

Implementation of Vehicle Accident Detection and Reporting System

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ABSTRACT

Road traffic accidents are a major safety concern, where delays in accident identification and emergency medical response can significantly increase the risk of fatalities. This paper presents the implementation of a Vehicle Accident Detection and Reporting System designed to automatically detect vehicular accidents and rapidly communicate accident information to emergency contacts. The proposed system integrates an Arduino Uno R3, MEMS accelerometer, GPS module, GSM module, LCD display, buzzer, and motor control unit. The MEMS sensor continuously monitors vehicle movement and identifies abnormal acceleration or tilt corresponding to an accident. Once an accident is detected, the Arduino processes the sensor information, obtains the geographical coordinates through the GPS module, and uses the GSM module to transmit an SMS containing the accident location and impact direction. The developed prototype identifies right-, left-, front-, and rear-impact conditions and performs corresponding notification and safety actions. The proposed system therefore provides an economical and automated approach for reducing accident-reporting delays and improving emergency response.

Keywords— Accident Detection, Arduino Uno, MEMS Accelerometer, GPS, GSM, Vehicle Safety, Emergency Alert, SMS.

INTRODUCTION

The rapid increase in road traffic accidents has become a significant concern because accidents frequently result in fatalities, injuries, and property damage. One of the major factors influencing accident severity is the delay between the occurrence of an accident and the arrival of medical assistance. Conventional accident-reporting methods often depend on drivers, passengers, or bystanders to inform emergency services, resulting in delayed or incomplete communication. Therefore, an automated mechanism capable of detecting an accident and immediately reporting its location is required.

The proposed Vehicle Accident Detection and Reporting System addresses this problem through the integration of sensing, processing, positioning, and wireless communication technologies. An Arduino-based control unit receives information from the MEMS accelerometer to identify abnormal vehicle movement or impact. After detecting an accident, the GPS module determines the geographical position, while the GSM module automatically sends the accident information through SMS. This reduces dependence on manual reporting and establishes a direct communication mechanism between the accident location and emergency contacts or treatment centres.

LITERATURE SURVEY

Sulaiman and Othman [1] proposed a Vehicle Accident Avoidance System using ultrasonic sensors, cameras, and radar for monitoring the surroundings of a vehicle. Their system incorporated functions such as Forward Collision Warning, Automatic Emergency Braking, and Lane Departure Warning to reduce collision probability. The study also identified artificial intelligence and Vehicle-to-Everything communication as possible improvements for future vehicle safety systems. Devkar *et al.* [2] developed an Accident Prevention System employing electronic sensing and embedded processing technologies for identifying potential vehicle hazards. Their approach emphasized continuous environmental monitoring and automatic intervention to reduce accidents resulting from driver distraction and delayed human reaction.

Vinod and Durdi [3] investigated collision avoidance in vehicles using Controller Area Network (CAN) technology. The system allows information obtained from sensors such as radar, ultrasonic sensors, and cameras to be transmitted to the vehicle control unit, where potential collision conditions are evaluated. Safety operations such as braking and steering adjustment can subsequently be initiated. Kuttukkaran *et al.* [4] proposed an intelligent accident detection and alert system that employs accelerometers and gyroscopes to recognize abnormal vehicle motion. After detecting an accident, the system automatically communicates GPS coordinates and accident-related information to emergency medical services, reducing delays associated with manual reporting.

PROBLEM STATEMENT

Road accidents, particularly those involving two-wheelers, can lead to fatalities when emergency assistance is delayed. Existing conventional approaches do not always provide an automated and reliable method for detecting accidents and immediately notifying emergency contacts with accurate location information.

OBJECTIVES

The main objectives of the proposed work are:

1. To design and implement an automatic vehicle accident detection system using a MEMS sensor and Arduino controller for identifying abnormal vehicle impacts and accident directions.
2. To determine the accident location using GPS and automatically transmit accident information to predefined emergency contacts through GSM communication.

PROPOSED SYSTEM

The proposed system integrates an Arduino Uno R3, MEMS accelerometer, GPS modem, GSM SIM module, 16×2 LCD display, alarm/buzzer, engine or DC motor, and regulated power supply. The Arduino acts as the central controller and continuously processes signals obtained from the MEMS accelerometer. The block diagram in the project report shows the MEMS sensor, GPS module, GSM module, LCD, alarm, and engine interfaced with the Arduino Uno R3.

Under normal operating conditions, the vehicle continues to operate while the controller monitors acceleration. When abnormal movement exceeds the predetermined condition, the controller interprets the corresponding sensor axis to determine the direction of impact. The GPS module then provides location coordinates and the GSM module transmits the accident information as an SMS. The LCD indicates system status, the buzzer produces a local warning, and the motor is stopped as a safety operation.

BLOCK DIAGRAM

Fig. 1 shows the block diagram of the Vehicle Accident Detection and Reporting System, with the Arduino Uno R3 acting as the main controller. The MEMS sensor detects accident conditions, while the GPS and GSM modules provide location tracking and alert communication; the LCD, alarm, and engine control provide system indication and safety response.

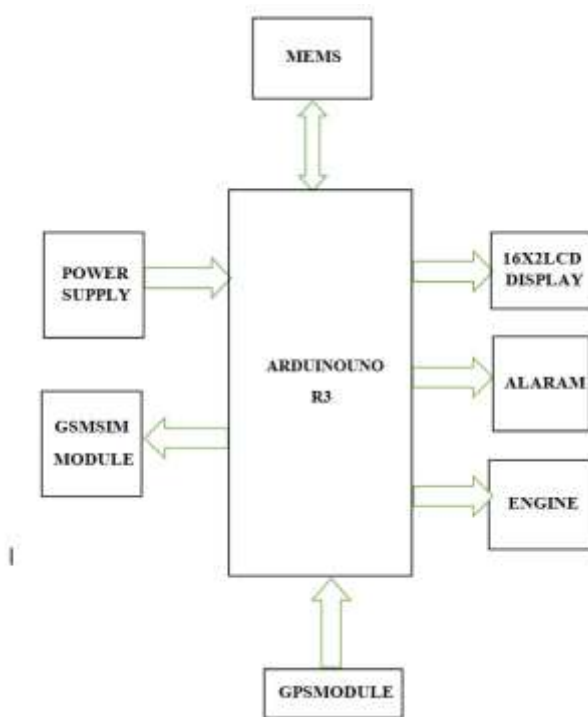


Fig 1 block diagram

CIRCUIT DIAGRAM

Fig. 2 shows the circuit diagram of the vehicle accident detection and reporting system, illustrating the electrical connections between the microcontroller, sensing, indication, and motor-control sections. The circuit coordinates sensor inputs with LED/buzzer indications and relay-based motor control to provide the required safety response.

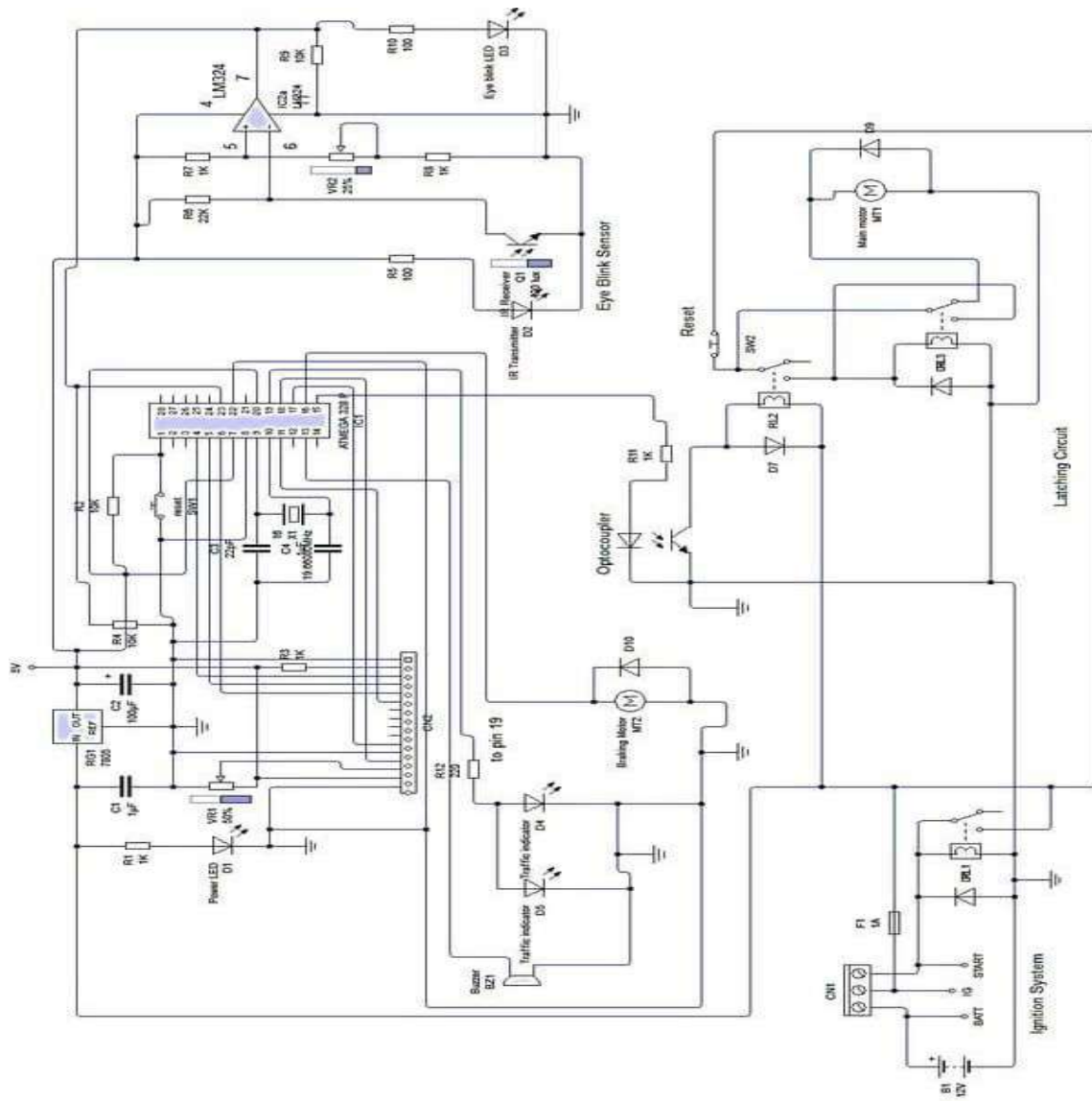


Fig 2 Circuit diagram of Vehicle accident detection and reporting system

PROPOSED SYSTEM

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METHODOLOGY

The methodology begins with continuous monitoring of the vehicle using the MEMS accelerometer. The sensor generates signals corresponding to movement along different axes, which are processed by the Arduino Uno. Depending on the direction and magnitude of movement, the controller determines whether the vehicle is operating normally or whether an accident condition has occurred. Arduino IDE 1.8.19 is used to write, compile, and upload the control program to the Arduino board.

After an accident is identified, the controller activates the GPS module to obtain the geographical coordinates of the accident. The GSM module subsequently transmits an SMS containing the location and detected impact direction to the predefined contact. Simultaneously, the LCD displays accident and message-transmission information, the buzzer provides an audible warning to nearby individuals, and the motor is switched OFF. The complete signal flow from accident detection through location acquisition, notification, and motor control enables rapid emergency reporting.

RESULTS AND DISCUSSION

The **Fig. 3** developed prototype was tested under both normal and simulated accident conditions to evaluate its performance. During an accident, variations in the MEMS accelerometer signals were used to determine the direction of impact. A **left-side accident** was identified by negative X-axis movement, while positive Y-axis acceleration indicated a **front accident**, and negative Y-axis movement represented a **rear-impact condition**. Once an accident was detected, the GPS module obtained the location coordinates and the GSM module transmitted the accident location and corresponding impact direction through SMS.

The system also provides an LCD indication of the detected condition and message-transmission status. After accident detection, the motor is switched OFF as a safety measure and an audible buzzer is activated to attract the attention of nearby people. Emergency contacts receiving the SMS can use the transmitted GPS coordinates to identify the accident location. These results demonstrate the capability of the prototype to integrate accident detection, impact-direction identification, location tracking, local warning, and wireless emergency notification within a single system.



Fig 3 hardware setup

CONCLUSION

The Vehicle Accident Detection and Reporting System demonstrates the successful integration of Arduino, MEMS sensing, GPS positioning, and GSM communication for automatic accident detection and emergency notification. The system detects abnormal vehicle movements, determines the direction of impact, obtains real-time accident-location information, and communicates the corresponding details through SMS.

The developed system provides a practical approach for improving road safety by minimizing the delay between accident occurrence and emergency notification. Its modular architecture also provides opportunities for future integration with IoT platforms, mobile applications, centralized emergency databases, and advanced intelligent transportation systems.

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