Journal of Applied Science, Engineering, Technology and Management
Vol. 03, Issue 02, December 2025 pp. 19-24

Integration of Sensor and GPS System in Multisource Electric Vehicle for Accident Control and Safety

Anu M. Ajit
Dept. of Electrical & Electronics Engineering
Universal Engineering College
Thrissur,India
anu.ajit@uec.ac.in

Aswin K. A.
Dept. of Electrical & Electronics Engineering
Universal Engineering College
Thrissur,India
er.aswinka@gmail.com

Anandhakrishna C. U.
Dept. of Electrical & Electronics Engineering
Universal Engineering College
Thrissur,India
er.anandhakrishna@gmail.com

Ajay Krishna V. S.
Dept. of Electrical & Electronics Engineering
Universal Engineering College
Thrissur,India
ajaykvs1234@gmail.com

Abstract*— Nowadays, the major reason for road accidents is over speed, fire accidents, and driver's negligence. This research study intends to overcome these challenges by using fire detection and accident detection. If in case any accidents occur, it sends instant SMS and live location to the related Road centers like RTC centers, hospitals, fire stations, etc., This makes the accident the location to be immediately known and it helps to save valuable lives. The flame sensor is used for fire detection. The paper is based on the ARDUINO, all the sensors are connected to it and send SMS of the live location through the GPS and GSM module. The vehicle accident location tracking system integrates several safety features using GSM (Global System for Mobile Communications) and GPS (Global Positioning System) technologies. The primary objective of the system is to enhance passenger and vehicle safety by addressing the major causes of road accidents such as over speeding and fire accidents. The system is designed to detect accidents and immediately notify relevant authorities by sending SMS alerts with the live location of the incident to road centers, hospitals, and fire stations. This rapid communication is intended to ensure that the accident site is quickly identified, thereby facilitating prompt rescue operations and potentially saving lives. Overall, the system aims to reduce the impact of road accidents by ensuring timely detection and communication, thereby improving the safety of passengers and vehicles. This system is particularly useful in scenarios where accidents occur in remote areas, where timely detection and response are crucial. By leveraging advanced technologies like GPS, GSM, and various sensors, the proposed system represents a significant step forward in improving road safety.

Keywords—Servo Motor, Linear Actuator, Global Positioning System, Global System for Mobile Communications, Internet of Things, Over speeding.

I. INTRODUCTION

This research highlights the urgent need for comprehensive fire safety systems in vehicles to prevent fatalities. Existing systems often only alert the driver or suppress fire without actively aiding passenger evacuation, leaving risks from toxic gases and locked doors unaddressed [1]. This proposed system aims to overcome these issues by utilizing temperature and smoke sensors to detect fire, automatically unlock doors, sound alarms, and activate fire extinguishers. Designed with redundancy, each door has an independent system, ensuring passengers can escape or be rescued even if one door's mechanism fails [2]. Additionally, real-time GPS tracking and accident detection will improve response times by notifying family members, emergency services, and police in case of an accident, addressing the growing need for prompt assistance amid increasing traffic and reckless driving [3].

This project aims to improve safety by notifying the appropriate emergency services immediately when incidents occur. With transportation being integral to our daily lives, advancements have made travel easier but also brought new risks. The system proposed here will improve passenger safety by providing real-time updates to relevant centres, such as vehicle depots, fire stations, and hospitals [4].

eISSN 2584-0371

Received for review: 05 - 07 - 2025
Accepted for publication: 15 - 08 - 2025
Published: 30 - 08 - 2025

II. LITERATURE REVIEW

A. *Vehicle accident location tracking system using GSM and GPS*

This system is developed by K. Ramesh Chandra, Seelam Himaja,Pulaparthi Ramyanjani, Reddy John Vesli, Shaik Farid, Sykham Sai Konda Reddy.

The system's primary objective is to enhance passenger safety by integrating detection sensors for incidents such as alcohol use, fire, and accidents, providing real-time monitoring and responses. Upon detecting an accident, it sends instant SMS alerts with the live location to emergency response centers (like hospitals, police ,and fire stations) to expedite assistance. The system also checks for alcohol on the driver's breath before starting the vehicle , disabling it and notifying authorities if alcohol is detected. In case of fire, a flame sensor activates an automatic sprinkler system and alerts the nearest fire station via GPS and GSM. Solar panels are included for eco-friendly power, ensuring continuous operation. Authorities receive a Google Maps view of the incident location to improve response accuracy and speed [4].

B. *Iot based collision detection warning system, emergency door and seat belt unlock in e-vehicles*

This research aims to develop an IoT-enabled system for electric vehicles that detects collisions and automatically unlocks doors and seat belts during an accident. The system uses ultrasonic sensors for collision warning, a knock sensor for impact detection, and a delay timer to automatically unlock seat belts and doors 15-30 seconds after a collision. This delay is crucial to prevent accidental unlocking during vehicle rollovers. Additionally, the system notifies emergency contacts and local hospitals through GPS and GSM modules, providing a timely response to accidents [5].

C. *Hardware implementation of fire detection, control, and automatic door unlocking system for automobiles*

The primary objective of this study is to address the critical safety issue in vehicle fire emergencies by developing a hardware-based system capable of detecting fires in an automobile, activating a fire extinguisher, and automatically unlocking the doors. The proposed system integrates temperature and smoke sensors to detect fire conditions and relies on servo motors to release fire extinguishers and unlock doors, thus providing a rapid and automated response to prevent fatalities in such incidents [6].

D. *GPS and GSM-based vehicle tracking system*

This system is developed by Abadal-Salam T. Hussain, Omer K Ahmed, Mohammed Fadhil, Shouket A. Ahmed, Taha A. Taha, Hazry Desa

The paper aims to address the growing issue of vehicle theft by developing a cost-effective, user-controlled vehicle tracking system using GPS and GSM technologies. The system allows vehicle owners to track their vehicles independently without relying on authorities. By integrating a PIC microcontroller with GPS and GSM, the system provides real-time location data, enabling owners to monitor their vehicle's location via SMS notifications. This design is intended to offer an affordable solution that enhances vehicle security and aids in recovery efforts [7].

E. *Design and implementation of a fire detection and control system for automobiles using fuzzy logic*

This system is proposed by Robert Sowah, Kwame O. Ampadu, Abdul Ofoli, Koudjo Koumadi, Godfrey A. Mills, Joseph Nortey.

This paper addresses the need for an efficient fire detection and suppression system in automobiles due to the significant risk of vehicle fires, which can result in extensive property damage and safety risks. The authors propose a fuzzy logic-based control system implemented on an Arduino microcontroller to detect and extinguish fires in various sections of a vehicle. The system employs multiple sensors to monitor parameters like temperature, smoke, and flames, automatically activating a CO2-based suppression system to extinguish the fire without driver intervention [8].

F. *An Arduino-based automatic accident detection and location communication system*

This system is proposed by Souvik Roy, Akanksha Kumari, Pulakesh Roy, Rajib Banerjee.

The paper addresses the pressing issue of road accident fatalities, particularly in remote areas where timely medical intervention is challenging. The proposed system, called the Automatic Accident Detection and Location Communication System (AAADLCS), is designed to automatically detect accidents using an accelerometer and a limit switch, then communicate the vehicle's location via GPS and GSM to emergency services and family members. The primary goal is to reduce the delay in providing medical assistance to accident victims, potentially lowering mortality rates [9].

III. METHODOLOGY

A. *Methodology of Existing System*

The existing system in vehicle safety primarily relies on passive measures such as airbags, seat belts, and mechanical braking systems. While some vehicles incorporate basic GPS tracking for navigation, they lack real-time accident detection and prevention capabilities. Safety sensors like ABS and traction control are used but do not communicate with external systems to enhance accident response. It detects fire and sprinkles water, reducing fire accidents and saving important lives Additionally, emergency assistance depends on manual calls from bystanders, leading to delays in medical aid. Furthermore, there is no automated system to predict or actively prevent collisions using real-time sensor data [4].

B. Methodology of Proposed System

The existing system in vehicle safety primarily relies on passive measures such as airbags, seat belts, and mechanical braking systems. While some vehicles incorporate basic GPS tracking for navigation, they lack real-time accident detection and prevention capabilities. Safety sensors like ABS and traction control are used but do not communicate with external systems to enhance accident response. Additionally, emergency assistance depends on manual calls from bystanders, leading to delays in medical aid. Furthermore, there is no automated system to predict or actively prevent collisions using real-time sensor data.

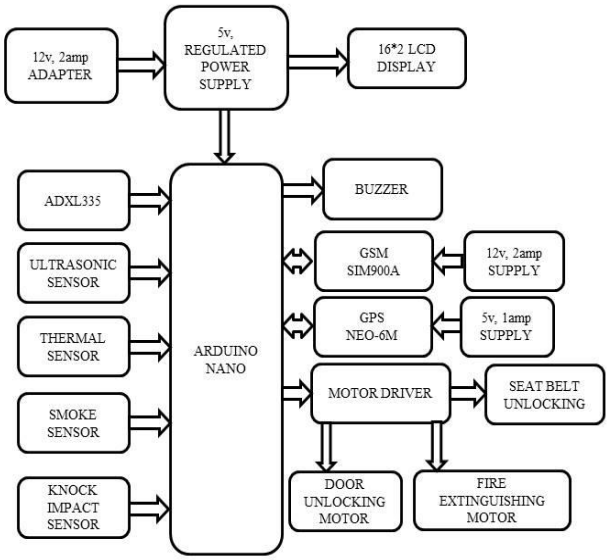

Fig. 1. Block diagram of proposed system

The block diagram of the proposed system is shown in Fig. 1.The proposed system aims to overcome these limitations by integrating multiple sensors such as ultrasonic, accelerometer, and temperature sensors for real-time hazard detection. A GPS module continuously tracks the vehicle's location and, in case of an accident, sends alerts to emergency contacts via GSM or IoT-based communication. The system incorporates an automatic emergency braking mechanism that activates upon detecting an imminent collision. Additionally, a servo-controlled seatbelt unlock system ensures quick evacuation during accidents. A microcontroller processes sensor data to make real-time safety decisions, while a display module provides live feedback. By combining these technologies, the proposed system shifts from a reactive approach to an intelligent and proactive accident prevention and safety solution. The circuit diagram of safety system is shown in Fig. 2.

IV. RESULTS

1.Accurate Accident Detection

The system effectively detected accidents using a combination of accelerometer, ultrasonic, and temperature sensors. These sensors identified sudden impacts, rollovers, and fire hazards, ensuring quick response to critical situations. The accelerometer detected abrupt changes in motion, the ultrasonic sensor identified nearby obstacles, and the temperature sensor monitored heat levels to detect potential fires. This multi-sensor approach provided a highly accurate accident detection mechanism, making vehicles smarter and safer.

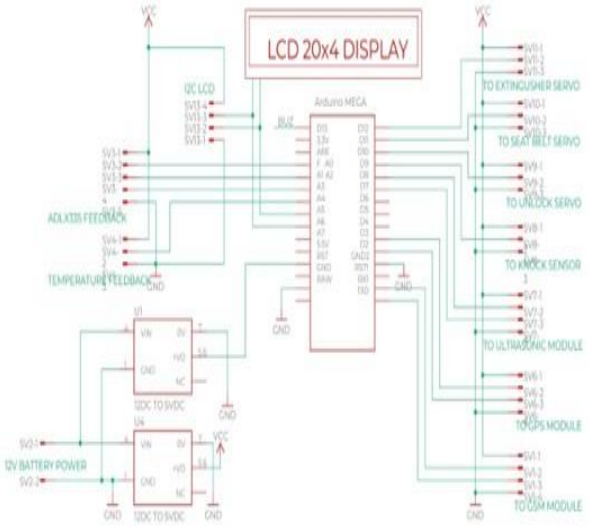

Fig. 2. Circuit Diagram

2.Real-Time Location Tracking

A GPS module was integrated to continuously track the vehicle's location and provide precise accident site identification. In case of an emergency, the system automatically sent the GPS coordinates to emergency responders, reducing delays in medical assistance. This feature was crucial for quick rescue operations, especially in remote or high-risk areas where locating a crashed vehicle manually would be difficult.

3.Automated Emergency Alerts

To enhance post-accident response, a GSM-based communication system was used to send automated emergency alerts. When an accident occurred, the system detected the crash, retrieved the GPS location, and sent an SMS alert to family members and emergency responders such as 100,101,108. This ensured that even if the driver or passengers were unconscious, help could still be summoned without any manual intervention, significantly improving survival chances in critical situations.

Fig. 3. Extinguisher and extinguishing system

4.Extinguishing System

This is the servo-controlled fire extinguisher system designed for automated or remote fire suppression. It consists of an aerosol fire extinguishing canister mounted on a custom frame with a servo motor that presses the nozzle to release the extinguishing agent when triggered. The extinguishing system shown in Fig. 3.

5.Smart Seatbelt Unlock Mechanism

A servo-controlled seatbelt unlock system was developed to prevent passengers from getting trapped inside the vehicle after a crash. Upon accident detection, the microcontroller triggered the servo motor to release the seatbelt lock, enabling quick and easy evacuation. This feature was especially useful in cases of fire, vehicle submersion, or overturned crashes, where rapid escape could be life-saving. Seat belt unlocking mechanism shown in Fig. 4.

Fig. 4. Seatbelt unlocking mechanism

6.Effective Braking System Integration

The system included an automatic emergency braking mechanism that engaged when a potential collision was detected. Using real-time data from sensors, the system applied brakes either to prevent an accident or to minimize crash severity. This proactive safety feature significantly reduced the impact force in accidents, improving vehicle control and passenger protection.

7.Door Unlocking System

A seat belt unlock system for accident safety is designed to automatically release the seat belt in emergency situations, such as after a crash. It consists of a servo that disengages the seat belt latch when triggered by an accident detection system, which include accelerometers, crash sensors. Fig. 5 shows door unlocking linear actuator.

Fig. 5. Door Unlocking Linear Actuator

8.User-Friendly Interface

An LCD display module was incorporated to provide real-time updates on the system's status. The display showed live sensor readings, emergency alerts, and braking activation, keeping the driver informed of potential hazards. This feature improved situational awareness, allowing drivers to take preventive action when necessary. Wiring and control circuit is shown in Fig.6.

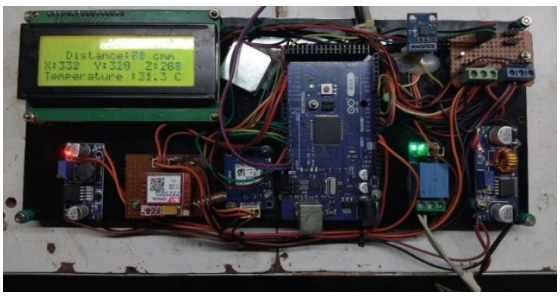

Fig. 6. Wiring and Control Circuit

9.Energy-Efficient Operation

Designed for electric vehicle compatibility, the system was optimized for low power consumption. Sensors and communication modules operated only when needed, ensuring minimal battery drain. The microcontroller-based design efficiently managed power usage, making the system both sustainable and reliable for long-term use.

V. DISCUSSION

1.Effective Braking System Integration

The system included an automatic emergency braking mechanism that engaged when a potential collision was detected. Using real-time data from sensors, the system applied brakes either to prevent an accident or to minimize crash severity. This proactive safety feature significantly reduced the impact force in accidents, improving vehicle control and passenger protection.

2.User-Friendly Interface

An LCD display module was incorporated to provide real-time updates on the system's status. The display showed live sensor readings, emergency alerts, and braking activation, keeping the driver informed of potential hazards. This feature improved situational awareness, allowing drivers to take preventive action when necessary.

3.Energy-Efficient Operation

Designed for electric vehicle compatibility, the system was optimized for low power consumption. Sensors and communication modules operated only when needed, ensuring minimal battery drain. The microcontroller-based design efficiently managed power usage, making the system both sustainable and reliable for long-term use.

4. Cost-Effectiveness

One of the key goals of the project was to develop a low-cost safety mechanism for EVs. By using off-the-shelf components and a modular design, manufacturing costs were minimized without compromising durability and performance. The elimination of fire is also beneficial for passenger safety and vehicle safety.

VI. CONCLUSION

In conclusion, the proposed system aims to significantly reduce accidents and enhance passenger safety by integrating collision detection, accident response, and fire prevention technologies. An Arduino-based collision detection system demonstrated effective functioning on an RC model, using ultrasonic sensors to warn drivers of potential collisions. For real-world applications, sensors with greater detection ranges are recommended. The system is also designed to automatically alert emergency services and family members upon an accident, using GPS to provide accurate location data in real-time. The AAADLCS (Automobile Accident and Anti-Door Locking Control System) improves response time, which is critical to increasing survival rates, and efficiently directs medical services to accident scenes.

A critical safety feature is the automated fire detection and extinguishing mechanism that activates without driver intervention, addressing situations where doors may be locked and passengers unable to escape. Each door is equipped with independent safety mechanisms, ensuring that passengers have multiple exit points in emergencies. This feature, combined with a fire suppression system, reduces fire-related fatalities in electric and traditional vehicles. For enhanced functionality, integrating Google Maps with GPS/GSM tracking enables remote vehicle monitoring and faster emergency response. Although this system may increase vehicle costs, the enhanced safety justifies the investment, especially for vehicles transporting vulnerable groups, such as school buses. Future improvements could include a user-friendly circuit design, SMS-based activation/deactivation for security, and displays showing essential vehicle information and emergency contacts. This adaptable system offers a scalable solution that can evolve to meet future automotive safety needs without requiring complete redesigns, making it both effective and economical.

VII. FUTURE SCOPE

A user-friendly mobile app would serve as the central interface for drivers, providing real-time monitoring of vehicle health, emergency alerts, and immediate assistance, all connected through IoT-based systems. These systems continuously transmit data to cloud platforms for diagnostics, vehicle status, and emergency alerts. By using machine learning algorithms, the system can predict and detect potential accidents based on historical driving patterns, environmental data, and real-time sensor inputs. The AI-driven system could proactively warn drivers of dangers like sudden braking, lane drifting, or high-speed proximity to other vehicles, and in some cases, it could automatically initiate emergency braking or steering adjustments.

REFERENCES

[1] I. S. Wichman, "Material flammability, combustion, toxicity and fire hazard in transportation," Prog. Energy Combustion Sci., vol. 29, no. 3, pp. 247–299, 2003.

[2] Robert Sowah, Kwame O. Ampadu, Abdul R. Ofoli,."A Fire Detection and Control System in Automobiles". IEEE Industry Applications Magazine, March/April 2019.

[3] Parag Parmar, Ashok M. Sapkal; "Real Time Detection and Reporting of Vehicle Collision".International Conference on Trends in Electronics and Informatics IEEE 2017.

[4] K. Ramesh Chandra, Pulaparthi Ramyanjani, Shaik Farid, Seelam Himaja, Reddy John Vesli, Sykham Sai Konda Reddy," Vehicle Accident Location Tracking System using GSM and GPS ". Proceedings of the Fourth International Conference on Smart Electronics and Communication (ICOSEC-2023).

[5] Selva Narendran S, Dr. G Prakash , Aslin Jijo G M, Santhosh Kumar M 'IOT based Collition detection warning system, Emergency door and seat belt unlock in E-Vehicle", International Conference on Computer, Power and Communications (ICCPC) IEEE 2022.

[6] J. Joy Mathavan, A. W. Faslan, N. U. A. Basith, W.V.S.D. Wanigasinghe "Hardware Implimentation of Fire Detection , Control and Automatic Door Unlocking System for Automobiles" , Proceedings of the fourth International Conference on Trends in Electronics and Informatics (ICOEI 2020)

[7] Abadal-Salam T. Hussain, Omer K Ahmed, Mohammed Fadhil, Shouket A. Ahmed, Taha A. Taha, Hazry Desa, "GPS and GSM Based Vehicle Tracking System", 7th International Symposium on Innovative Approaches in Smart Technologies IEEE 2023.

[8] Robert Sowah, Kwame O. Ampadu, Abdul Ofoli, Koudjo Koumadi, Godfrey A. Mills, Joseph Nortey, "Design and Implementation of A Fire Detection and Control System for Automobiles Using Fuzzy Logic", 2016 IEEE Industry Applications Society Annual Meeting.

[9] Souvik Roy, Akanksha Kumari, Pulakesh Roy, Rajib Banerjee, "An Arduino Based Automatic Accident Detection and Location Communication System", International Conference for Convergence in Engineering IEEE 2020.