International Journal of Research and Development in Engineering Sciences
ISSN: 2582 - 4201(Online) , http://www.ijrdes.com/
Regular Issue, Vol. 8, Issue. 3 ( May – June ) , 2026 , Pages: 8 - 14
*Received*: 16 July 2025 ; *Accepted:* 27 April 2026 ; *Published:* 12 May 2026
https://doi.org/10.63328/IJRDES-V8RI3P2
https://www.youtube.com/watch?v=-9-lFGm2YCI
Original Paper : Applied Research – Experimental Research Paper

# IoT based Smart Helmet for Two Wheeler Accident Detection and Emergency Alert System Using ESP32 and Cloud SMS Integration

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**Abstract:** This is an Internet of Things (IoT) based smart helmet system that is designed to improve the safety of two-wheeler riders with collision detection and an emergency alert system. The device uses ESP32 as the main controlling unit and an MPU6050 sensor module that has a three-axis accelerometer and gyroscope. The system continuously monitors motion and acceleration. If a sudden increase in acceleration beyond predefined threshold values is detected, it is considered as an accident. When an accident is detected, the system fetches the rider's location using the NEO-6M GPS module and then sends the crash data to the backend server via an HTTP POST request over Wi-Fi. The request contains the crash data such as an alert message and GPS coordinates (Latitude and Longitude). The backend server has an API endpoint (/api/crash) that receives the POST requests from the ESP32. When a POST request is made, the backend receives the data and processes it. After receiving the crash information, the backend uses a cloud-based SMS services to send an SMS to pre-defined emergency contacts. The SMS consists of a short alert message paired with the coordinates and a Google Maps link generated from the coordinates received from the GPS module. This helps in locating the rider in case of an emergency. The proposed system is a prime example of the combined working of IoT-driven sensors, embedded processing and wireless communication, and thereby reducing the time for emergency response time and improving the overall road safety of the motorcycle/scooter operators.
**Keywords:** IoT, Smart Helmet, ESP32 Microcontroller, MPU6050 Sensor, SMS Notification, Road Safety.

## 1. Introduction

Two -wheeler transportation is one of the most widely used modes of transportation as it is the cheapest and most convenient form of transport. However, the two-wheeler riders are inherently exposed to a greater risk compared to occupants of enclosed vehicles as they do not have structural protection and stability. In many road accidents, the severity of injuries will not only be given by the impact but the delay in getting medical assistance. Situations where the rider becomes unconscious or physically incapacitated leave them unable to communicate the accident's occurrence, further postponing emergency response and critical medical care. To overcome these issues, automatic accident detection systems have been shown to be an effective way to improve rider safety. Here, we propose a new smart helmet system using Internet of Things (IoT) technology, which ultimately monitors rider behaviour and detects unusual crash events. The proposed system includes an MPU6050 module, containing a three-axis gyroscope and accelerometer, to provide an accurate measurement of acceleration and angular velocity. The system dynamically interprets abrupt changes and peaks in acceleration to detect the possibility of a collision, all without driver input. Computational processing and analysis is achieved by the ESP32 microcontroller, which is used as the system's brain. The system samples and analyses the data from sensors and compares it against the safe limits to ascertain if the acceleration pattern represents a crash. Once a collision is detected, a NEO-6M GPS module is triggered to obtain location coordinates, facilitating precise location of the crash scene. This localised information is essential for quick response of first responders and appropriate medical care. To ensure fast and reliable notification, a cloud-based crash alert system

ISSN: 2582 - 4201(Online) , http://www.ijrdes.com/ , IJRDES, Vol. 8, Issue 3 , 2026 , https://doi.org/10.63328/IJRDES-V8RI3P2

is implemented based on Short Message Service (SMS). Upon accident detection and subsequent geolocation, the ESP32 sends the pertinent data to the back end server through an HTTP POST to a Wi-Fi-connected server.

The server receives it through a specified API endpoint, which then uses a cloud-based SMS service to send a message to pre-arranged emergency contact numbers. The message transmitted to the emergency contacts contains critical information such as the collaborator family's phone numbers and notifies them about the accident, along with the GPS coordinates and a link to an automatically generated Google map for easy access to the accident location. The integration of smart crash detection, geo-location, and networked dissemination, makes the proposed IoT-based smart helmet system a practical approach to reduce response time. In turn, this may improve survival rates and provide greater safety for two-wheelers.

## 2. Literature Survey

K. Reddy, A. Sharma, and V. Kumar [1] designed an Internet of Things (IoT) accident detection system using multi-axis motion sensors and wireless communication. The proposed system includes an acceleration-gyroscope sensor to measure abrupt changes in motion and send the data to a cloud-based server for analysis. The system design facilitates remote monitoring and logging, allowing for accident analysis. But the need for constant internet connectivity could lead to a delay in the sending of alert messages in a low-network infrastructure. The paper notes the benefits of integrating embedded sensors with cloud computing services for scalability and real-time processing.

P. Mehta and R. Singh [2] implemented a smart accident alarm system which uses GPS and GSM platforms to generate location-based emergency messages. The system monitors accidents through certain acceleration parameters and transfers coordinates and alerts to the concerned parties. The system guarantees prompt notification but its dependence on a single threshold may impact on precision in varying riding scenarios. This study highlights the importance of real-time location and alerting in strengthening the effectiveness of emergency reporting.

L. Verma and S. Patel [3] have designed a microcontroller-based system for accident detection using acceleration data from an accelerometer to detect accidents. It tracks acceleration variations and activates alarm through a communication medium. While this system is inexpensive and straightforward to execute, it does not include sophisticated data filtering techniques and multi-dimensional data analysis, potentially leading to false positives in normal cycling situations. The research suggests that while accelerometers are effective in detecting accidents, adding other factors can enhance the system's accuracy.

R. Iyer and M. Nair [4] developed a smart helmet system for embarking on a safer journey using real-time monitoring and automatic accident alert using IoT. Their system uses movement sensors, fall detection algorithms and communication devices to detect collisions and trigger alarms. While the system offers extensive features, the detection of the accident is still based on threshold values, which limits the ability to support different driving conditions. The research is a proof of concept that IoT wearables can significantly enhance safety on the road and help respond to accidents.

S. Gupta and A. Tiwari [5] proposed an accident detection and alert system that combines vibration sensors with location services via GPS. It uses vibration to detect collision and sends via SMS the location with the accident details. This system offers timely alerts but relying solely on vibration sensors can result in false alarms because of disturbances from the road surface. The research highlights the importance of more accurate sensing for improved detection.

M. Khan, R. Das, and P. Roy [6] have outlined the basic IoT architecture integrating the sensing, processing and communication. The research sheds light on the role of embedded systems, real-time processing and wireless communication technologies in creating smart monitoring systems. While not directly related to accident detection, the study lays down a robust theoretical framework for IoT based smart safety systems, such as wearable devices, including smart helmets.

## 3. Existing System

Currently, two-wheeler accident detection systems mainly comprise simple impact detection and automatic notification systems developed through the Internet of Things (IoT). These typically involve the use of accelerometer or vibration sensors, microcontrollers and communication units like GSM or cloud services. The basic operation of these systems is based on detecting abrupt variations in motion variables, such as acceleration, versus set threshold values [7]. If the acceleration measured is above the threshold limit, then the system identifies the crash and activates an alarm. The message alerts include location information from GPSs and the alarm is sent to prior registered contacts. This eliminates the need for incident reporting and allows quicker response times in an emergency. Some systems have also added other features including location monitoring through GPS, and data

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streaming (storing data in the cloud) for post-accident monitoring and analysis. Some innovative solutions try to enhance detection accuracy by incorporating multiple motion-related information such as angular velocity and acceleration, while others focus on providing wearable items such as smart helmets that incorporate sensors and alerts into rider equipment. These innovations represent the increasing use of IoT technologies for road safety to shorten the time taken to respond to accidents and to enhance survival rates [8].

While these are great developments, current systems have a few shortcomings that impact their effectiveness and convenience. A key limitation is the use of arbitrary threshold-based detection algorithms that fail to comprehend the context of accidents in contrast to normal riding situations. Accelerations resulting from sudden braking, potholes and speed breakers can mimic the impact of crashes and trigger false alarms. On the other hand, small impacts or gradually falling might not trigger the threshold values, leading to false negatives. This underscores the shortcomings of many systems in understanding on-road conditions [9]. Beyond detection, communication and integration issues also hinder performance. GSM-based systems may not transmit timely or accurate warnings as a result of poor network coverage, particularly in rural regions. Likewise, cloud based systems may have processing and response delays if Internet connections are weak. There may also be insufficient filters and multi-axis data processing to eliminate noise and complications from the acceleration data. In summary, although current systems implement a basic approach to accident detection and emergency alerting, they may lack reliable accuracy, scalability and robustness. This highlights the need for more effective approaches that include multi-axis sensors, intelligent thresholding systems, real-time data processing, and reliable communication systems. Overcoming these shortcomings will be key to creating a more accurate and robust accident detection system that can operate reliably in the real world [10].

## 4. Proposed System

The proposed system is an Internet of Things (IoT)-based smart helmet, which is designed to identify the crash events and autonomously send emergency alerts via an SMS-based communication mechanism. The system has modules for sensing the system's motion and processing the data, validating whether a crash has occurred, tracking the location and data transmission to the backend server. All operations are automatic, and do not need any rider intervention. The motion sensing unit is equipped with an MPU6050 module, which is a combination of three-axis accelerometer and gyroscope [11]. The accelerometer detects linear acceleration in X, Y, and Z axis, and the gyroscope detects angular velocity (change in orientation) in a sudden manner. These readings from the sensors are continuously transmitted to an ESP32 microcontroller, which works as a central processing unit of the whole. The result of the resultant magnitude of the acceleration is computed by ESP32 using vector computation:

$$A = \sqrt{Ax^2 + Ay^2 + Az^2}$$

This resulting acceleration is the sum of the effect force on the rider regardless of direction. The value of a preset threshold is chosen in respect of experimental observations and literature studies. The threshold value in the proposed system will be 30,000. Once the calculated value of the acceleration is more than this value, the system treats the incident in question as a possible crash [12].

A predefined threshold value (T) is selected based on experimental analysis. In the proposed system, the threshold is set as:

$$T = 30000$$

$$\text{Crash} = \{1 \; if \; A > T \; 0 \;\; otherwise$$

The ESP32 ensures that the crash has occurred by continuously measuring the acceleration values over a short period to eliminate false detections due to road irregularities or abrupt braking. The system has a buzzer that is activated when the crash is confirmed. This warning is an indicator of accident detection in the area and can be noticed by the passersby. Once the crash is confirmed, the system gets the geographical location of the rider through the NEO-6M GPS module. It is able to give the current latitude and longitude positions, which is then worked out by ESP32. Location information must be accurate to ensure that family members or emergency responders reach the accident site on time without delay [13].

The ESP32 then assembles an emergency alert message with crash details as well as the GPS location. This message is then sent to the backend server as a HTTP POST request with the crash data as JSON. The backend then receives the request at /api/crash endpoint and extracts the JSON data and processes it. Then the backend uses an online cloud based SMS service to trigger and alert SMS to emergency contacts registered in the system. Communicating via SMS will guarantee stable delivery of messages and enable the contact of specific location information to be included in the alert message. The whole mechanism is automatic, and it does not need any intervention from the rider. Combining the features of impact detection, notifications, location tracking, and automated emergency communication in one smart helmet, the proposed system will enhance the time of emergency response greatly and the likelihood of receiving medical help in time. The system is cheap, small and can be applied to the field which makes it a good safety

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measure for two-wheeler riders [14].

The ESP32 provides a continuous data collection scheme and sensor outputs are sampled by preprogrammed intervals to handle anomalous events as fast as possible. This continuous surveillance will ensure instantaneous recording of sudden, unexpected crashes, and thus will minimize the time gap between the occurrence of an incident and its transmission to an alert system. One of the design aspects that can be found in the proposed system is reliability. Crash-detection logic is also implemented by difference between the use of vector magnitude on-the-fly computation with threshold-value-based comparison to provide an augmented detection fidelity. The system also reduces the chance of missing real crash incidences by measuring the acceleration in all the three orthogonal planes instead of one dimension. The threshold is established through experimental testing in a wide range of different conditions during the course of riding to balance sensitivity to false-positives to the minimum [15].

## 5. System Architecture

The system architecture is organised as a layered Internet of Things (IoT) system to enable real-time detection of accidents and emergency response. The system architecture is divided into four key players: the sensing layer, processing and decision layer, localization layer and communication layer. These layers work together to ensure accurate detection of accidents, seamless event transmission and prompt alerting. This approach facilitates system scalability, reliability, and maintainability, and is thus suitable for real transportation systems. The sensing layer is designed to capture real-time data about motion, using the MPU6050 sensor device, which includes a triaxial accelerometer and triaxial gyroscope. The accelerometer measures the acceleration along X, Y, and Z axes, whereas the gyroscope measures ride's orientation and rotational velocity of the rider. These values comprehensively describe motion. The raw accelerations (Ax, Ay, Az) measured by the sensor are sent to the data processing unit where the resultant acceleration is calculated using the vector expression

$$A = \sqrt{Ax^2 + Ay^2 + Az^2}$$

This is the magnitude of the acceleration, regardless of direction. The threshold (T) is used to detect potential crashes, with a value of A>T implying a crash. The system also introduces time-based validation to enhance the detection accuracy and reduce false detections from hard braking or pavement irregularities by checking whether the threshold is exceeded for a few seconds before a crash is detected. The processing and decision layer of the system is based on the ESP32 microcontroller, acting as the system's control unit. This is responsible for data collection in real-time, mathematical calculations, and decision-making algorithms. When a crash is detected, the ESP32 triggers a buzzer, which provides an instant auditory warning to nearby people. This forms a primary layer of emergency response, providing the possibility of alleviating the wait time for primary assistance before remote communication is triggered. Once the crash has been detected, the localization and communication layers initiate alarm messages in a pipeline. The localization layer uses the NEO-6M GPS module to send GPS coordinates (latitude and longitude) to the mobile device through satellite communication. This information is incorporated into an emergency message. Then the communication layer connects to a Wi-Fi network, sending the accident information to a server using an HTTP POST request in JSON format. The data is received by the backend server at a specific API endpoint, and the server automatically sends out an alert message via the cloud-supported SMS system. The emergency contacts are sent an SMS including the crash details as well as a direct link to the crash location, facilitating quick locating of the crash location. In essence, the proposed system architecture integrates sensing, computing, localization, and communication to create a unified platform that provides continuous monitoring, reliable crash detection and timely accident notification. Through the integration of IoT devices and wireless communication, the proposed system can increase the safety of the riders, minimize accident response times and ultimately improve accident outcomes [17].

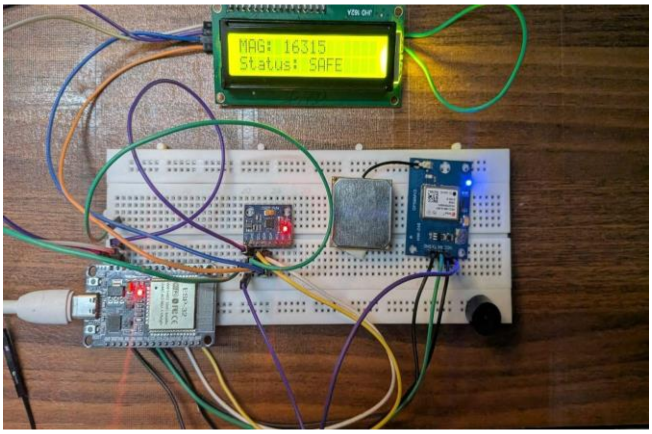


**Figure. 1**. System Prototype

Figure 1 above is the hardware model created for the smart helmet accident detection system using ESP32, MPU6050 accelerometer and gyroscope sensor, NEO-6M GPS Module, Buzzer, and a 16×2 LCD Module. The MPU6050 is a tri-axial sensor that constantly checks acceleration and tilt measurements in the x, y and z axes to recognize any abnormal movements when an accident occurs. The GPS module is used to identify the current location of the rider, which will be displayed on the LCD along with other system information. Buzzer serves as an immediate alarm in case of any emergency situation. The

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LCD screen displays "Status: SAFE" as no accident has been detected.

## 6. Results And Discussion

In order to test the functionality of the proposed system, experimental work was performed both in regular riding and in simulated crash scenarios. The sensor module MPU6050 was continuously used to collect motion data, which was further processed in real time by the ESP32 microcontroller. The accelerometer detected the magnitude of linear acceleration along the X, Y, and Z axes, and the overall acceleration magnitude was then calculated using vector computation. A predefined threshold value was used to differentiate between regular riding and crash events. The magnitude of acceleration during normal riding conditions remained consistent and generally did not exceed 16,000. Figure 2 shows that fluctuations were caused only in small amounts by natural rider movement and road irregularities. Nevertheless, all these values remained below the crash detection threshold, confirming that the system does not generate false accident signals when the rider is not in a crash situation.

Figure 2 illustrates three-axis acceleration (Ax, Ay, Az) data from the MPU6050 sensor during rider motion. The variations across the axes depict the dynamic movement of the helmet while riding. These continuous measurements allow the system to track motion patterns and identify abnormal impact events. Crash tests were simulated through sudden impacts and quick falls. On these occasions, acceleration was high and surpassed the set crash threshold of 30,000. As illustrated in Figure 4, once the magnitude of acceleration exceeded this threshold, the system was able to identify a crash. Upon detection, the ESP32 immediately activated the buzzer to provide a local alert, and the emergency alert process was initiated. A further evaluation was conducted to analyse the effect of various threshold values on system performance. Figure 5 shows the correlation between false positives and the crash detection threshold.

The findings indicate that lower threshold values result in a higher false detection rate due to normal riding challenges such as speed breakers or sudden braking. Increasing the threshold reduces false positives without compromising crash detection accuracy. A threshold value of 30,000 was selected based on the experimental results, as it offers a sound balance between detection sensitivity and reliability. Whenever a crash is detected, the system uses the NEO-6M GPS module to determine the rider's location. The latitude and longitude coordinates are then transmitted to the backend server via an HTTP POST request over Wi-Fi. The backend processes the received crash data and sends an SMS notification through a cloud-based messaging service. The alert message includes the GPS coordinates along with a Google Maps link, enabling emergency contacts to locate the rider quickly.

Overall, the experimental findings demonstrate that the proposed system is capable of identifying crash events with a high degree of accuracy and a low number of false alerts. The combination of real-time motion detection, threshold-based crash identification, GPS tracking, and automatic SMS notification ensures an efficient and reliable emergency response system for two-wheeler riders.

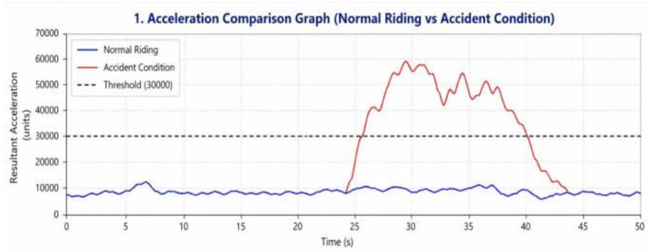


**Figure. 2**. Acceleration Comparison Graph (Normal Riding vs Accident Condition)

Fig. 2 illustrates the acceleration values obtained during normal riding and accident conditions over a period of time. The blue curve depicts normal riding values which indicate steady acceleration values ranging between 7000 and 11000 units. In normal riding, the acceleration values are constant indicating that the bike is moving normally without any abnormality.

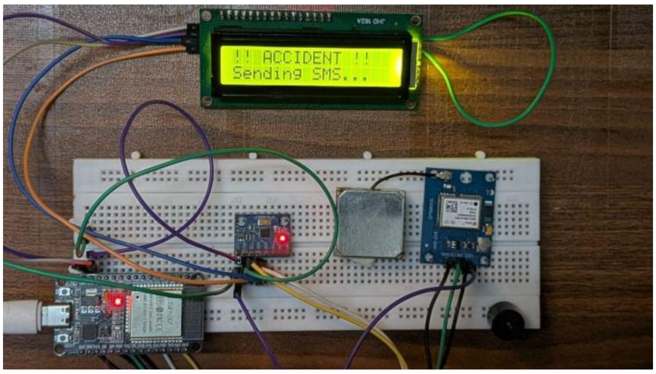


**Figure. 3** System Prototype after detecting crash

On the other hand, the red curve shows high acceleration values during accident. There is a sudden spike after 25 seconds when the acceleration becomes greater than the value of 30000 units and almost reaches 60000 units. The dotted black curve is the threshold which is used to identify an accident. As the acceleration exceeds the threshold value, this indicates that an accident is detected by the system. Fig. 3 presents the three-axis acceleration data (Ax, Ay, and Az) of the MPU6050 sensor when the rider moves. The deviations in the X, Y and Z planes are the inherent motions of the helmet during a ride. These

ISSN: 2582 - 4201(Online) , http://www.ijrdes.com/ , IJRDES, Vol. 8, Issue 3 , 2026 , https://doi.org/10.63328/IJRDES-V8RI3P2

sensor reading records can be used continuously to track real time motion trends and present the required information to detect abnormal impacts that may suggest the occurrence of a crash.


**Figure. 4**. Crash Detected Location

Figure 4 shows the latitude and longitude values displayed on the LCD after accident detection. These coordinates are obtained from the NEO-6M GPS module and help in identifying the exact location of the rider. The location data is sent to the backend server and used to generate emergency alerts with Google Maps access for faster response.

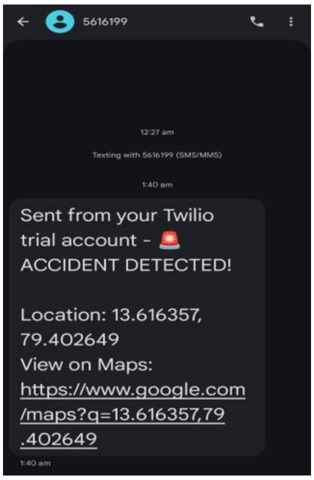


**Figure. 5**. Received Message demonstrating the location of Accident

Figure 5 shows the emergency SMS alert received after accident detection. The message contains the accident warning, latitude and longitude coordinates, and a Google Maps link for identifying the exact location of the rider. This helps emergency contacts respond quickly and provide immediate assistance.

### *6.1. Performance Evaluation of Impact DetectionMechanism*

The crash detection performance of the proposed system is tested on the variation of resultant acceleration computed from real-time experimental sensor readings. Under normal riding conditions, the acceleration magnitude varies steadily and remains within acceptable bounds associated with ordinary driving activities such as acceleration, braking, and minor bumps and vibrations due to the road. Conversely, the impact cases result in sudden and severe variations in the computed acceleration, well above the threshold level. Such pattern distinction facilitates the distinction between regular and irregular riding. The threshold value is selected empirically via trial and error to only generate alarms for larger impacts. Finally, the use of a brief time window for validation adds to the system's reliability, as temporary spike values do not trigger crash alarms. This mechanism strikes a balance between high sensitivity and fidelity in real-time accident detection.

### *6.2. System Reliability and Response Efficiency*

The major advantage of the proposed system is its ability to provide immediate and automated emergency response. Once an accident is detected, it triggers an immediate local alarm and begins a series of communications remotely. The real-time GPS-based localization ensures the precise location of the crash, and Wi-Fi data transfer ensures timely communication with the server. The rapid response provided by the generation of emergency alert messages via cloud-based messaging services ensures that the time between the accident event and the issue of an alert message is shortened. The proposed system increases reliability compared to traditional systems based on manual reporting or late report transmission by providing a steady and rapid response, which is vital in accidents.

### *6.3. Comparative Advantage Over Conventional Approaches*

The smart helmet system presents significant improvements over current methods of detecting accidents with its use of multi-axis sensing, on-board processing, and communication. Existing systems might be based on single-axis detection or vibration-triggered mechanisms, which can lead to errors and false detections. However, the proposed multi-axis accelerometer and gyroscope allow for detailed motion profiling, including both linear and angular movements. Efficient data processing by the ESP32 microcontroller supports decision-making in real-time with low latency. Moreover, the integration of GPS and Internet of Things (IoT) communication ensures that not only are alarms triggered automatically, but also that location data is included. This comprehensive approach not only enhances detection accuracy, reduces false alarms, and optimises the efficacy of emergency response systems.

## 7. Conclusion and Future Scope

This paper proposes an Internet of Things (IoT) smart

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helmet system for the accident detection and emergency alerting system in two wheeled vehicles. The system combines an MPU6050 sensor module, which includes a tri-axial accelerometer and gyroscope, with an ESP32 microcontroller to track the user's movement. The system accurately detects real-time crashes through simple calculations of the resultant acceleration magnitude and comparing them against a threshold value. Through experimental assessment, it is shown that the proposed system successfully distinguishes between normal, safe motion and crash accidents. Under normal conditions, the accelerations fall within the safety zone, while crashes generate large accelerations, surpassing the threshold. This confirms the efficacy of the threshold-based crash detection system to effectively detect a crash scenario and avoid false alarms due to sudden braking or road unevenness. Once a crash is detected, the system immediately obtains the current location of the rider with the aid of the NEO-6M GPS module, and sends it to the backend server over Wi-Fi using HTTP communication. The back-end server then processes the information and sends an auto-generated text message to a predetermined set of family or friends with a Google Maps link for accurate location information. This end-to-end automated mobile communication helps in realising faster response and better chances of medical care. In conclusion, the system has shown that the use of IoT sensors, embedded processing and wireless communication has the ability to provide a safe, efficient, low-cost and scalable system for crash detection and emergency communication. Its lightweight design and real-time announcement functionality make it feasible for deployment and can lead to enhanced road safety and mitigation of fatality risks among two-wheeler riders.

## References


[1]. K. Reddy, A. Sharma, and V. Kumar, "IoT-based accident detection and emergency response system using multi-axis sensors," International Journal of Advanced Research in Computer Science and Engineering, vol. 10, no. 3, pp. 45–52, 2021.

[2]. P. Mehta and R. Singh, "Smart accident detection and alert system using GPS and GSM technology," International Journal of Engineering Research & Technology (IJERT), vol. 9, no. 6, pp. 120–125, 2021.

[3]. L. Verma and S. Patel, "Microcontroller-based vehicle accident detection system using accelerometer," International Journal of Innovative Technology and Exploring Engineering (IJITEE), vol. 8, no. 9, pp. 2100–2105, 2020.

[4]. R. Iyer and M. Nair, "IoT-enabled smart helmet for accident detection and rider safety," International Journal of Scientific & Technology Research, vol. 9, no. 5, pp. 150–155, 2020.

[5]. S. Gupta and A. Tiwari, "Accident detection and alert system using vibration sensor and GPS," International Journal of Computer Applications, vol. 178, no. 7, pp. 25–30, 2020.

[6]. M. Khan, R. Das, and P. Roy, "A survey on IoT architecture and applications for smart monitoring systems," IEEE Access, vol. 8, pp. 164–189, 2020.

[7]. S. Kumar, R. Verma, and P. Singh, "IoT-based accident detection system using accelerometer and GSM module," International Conference on Communication and Signal Processing (ICCSP), pp. 1123–1127, 2021.

[8]. S. P. K. Gudla, P. Nutipalli, and C. R. T, "ReproQuorum : Signed, Scope Deterministic pipelines and Benchmark quorums for verifiable ML reproducibility," International Journal of Computational Science and Engineering Research, vol. 3, no. 1, p. 52, Jan. 2026, doi: 10.63328/ijcser-v3ri1p6.

[9]. K. R. Kuppireddy, R. T, R. Yagireddi, and J. V. G. P. R. Pyla, "Real-Time Stampede Risk Prediction from Crowd Videos Using YOLOv8 and Spatio-Temporal Modeling," International Journal of Computational Science and Engineering Research, vol. 3, no. 1, p. 44, Jan. 2026, doi: 10.63328/ijcser-v3ri1p5

[10]. G. P. S and S. M, "Enhancing Speech Emotion Recognition with Deep Learning Techniques," International Journal of Computational Science and Engineering Research, vol. 3, no. 1, p. 1, Jan. 2026, doi: 10.63328/ijcser-v3ri1p1.

[11]. G. P. S and S. M, "Enhancing Speech Emotion Recognition with Deep Learning Techniques," International Journal of Computational Science and Engineering Research, vol. 3, no. 1, p. 1, Jan. 2026, doi: 10.63328/ijcser-v3ri1p1.

[12]. R. N, "The impact of digital transformation on leadership and management styles," International Journal of Computational Science and Engineering Research, vol. 2, no. 1, Mar. 2025, doi: 10.63328/ijcser-v2ri1p6.

[13]. N. R. Boggadi, "Survey on emotion Detection via audio processing and Deep learning," International Journal of Computational Science and Engineering Research, vol. 2, no. 2, p. 30, Jun. 2025, doi: 10.63328/ijcser-v2ri2p6.

[14]. D. Bhuvannagari and S. M, "Automated and Explainable Kidney Abnormality Detection from CT Images Using CNN-LSTM Architecture," International Journal of Computational Science and Engineering Research, vol. 2, no. 3, p. 1, Jul. 2025, doi: 10.63328/ijcser-v2i3p1.

[15]. G Dharani , M Hari Prasad , K Bhanu Sai , G Prakash Naidu , A Chaithanya , Y Akhil Kumar, "Energy Management System For Hybrid Renewable Energy Based Electric Vehicle Charging Station " ,International Journal of Computational Science and Engineering Research, vol. 1, no. 2, May. 2024, doi: https://doi.org/10.63328/IJCSER-V1RI2P7

[16]. S. Tada and J. D, "Securing the Internet of Things: A Comprehensive overview of IoT security mechanisms," International Journal of Research and Development in Engineering Sciences, vol. 7, no. 2, p. 1, Mar. 2025, doi: 10.63328/ijrdes-v7ri2p1.

[17]. L. Jaladi and N. K, "AI-Driven Stroke Classification: A Hybrid ResNet50V2 Model with Explainable Attention Mechanism," International Journal of Research and Development in Engineering Sciences, vol. 6, no. 5, p. 6, Oct. 2024, doi: 10.63328/ijrdes-v7ri5p9.


## Declaration

**Conflicts of Interest:** The authors declare no conflict of interest.

**Author Contribution:** All authors wrote the main manuscript text and also consent to the submission.

**Ethical approval:** Not applicable.

**Consent to Participate:** All authors consent to participate.

**Funding:** Not applicable, and No funding was received

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Not applicable.

**Personal Statement:** We declare with our best of knowledge that this research work is purely Original Work and No third party material used in this article drafting. If any such kind material found in further online publication, we are responsible only for any judicial and copyright issues.

ISSN: 2582 - 4201(Online) , http://www.ijrdes.com/ , IJRDES, Vol. 8, Issue 3 , 2026 , https://doi.org/10.63328/IJRDES-V8RI3P2

**Acknowledgements**

We thank everyone who inspired our work.