

“Research Paper Accident Detection and Alert System”

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Abstract— The Road accidents are a major cause of fatalities worldwide, often due to delays in emergency response. This project presents an Accident Detection and Alert System designed to automatically detect vehicular accidents and immediately notify emergency services, thereby reducing response time and potentially saving

The system utilizes sensors such as accelerometers, gyroscopes, and vibration sensors to monitor sudden changes in motion or impact. When a significant abnormality is detected, the system verifies the occurrence of an accident using predefined threshold values. Upon confirmation, it retrieves the geographical location using GPS technology and sends an alert message via GSM or internet-based services to predefined emergency contacts, nearby hospitals, and authorities.

Additionally, the system can include a mobile application interface that allows users to manually trigger alerts in case of emergencies. Advanced implementations may incorporate machine learning algorithms to improve detection accuracy and minimize false positives.

The proposed solution is cost-effective, reliable, and capable of real-time operation. By integrating hardware and software components, this system aims to enhance road safety and provide timely assistance to accident victims, ultimately contributing to a reduction in mortality rates.

1. INTRODUCTION

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The proposed solution is cost-effective, reliable, and capable of real-time operation. By integrating hardware and software components, this system aims to enhance road safety and provide timely assistance to accident victims, ultimately contributing to a reduction in mortality rates. The implementation of such a system has significant potential in improving road safety and reducing mortality rates caused by delayed emergency response. It is cost-effective, efficient, and can be integrated into existing vehicles as well as future smart transportation systems. By ensuring faster communication and immediate assistance, the Accident Detection and Alert System contributes to saving lives and enhancing the overall effectiveness of emergency response services.

2. LITERATURE REVIEW

2.1. Study 1: GPS and GSM-Based Accident Detection

Early accident detection systems relied on accelerometers, GPS, and GSM modules. Detects vehicle collisions using vibration and acceleration sensors. Sends accident location through SMS. Reduces emergency response time.

Limitations: False alarms due to sudden braking or speed breakers. Limited accuracy without multiple sensors.

2.2 Study 2: IoT-Based Accident Detection Systems

Researchers introduced IoT-enabled accident detection systems integrating multiple sensors.

Uses accelerometer, gyroscope, vibration, and GPS sensors. Real-time monitoring of vehicle status. Automatic notification to emergency services. Cloud-based storage and monitoring.

Limitations: Depends on reliable internet connectivity. Sensor calibration affects detection accuracy.

2.3 Study 3: Smartphone-Based Accident Detection Modern smartphones contain built-in sensors that can identify vehicle accidents. Uses smartphone accelerometer and GPS.

No additional hardware required. Low-cost implementation.

Phone placement affects accuracy. Cannot distinguish severe crashes from accidental phone drops.

2.4 Study 4: Computer Vision-Based Accident Detection

Recent studies apply Computer Vision techniques to CCTV footage and dashboard camera videos. Detects vehicle collisions automatically. Real-time video analysis. No physical

sensors are required on vehicles. Suitable for smart city surveillance systems.

Performance decreases in poor lighting, rain, or fog. Requires high-quality cameras and computational resources.

2.5 Study 5: YOLO-Based Accident Detection The latest research uses YOLO (You Only Look Once) models for detecting accidents in real time.

High-speed object detection. Detects vehicles, collisions, overturned vehicles, and road obstacles. Suitable for edge devices and intelligent transportation systems. High accuracy with low inference time. Requires large annotated datasets. Performance depends on camera angle and weather conditions.

2.6 Study 6: AI-Based Integrated Accident Detection Systems Recent AI systems combine IoT, Deep Learning, GPS, Cloud Computing, and Emergency Alert mechanisms.

Automatic accident detection. Real-time location tracking. Cloud database integration. Hospital and emergency notification.

3. PROBLEM STATEMENT

The Road accidents are a major cause of injuries, fatalities, and economic losses worldwide. In many cases, delayed detection of accidents and late communication with emergency services increase the severity of injuries and reduce the chances of saving lives. Traditional accident reporting methods rely on eyewitnesses or manual phone calls, which can be unreliable or unavailable, especially in remote areas or during night-time. Existing sensor-based systems often suffer from false alarms caused by sudden braking or road bumps and may require expensive hardware installations.

To address these challenges, there is a need for an intelligent, automated accident detection and alert system that can accurately detect road accidents in real time using Computer Vision and Deep Learning. The system should immediately notify emergency contacts, hospitals, or rescue authorities by sharing the precise accident location and relevant information. Such a solution aims to minimize emergency response time, improve rescue operations, reduce false detections, and ultimately save lives by ensuring timely medical assistance.

4. Proposed System:

Proposed System: Accident Detection and Alert System The proposed Accident Detection and Alert System is an AI-based solution that uses YOLOv8, Computer Vision, and IoT technologies to detect road accidents in real time and immediately notify emergency services. The system processes live video streams from CCTV cameras or dashboard cameras to identify vehicles and detect collision events. Once an accident is detected, the system determines the accident location using GPS and automatically sends alerts to hospitals, police stations, and registered emergency contacts.

The system consists of a camera module for capturing live video, a YOLOv8-based deep learning model for vehicle and accident detection, a backend server for **processing and** storing accident information, and an alert module that communicates with emergency services. The backend also maintains a database of accident records for future analysis and reporting.

Working of the Proposed System Capture live video using a CCTV or dashboard camera. Preprocess video frames for efficient analysis.

Use the YOLOv8 model to detect vehicles and identify accident events in real time. Verify the detected accident to reduce false alarms. Retrieve the accident location using the GPS module (or camera location metadata). Store accident details, including time, location, and images, in the database. Automatically send alert messages containing the accident location and details to hospitals, police, and registered emergency contacts. Display accident information on a monitoring dashboard for authorities.

6. Implementation

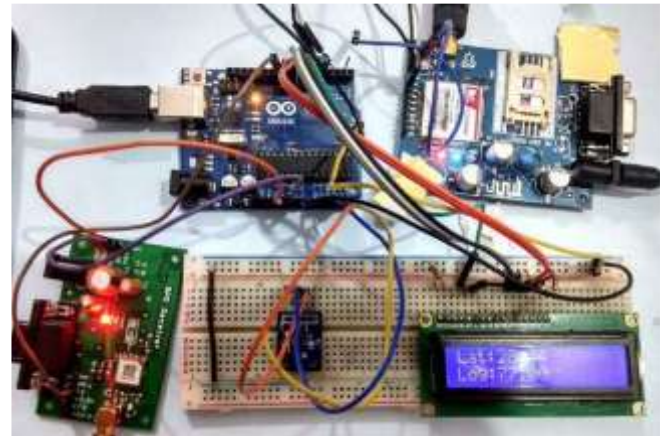


Fig 6.1: Developed IoT-Based Accident Detection Model

The hardware part plays a crucial role in detecting accidents. Different components are connected together to form a complete system. The above figure shows the developed hardware model of the IoT-based Accident Detection and Alert System. The system includes sensors, microcontroller, GPS, and GSM modules connected together to detect accidents and send alert messages. The Arduino Uno acts as the brain of the system. All sensors and modules are connected to it, and it processes the data received from them.

The accelerometer sensor is used to detect sudden changes in motion, such as rapid acceleration, deceleration, or tilting of the vehicle. If the vehicle meets with an accident, these values change drastically.

The vibration sensor helps in detecting strong impacts. During a collision, the vibration level increases suddenly, which is captured by the sensor.

The GPS module is used to determine the exact location of the accident. It provides latitude and longitude coordinates, which are very important for emergency services.

The GSM module is responsible for communication. It sends an SMS alert to predefined contacts when an accident is detected.

All these components are connected using proper wiring, and a stable power supply is provided to ensure smooth operation. This figure represents the connection of different hardware components such as Arduino, sensors, GPS, and GSM modules. All components are interconnected to enable data processing and communication for accident detection and alert generation.

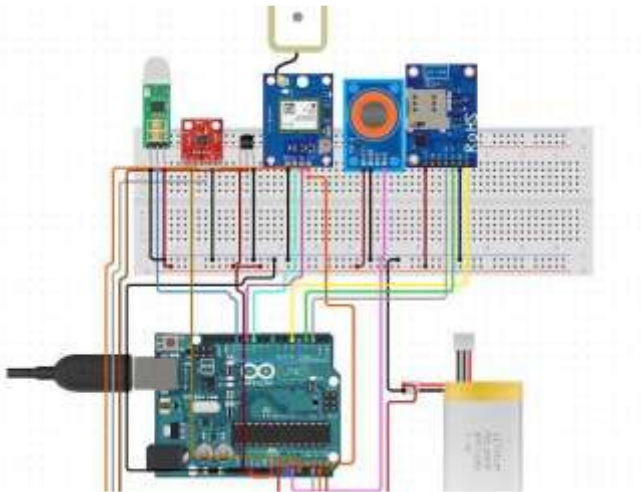


Fig 6.2: Hardware Connection of Accident Detection System

5. Results and Discussion

In this project, we developed an IoT-based Accident Detection and Alert System model to automatically detect accident conditions and send alert messages. After implementation, we tested the developed model under different simulated conditions to evaluate the performance of the system. The testing process helped us analyze detection accuracy, response time, and reliability of the proposed system.

We performed testing by applying various conditions such as sudden vibration, tilt, and impact. These conditions were used to simulate accident scenarios. During testing, we observed system behavior and verified whether the alert message was generated properly. The system continuously monitored sensor values and responded when abnormal conditions occurred.

The developed model was tested multiple times to ensure consistent performance. The system detected abnormal conditions and triggered the alert mechanism. After detection, the communication module generated an alert message. The system also continued monitoring after sending the alert.

2 Experimental Results

We tested the developed model under different conditions and observed the following results:

Normal Condition Testing

- The system continuously monitored sensor values
- No alert message was generated during normal operation
- The system remained stable during continuous monitoring

- No false detection occurred during normal conditions

Vibration Testing

- Sudden vibration was applied to the model
- Sensor values increased beyond threshold limit
- The system detected abnormal condition
- Alert mechanism was activated automatically
- Alert message was generated successfully

7. INPUT SCREENS

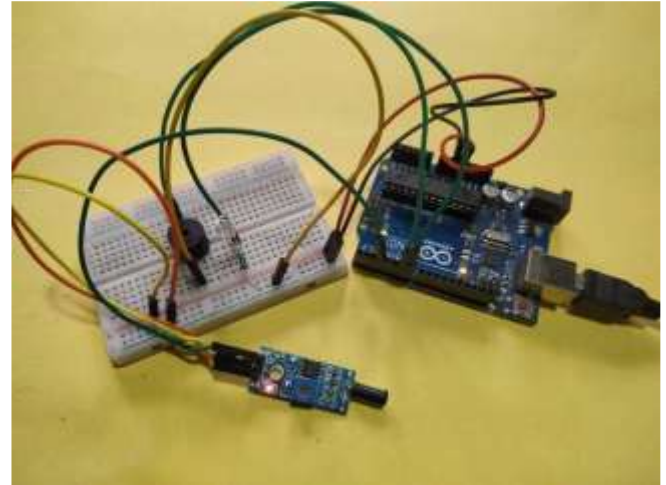


Fig 7.1: Vibration Testing of Accident Detection System



Fig 7.2: Impact/Tilt Testing of Accident Detection System

Table 5.1: Testing Results

Sr No	Condition	Sensor Response	Detected	Alert	Status
1	Normal	Stable	No	No	Success
2	Vibration	High	Yes	Yes	Success
3	Tilt	Changed	Yes	Yes	Success
4	Impact	Sudden	Yes	Yes	Success
5	Continuous	Stable	No	No	Success

6. Conclusion

In this paper, we successfully designed and developed an IoT-based Accident Detection and Alert System with the aim of reducing the delay in emergency response during road accidents. The primary objective of our work was to create a system that can automatically detect accident conditions and send alert messages along with location details to predefined contacts. Through the integration of sensors, microcontroller, GPS, and GSM modules, we were able to build a working model that demonstrates the practical implementation of this concept.

The system continuously monitors parameters such as vibration, tilt, and sudden impact using sensors. These parameters play an important role in identifying abnormal conditions that may indicate

an accident. When the sensor values exceed predefined threshold limits, the system detects it as a possible accident. To improve reliability, the system verifies the condition before triggering the alert mechanism. This helps in minimizing false detections and ensures accurate results.

Once an accident is confirmed, the system retrieves the exact location using the GPS module. The location information includes latitude and longitude coordinates, which are essential for identifying the accident spot. After obtaining the location, the GSM module sends an alert message to predefined emergency contacts. This automatic alert mechanism ensures that information reaches the concerned persons without any delay, even if the victim is unable to communicate.

During implementation, we focused on making the system simple, cost-effective, and efficient. The components used in the system are easily available and require minimal maintenance. The system was designed to operate automatically without any manual intervention. This makes it highly useful in real-world scenarios, especially in situations where immediate action is required.

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