

Vehicle Accident Detection, Prevention and Reporting System

Pratik Godase¹, Pavan Pandit², Rutuja Patil³, Prof. M. M. Zade⁴

^{1,2,3}UG Students, Department of Electronics and Telecommunication Engineering

⁴Assistant Professor, Department of Electronics and Telecommunication Engineering
SKN Sinhgad College of Engineering, Pandharpur

Abstract: *The Vehicle Accident Detection, Prevention, and Reporting System integrates alcohol sensing, drowsiness monitoring, accident detection, and alert mechanisms into a single low-cost platform. The alcohol sensor ensures that vehicle operation is prevented when the driver is intoxicated, while the eye-blink sensor continuously monitors drowsiness levels to reduce fatigue-related risks. The ADXL accelerometer reliably detects sudden impact forces, and the GPS enables immediate transmission of real-time accident location data through alerts with Google Maps links. The inclusion of the L298N motor driver ensures that preventive actions, such as restricting ignition, are enforced effectively.*

By combining prevention, detection, and emergency communication, the system functions as a comprehensive safety framework rather than a standalone monitoring tool. It addresses both pre-accident conditions and post-accident assistance, thereby reducing the chances of collisions and minimizing delays in emergency response. The use of Arduino as the central controller makes the system cost-effective, scalable, and adaptable to a wide range of vehicles, which is particularly beneficial in developing countries where road accidents remain a critical challenge.

In its future development, the system can be expanded with cloud-based monitoring platforms, artificial intelligence for predictive accident analysis, and adaptive thresholding to improve accuracy on rough terrains. Large-scale implementation across vehicular networks will also allow integration with smart city infrastructure, enabling traffic authorities and healthcare providers to receive automated accident notifications. With these advancements, the proposed system holds strong potential to significantly improve road safety, reduce casualties, and contribute to the development of intelligent transportation systems..

Keywords: Vehicle accident detection, alcohol sensing, drowsiness monitoring, GPS, IoT, emergency response

I. INTRODUCTION

Road accidents continue to represent one of the most pressing global challenges, leading to severe human, social, and economic consequences each year. As highlighted by the World Health Organization (WHO), road traffic accidents claim millions of lives annually, while millions more are left with permanent disabilities and long-term injuries [1]. The economic burden associated with accidents, including medical expenses, insurance claims, and loss of productivity, further exacerbates the problem [2]. demands not only stricter regulations but also the adoption of advanced technological interventions for prevention, detection, and timely assistance.

Among the various causes of accidents, drunk driving and driver fatigue remain the two most dominant and recurring issues. Alcohol consumption impairs cognitive abilities, slows down reflexes, and reduces driver alertness, significantly increasing the chances of collisions [3]. Despite the implementation of traffic laws, breath analyser checkpoints, and surveillance mechanisms, alcohol-related accidents remain alarmingly high. Similarly, driver drowsiness has been identified as a critical factor in long-distance driving and nighttime travel, where prolonged fatigue leads to micro-sleep episodes and slower reaction times [4]. Studies indicate that drowsiness-related accidents are often more severe due to delayed braking and inattentiveness, highlighting the urgent need for real-time monitoring of driver behaviour.



Another crucial aspect linked to fatalities is the absence of instant accident reporting systems. In most cases, accident victims are either unconscious or unable to call for help, which results in significant delays in receiving medical attention [5]. Conventional reporting relies heavily on bystanders, police patrols, or random witnesses, making it unreliable and time-consuming. This delay often turns survivable accidents into fatal incidents. Hence, integrating automated accident detection with immediate communication to emergency contacts and medical facilities can drastically reduce response times and improve survival chances.

With rapid advancements in embedded systems and Internet of Things (IoT) technologies, it has become feasible to design low-cost, intelligent vehicular safety systems. Microcontrollers such as ESP32 provide a flexible platform for integrating diverse sensors and communication modules, enabling real-time monitoring and response at minimal cost [6]. Individual components like MQ-3 alcohol sensors, infrared eye-blink detectors, ADXL accelerometers, GPS have already proven effective in different contexts [7]–[8]. However, when implemented in isolation, these systems address only one aspect of road safety, leaving significant gaps in overall accident prevention and post-crash management.

Recent research trends emphasize the power of sensor fusion in enhancing reliability and efficiency. Alcohol detection modules can effectively prevent ignition if the driver is intoxicated, while eye-blink sensors continuously monitor eyelid activity to detect drowsiness before it leads to unsafe driving [9]. At the same time, accelerometer-based accident detection systems can identify abnormal collision forces, and when combined with GPS modules, provide precise accident localization and automated emergency alerts to stakeholders [10]. Such integration of preventive and corrective measures into a unified framework marks a significant step toward intelligent transportation systems.

Motivated by these insights, the present work focuses on the design and development of a Vehicle Accident Detection, Prevention, and Reporting System that combines alcohol detection, drowsiness monitoring, accelerometer-based accident detection, and GPS-enabled communication. The proposed system not only prevents unsafe conditions such as drunk and drowsy driving but also ensures that, in the event of an accident, real-time location data is immediately transmitted to emergency contacts through Google Maps links. By bridging preventive safety mechanisms with automated post-crash reporting, this work aims to create a cost-effective, reliable, and scalable model that can significantly minimize both accident occurrence and delays in medical response. Future extensions of this system may involve cloud-based monitoring, artificial intelligence-driven driver behaviour analytics, and deployment across vehicular networks to further enhance road safety and traffic management.

II. LITERATURE SURVEY

Supriya Sarker *et al.* [1] proposed an IoT-based intelligent accident detection and location tracking model that relies on vehicle-mounted sensing modules to continuously monitor driving conditions. The system was designed to automatically identify accidents by detecting abnormal collision forces and then retrieving real-time GPS coordinates to determine the exact accident location. Once an incident was confirmed, these coordinates were instantly transmitted to a central monitoring server and nearby hospitals through GSM and cloud-based communication channels. This automation minimized the reliance on bystanders or passersby to report accidents, thereby significantly reducing delays in initiating emergency medical services. The authors further highlighted the scalability of their IoT framework, noting its potential integration into smart city infrastructure for large-scale traffic monitoring and coordinated response mechanisms.

The study also explored how hospital networks could be integrated with the system, enabling medical facilities to receive accident alerts in advance and prepare resources such as ambulances and emergency staff proactively. This proactive approach could drastically reduce the “golden hour” response time, which is critical for saving lives in road accidents. Additionally, the authors emphasized the role of cloud connectivity in maintaining historical crash data, which could later be used for accident analysis, insurance verification, and road safety audits. Another significant contribution of their work was the foresight in suggesting the use of artificial intelligence and predictive analytics. By combining real-time crash data with machine learning models hosted on the cloud, the system could potentially move beyond detection to accident prevention by identifying high-risk driving behaviours and hazardous zones. Their research thus set a strong foundation for future intelligent transportation systems that combine IoT, cloud, and AI for holistic accident management and prevention.



R. Thamizharasi *et al.* [2] developed a real-time drowsiness detection system using an infrared (IR) eye-blink sensor that continuously tracked the driver's eye movements to determine levels of alertness. The system operated on the principle that prolonged eyelid closure or irregular blink patterns strongly correlate with fatigue and drowsiness. Once such conditions were detected, the system instantly activated an audio alarm to alert the driver and prevent a potential accident. The study demonstrated that this approach was particularly effective in reducing accidents caused by driver fatigue during night journeys, highway driving, and long-haul operations where concentration typically declines over time.

Although the system was cost-effective and simple to implement, the authors identified several limitations. Sensor accuracy was reduced under strong sunlight, where IR interference affected detection reliability, and the system occasionally misinterpreted normal eye movements as drowsiness. The presence of spectacles or tinted glasses further complicated detection due to reflection and obstruction of IR light. To address these issues, the authors suggested a hybrid approach that integrates IR sensors with complementary technologies such as image processing through cameras or EEG-based monitoring of brain activity. Such integration could enhance detection accuracy by validating IR sensor readings against additional physiological parameters.

The research also emphasized the broader implications of fatigue detection systems in intelligent transportation. By incorporating such drowsiness monitoring into modern vehicles, accidents related to human error could be significantly reduced, which is vital given that driver fatigue remains one of the leading causes of road mishaps globally. The authors further recommended connecting the system with communication modules such as GSM or IoT platforms, which would not only alert the driver but could also notify emergency contacts or fleet management systems when critical drowsiness levels were recorded. This extension would transform the solution from a simple alert system to a proactive accident-prevention and safety management tool. Thus, the study highlighted how low-cost, sensor-driven solutions, when integrated with advanced communication and analytics, could substantially enhance driver safety and road accident prevention.

R. Krishnan *et al.* [3] presented a system for alcohol detection and vehicle ignition control that utilized the MQ-3 alcohol sensor integrated with an Arduino microcontroller to enhance road safety. The system was designed to analyse the alcohol concentration in a driver's breath, and if the value exceeded a predefined threshold, the ignition circuit of the vehicle was automatically disabled, preventing the engine from starting. This direct intervention mechanism effectively discouraged drunk driving by ensuring that intoxicated drivers could not operate their vehicles. The authors emphasized that the MQ-3 sensor, known for its high sensitivity to ethanol vapours, offered a reliable method for identifying alcohol consumption in real time, making it a practical choice for low-cost safety solutions.

Their experiments demonstrated that the system could consistently detect alcohol within seconds, offering immediate feedback and control. However, the study also highlighted some limitations related to environmental influences. Factors such as humidity, temperature, and the presence of other volatile gases could affect sensor readings, leading to possible false positives or reduced accuracy over time. These challenges necessitated periodic calibration of the sensor to maintain reliability, particularly in diverse driving environments. The researchers suggested that calibration routines could be automated or supplemented with advanced filtering algorithms to address these environmental interferences.

In addition to ignition control, the authors proposed extending the system's capabilities by integrating it with GSM and GPS modules. Such an integration would allow the system not only to prevent the vehicle from starting but also to send emergency alerts or notifications to authorities, family members, or fleet managers if intoxication was detected. This enhancement could transform the system from a preventive tool into a comprehensive safety solution that actively engages emergency communication channels. The study concluded that incorporating alcohol detection into vehicular systems could significantly reduce one of the leading causes of traffic accidents worldwide—drunk driving—and emphasized its potential for integration into both private vehicles and commercial fleets to improve overall transportation safety.

A. Kumar *et al.* [4] designed a cost-effective accident detection and alert system by integrating an ADXL335 accelerometer with GPS and GSM modules, controlled through an Arduino microcontroller. The accelerometer was tasked with continuously monitoring acceleration along multiple axes, and sudden changes beyond a predefined threshold were interpreted as collision events. Once such an event was detected, the system immediately collected GPS



coordinates to identify the exact accident location and transmitted these details via GSM to preconfigured emergency contacts. This rapid communication reduced the dependency on external reporting and enabled emergency services to be dispatched more quickly, thereby addressing the critical time gap that often determines survival rates in road accidents.

The authors validated their design through experimental testing, which showed reliable detection of collision scenarios and swift message delivery within a matter of seconds. The use of low-cost sensors and open-source hardware platforms made the system both affordable and accessible, presenting a viable solution for large-scale deployment in developing regions where advanced safety features are often absent in vehicles. However, the researchers also observed certain drawbacks. The system occasionally generated false alarms, particularly when the vehicle traversed rough terrains, speed breakers, or potholes, where the accelerometer registered abrupt movements that mimicked collision signatures. To overcome this issue, the study suggested the implementation of adaptive thresholding or machine learning algorithms capable of distinguishing between normal driving vibrations and actual accidents.

In addition, the authors emphasized that the integration of GPS and GSM modules extended the utility of their system beyond simple detection. By ensuring that real-time location data was transmitted immediately after an incident, the system created a direct channel of communication between vehicles and emergency responders. This could significantly reduce the "golden hour" response delay, which is critical in saving lives. The researchers also pointed to future advancements where such systems could be linked with centralized databases, traffic management centres, or hospital networks to enhance large-scale accident management. Overall, their work demonstrated that combining accelerometers with communication technologies provides a practical, low-cost framework for accident detection, while highlighting the importance of continuous innovation to minimize false triggers and increase reliability under real-world driving conditions.

P. Singh *et al.* [5] developed a comprehensive vehicle safety prototype that combined multiple modules, including alcohol detection, accident detection, and GSM-based emergency alerts, into a single unified framework. The system employed Arduino as the central processing unit to coordinate data from various sensors and generate corresponding outputs. For alcohol detection, the MQ-3 sensor was used to monitor the driver's breath and prevent vehicle ignition if intoxication was detected. Accident detection was managed using an accelerometer that identified sudden changes in motion, while a GPS module retrieved real-time location data, which was then transmitted through GSM to emergency contacts. Additionally, buzzers and alert systems were incorporated to provide immediate warnings in critical situations. This multi-layered approach provided both preventive and responsive measures, making it more effective than single-feature systems.

The authors emphasized that their innovation lay in the integration of different safety features into a single low-cost platform. By combining preventive measures such as alcohol detection and drowsiness monitoring with responsive actions like automatic emergency alerts, the system addressed multiple dimensions of road safety simultaneously. Experimental results validated the reliability of sensor fusion, as the coordinated use of multiple modules reduced the probability of missed detections compared to standalone solutions. However, the prototype was tested only on a small scale and under controlled conditions, limiting its ability to fully represent real-world driving environments. The authors noted that large-scale implementation would require additional calibration and field testing to handle factors such as varying road conditions, climate, and user behaviour.



III. PROPOSED METHODOLOGY

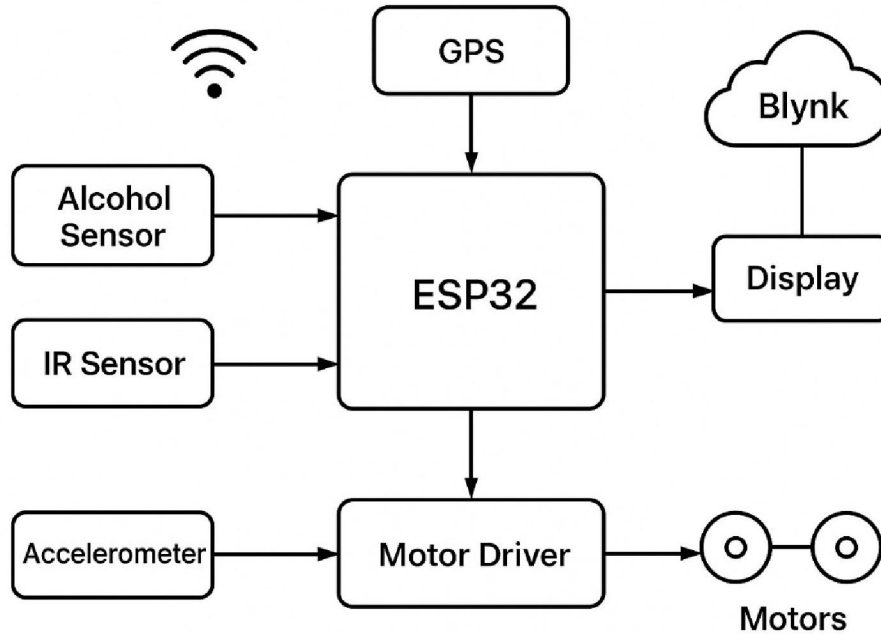


Fig. Block Diagram of proposed system

ESP32:

The ESP32 serves as the main controller, managing all connected sensors and modules. With its built-in Wi-Fi and Bluetooth, it can automatically send emergency alerts to mobile devices or servers. The dual-core processor allows simultaneous monitoring of the accelerometer, eye blink sensor, and other critical inputs, ensuring fast and reliable detection of driver drowsiness or accidents. ESP32 supports multiple GPIO pins, enabling seamless integration with sensors like ADXL335, eye blink sensor, as well as GPS and GSM/A9G modules for real-time location tracking and message transmission. Its low power consumption ensures consistent operation, while its processing capabilities allow it to detect accidents or abnormal driver behavior and trigger prevention or alert mechanisms.

Alcohol Sensor (MQ-3):

The alcohol sensor detects the presence of alcohol in the driver's breath. It changes its resistance when exposed to alcohol vapours and produces a corresponding voltage output. Arduino reads this value and, if it exceeds a threshold, the vehicle is stopped through the motor driver and an alert message is generated.

Eye Blink Sensor:

The eye blink sensor works using infrared rays to monitor the driver's eye activity. Normal blinking produces quick responses, but if the eyes remain closed for a longer time, the Arduino interprets it as drowsiness. In such a case, the buzzer is activated to alert the driver immediately.

Accelerometer:

The accelerometer continuously senses acceleration and tilt of the vehicle along three axes. In the event of a collision or sudden impact, there is an abrupt change in values which is detected by the Arduino. This is considered an accident condition and triggers the alert mechanism.



GPS Module:

The GPS module receives signals from satellites to calculate the latitude and longitude of the vehicle. It sends this location data to Arduino in real time. During an accident, Arduino fetches the current coordinates from GPS to include in the emergency alert message.

Motor Driver (L298N) and DC Motors:

The L298N motor driver receives control signals from Arduino and powers the DC motors accordingly. Under safe driving conditions, the motors run normally, but when alcohol or accident conditions are detected, Arduino instructs the motor driver to cut off power, thereby stopping the vehicle

Expected Conclusion

This paper presents an Arduino-based Vehicle Accident Detection, Prevention, and Reporting System that integrates multiple safety features, including alcohol sensing, drowsiness monitoring, accident detection, and IoT-enabled alert mechanisms. The alcohol sensor and eye-blink sensor are employed to ensure preventive safety by restricting vehicle operation when the driver is intoxicated or drowsy, thereby reducing the chances of accidents before they occur. The ADXL accelerometer continuously monitors sudden changes in acceleration to provide reliable accident detection, while the GPS module is responsible for instant reporting of the vehicle's location to emergency contacts via alerts containing Google Maps links. The prototype is being designed to identify unsafe driving behaviours, detect accidents in real time, and generate timely alerts that minimize delays in emergency response. By combining multiple sensors with low-cost embedded hardware such as ESP32 and L298N motor driver, the system aims to enhance road safety while remaining cost-effective and scalable. Moreover, the integration of different modules into a unified framework provides a seamless safety solution that not only focuses on accident detection but also emphasizes prevention. Future developments will include cloud connectivity for remote monitoring, adaptive thresholding techniques to reduce false accident triggers on rough terrains, and deployment in large-scale vehicular networks to evaluate its efficiency in real-world conditions. With these enhancements, the system has the potential to serve as a practical and affordable safety solution for intelligent transportation systems, improving driver monitoring, accident response times, and overall traffic management.

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