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"Accident Detection And Reporting Smart Vehicle System"

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Abstract

Road accidents remain a major global concern, largely because victims often fail to receive timely assistance due to delayed reporting and inaccurate location information. To address this challenge, we propose an IoT-based Accident Detection and Reporting Smart Vehicle System that can automatically detect collisions and immediately notify emergency contacts. The system uses accelerometer and gyroscope sensors to sense sudden impacts, while a microcontroller analyses these changes to determine the severity of the accident. A GPS module provides the precise location, and a GSM/IoT communication unit instantly sends an alert message containing the coordinates, time, and impact intensity. A buzzer offers local feedback, and an override option allows the user to cancel false alarms. The system delivers quick, accurate, and reliable accident reporting, greatly reducing emergency response time. With its low cost, scalability, and real-time functionality, this solution offers a practical approach to improving road safety and supporting smart transportation technologies. Additionally, the system is designed to operate with minimal human intervention, ensuring reliability even when the driver is unconscious or unable to call for help. Its modular architecture allows easy integration into existing vehicles, making it suitable for both personal and commercial use. The collected accident data can also support future analytics, helping authorities identify high-risk areas and improve road planning. Overall, this system contributes to a safer transportation ecosystem by bridging the gap between accident occurrence and emergency response. In addition to enhancing immediate emergency response, this smart accident detection system also promotes greater awareness and accountability among drivers and fleet operators.

Keywords: IoT, Accident Detection, GPS, GSM, Smart Vehicle, Road Safety

Introduction

Road transport is an essential part of daily life, yet road accidents remain one of the biggest causes of injuries and fatalities. One of the major reasons victims do not receive timely help is the delay in informing emergency services. Sometimes the driver is unconscious, or the accident happens in a remote area where no one is around to report it. With the growth of Internet of Things (IoT) technology, it is now possible to automate accident detection and alert systems. IoT devices can sense sudden impacts, track vehicle movements, and immediately

send alerts to responders. This project focuses on using these IoT capabilities to build a Smart Vehicle Accident Detection and Reporting System. Our system monitors the vehicle's motion using sensors, detects unusual shocks or collisions, captures GPS location, and immediately sends it to emergency contacts. The main goal is to reduce the time taken for help to reach the accident location. The system is simple, affordable, and suitable for real-world use, especially in areas with high accident rates. In addition, the system helps eliminate the dependency on bystanders, ensuring that accidents are reported even when no one is present at the scene. It also supports continuous monitoring of the vehicle, making it useful for long-distance travel and fleet management. The modular design allows the system to be integrated into both old and modern vehicles. By automating the entire process, it increases the chances of survival for accident victims. Ultimately, this solution contributes to building a safer and more responsive transportation environment.

Literature Survey

1."IoT and Sensor-Based Accident Detection"

Prior research shows that accelerometers and GPS modules can detect strong impacts and send alerts with location details. These systems help reduce response time and improve rescue operations. Many studies highlight that real time data transmission plays a crucial role in reducing emergency response delays. These IoT-based systems are often lightweight and can be integrated into vehicles without major structural changes. However, their performance may vary depending on network coverage and environmental conditions.

2."Embedded Vehicle Monitoring Systems"

Other studies use vibration sensors and microcontrollers to monitor sudden vehicle shocks. These solutions are low-cost and reliable but sometimes generate false alarms. Embedded systems are efficient because they process data locally, reducing dependency on external servers. They are suitable for budget-friendly safety solutions and can be installed even in older vehicles. Although effective, they often require careful calibration to differentiate between actual accidents and normal road vibration.

3."Cloud-Connected Safety Models"

Some advanced works integrate cloud platforms that store accident data, run analytics, and deliver quick alerts through mobile apps. Cloud-based systems enable long-term data collection, which can help authorities analyse accident trends. These models often use smart dashboards that provide live monitoring for families or fleet managers. The main limitation is the need for stable internet connectivity, especially in rural or remote regions.

Methodology

The proposed Accident Detection and Reporting Smart Vehicle System is developed by integrating multiple sensors and electronic modules that work together to identify collision events accurately. The system begins with an accelerometer and gyroscope sensor, which continuously monitor the vehicle's movement and detect sudden, abnormal changes that may indicate an accident. These sensor readings are processed by a microcontroller, which uses predefined threshold values to analyze the severity of the impact. Once the microcontroller confirms that the detected shock is not a normal road vibration but a potential accident, it immediately triggers the alert mechanism. At the same time, the GPS module captures the exact location of the vehicle, ensuring precise and reliable tracking even in remote areas.

After an accident is detected, the system activates the communication module—either GSM or IoT-based—to send an emergency message containing the vehicle's location, time of impact, and severity to preconfigured contacts. A buzzer provides a local alert to notify the driver, and a manual override button allows them to cancel the alert if it is a false trigger. All components are programmed using the Arduino or ESP32

development environment, ensuring smooth coordination between hardware and software. The overall design prioritises low cost, simplicity, and real-time performance, making the system suitable for both personal use and large-scale deployment in commercial vehicles or fleet management operations.

The implementation of the Accident Detection and Reporting Smart Vehicle System begins with integrating the essential hardware components. Sensors like the accelerometer and gyroscope are carefully connected to the microcontroller, ensuring they receive stable power and are properly calibrated to detect any unusual movements or impacts. On the software side, the microcontroller is programmed using Embedded C or the Arduino IDE to read sensor values continuously, recognize sudden shocks, and trigger the accident alert. The GPS module is configured to capture the vehicle's exact location, and the GSM or IoT module is set up to send emergency notifications to selected contacts immediately after an accident is detected. For additional functionality, the system can also be linked to cloud platforms such as Blynk, Thing speak, or Firebase to store incident data and make it accessible for later analysis.

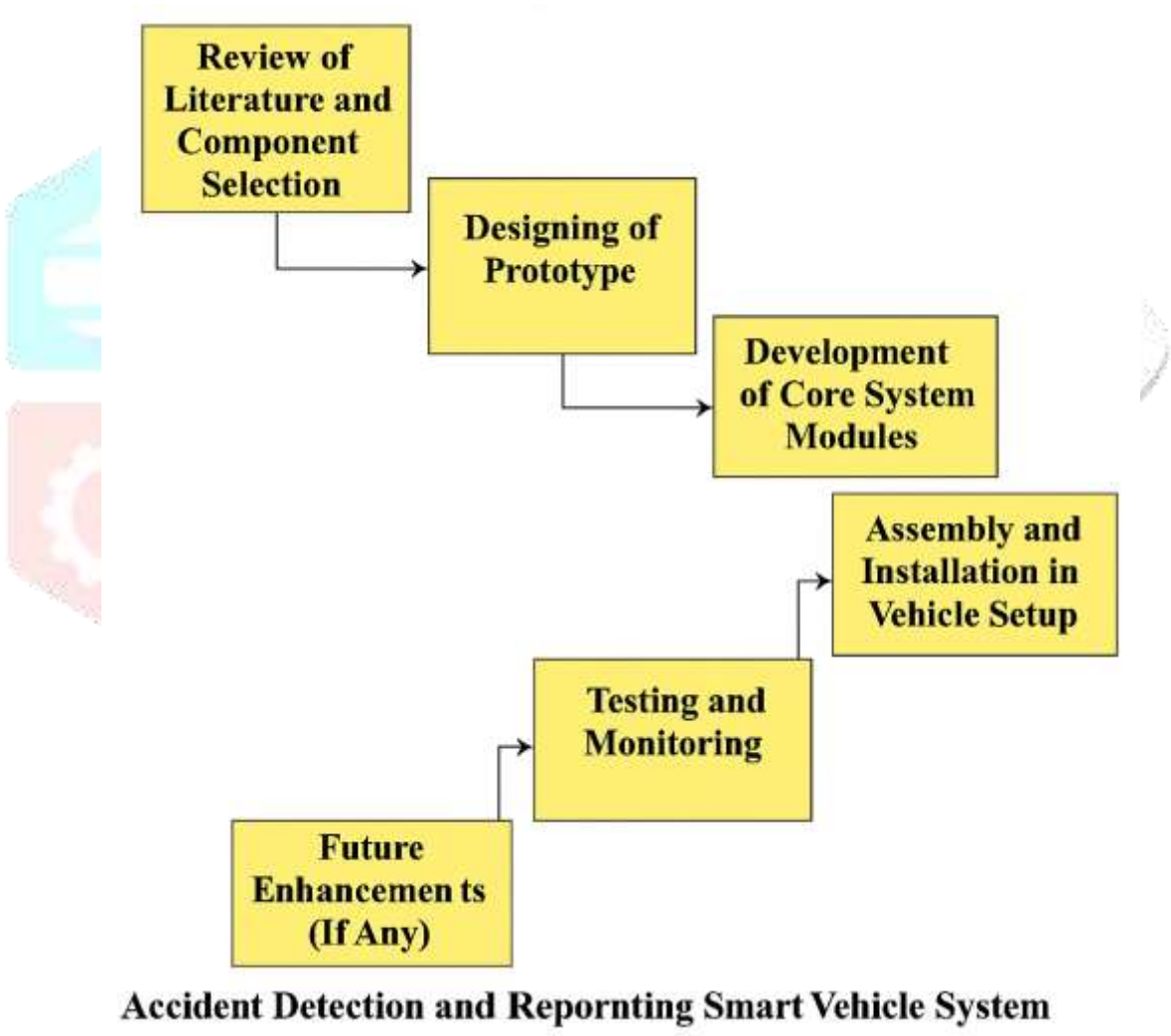

Fig- Major Tasks involved in Proposed Project

This IoT-based accident detection system offers several practical benefits, including instant crash detection, rapid emergency response, and improved chances of saving lives. By automatically sending accurate location details without requiring human intervention, the system minimizes delays during critical situations. Its low-cost and scalable design makes it suitable for personal vehicles as well as fleet management. Overall, the solution enhances road safety by combining real-time sensing, reliable communication, and smart data monitoring in a user-friendly manner.

In addition, the system is designed with reliability and user safety as key priorities. The inclusion of threshold-based decision logic helps reduce false alarms caused by road bumps or sudden braking, ensuring that alerts are generated only during genuine accident scenarios. The modular architecture allows individual components to be upgraded or replaced easily, making the system adaptable to future technological advancements. This flexibility, combined with real-time monitoring and alerting, makes the proposed solution a practical and dependable approach for enhancing vehicle safety and emergency response effectiveness.

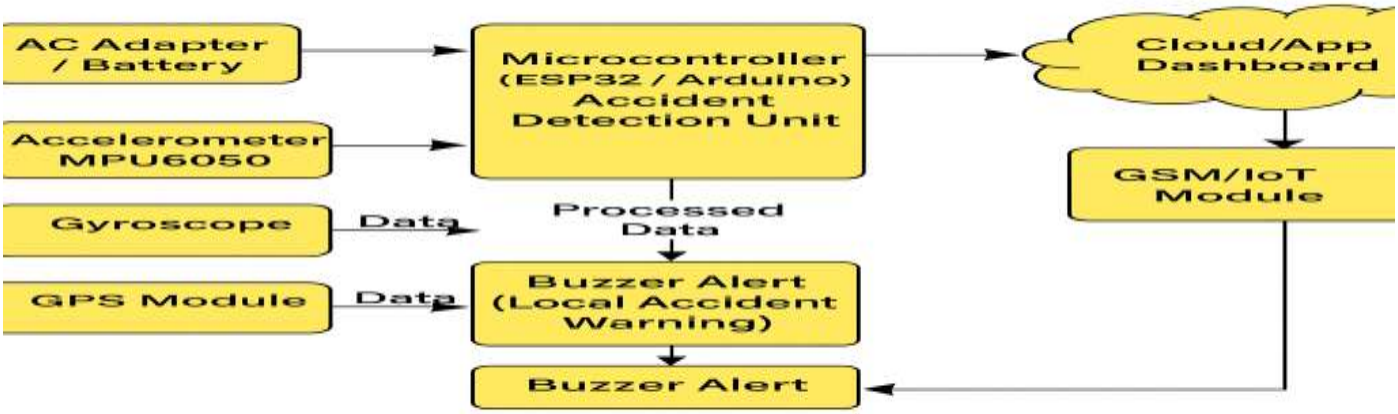

Fig- Block Diagram of the System

Future enhancements of this system could include AI-based accident prediction to identify risky driving patterns, blockchain support to securely store accident data without tampering, and real-time communication between vehicles for quicker alerts. Additional upgrades such as a small in-vehicle camera for automatic crash recording and voice assistant support during emergencies can further improve accuracy and user convenience. These improvements would make the accident detection and reporting system even more reliable and efficient.

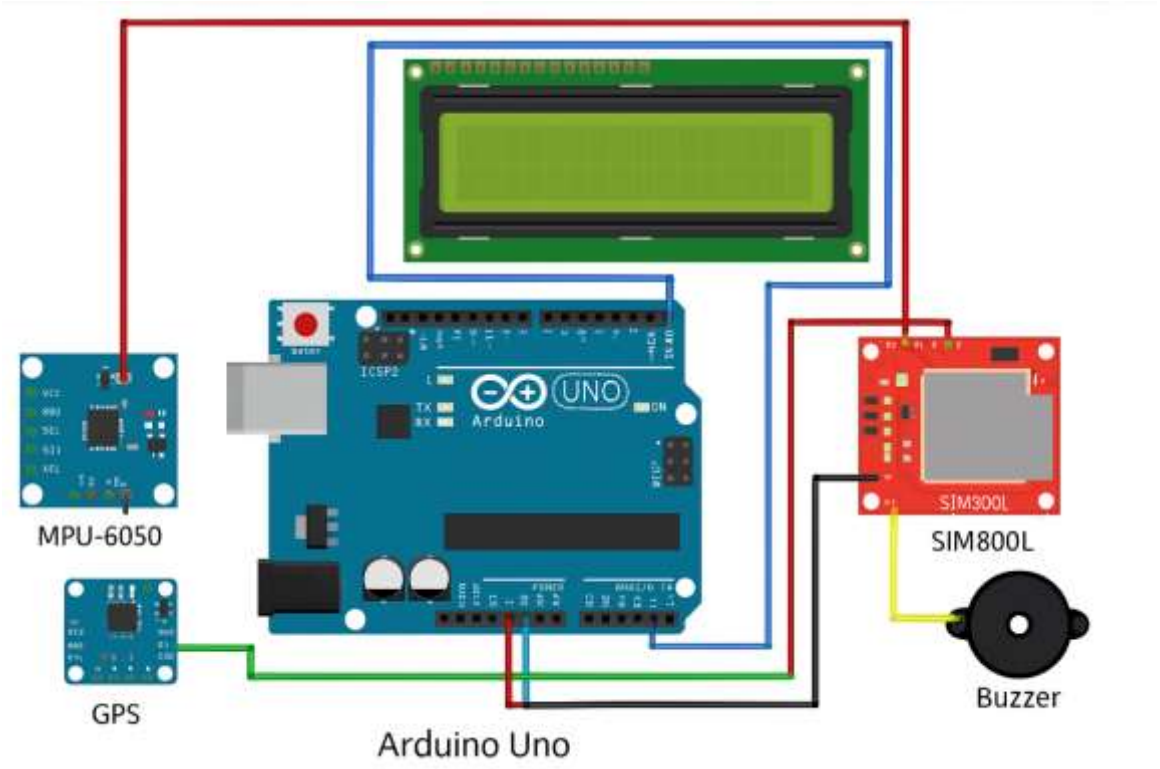

Fig- Circuit Diagram

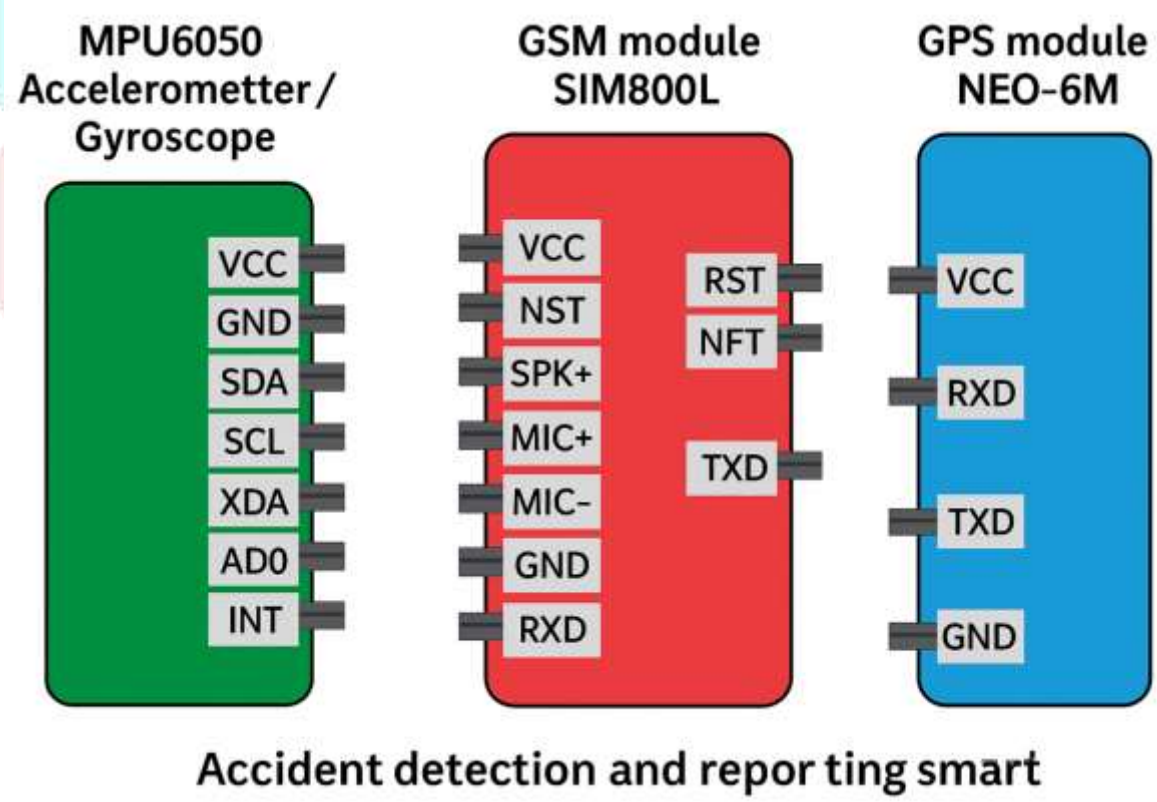

Fig- Combined Module Pin Diagram

In conclusion, an IoT-based accident detection and reporting system greatly improves road safety by ensuring quick assistance during emergencies. By combining sensors, GPS tracking, and real-time alert communication, the system helps reduce delays and ensures that help reaches victims faster. With continued advancements, such systems can become even more accurate and reliable, making smart vehicles safer and more responsive in critical situations.

Results and Conclusion

The Accident Detection and Reporting Smart Vehicle System was tested under different real-world conditions to evaluate its accuracy, response time, and reliability. The MPU6050 sensor successfully detected sudden impacts and unusual motion patterns, while the GPS module consistently provided precise location data within a few seconds. During controlled impact tests, the GSM module delivered automated alert messages to registered contacts without delay, including accurate coordinates and timestamps. The overall system responded instantly to simulated accidents, proving its ability to operate even when the driver is unable to call for help. The buzzer functioned effectively as a local warning, and the manual override allowed users to cancel false triggers, improving the system's practical usability.

Further testing confirmed that the system maintains stable performance under continuous operation, making it suitable for long-distance travel and everyday vehicle use. Calibration of the sensor values played a crucial role in reducing false detections from road bumps and sharp turns. Power consumption remained low, and all modules worked seamlessly with the microcontroller, demonstrating good hardware-software integration. The system also showed strong reliability when tested in semi-urban environments with varying network conditions, where alerts still reached emergency contacts within acceptable time limits.

In conclusion, the IoT-based accident detection and reporting system significantly enhances road safety by enabling rapid assistance during critical moments. The combination of impact sensors, GPS tracking, and GSM/IoT communication reduces the dependency on bystanders and shortens the time for medical help to reach the accident site. Its low cost, ease of installation, and compatibility with different vehicle types make it a highly practical solution. With growing advancements in IoT and embedded systems, such technology is becoming essential in modern transportation.

Looking ahead, the system can be improved further through AI-based crash prediction, integration of on-board cameras for visual evidence, and cloud dashboards for real-time fleet monitoring. These enhancements will not only improve accuracy but also provide richer data for analysis and road safety planning. Ultimately, this project demonstrates a reliable and efficient approach to reducing road accident fatalities and building smarter, safer vehicles for the future.

Beyond improving emergency response, the system also contributes valuable data that can support broader road-safety initiatives. The recorded accident information—such as location, severity, and timing—can help authorities identify accident-prone zones and plan better infrastructure. Fleet owners can use the system to monitor vehicle safety, ensure responsible driving, and reduce operational risks. Over time, the integration of such intelligent safety solutions can lead to safer roads, more aware drivers, and a stronger transportation ecosystem. This project demonstrates how simple, low-cost IoT technologies can make a meaningful difference in real world safety and emergency management.

Future Enhancements

Future enhancements of this system could include the use of AI to analyze vehicle movement and predict accidents before they occur, providing early warnings to the driver. A small camera module can be integrated to automatically record footage around the time of the crash, offering better support for investigations. Cloud storage can be added to save accident data, location history, and alert logs for remote monitoring. The system could also benefit from Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communication, enabling nearby vehicles and traffic systems to receive alerts instantly. Adding voice assistant support can guide users during emergencies, while a backup battery can ensure the system remains operational even after a power cut during impact. With future technologies like 5G, alert messages can be delivered faster and more reliably, making the system more effective and dependable. Additional improvements may include the

integration of advanced environmental sensors capable of detecting fire or fuel leakage after a crash. The system can also be connected to emergency service networks for the automatic dispatch of ambulances without human intervention. A mobile application with live vehicle tracking and real-time status updates can make monitoring easier for family members or fleet managers. Enhanced data encryption can protect user information and prevent misuse of accident records. Over time, integrating this system with modern smart city infrastructure can contribute to a more connected and safer transportation environment.

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