International Journal of Scientific Research and Engineering Development-– Volume X Issue X, Year
Available at www.ijsred.com

RESEARCH ARTICLE OPEN ACCESS

IOT-Based Smart Helmet with Accident Detection using GPS tracking

Prachi Jadhav [1] ,Maseera Momin [2] , Priyanka Mhetre [3] ,Vaishnavi Chand [4] , Ms. Nilam Randive [5] ,

[1] (Computer Engineering, Dr. D.Y. Patil Polytechnic, Kolhapur, Maharashtra prachij25906@gmail.com)
[2] (Computer Engineering, Dr. D.Y. Patil Polytechnic, Kolhapur, Maharashtra maseeram926@gmail.com)
[3] (Computer Engineering, Dr. D.Y. Patil Polytechnic, Kolhapur, Maharashtra piyamhetre06@gmail.com)
[4] (Computer Engineering, Dr. D.Y. Patil Polytechnic, Kolhapur, Maharashtra vaishnavivishalchand@gmail.com)
[5] (Computer Engineering, Dr. D.Y. Patil Polytechnic, Kolhapur, Maharashtra nilamrandive2716@gmail.com)

----------**********----------

Abstract:

This project presents a smart helmet system specifically designed for two-wheeler riders to improve road safety by incorporating advanced sensors that can detect accidents and automatically trigger emergency alerts. Unlike earlier helmet designs that focused solely on physical protection and required manual action from the rider or bystanders, this smart helmet offers digital intelligence by continuously monitoring movement and enabling instant communication with emergency contacts when an accident occurs. Creating this smart helmet involves overcoming several technical challenges, such as ensuring sensor accuracy to distinguish between normal vibrations and actual accidents, ensuring alert reliability in different conditions, optimizing power usage, keeping costs low, and making it durable for various weather and road conditions. In the case of an accident, the helmet system allows for quick recovery by automatically sending live location data and status updates to emergency contacts and rescue teams. This reduces the time it takes for help to arrive, increases the chances of timely medical assistance, and provides useful data for monitoring and improving future safety measures.

Keywords: **Smart Helmet, IOT , Accident Detection, GPS Tracking, GSM Module**

----------**********----------

1. INTRODUCTION OF IOT BASED SMART HELMET WITH ACCIDENT DETECTION AND GPS TRACKING :

As the number of two-wheeler users increases across the country, road safety has become a major concern for both individuals and society. Traditional helmets offer protection during a crash but provide limited help during the critical moments after an accident. Many lives are lost not because injuries are unavoidable, but because timely help does not reach the scene quickly. Two-wheeler accidents often occur in isolated areas or during off-peak hours, making it hard for bystanders or riders to alert authorities. Injured riders may be unconscious or unable to communicate, further delaying emergency response and increasing the risk of severe injury or death.

To address these limitations, there is a pressing need for technology-driven safety solutions.

This project introduces an IoT-based smart helmet that bridges the gap between passive safety (physical protection) and active post-accident intervention (immediate notification and location sharing). By integrating advanced sensors, a GPS module, and a communication system into a standard helmet, the project aims to significantly improve accident outcomes for two-wheeler riders. The smart helmet is unique as it not only monitors the rider's movements and detects accidents automatically, but also sends out emergency alerts with live location updates to pre-selected contacts without any rider action. Unlike traditional manual reporting or apps that require user input, this helmet offers fully automated accident detection using integrated sensors like the MPU6050 accelerometer and gyroscope.

As soon as the helmet detects an unusual impact or sudden movement indicative of an accident, it initiates an emergency protocol: retrieving exact GPS coordinates and sending real-time SMS alerts to emergency responders or family members. This system ensures that critical moments are not missed, improving the chances of rapid medical intervention and recovery.

Building such a smart helmet comes with its own set of challenges.

Key issues include ensuring the sensors can differentiate between real accidents and normal riding vibrations, maintaining consistent and reliable performance across various environmental and road conditions, and keeping the helmet affordable and durable for daily use. The design must also ensure low power consumption for extended use and seamless integration with rider needs, whether for commercial, industrial, or personal use. The helmet has been designed with these practical considerations in mind, laying the foundation for a scalable solution applicable in various settings.

Recent advancements in engineering and transportation safety have significantly expanded the possibilities for real-time monitoring, rider protection, and accident prevention.

Modern smart helmets include features such as alcohol detection, fall and accident identification, location tracking, over-speed and overload alerts, and enforcement of helmet usage before ignition. These technological advances are supported by sensors like the IR sensor for helmet detection and the MQ-3 sensor for alcohol monitoring.

Some systems even prevent bike ignition unless the helmet is worn correctly and the rider passes a basic alcohol threshold test, reducing the risk of

impaired riding.

Additionally, wireless communication modules such as RF transmitter-receiver pairs and GSM/GPS modules allow the helmet to function as both a personal protection device and a real-time emergency responder.

Upon detecting an accident, the system quickly transmits precise GPS coordinates and vital status updates to registered emergency contacts—sometimes even integrating with traffic management infrastructure for faster medical dispatch and city-wide safety improvements. Beyond physical protection, these smart safety systems introduce new dimensions to rider awareness, health monitoring, and responsible driving behavior.

Integration with mobile applications allows users to track their trips, monitor vital statistics, and receive smart notifications. City planners and administrators benefit from aggregated accident data, which informs infrastructure development, traffic law enforcement, and safety campaigns targeting high-risk demographics or areas.

The relevance of this project extends beyond personal benefit to broader social, economic, and technological domains.By leveraging proven IoT frameworks and affordable components, this smart helmet project aims to set a new standard for proactive rider protection, enable faster accident recovery, and contribute positively to the nation's road safety goals. Through continuous innovation, rigorous real-world testing, and attention to scalability, the project stands as a practical and forward-thinking solution to one of the most pressing challenges of modern urban mobility.

2.LITERATURE SURVEY / EXISTING SYSTEM OF IOT BASED SMART HELMET WITH ACCIDENT DETECTION AND GPS TRACKING :

[1] Smart Helmet based Accident Detection and Notification System for Two-Wheeler Motor Cycles – Mamidi Kiran Kumar. While developing the system, we faced the drawback of high cost implications. Integrating multiple sensors and communication modules increases the overall system price, making it difficult to manufacture affordable helmets for all two-wheeler users. This limitation affects the broad adoption of the technology, especially in regions where riders look for lower-cost safety solutions. [2] Accident Detection Based on IoT Using Smart Helmet – Yuvaraj R .While developing the system, we faced limitations due to the heavy dependency on sensor accuracy. The system's reliability is affected by sensors that can sometimes mistake sudden but harmless movements for accidents or fail to detect actual collisions. This challenge makes the solution less reliable in real-world conditions, where environmental factors can interfere with precise readings. [3] An IoT Based Intelligent and Smart Helmet for Bike Riders Using Arduino – Rahul Kamdi. While developing the system, we encountered drawbacks related to battery limitations. The continuous operation of sensors and communication devices drains the battery quickly. This reduces the time the helmet can function safely between charges, making it inconvenient for riders who may forget or have limited access to frequent recharging. [4] Development of an AI-Integrated Smart Helmet for Motorcycle Accident – Chatkhane Pearkao. While developing the system, we observed that maintenance requirements posed a significant drawback. Advanced features and AI integration make the system more complex and require regular updates and troubleshooting. This increases the time, effort, and technical support needed to keep the helmet running efficiently. [5] Internet of Things-Based Smart Helmet with Accident Identification – Alyssa Dainelle T. Alcantara. While developing the system, we discovered limitations in high computational requirements. To process and analyze data from various sensors in real time, the system needs powerful hardware. This increases power consumption and cost, and can make the device bulkier or harder to maintain for everyday users. [6] Smart Helmet based Accident Detection and Notification – Satavisha Datta. While developing the system, we came across privacy concerns as a major drawback. Automated tracking

and notification features mean that helmet location and movement data are collected and shared, which could lead to privacy risks if not managed properly. Users may feel uncomfortable about their whereabouts being tracked continuously.

[7] Intelligent Helmet System for Prevention of Accidents – Sravan Kumar. While developing the system, we faced the challenge of high power consumption. The sensors and alert modules require continuous power to function, and this can rapidly deplete standard batteries, making the solution less sustainable for long rides or practical everyday use.

Topic	Author	Advantages	Limitations
Smart Helmet based Accident Detection and Notification System for Two-Wheeler Motor Cycles	Mamidi Kiran Kumar	Safety	Cost Implications
Accident Detection Based on Iot Using Smart Helmet	Yuvaraj R	Life-saving	Dependancy on Sensor Accuracy
An IoT Based Intelligent and Smart Helmet for Bike Riders Using Arduino	Rahul Kamdi	Awaren ess	Battery
Development of an AI-Integrated Smart Helmet for Motorcycle Accident	Chatkhane Pearkao	Prevention	Maintenance
Internet of Things-Based Smart Helmet with Accident Identification	Alyssa Dainelle T. Alcantara	Versatility	High Computational Requirements
Smart Helmet based Accident Detection and Notification	Satavisha Datta	Automation	Privacy Concern
Intelligent Helmet System for Prevention of Accidents	Sravan Kumar	Monitoring	Power Consumtions

From the literature survey, we studied various existing smart helmet systems and identified several limitations such as high cost, dependency on sensor accuracy, battery issues, maintenance problems, high computational requirements, privacy concerns, and high power consumption. After analyzing these defects, we designed and implemented our Smart Helmet with Accident Detection and GPS Tracking to overcome these drawbacks by making it cost-effective, energy-efficient, more reliable, and capable of providing accurate accident detection with real-time location tracking for quick emergency response.

3.MATERIALS OF IOT BASED SMART HELMET WITH ACCIDENT DETECTION AND GPS TRACKING:

To build the Smart Helmet, I focused on three main goals: low cost, useful features, and real-life use. I selected materials that are affordable and easy to get. Every step was taken to make a working model, not just a theory. This helmet is designed for daily riders, especially in India, where road safety is very important.

Selection of Hardware Components:

1. Microcontroller: ESP32 / NodeMCU / Arduino UNO:

The Microcontroller acts as the brain of the system, constantly receiving data from the MPU6050 sensor. When an accident is detected, it starts a sequence to acquire location data and generate emergency alerts. The microcontroller fetches live location coordinates from the GPS Module, processes this data, and prepares a formatted message for alerting.

2. Sensors: MPU6050 (Accelerometer & Gyroscope), optional IR sensor:

The MPU6050 sensor continuously monitors the motion and orientation of the helmet. It sends real-time acceleration and gyroscopic data to the microcontroller. Whenever the sensor detects a rapid acceleration, collision, or fall (by comparing readings against preset threshold values), it triggers the accident detection logic within the microcontroller

3. GPS Module: Neo-6M :

Upon request from the microcontroller (after accident detection), the GPS Module provides the current latitude and longitude of the helmet.
This geographic information is essential for pinpointing the accident location. The GPS data is transferred to the microcontroller, which will integrate it into the alert message sent out by the GSM module.

4. GSM Module: SIM800L:

The GSM Module (SIM800L) is interfaced with the microcontroller and receives the formatted message containing the accident alert and GPS location. Using cellular connectivity, the GSM module sends an SMS containing a Google Maps link to predefined emergency contacts. The GSM module also sends a trigger signal to the buzzer for auditory alerts within the helmet.

5. Power Supply: Rechargeable battery with charger module:

The system begins with the Power Supply, which distributes electrical power required to operate all modules and components in the helmet, such as the sensor (MPU6050), microcontroller, GPS, GSM modules, and buzzer.

6. Indicators: LED, Buzzer:

When an accident is detected, the buzzer is activated through the GSM module (as instructed by the microcontroller). The buzzer provides immediate sound or vibration feedback, which can alert nearby individuals or the rider himself in less severe falls.

Selection of Software Components:

1. Arduino IDE (for programming and serial monitoring):

Arduino IDE is a software tool that allows writing code for Arduino boards easily. It is used to upload programs on the board and also to check what the board is sending or receiving by displaying this information on your computer screen. This makes programming and communication with hardware simple for beginners and experts.

2. Google Maps API (for location link):

Google Maps API lets the project send the exact location of the helmet directly to Google Maps. This is useful for sharing live location in case of an accident or for general tracking purposes.

3. Fritzing (for circuit diagram):

Fritzing is a user-friendly tool to draw electronic circuit diagrams. It helps visually explain how all electronic parts are connected in the helmet and creates neat diagrams to use in reports or presentations.

4. DATA FLOW OF IOT BASED SMART HELMET WITH ACCIDENT DETECTION AND GPS TRACKING:

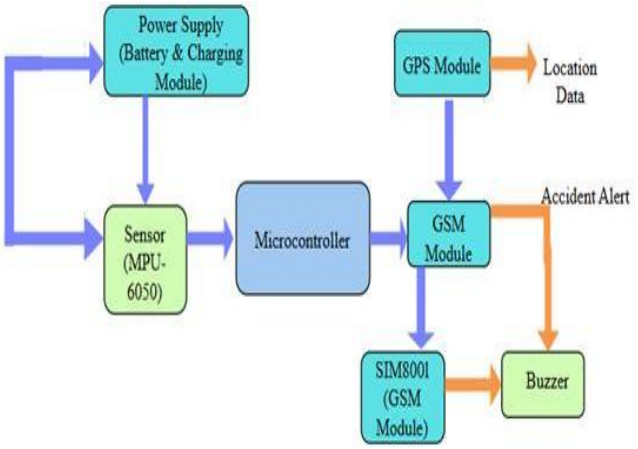

Fig 1: Block Diagram of IOT-Based Smart Helmet with Accident Detection using GPS Tracking

The power source consistently maintains the activation of all helmet modules during regular use. The microcontroller continuously monitors movement and conditions using sensor data from the MPU6050 accelerometer. If the MPU6050 identifies an unexpected or rapid acceleration during an accident, the microcontroller instantly initiates specific accident logic. The GPS module is asked for the current location, which is then forwarded together with information about the accident to the GSM module. The GSM module utilizes mobile technology to send an SMS with the accident status and live coordinates to emergency contacts, while the buzzer produces a loud sound to immediately warn those in the vicinity. The integration of all these components enables timely accident detection, quick location sharing, and dependable emergency communication. Following a road accident, this system aids in enhancing the speed and precision of emergency response, hence increasing rider safety.

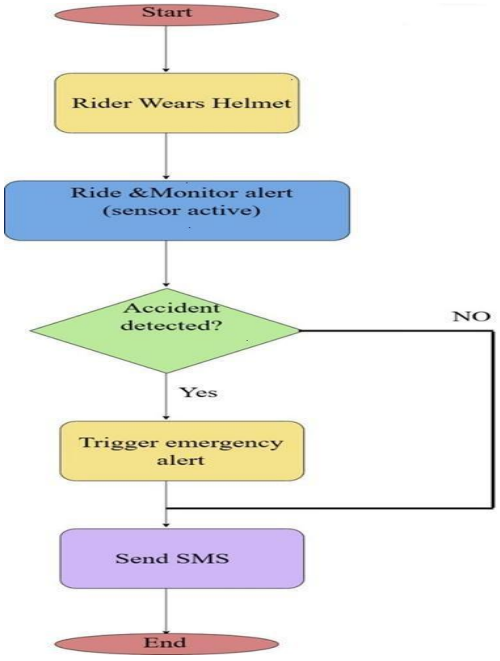

Fig 2 : Flowchart of IOT-Based Smart Helmet with Accident Detection using GPS Tracking

When the rider dons the helmet and, the procedure begins. Following this, the helmet's sensor turns on and starts monitoring for any odd movement or alerts while the rider is moving. The system maintains regular monitoring if the sensor does not identify an accident. However, the system will send out an urgent warning right away if the sensor detects an accident. The incident is then reported to emergency contacts via SMS message. When the SMS is transmitted, the process comes to an end. In this manner, all activities occur gradually, and the data advances only when the sensor identifies an accident, providing the rider with immediate reaction and safety.

5.METHODOLOGY/IMPLEMENTATION PLAN OF IOT BASED SMART HELMET WITH ACCIDENT DETECTION AND GPS TRACKING:

1. Requirement Analysis:

First, study how accident detection works in real life and decide which components are needed. This means learning about sensors, microcontrollers, and modules that can help find accidents and send alerts.

2. Design:

Next, make a block diagram to show how all the parts will connect and work together. Draw how wires and circuits will link up, and write out the logic for how the helmet should behave in different situations.

3. Component Procurement:

After designing, purchase all the hardware needed—sensors like the MPU6050, microcontroller (like Arduino), GPS, and GSM modules. Make sure every part matches the requirements you studied earlier.

4. Testing Modules:

Test each important module (MPU6050 sensor, GPS, and GSM) separately. This confirms they all work before combining them. For example, check if the sensor can sense movement, if GPS can get location, and if GSM can send messages.

5. Assembly:

Carefully mount all the modules on the helmet. Connect the wiring as per your circuit diagram, so all parts are connected and powered properly.

6. Coding:

Write the Arduino code to read data from the sensors and trigger actions (like sending SMS) when needed. Upload this code onto the microcontroller and check if it runs as expected.

7. Integration :

Combine all modules, connect everything according to your plan, and run field tests. This helps you see if all components work well together as one complete system.

8. Testing:

Simulate accident situations (like shaking or sudden movement) to test if the system correctly detects an accident, sends alerts, and provides the GPS location.

9. Deployment:

Finally, prepare and present the working prototype—making sure everything looks clean, works reliably, and is ready for demonstration.

6. EXPECTED OUTPUT / RESULTS OF IOT BASED SMART HELMET WITH ACCIDENT DETECTION AND GPS TRACKING:

The finished smart helmet prototype will deliver an advanced and complete safety solution tailored for two-wheeler riders. It will combine accident detection, real-time location tracking, and instant SMS alerts in a smooth and integrated way. Once the rider puts on the helmet and starts riding, the built-in accelerometer sensor, such as the MPU6050, stays constantly active and carefully watches every small movement and change in acceleration. If a sudden crash or fall happens, the sensor quickly detects unusual acceleration patterns that clearly show an accident. This immediate detection then activates the microcontroller to start the emergency response process. As soon as an accident is identified, the system quickly gets the exact real-time GPS location of the rider through the built-in GPS module. This important location data is then used to trigger the GSM module, which automatically sends an SMS alert. The alert message is carefully created to include important details about the accident and a clickable Google Maps link that shows the rider's exact location. This message is sent to pre- registered emergency contacts within a few seconds, ensuring fast notification and enabling quick emergency help or support. This well- organized system design allows the helmet to function not just as protective gear but also as a smart, connected safety tool. It greatly improves rider safety by offering fast accident recognition, accurate location sharing, and immediate communication. All these features work together to save time in emergencies and could potentially save lives.

1. False alarms caused by typical vibrations :
Many prior smart helmets had trouble distinguishing between real incidents and little vibrations, minor blows, or unexpected but harmless motions. Due to this, there were inaccurate emergency warnings or missed accident detections, which caused inconvenience and eroded faith in the system. In your project, this problem is solved by precisely configuring the thresholds of the MPU6050 sensor and employing sophisticated microcontroller logic to correctly differentiate between typical riding vibrations and actual accident situations.

2. Waiting for assistance because of manual alert systems :
In the past, the rider or bystanders had to physically summon assistance after an accident using the traditional helmet and accident systems When someone was unconscious or seriously injured, this frequently resulted in fatal delays in getting emergency care. As soon as an accident is detected

the sophisticated helmet that has been created automatically sends a live GPS location and accident warning to registered emergency contacts using the GSM module, ensuring prompt intervention without requiring human intervention.

3. Managing Power for Uninterrupted Operation :

Due to the continuous operation of sensors and communication modules, several intelligent helmet systems suffered from excessive battery depletion. This rendered the gadgets unreliable for riders traveling great distances or utilizing them for extended periods. The helmet is practical for everyday and business usage because of its low-power sensor operations techniques and an optimized power supply, which extends battery life and ensures dependable performance even on long trips.

7. FUTURE SCOPE OF IOT BASED SMART HELMET WITH ACCIDENT DETECTION AND GPS TRACKING :

1. Heart Rate–Based Accident Confirmation :

In the future, a heart rate monitoring sensor can be added to the system to track sudden changes in the rider's heart rate.

When an accident happens, the rider's heart rate often spikes due to shock or stress. By detecting this sudden increase in heart rate along with other sensor data, the system can better confirm if an accident has occurred and reduce false alarms.

2. Cloud Storage and Accident Data Analytics :

The system can be linked to cloud platforms to store and analyze large amounts of accident-related data. This analysis can help researchers and lawmakers understand common accident patterns and create better safety measures and accident prevention plans.

3. AI-Based Accident Prediction System :

Using artificial intelligence and machine learning, the system can be made smarter to predict situations that might lead to accidents, based on rider behavior and environmental factors.

This can help improve overall road safety.

4. Mobile Application Enhancement :

A more advanced mobile app can be created to offer real-time monitoring, emergency alerts, health reports, and accident history. This will make the system easier to use and more effective for the rider.

8. CONCLUSION OF IOT BASED SMART HELMET WITH ACCIDENT DETECTION AND GPS TRACKING :

The IoT-Based Smart Helmet with Accident Detection and GPS Tracking system is a modern safety innovation that protects two-wheeler riders by fusing IoT technologies with embedded sensors. While the helmet is being worn, its sensors are always on the lookout for accidents or odd motions, and if a collision is detected, it uses GPS and GSM modules to determine the real-time location and send immediate warnings to emergency contacts. This automated, methodical approach makes sure that assistance arrives at the accident scene right away, which can help save lives and lessen the severity of injuries.

The design is practical and economical for regular cyclists as well as scalable for wide usage in cities or industries since it employs basic electronics and inexpensive components. This helmet system integrates with mobile apps or dashboards to facilitate remote data tracking and responsible riding behavior monitoring in addition to providing rapid alerts. Together, these characteristics close the gap between an accident occurring and an emergency response, providing dependable safety that extends beyond conventional helmet protection.

9. REFERENCES:

[1] https://www.researchgate.net/publication/371309635_Smart_Helmet_based_Accident_Detection_andNotification_System_for_Two-Wheeler_Motor_Cycles
[2] https://ieeexplore.ieee.org/document/ 110 19230/authorsauthors
[3] https://ijisae.org/index.php/IJISAE/ article /view/4384
[4] https://pmc.ncbi.nlm.nih.gov/articles/ PMC11846507/
[5] https://www.mdpi.com/2673-4591/58/1/129
[6] https://ijireeice.com/papers/smart-helmet-based-accident-detection-and-notification/
[7] https://www.ijraset.com/research-paper/intelligent-helmet-system-for-prevention-of-accidents
[8] https://www.arduino.cc
[9] https://www.geeksforgeeks.org/digital-logic/microcontroller-and-its-types/
[10] https://www.ijert.org/real-time-accident-detection-and-alcohol-monitoring-using-a-smart-helmet
[11] https://www.ijraset.com/research-paper/smart-helmet-with-sensor-fusion-and-mobile-connectivity
[12] https://www.ijert.org/smart-helmet-using- iot
[13] https://www.geeksforgeeks.org/ project-idea-iot-based-emancipator-helmet/
[14] https://matjournals.net/engineering/ index .php/JoBDABI/article/view/1559
[15] https://www.ijert.org/intelligent-helmet-using-iot
[16] https://ijireeice.com/papers/smart-helmet-based-accident-detection-and-notification/
[17] https://www.ijraset.com/research-paper/smart-helmet
[18] https://www.ijarcs.info/index.php/ Ijarcs/ article/view/6577
[19] https://journalijsra.com/content/smart-helmet-accident-detection-and-prevention-using-iot
[20] https://journal.ijresm.com/index.php /ijresm/ article/view

