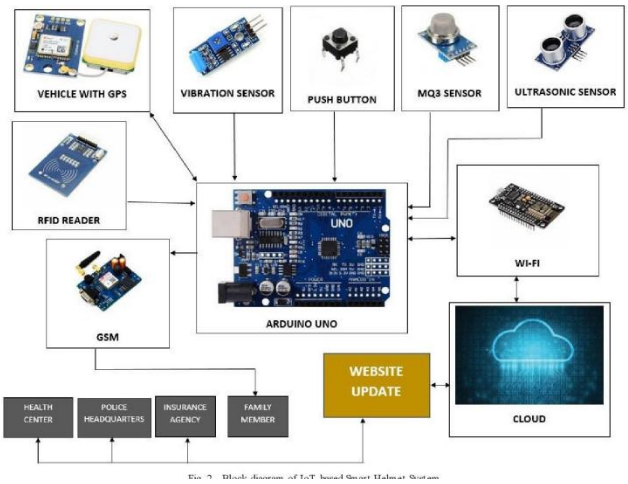


fIG-11:alcohol detection using smart helmet system

A.Sathiyaraj,et.al[13]: Ever since the introduction of the first motor vehicle, the automobile sector has have been progressing by leaps and bounds. Two-wheelers are not an exception, but the safety of the driver is yet a dangerous predicament. By the very construction and design of the two-wheeler, the driver is exposed to accident more than the conventional four-wheeler motorized vehicle. Hence, in this paper we are suggesting a complete solution for the protection of the driver of a two-wheeler. The suggested solution is designed to accomplish three chief tasks. Firstly, detection of alcohol which would be needed to determine whether the rider is intoxicated with alcohol. Secondly, a two-wheeler fall detection system which would need to alert the emergency contacts in the event of an accident or a serious two-wheeler fall.

Selva,et.al[14]: The concept of Smart Helmet aims to provide the same for Bikes. With features like built-in Black Box, GPS logging which will keep track of the rider's location and can be accessed in case of emergency. A collision sensor will alert in case the rider meets with an accident and or is drunken driving. The helmet makes use of ATMega32u4 with AI Thinker's A7 GSM-GPS module for GPS logging, collision sensing and sending emergency SMS. The article also details the 2017 ILAE classification system, which categorizes epilepsy based on seizure type, aiming for more accurate diagnosis and effective treatment. It describes four main categories of epilepsy: focal, generalized, combined generalized and focal, and unknown onset epilepsy, outlining the characteristics of seizures within each type. Furthermore, the article introduces various epilepsy syndromes, which are defined by a collection of medical features,and outlines diagnostic procedures such as physical examinations, laboratory tests, EEGs, and imaging. Therapy methods such as antiepileptic medications, surgery, diet of specific purpose, and vagus nerve stimulation, are also covered.

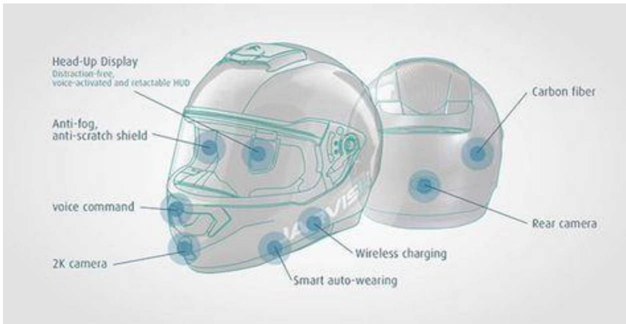


Fig 12:Implementation of Alcohol and Collision Sensors in a Smart Helmet

P. Pradeesh,et.al[15]: As an example of the Internet of Things (IoT)–gateways, a smart helmet is one of the central devices which provide unique functionalities. The emergence of smart helmets with IoT connectivity infrastructure aids to foster connected health and safety in different sectors. To that end, we provide detailed analysis of smart helmet technology and its key features and uses for health and safety. Overview of current smart helmet systems is given along with a review of the sensor attributes used in the prototyping demonstrations. In general, we sought to venture into new possibilities.

3.PROPOSED SYSTEM

The IoT-based Alcohol Detection and Motion Sensor System proposed here aims to improve road safety by ascertaining if the driver has been drinking and by tracking the vehicle's motion for any unusual activity like accidents or collisions. An MQ-3 alcohol sensor is employed to sense alcohol in the driver's breath. Whenever alcohol content crosses a predetermined level, the system promptly sends an alert and disallows the vehicle ignition.Vibration or accelerometer sensor tracks the movement of the vehicle in order to sense accidents or abrupt hits. In case of an accident, the system automatically sends an alert message with the GPS position of the vehicle to the enrolled emergency contact via a GSM module. The microcontroller (for example, Arduino or NodeMCU) powers the system and handles sensor data processing and communication between modules via an IoT platform. The IoT connectivity provides real-time monitoring and data storage on the cloud for future analysis.

4. BLOCK DIAGRAM

This block includes sensors to detect whether the rider is wearing the helmet. An IR sensor (infrared) or pressure sensor is placed inside the helmet to check for head presence. If the sensor does not detect that the helmet is worn, it sends a signal to the microcontroller, which can block the vehicle from starting.

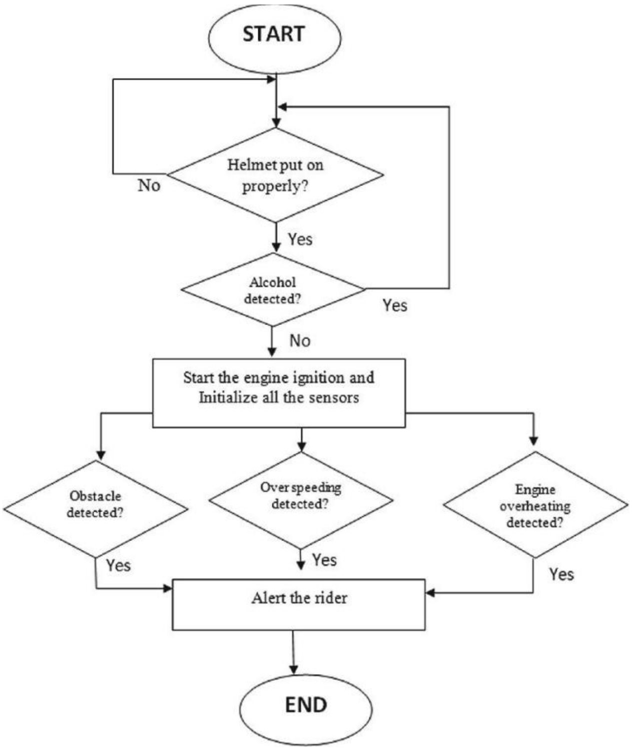


Fig 11 : Block Diagram

This ensures helmet compliance before riding.Sensors (Alcohol, Helmet Detection, Motion) feed real-time data into the Microcontroller. The Microcontroller processes this data and decides: Whether to allow ignition (via Relay Module). When to send SMS alerts through the GSM Module. GPS Module provides the current location in case of an emergency.The power supply is the starting point of the system. It provides necessary electrical energy to all components, including sensors and the microcontroller. Usually, this comes from a rechargeable battery or a standard 9V battery. The power may pass through a voltage regulator to ensure stable and safe operation.

5.SYSTEM DESIGN AND SENSORS USED

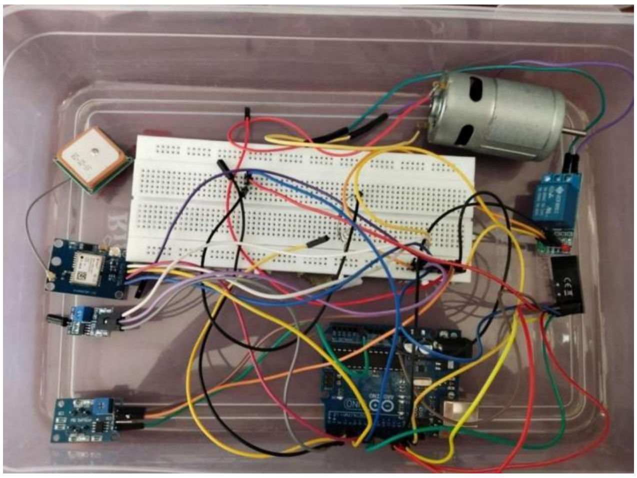


Fig5: System design

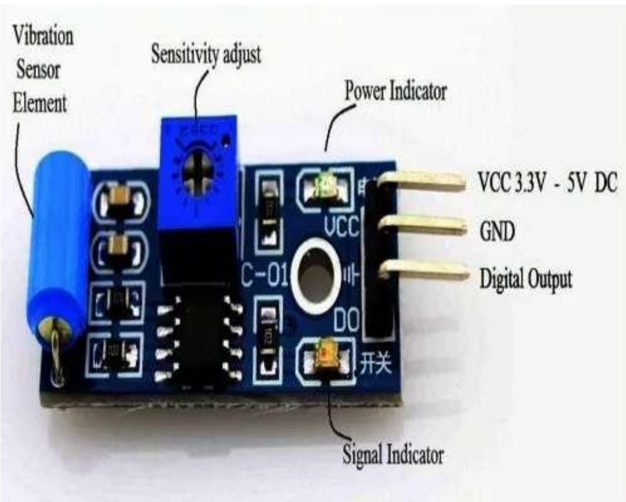
Fig 5 shows The system will help improve rider safety by keeping track of alcohol intoxication and helmet use, sensing movement or collision incidents, and providing real-time alerts to emergency contacts through IoT communication.In the proposed IoT-based smart helmet system, all components are connected to a central microcontroller like an Arduino, which is the system brain. The MQ-3 alcohol sensor is interfaced to an analog input pin of the microcontroller to sense the rider's breath for alcohol. An IR sensor or pressure sensor, mounted within the helmet, is interfaced to a digital input pin and verifies if the helmet is properly worn. The MPU6050 movement sensor (an accelerometer and gyroscope) is coupled through I2C data lines (SDA and SCL) to sense abrupt motions, shocks, or drops, signaling a possible accident. A relay module is interfaced to a digital output pin and is coupled to the automobile's ignition circuit; it permits or prevents the engine to start depending on safety parameters. A GSM module (such as SIM800L) is interfaced through serial communication (TX and RX pins) to send SMS messages in case of emergencies.

1.MQ3 sensor (Alcohol Sensor)

The MQ3 sensor is a low-cost, analog gas sensor designed to detect alcohol and other volatile organic compounds (VOCs) like ethanol in the air. It functions by sensing changes in its internal resistance when exposed to these gases, providing both an analog output proportional to the gas concentration and a digital output that can be set with a potentiometer.MQ3 sensor is a special kind of sensor that can only sense the alcohol from the moisture in the air MQ3 sensor input is 5V which can be provided by the Vcc pin of the sensor. mq3 sensor may go wrong when we utilize it for hours..

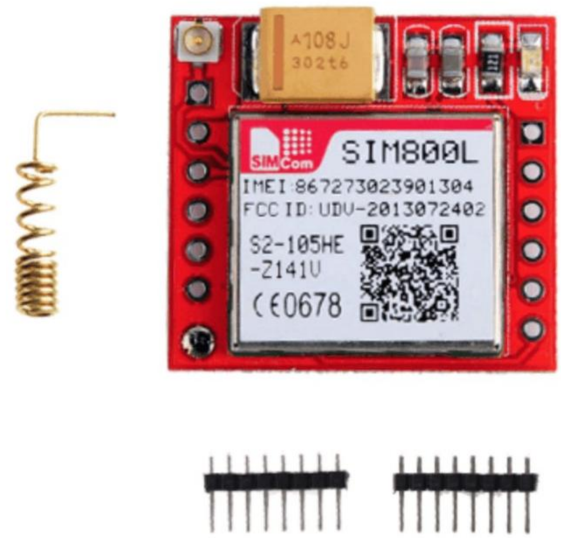
the moisture content of alcohol can be detected by the sensor. inside the sensor, there is a metal electrode that can be activated when comes into contact with the alcohol.there is electron flow between the electrode used inside the mq3 sensor. when the sensor comes in contact with alcohol the conductivity of the same electrode will be high.this sensor wil help in this smart helmet malfunction when we use it for hours.project using arduino that can be detected at the output pin. so, we can connect this mq3 sensor with Arduino or whatever controller we are suing here. MQ3 sensor input is 5V which can be provided by the Vcc pin of the sensor. mq3 sensor may go wrong when we utilize it for hours.

2.vibration Sensor SW-420



The other crucial sensor is Vibration sensor. the model number is SW-420 for the provided vibration sensor.the operation of the vibration sensor is very easy.there are many small metal balls filled inside the cylindrical shape case. inside the sensor there are several metal line. both of the two line are connected to ground and signal wire. when there is vibration then the ball contacts both the lines and carry the electricity and provide the signal at output pin. this vibration sensor is employed to initiate the gsm module. vibration sensor is sending the signal to the arduino continuously. Arduino is our microcontroller in this project of smart helmet. if there is any increase in the signal it in the arduino, the arduino will take action based on the signal.

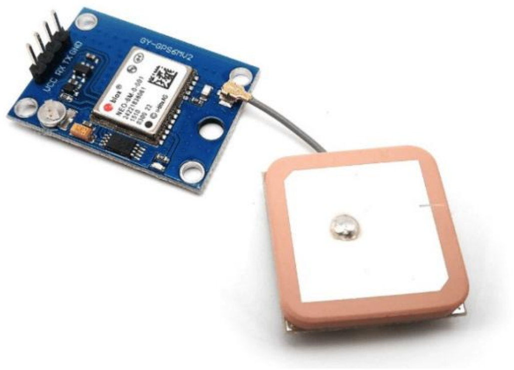
3.GSM SIM800L Module



We use GSM SIM800L Module in this smart helmet project to navigate the location. it will be triggered with the vibration sensor.GSM SIM800L is a low power module which support 2g 3g sim for communication. GSM SIM800L module is small in size and low cost GSM module that allows you to connect your device to the gsm network. it have the ability to communicate with other devices via SMS, voice calls, or GPRS. there are quad bands given that can be supports 850/900/1800/1900 MHz frequency band Sim800l module can be run over the 2g and 3g band. The module support the UART protocol. to enable the protocol there is two pin Rx and Tx. by these pin the module transfer and receive the data. It runs from 3.3 volts to 5v but need at least 2 amp power. i suggest give 5v 2amp external power supply. To power the module.

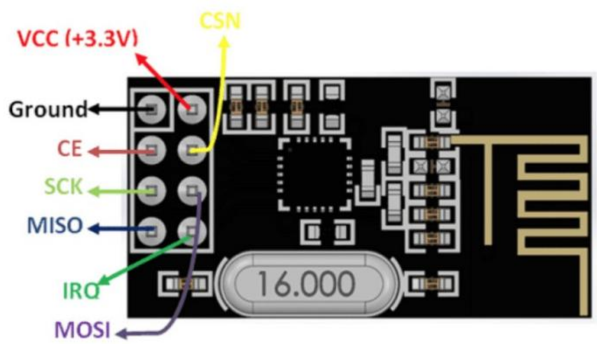
4. GPS Module neo 6m module

A GPS module is a hardware device containing an antenna, receiver chip, and processor that receives signals from satellites to calculate and provide location, speed, and time data, typically using a method called trilateration. These modules are essential components in smartphones, vehicle navigation systems, asset trackers, and drones, enabling precise location-based services by communicating with the Global Positioning System (GPS) and other global navigation satellite systems (GNSS).Neo 6M module is use for sending the current location in this arduino based helmet project. The NEO-6M GPS module is a low cost and small size module which can receive the gps signal and can be provide position with lattitude and Longitude with time.



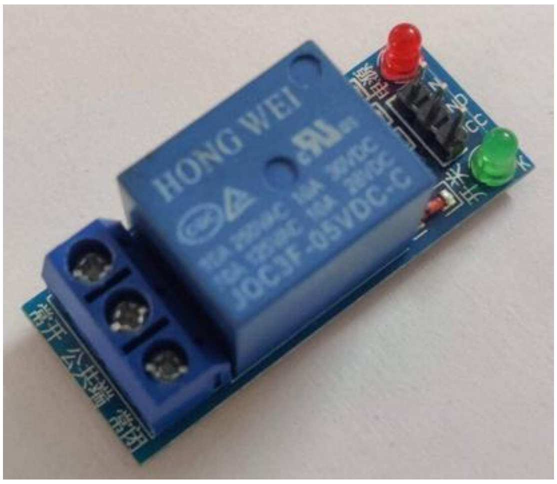
it work with the global positioning system also it supports global navigation satelite system.The gps neo 6m module can be communicate with any microcontroller with the UART protocol in this project this module will be connect to the arduino with the UART protocol and use rx and tx pin to connect the system. There is a library which can help to callibrate the sensor with the coding. Some common applications for the NEO-6M GPS module include navigation systems, geotagging, tracking devices, and unmanned aerial vehicles (UAVs). It is important to note that the module requires a clear view of the sky to receive GPS signals, and may not work well indoors or in areas with poor satellite coverage.

5.NRF module NRF24L01



There are two devices in this smart helmet project one is a transmitter and another is a receiver in both of them we require to send the data. so we are employing NRF module for bidirectional communication.NRF module are low cost ultra power module in small size that operates 2.4 GHZ wireless trans receiver. which can be employed in wireless communication project. you can also connect several nrf module and establish communincation between all the NRF Module. NRF module utilize SPI (serial peripheral interface) protocol to establish the communication among all the device we have two nrf moduel one will be connected to the transmitter and other will be connected to receiver module.

6.Single channel Relay module



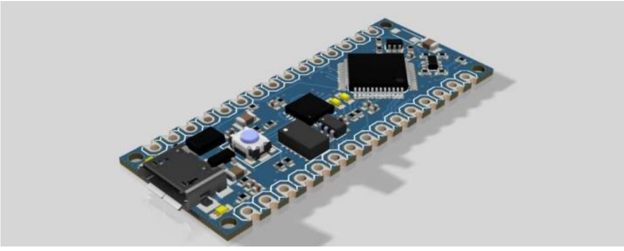
Here in the receiver section we are using a relay which will be trigger the motor which is to be pretend the bike engine.when it receive the data from the tranmitter and start the motor it need to be trigger by the relay module. relay module will be use to operate the 12v DC motor.

7. DC motor 12v

We are using here 12v dc motor with gears . If the driver is drung the motor will be turn off. it means the bike engine will be turn off.12v dc motor connected via 12v external poswer supply. which is connected through the relay which always will be triggered from the relay. Arduino can’t run a dc motor due to back emf and low current at the pins.

8. Arduino nano

The Arduino Nano 33 BLE Sense Rev 2 is like a tiny and extremely functional development board designed forembedded electronics projects. It provides a higher specification of the Nano 33 BLE Sense with the inclusion of somesensors and communication.



It is powered by the Nordic Semiconductor nRF52840 chip-based board.providing Bluetooth Low Energy (BLE) connectivity to facilitate wireless communication. What makes the Nano 33 What sets the BLE Sense Rev 2 aside is its comprehensive sensor set enabling it to be perfect for IoT projects, wearables, and edge computing. It features a 9-axis IMU (Inertial Measurement Unit) for movement detection, environmentweeney temperature, humidity, and pressure sensors, and a microphone for audio detection. The sensors allow the development of motion tracking, environmental sensing, and audio programs processing. The board also enjoys an easy-to-use form factor with the board's small size making it Suitable for space-limited projects. The board may be programmed with the Arduino IDE simplifying it the development process both for new users and seasoned users. Overall, the Arduino Nano 33 BLE Sense Rev 2 is quite the powerful and highly featured dev board that merges wireless connectivity with breadth of sensors in order to facilitate the construction of innovative and interactive projects.

6.SOFTWARES USED

The software modules have a significant role to play in programming, controlling, and monitoring the IoT-based smart helmet system. The system proposed here uses a combination of embedded programming, IoT platforms, and data communication interfaces for assuring reliable performance and real-time response.

1.Arduino IDE:
The Integrated Development Environment (IDE) of Arduino is employed for coding, compiling, and uploading the embedded C/C++ code onto the microcontroller (Arduino Uno or NodeMCU). It supports the integration and manipulation of sensors like the MQ-3 alcohol sensor, accelerometer, and vibration sensor. The IDE offers a basic interface to debug and optimize codes.

2.Embedded C Programming:
The Embedded C is used to implement the logic of alcohol detection, motion detection, and ignition control. The code specifies sensor thresholds, motor control commands, and IoT communication routines to have efficient execution and low-latency response in the microcontroller.

3.IoT Platform :
For real-time monitoring and visualization, cloud-based IoT platforms like ThingSpeak or Blynk are utilized. These platforms enable transmission of sensor data via Wi-Fi and remote access to helmet status, accident notifications, and location data.

4.Proteus :
The circuit simulation and testing are carried out prior to hardware implementation using Proteus Design Suite or Tinkercad. They simulate sensor operation, microcontroller reactions, and circuit connections to ensure system accuracy and performance.

5.GSM and GPS Communication Libraries:
Software libraries within the Arduino platform provide serial communication with GSM and GPS modules so that automatic location positioning and emergency message sending can be done on detection of an accident.

7.METHODOLOGY

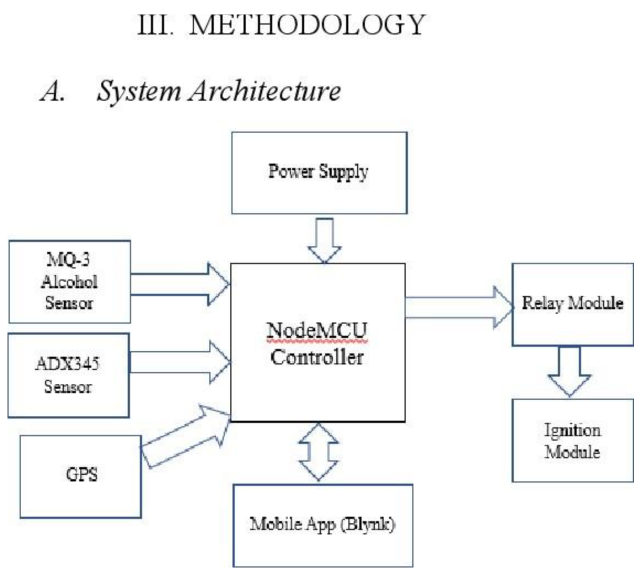


Fig12: Trends in Smart Helmets With Multimodal Sensing for Health and Safety

The envisioned IoT-enabled smart helmet system aims to improve the safety of the rider through the combination of alcohol detection, motion sensing, and real-time IoT connectivity. The system employs an MQ-3 alcohol sensor to read the breath alcohol concentration of the rider, whereas helmet wear and sudden accident/impact detection are carried out through an accelerometer and vibration sensor. The sensors are interfaced with a microcontroller (NodeMCU or Arduino Uno), which evaluates the sensor inputs and makes real-time decisions. In the event of alcohol detection beyond a preset limit or the helmet not being worn in the correct position, the ignition of the vehicle is disabled through a relay-controlled DC motor, which avoids the risk of driving under the influence. Upon accident detection, the accelerometer and vibration sensor initiate the GSM and GPS modules to autonomously report the location of the rider with an emergency notice to pre-defined contacts. Furthermore, the sensor inputs and helmet status are uploaded to an IoT platform, allowing remote monitoring through the website or mobile app. The software design in Embedded C with the Arduino IDE ensures background monitoring, quick response, and smooth sensor-to- IoT service communication. The approach stresses an all-encompassing method with the combination of preventive measures against drinking and driving with automated accident detection and notification and contributes towards the safer transport of two-wheelers.

8. RESULT

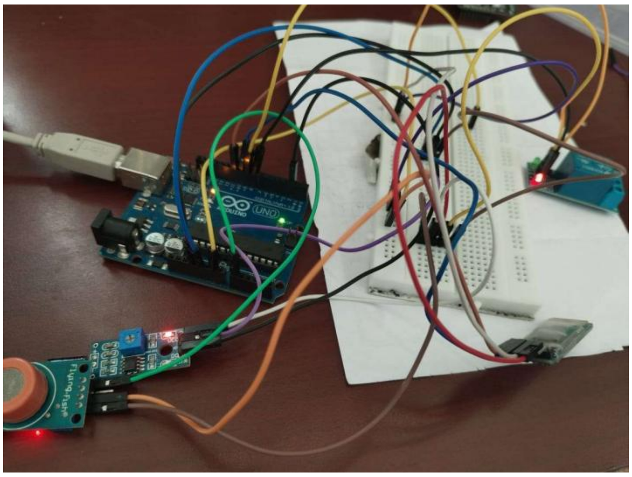


Fig13:IoT-Based Alcohol Detection and Motion Sensor System

The IoT-Based Alcohol Detection and Motion Sensor System was successfully designed, implemented, and tested. The system performed all its desired functions by detecting consumption of alcohol, tracking vehicle movement, and sending timely notifications using GSM and GPS technologies. The MQ-3 alcohol sensor, while testing, identified alcohol concentrations and turned off the vehicle ignition whenever the level rose above the predetermined threshold. The vibration sensor reacted well to abrupt shocks or unusual car movement, automatically initiating accident notifications.The IoT-Based Alcohol Detection and Motion Sensor System was successfully implemented, designed, and tested. The system accomplished all its objectives by identifying alcohol consumption, tracking movement of a vehicle, and sending timely alerts using GSM and GPS technologies. During testing, the MQ-3 alcohol sensor correctly identified alcohol amounts and disabled the car ignition once the concentration level had surpassed the predetermined threshold.The vibration sensor functioned well to respond to sudden shocks or car movement, automatically sending accident alerts. The GPS module gave accurate location data, with the GSM module sending emergency messages to the specified contact numberwithin seconds.

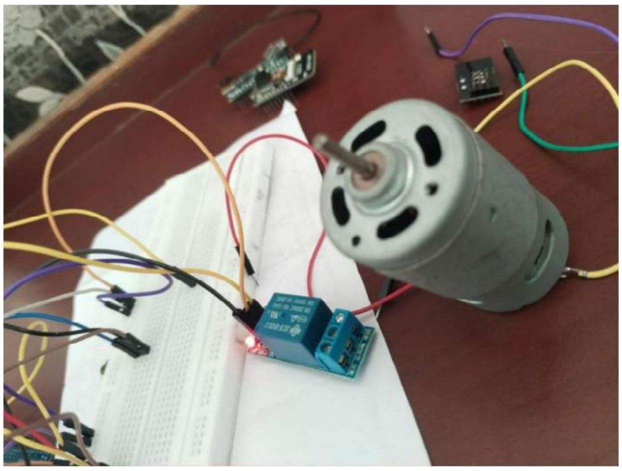


Fig14:IoT platform

The integration of the modules with the IoT platform provided real-time monitoring and visualization of data, providing round-the-clock tracking and rapid emergency response. The system exhibited superior accuracy, reliability, and stability with round-the-clock operations.Even though the system worked well, there are a few areas where future enhancements and improvements can be done to make it more efficient, scalable, and user-friendly.

Sensor Name	Actual Range	Threshold Range
MQ-3 Alcohol Sensor	0.04 mg/L to 4 mg/L (alcohol vapor)	> 0.25 mg/L or analog value > 300
IR Sensor	2 – 30 cm (depends on module)	Object detected within 5–10 cm
Pressure Sensor	Varies (e.g., FSR: 0–10 kg)	Pressure ≥ 1 kg
MPU6050 (Accelerometer)	±2g to ±16g (adjustable range)	Sudden change ≥ ±3g
MPU6050	±250 to	Angular

Sensor Name	Actual Range	Threshold Range
(Gyroscope)	±2000°/s	velocity > 300°/s
GPS Module	Global satellite range	No threshold (requires valid location fix)

The MQ-3 sensor is specifically designed to detect alcohol concentrations in the air. In the smart helmet project, it measures the rider's breath to determine if they are under the influence of alcohol.

const int alcoholThreshold = 300;

When the detected value exceeds the threshold of 0.25 mg/L (or analog output greater than 300), it indicates alcohol consumption, triggering a warning or preventing the bike from starting.The pressure sensor (often an FSR—Force Sensitive Resistor) is placed inside the helmet padding. It detects the pressure exerted when the helmet is worn.

if (alcoholValue > alcoholThreshold)

A pressure reading of at least 1 kg confirms that the helmet is properly fitted on the head, serving as an additional safety verificatiation.The accelerometer in the MPU6050 module senses linear acceleration and detects sudden movements or impacts. If the acceleration suddenly changes by more than ±3g, it indicates a possible crash or fall. The system then triggers a safety response, such as sending an alert message.The GPS module is used to determine the real-time geographical location of the rider. It provides latitude and longitude coordinates. In case of an accident detected by the sensors, the GPS module helps send the rider's location to emergency contacts or a monitoring system for assistance.

9.FUTURE SCOPE

Implementation of the IoT-Based Smart Helmet on this day indicates the potential and practical two-wheeler helmet safety product. There is also space for improvement and evolution in the years to come. The helmet can be converted into an intelligent, rugged, and market-compatible product with the implementation of newer technologies and smart systems. The following mentioned ones are among the prominent areas of development for the days to come IoT Cloud Integration The helmet can be integrated with IoT clouds like ThingSpeak, AWS IoT, or Google Firebase, information like drinking levels, crashreports, and GPS positions can be kept and accessed from afar. Machine Learning for Crash Detection Machine learning techniques may be trained to identify intricate patterns of crashes and distinguish between typical vibrations (such as speed humps) and real accidents. Alert System and Voice Command Voice integration with the alarm may allow hands-free operation like powering the system on/off, initiating SOS messages, or providing safety reminders. Solar-Powered Battery Charging Integrating solar panels in the helmet can prolong battery life and minimize the necessity of frequent recharging and render the device more eco friendly and user friendly. Integration with Mobile App A designated smartphone app can be programmed to Receive notification alerts. o Track ride history and safety ratings. Establish emergency contact listings and sensitivity features. Features Associated with Health Monitoring Additional sensors may be used to track heart rate, temperature, or even detection of fatigue relaying health information to the rider with the capacity for active medical interventions.

10.CONCLUSION

The IoT-Based Smart Helmet with Alcohol Detection and Motion Sensor was designed to improve the safety of riders with preventive and reactive technologies. The system effectively integrates the most important safety features like alcohol detection, helmet use verification, motion/crash detection, real-time location tracking, and emergency alerting. The test results affirm that the helmet is highly effective in preventing vehicle ignition under hazardous circumstances—i.e., when the rider is drunk or helmet-less—hence solving two primary causes of road accidents: drunken driving and neglect of helmets. The capacity of the system to sense crashes and automatically send an SOS message with GPS location to emergency contacts solidifies its position as a life-saving device. The use of GSM and GPS modules to send emergency alerts in real time, even without internet access, makes it ideal for deployment in remote or low-network zones. The whole system runs effectively using battery power, so it is portable, accessible, and reliable.Lastly, this prototype for a smart helmet shows a significant advancement in cutting down road deaths and encouraging safe riding practices. Yet, some developments for the future could involve the inclusion of IoT cloud platforms for off-site monitoring, voice alerts, or application of machine learning algorithms to identify patterns of crashes more effectively. Further, work on compacting the devices and increasing robustness will prepare the device for commercial use. The project provides a good foundation for future generation smart wearables in the domain of intelligent transportation systems.

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