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ARDUINO-BASED INTELLIGENT ACCIDENT DETECTION & SOS ALERT MECHANISM

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Keywords

Accident Detection,
Arduino Uno,
GPS Tracking,
GSM Communication,
Emergency Alert System.

Abstract

Road accidents frequently lead to severe injuries and fatalities due to delays in emergency assistance. This work presents an Arduino-based Intelligent Accident Detection and SOS Alert Mechanism for automatic accident identification and emergency notification. The system employs an ADXL335 accelerometer to monitor sudden impact events, while a NEO-6M GPS module determines the vehicle location. Upon detecting an accident, an Arduino Uno processes the sensor data and activates a SIM800L GSM module to transmit an alert message containing location details and initiate an emergency call. A manual SOS feature is also incorporated to enable users to request assistance during critical situations. Experimental testing demonstrated reliable accident detection and timely communication of emergency information. The proposed system offers a simple, economical, and effective approach for improving road safety and reducing emergency response time.

1. INTRODUCTION

Road accidents are a major public safety concern worldwide, causing significant loss of life and property every year. In many cases, the severity of injuries is aggravated by delays in providing medical assistance. Timely reporting of accidents and accurate location information are essential for improving emergency response and increasing the chances of survival of accident victims.

Conventional accident reporting methods rely on victims, eyewitnesses, or nearby individuals to contact emergency services. However, in severe accidents, victims may be unconscious or unable to seek help. Furthermore, accidents occurring in isolated areas may remain unreported for a considerable period, resulting in delayed rescue operations.

Advancements in embedded systems, wireless communication, and sensor technologies have enabled the development of intelligent safety systems capable of automatic accident detection and notification. The integration of microcontrollers with GPS and GSM technologies provides an effective solution for real-time accident monitoring and emergency communication.

This paper presents an Arduino-Based Intelligent Accident Detection and SOS Alert Mechanism that automatically detects vehicle accidents and transmits emergency notifications containing location details. The system utilizes an ADXL335 accelerometer sensor for impact detection, a NEO-6M GPS module for location tracking, and a SIM800L GSM module for sending alert messages and making emergency calls. A manual SOS feature is also incorporated to allow users to request assistance during emergency situations.

The proposed system aims to provide a reliable, economical, and user-friendly solution for improving road safety by reducing the time required to report accidents and initiate rescue operations.

2. OBJECTIVES

The main objectives of the proposed system are as follows:

2.1 To develop an automated system capable of detecting vehicle accidents using an accelerometer sensor.

2.2 To continuously monitor vehicle movement and identify sudden impacts or abnormal acceleration.

2.3 To determine the accident location accurately using a GPS module.

2.4 To transmit emergency alerts containing location information through GSM communication.

2.5 To initiate emergency calls to predefined contacts for immediate assistance.

2.6 To provide a manual SOS feature that allows users to request help during emergency situations.

2.7 To reduce the time required for accident reporting and rescue operations.

2.8 To enhance road safety through a reliable and cost-effective embedded system.

3. LITERATURE REVIEW

Accident detection and emergency response systems have attracted significant research attention due to the increasing number of road accidents and the need for rapid medical assistance. Various researchers have proposed intelligent transportation solutions using sensors, wireless communication technologies, and embedded systems to improve accident detection and reporting.

Fernandes et al. (2016) developed an automatic accident detection system integrated with multimodal alert dissemination techniques. Their approach utilized smartphone sensors such as accelerometers, gyroscopes, and magnetometers to detect collision events and communicate emergency information. The study demonstrated the effectiveness of sensor-based accident detection in intelligent transportation systems. Sharma et al. (2017) proposed an accident alert and vehicle tracking mechanism using GPS and GSM technologies. Their system automatically detected accidents and transmitted location information to emergency responders. The study highlighted the importance of reducing the delay between accident occurrence and rescue operations. Khaliq et al. (2018) introduced an accident detection and management application for vehicular environments. Their work employed vehicular communication networks and Internet-of-Things (IoT) concepts to assess accident severity and facilitate emergency assistance. The proposed framework improved traffic management and emergency response efficiency. Kinage and Patil (2019) presented an IoT-based intelligent system for vehicle accident prevention and detection. The system incorporated multiple sensors, including accelerometers and infrared sensors, to monitor vehicle conditions and generate alerts when abnormal situations were detected. Roy et al. (2020) developed an Arduino-based automatic accident detection and location communication system. Their research demonstrated the successful integration of GPS and GSM modules for real-time accident reporting and location tracking. The system provided a cost-effective solution for emergency communication. Trung et al. (2021) designed an automobile accident detection and messaging system using Arduino, accelerometer, GPS, and GSM modules. Experimental results indicated that the system achieved rapid response and reliable accident notification, making it suitable for practical vehicular applications. Kaul and Altaf (2022) proposed a traffic safety management approach based on vehicular ad hoc networks (VANETs). Their work focused on collision detection, traffic management, and information dissemination to enhance road safety in connected transportation systems.

Patil and Pardeshi (2023) developed an accident detection, prevention, and reporting system utilizing Arduino, GPS, and GSM technologies. The system automatically transmitted accident information and location details to emergency services, thereby improving rescue efficiency. Akkalkot et al. (2024) proposed a smart accident detection and reporting system that integrated accelerometer-based detection with cloud-based data storage and additional sensors for monitoring driver conditions. Their approach demonstrated the growing trend toward intelligent and connected vehicle safety systems. Ravali and Hemalatha (2025) presented an IoT-based driver alert system incorporating speed monitoring, alcohol detection, obstacle detection, GPS tracking, and GSM communication. The study emphasized preventive safety measures alongside accident reporting capabilities.

Although significant progress has been achieved in accident detection and reporting technologies, many existing systems either rely on complex IoT infrastructures, require continuous internet connectivity, or focus primarily on accident prevention rather than immediate emergency communication. The proposed Arduino-Based Intelligent Accident Detection and SOS Alert Mechanism addresses these limitations by combining accelerometer-based accident detection, GPS location tracking, GSM-based emergency notification, and a manual SOS feature within a simple, low-cost, and reliable embedded platform.

4. COMPONENT DETAILS

The proposed Arduino-Based Intelligent Accident Detection and SOS Alert Mechanism consists of several hardware components that work together to detect accidents, determine location coordinates, and communicate emergency alerts. A brief description of each component is presented below.

4.1 Arduino Uno

The Arduino Uno serves as the central processing unit of the system. It is based on the ATmega328P microcontroller and is responsible for collecting sensor data, processing accident detection algorithms, and controlling communication between various modules. Due to its simplicity, low power consumption, and ease of programming, Arduino Uno is widely used in embedded system applications.

Figure 1:- Arduino Uno

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4.2 ADXL335 Accelerometer Sensor

The ADXL335 is a three-axis accelerometer capable of measuring acceleration along the X, Y, and Z axes. In the proposed system, it continuously monitors changes in vehicle motion and detects sudden impacts or abnormal acceleration patterns that may indicate an accident. The sensor provides analog output signals corresponding to the measured acceleration values.

Figure 2:- ADXL335 Accelerometer Sensor

4.3 NEO-6M GPS Module

The NEO-6M Global Positioning System (GPS) module is used to determine the geographical location of the vehicle. It receives signals from satellites and calculates latitude and longitude coordinates. These coordinates are included in the emergency alert message, enabling rescuers to identify the exact location of the accident.

Figure 3:- NEO-6M GPS Module

4.4 SIM800L GSM Module

The SIM800L GSM module provides wireless communication capabilities for the system. It is responsible for sending Short Message Service (SMS) alerts and initiating voice calls to predefined emergency contacts. The module operates through a cellular network and enables rapid transmission of accident information.

Figure 4:- SIM800L GSM Module

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4.5 16×2 LCD Display

A 16×2 Liquid Crystal Display (LCD) is used to provide real-time information regarding system operation. It displays messages such as system initialization, GPS status, accident detection notifications, SOS activation, and successful alert transmission. The display enhances user interaction and system monitoring.

Figure 5:- 16×2 LCD Display

4.6 RGB LED Indicators

RGB LEDs are incorporated to provide visual indications of different system states. Green LED indicates normal operation, red LED signifies accident detection or emergency conditions, and other colour combinations may be used to represent communication or processing status.

Figure 6:- RGB LED Indicators

4.7 Buzzer

The buzzer serves as an audible warning device. It is activated when an accident is detected or when the SOS mode is triggered. The sound alert helps attract immediate attention and also provides the user with an opportunity to cancel false accident detections.

Figure 7:- Buzzer

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4.8 Manual SOS Push Button

A manual SOS push button is included to enable users to request emergency assistance during critical situations that may not involve a vehicle collision. Pressing the button activates the emergency notification procedure, including location acquisition and transmission of alert messages.

Figure 8:- Manual SOS Push Button

4.9 LM2596 Buck Converter

The LM2596 buck converter is used to provide a stable and regulated voltage supply to the SIM800L GSM module. Since the SIM800L operates reliably within a voltage range of approximately 3.7 V to 4.2 V, direct connection to higher voltage sources may damage the module or cause unstable operation. The buck converter efficiently steps down the input voltage to the required level while maintaining high power conversion efficiency. It also helps prevent voltage fluctuations during GSM transmission, thereby ensuring reliable SMS and call functionality. The use of a buck converter improves the overall stability and performance of the proposed system.

Figure 9:- LM2596 Buck Converter

4.10 BO Motor

A BO (Battery Operated) motor is used in the prototype to simulate the movement of a vehicle during testing and demonstration. The motor provides controlled motion to the model vehicle, enabling the accelerometer sensor to monitor variations in acceleration under different operating conditions. Although the BO motor is not directly involved in accident detection or emergency communication, it assists in evaluating the performance of the proposed system under simulated vehicle movement. Due to its compact size, low power consumption, and ease of operation, the BO motor is widely used in educational and prototype-based automotive projects.

Figure 10:- BO Motor

4.11 Power Supply Unit

Four 1.5 V batteries connected in series are used to provide a 6 V supply for the prototype vehicle section. The battery pack serves as an independent power source for the BO motor and associated components used during system testing and demonstration. This arrangement enables the prototype to simulate vehicle movement under different operating conditions. The Arduino Uno is powered separately through a regulated external supply, ensuring stable operation of the control and communication modules.

Figure 11:- Power Supply Unit

5. METHODOLOGY

The proposed Arduino-Based Intelligent Accident Detection and SOS Alert Mechanism operates through a sequence of sensing, processing, location tracking, and communication stages. The methodology adopted for the development of the system is illustrated below.

5.1 System Initialization

When the system is powered on, the Arduino Uno initializes all connected modules, including the ADXL335 accelerometer, NEO-6M GPS module, SIM800L GSM module, LCD display, LEDs, and buzzer. The LCD displays the system status while the GPS and GSM modules establish communication.

5.2 Continuous Monitoring of Vehicle Movement

The ADXL335 accelerometer continuously measures acceleration along the X, Y, and Z axes. These sensor readings are transmitted to the Arduino Uno for real-time monitoring. Under normal operating conditions, the measured acceleration remains within a predefined range.

5.3 Accident Detection

The Arduino continuously analyzes the accelerometer data to identify sudden impacts or abnormal changes in acceleration. When the measured acceleration exceeds a predetermined threshold value, the system interprets the event as a potential accident and initiates the emergency response procedure.

5.4 Alert Generation

Upon accident detection, the buzzer is activated and a warning message is displayed on the LCD screen. Visual indication is also provided through the LED indicators. A short delay period is introduced to allow the user to cancel the alert if the detection is caused by a non-critical impact or false trigger.

5.5 Location Acquisition

If the alert is not cancelled, the Arduino requests location information from the NEO-6M GPS module. The GPS receiver obtains the current latitude and longitude coordinates of the vehicle from available satellite signals.

5.6 Emergency Notification

The acquired location coordinates are processed and incorporated into an emergency message. Using the SIM800L GSM module, the system automatically sends an SMS containing the accident alert and location details to predefined emergency contacts. Simultaneously, an emergency phone call is initiated to ensure immediate attention.

5.7 Manual SOS Operation

In addition to automatic accident detection, the system includes a manual SOS switch. When the SOS button is pressed, the Arduino bypasses the accident detection stage and directly initiates the

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emergency notification procedure. This feature allows users to request assistance during medical emergencies, vehicle breakdowns, or other critical situations.

5.8 System Response

After successful message transmission and call initiation, the system continues monitoring the vehicle environment for subsequent events. The LCD displays the communication status, ensuring that the user is informed about the completion of the emergency alert process.

6. CIRCUIT DIAGRAM

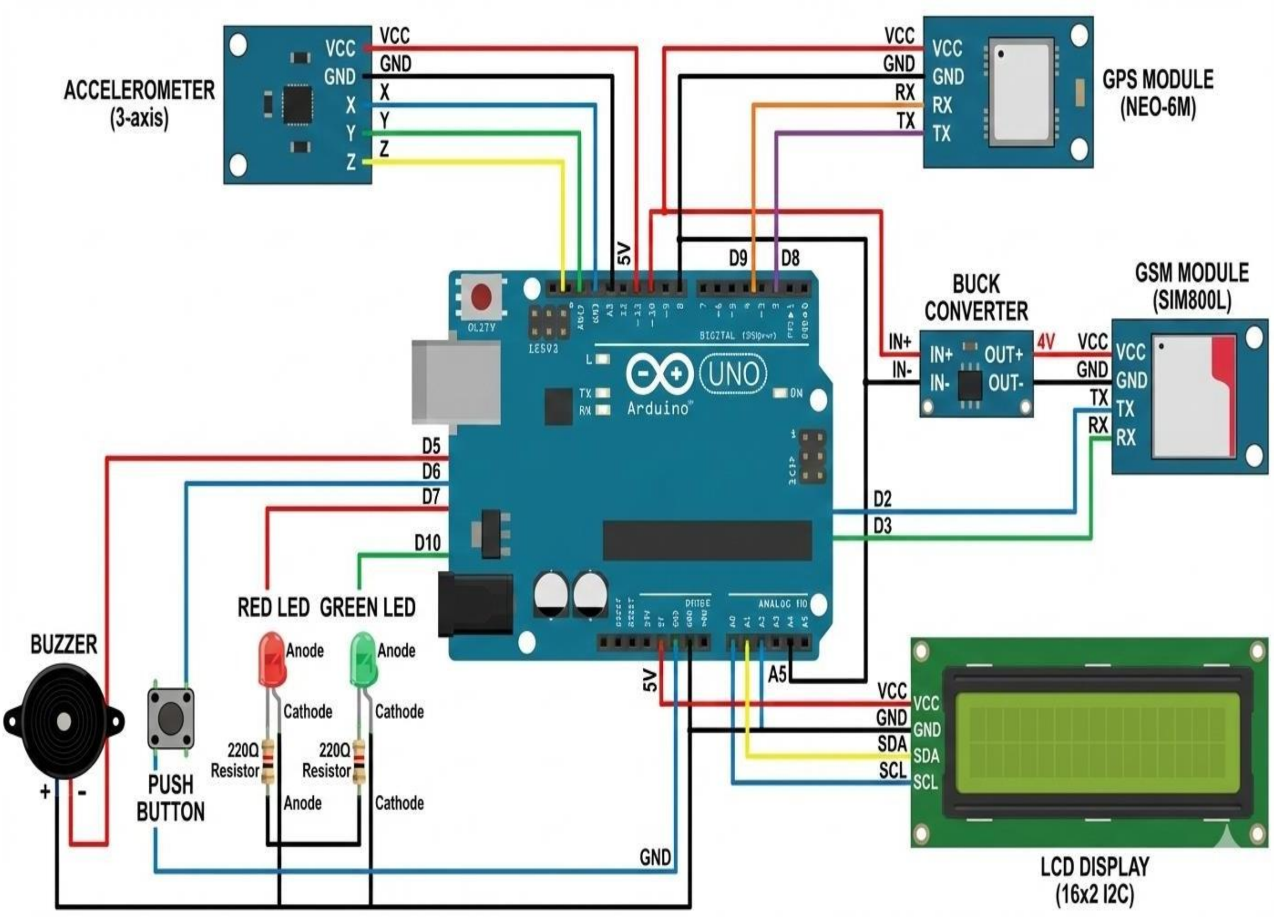

Figure 12:- Circuit Diagram

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7. HARDWARE MODEL

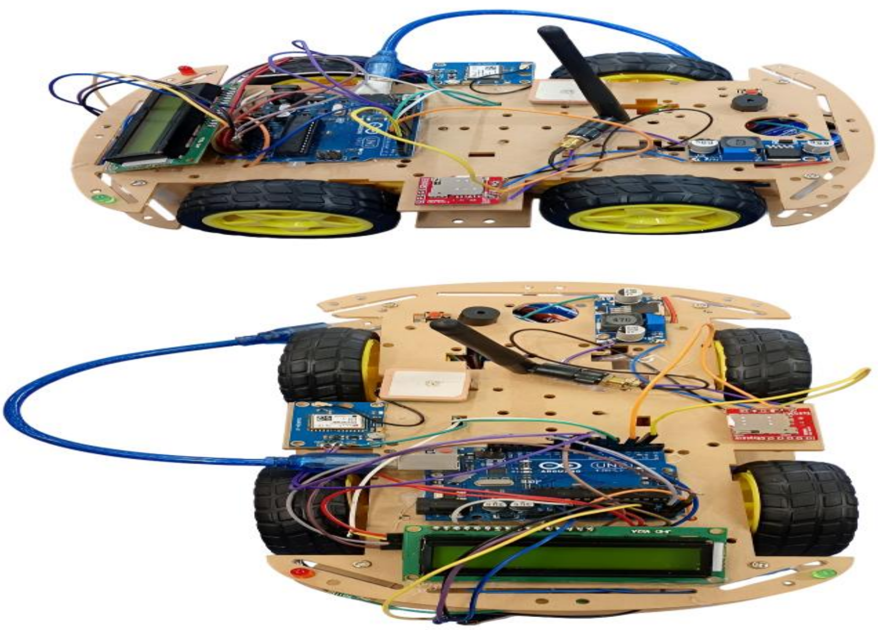

Figure 13:- Practical Hardware Prototype of the System

8. RESULTS AND DISCUSSION

The developed prototype of the Arduino-Based Intelligent Accident Detection and SOS Alert Mechanism was tested under different operating conditions to evaluate its performance and reliability. The evaluation focused on accident detection capability, GPS location tracking, GSM-based emergency communication, and manual SOS operation. The experimental observations obtained during testing are presented in the following tables.

Test No.	Test Condition	Accident Detected	GPS Location Acquired	SMS Sent	Call Initiated	Result
1	Normal vehicle movement	No	Yes	No	No	Successful
2	Minor vibration	No	Yes	No	No	Successful
3	Sudden impact (low intensity)	Yes	Yes	Yes	Yes	Successful

4	Sudden impact (high intensity)	Yes	Yes	Yes	Yes	Successful
5	Manual SOS activation	Not Required	Yes	Yes	Yes	Successful

Table 1. Experimental Test Results

The results indicate that the system was able to distinguish normal operating conditions from accident situations. Emergency alerts were generated only when the impact threshold was exceeded or when the SOS switch was activated.

Parameter	Observed Time (Seconds)
Accident Detection Time	1.5
GPS Coordinate Acquisition	8.2
SMS Transmission Time	4.1
Emergency Call Initiation	2.8
Total Alert Generation Time	16.6

Table 2. Response Time Analysis

The response time analysis demonstrates that the proposed system can communicate emergency information within a short duration after accident detection. The total response time mainly depends on GPS satellite availability and GSM network conditions.

Function Tested	Status
Accelerometer-Based Accident Detection	Successful
GPS Location Tracking	Successful
SMS Alert Transmission	Successful
Emergency Call Function	Successful
Manual SOS Operation	Successful
LCD Status Display	Successful
Buzzer Alert Generation	Successful
LED Indication System	Successful

Table 3. Functional Performance Summary

The functional performance evaluation confirmed the reliable operation of all hardware modules used in the proposed system. The ADXL335 accelerometer accurately detected impact events, while the GPS and GSM modules successfully performed location tracking and emergency communication tasks. The manual SOS feature provided an additional safety mechanism for emergency situations not associated with vehicle collisions.

Overall, the experimental results demonstrate that the proposed system is capable of detecting accident events, obtaining location information, and transmitting emergency notifications efficiently. The developed prototype offers a practical, low-cost, and reliable solution for improving road safety and reducing emergency response time.

9. ADVANTAGES & LIMITATIONS

9.1 Advantages

Automatic Accident Detection: The system automatically detects accident events without requiring human intervention.

Real-Time Emergency Notification: Emergency alerts are transmitted immediately after accident detection, reducing response time.

Accurate Location Tracking: The GPS module provides precise geographical coordinates, helping rescuers locate the accident site quickly.

Low-Cost Implementation: The use of readily available components such as Arduino Uno, GPS, and GSM modules makes the system economical.

Manual SOS Feature: Users can manually request assistance during emergencies such as medical issues, vehicle breakdowns, or personal safety threats.

Easy Installation and Operation: The system has a simple architecture and can be integrated into different types of vehicles.

Portable and Scalable: The design can be modified and expanded for various transportation and safety applications.

Improved Road Safety: Timely communication of accident information can help reduce fatalities and improve rescue efficiency.

9.2 Limitations

Dependence on GSM Network Availability: Emergency communication may be affected in areas with poor cellular network coverage.

GPS Signal Dependency: Accurate location tracking requires sufficient GPS satellite signals and may be less effective in tunnels or densely built urban areas.

Possibility of False Detection: Severe road bumps or sudden vehicle movements may occasionally trigger false accident alerts.

Power Supply Requirement: Continuous operation depends on a stable power source for all hardware components.

Limited Accident Severity Analysis: The current system detects impacts but does not classify the severity of accidents.

Environmental Influence: Sensor performance may be affected by excessive vibrations and environmental conditions.

Despite these limitations, the proposed system provides a practical and effective solution for automatic accident detection and emergency notification.

10. CONCLUSION

This paper presented an Arduino-Based Intelligent Accident Detection and SOS Alert Mechanism designed to improve road safety through automatic accident detection and emergency communication. The proposed system integrates an ADXL335 accelerometer, NEO-6M GPS module, SIM800L GSM module, Arduino Uno, and a manual SOS switch to detect accident events and transmit emergency notifications containing location information.

Experimental testing demonstrated that the system was capable of accurately detecting sudden impacts, acquiring GPS coordinates, and successfully sending SMS alerts and initiating emergency calls. The manual SOS feature further enhanced the functionality of the system by allowing users to request assistance during critical situations unrelated to accidents.

The results indicate that the proposed system provides a reliable, economical, and user-friendly solution for reducing delays in accident reporting and improving emergency response. Therefore, the developed prototype has significant potential for practical implementation in vehicles and can contribute to enhancing road safety and minimizing accident-related consequences.

11. FUTURE SCOPE

Although the proposed Arduino-Based Intelligent Accident Detection and SOS Alert Mechanism demonstrated satisfactory performance, several enhancements can be incorporated to improve its functionality and effectiveness in future applications.

IoT Integration: The system can be integrated with Internet of Things (IoT) platforms for real-time accident monitoring and cloud-based data storage.

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Mobile Application Support: A dedicated mobile application can be developed to provide instant notifications, live tracking, and emergency status updates.

Accident Severity Analysis: Advanced algorithms and additional sensors can be employed to estimate the severity of accidents and prioritize emergency response accordingly.

Automatic Hospital Notification: The system can be enhanced to automatically notify nearby hospitals and emergency services with accident details and location information.

Camera-Based Verification: Integration of cameras can help capture images or videos of accident events for verification and analysis.

Vehicle-to-Vehicle Communication: Future versions may incorporate vehicle-to-vehicle communication technologies to warn nearby vehicles and prevent secondary accidents.

Artificial Intelligence Integration: Machine learning techniques can be utilized to improve accident detection accuracy and reduce false alerts.

Renewable Power Support: Solar-assisted power systems may be incorporated to improve energy efficiency and ensure uninterrupted operation.

These enhancements can further improve the reliability, intelligence, and practical applicability of the proposed system, making it more suitable for advanced vehicle safety and smart transportation applications.

12. AUTHOR(S) CONTRIBUTION

The writers affirm that they have no connections to, or engagement with, any group or body that provides financial or non-financial assistance for the topics or resources covered in this manuscript.

13. CONFLICTS OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

14. PLAGIARISM POLICY

All authors declare that any kind of violation of plagiarism, copyright and ethical matters will take care by all authors. Journal and editors are not liable for aforesaid matters.

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16. REFERENCES

Fernandes, B., Alam, M., Gomes, V., Ferreira, J., & Oliveira, A. (2016). Automatic accident detection with multi-modal alert system implementation for ITS. *Vehicular Communications*, *3*, 1-11.

Sharma, S. S., Tendulkar, S., Kulkarni, S., & Prasad, E. C. (2017). Accident alert and vehicle tracking mechanism. *International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering*, *5*(3), 116-118.

Khaliq, K. A., Raza, S. M., Chughtai, O., Qayyum, A., & Pannek, J. (2018). Experimental validation of an accident detection and management application in vehicular environment. *Computers & electrical engineering*, *71*, 137-150.

Kinage, V., & Patil, P. (2019, December). Iot based intelligent system for vehicle accident prevention and detection at real time. In *2019 Third International conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud)(I-SMAC)* (pp. 409-413). IEEE.

Roy, S., Kumari, A., Roy, P., & Banerjee, R. (2020, September). An arduino based automatic accident detection and location communication system. In *2020 IEEE 1st International Conference for Convergence in Engineering (ICCE)* (pp. 38-43). IEEE.

Trung, N. B., Duc, H. L., & Viet, H. N. (2021, March). Building an Automobile Accident Detection and Messaging System Using Arduino. In *The International Conference on Intelligent Systems & Networks* (pp. 280-286). Singapore: Springer Singapore.

Kaul, A., & Altaf, I. (2022). Vanet-TSMA: A traffic safety management approach for smart road transportation in vehicular ad hoc networks. *International Journal of Communication Systems*, *35*(9), e5132.

Patil, V. R., & Pardeshi, S. S. (2023). Mechanism for accident detection, prevention and reporting system. *Materials Today: Proceedings*, *72*, 1975-1980.

Akkalkot, A., Ashtagi, R., Khaple, A., Mujawar, A., Maginmani, U. H., Padthe, A., & Ingle, R. (2024). A smart accident detection, prevention and reporting system using arduino. In *Artificial Intelligence and Information Technologies* (pp. 294-298). CRC Press.

Ravali, S., & Hemalatha, R. (2025, November). Driver Alert System: Sending Alert Messages upon Speed Control, Alcohol Detection and Object Detection Using IoT and Arduino. In *2025 International Conference on Electrical Engineering and Informatics (ICEEI)* (pp. 1-8). IEEE.