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Car Accident Detection using GPS&GSM

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ABSTRACT: This paper explore the creation and use of an Accident Alert System that brings together GPS, GSM, and accelerometer technology. The goal of the system is to quickly identify and report car accidents, helping to speed up emergency response times and possibly saving lives or reducing injuries. By combining these technologies, the system can track vehicle movements in real time, detect crashes by analyzing data from the accelerometer, and rapidly send out information about the accident to emergency services or chosen contacts. In this paper, we look at how the system is designed, what components are used, how it works, and where it could be applied. The main focus is on how important this system could be for improving vehicle safety and emergency response.

KEYWORDS: Accident Alert System, GPS, GSM, Accelerometer, Vehicle Safety, Emergency Response

I. INTRODUCTION

The development of accident detection and reporting systems has gained significant attention in recent years due to the rise in traffic accidents. [1] introduced an automated accident detection framework for two-wheelers, incorporating communication technologies to provide timely incident reporting. Building on this concept, [2] proposed an IoT-based smart accident detection and alert system, integrating sensors for real-time detection and alert transmission. [3] explored the use of GPS, GSM, and buzzers in accident detection systems, enabling vehicles to communicate their location and alert nearby medical services. [4] advanced this idea by focusing on a GSM- and GPS-based accident detection system that automatically sends location data to predefined emergency contacts.[5] developed a vehicle Tracking system using GPS and GSM to continuously monitor vehicle status and location during accidents.[6-7]further enhanced accident detection systems by adding accelerometers to detect vehicle impact, transmitting precise accident data using wireless communication technologies. Finally, [8-9]contributed by refining GPS- and GSM-based vehicle tracking and accident detection systems, emphasizing faster response times to emergencies. Together, these efforts highlight the importance of integrating modern communication technologies in accident detection and prevention systems.

II. RELATED WORK

Meena et al. (2014) proposed an Automatic Accident Detection and Reporting Framework for Two-Wheelers that employs GPS and GSM to send accident alerts in real-time, providing timely reporting to emergency responders. This system focuses on two-wheelers, where the need for swift reporting is crucial due to high accident rates and potential vulnerability [1].

Building on this, Suresh Babu et al. introduced an IoT-based Smart Accident Detection and Alert System designed to detect accidents in real-time using various sensors and IoT technologies. This system not only detects accidents but also sends alerts to designated emergency contacts via wireless networks, enhancing the speed of communication [2].

Muhammad Ahmad Baballe et al developed an Accident Detection System with GPS, GSM, and a Buzzer, which integrates buzzers as an additional alert mechanism, notifying not only emergency services but also people in the surrounding area. This design aims to increase the likelihood of immediate help through both communication channels and audible warnings [3].

Similarly, Dangat et al presented a GSM and GPS Based Accident Detection System where accident detection is achieved through GPS, and GSM is used to send notifications to pre-set emergency contacts. This system focuses on making emergency alerting more efficient by automating the entire notification process without human intervention [4].

Gajjar and Desai (2018) worked on a Vehicle Accident Detection and Tracking System using GPS and GSM. Their system is equipped to track the vehicle in real time, continuously transmitting location data to a control center, allowing for ongoing monitoring and quick responses in case of an accident [5].

Mishra et al (2017) and Ravi & Kumar (2016) advanced these systems by incorporating accelerometers for more accurate detection of accidents. Their systems can distinguish between normal driving conditions and actual accidents, ensuring that emergency alerts are sent only when needed. This refinement helps in minimizing false alarms while maintaining accuracy in detecting accidents [6-7].

Sharma et al (2015) focused on Design and Development of Vehicle Accident Detection Systems using GPS and GSM Technology, which contributed further by enhancing communication protocols, allowing faster data transmission from the vehicle to emergency services. Their system significantly reduces the time between accident occurrence and emergency response [8].

Tadesse & Bayu (2019) emphasized the need for efficient tracking alongside detection in their Vehicle Accident Detection and Tracking System using GPS and GSM. Their system ensures that emergency responders can track the exact location of an accident, facilitating quicker and more effective intervention [9].

We referred to the work of Pallavi Deshpande et al. (2019) & (2021) to guide the structure, format, and flow of this paper for conference publication. While their studies informed our organizational approach, no direct content or references were used, ensuring the originality of this work [10-11]

III. BLOCK DIAGRAM

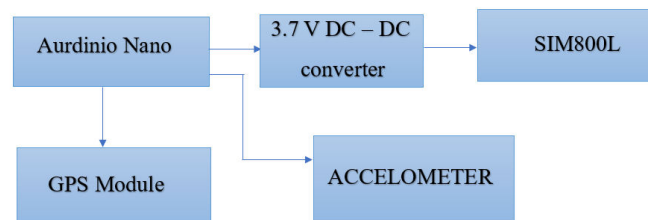


Fig 1. Block Diagram.

A Car Accident Detection System using Arduino, GPS, and GSM modules, along with a 3.4 V chopper (DC-DC converter), functions to detect accidents, retrieve the car's location, and send a notification to emergency contacts with the accident's location. Below is a breakdown of the components and their roles in the system, followed by an explanation of the block diagram.

Block Diagram Components:

Power Supply (Battery & 3.7 V Chopper): Battery: This supplies the system with the necessary power. In a vehicle, the power typically comes from the vehicle's 12V battery. 3.4 V Chopper (DC-DC Converter): This is a voltage regulator or buck converter used to step down the 12V input from the vehicle's battery to a stable 3.4V or 5V output, which is suitable for powering the Arduino, GPS, and GSM modules [Fig 1].

Arduino (Microcontroller): The Arduino serves as the central processing unit, collecting and processing signals from accelerometers to detect accidents, communicating with GPS for location data retrieval, and controlling the GSM module for message sending.

Accelerometer: The accelerometer detects sudden changes in a vehicle's speed or orientation, indicating potential accidents. It senses acceleration forces along X, Y, and Z axes and sends data to the Arduino. If deceleration or impact exceeds a threshold, the Arduino triggers accident detection [Fig 1].

GPS Module: The GPS module retrieves the vehicle's location after an accident, communicating with the Arduino via serial communication using TX/RX pins. The Arduino then requests the GPS module's location data upon detection. [Fig 1]

GSM Module: The Arduino uses the GSM module to send SMS alerts to predefined emergency contacts when an accident is detected and GPS data is retrieved. This information, along with GPS coordinates, aids emergency services in quickly reaching the accident location. [Fig 1]

IV. METHODOLOGY

The methodology for implementing a Car Accident Detection System using GPS and GSM involves several stages, from hardware integration to programming and testing. Below is a step-by-step breakdown of the process [Fig 2]:

1. Requirements and Component Selection

The first step is to identify the necessary hardware and software components required for the system.

Hardware Components:

Arduino (Microcontroller): Acts as the central unit controlling the sensors, GPS, and GSM modules.

GPS Module (e.g., NEO-6M): For retrieving real-time location data (latitude and longitude) of the vehicle.

GSM Module (e.g., SIM900/SIM800): For sending SMS notifications with location details to emergency contacts.

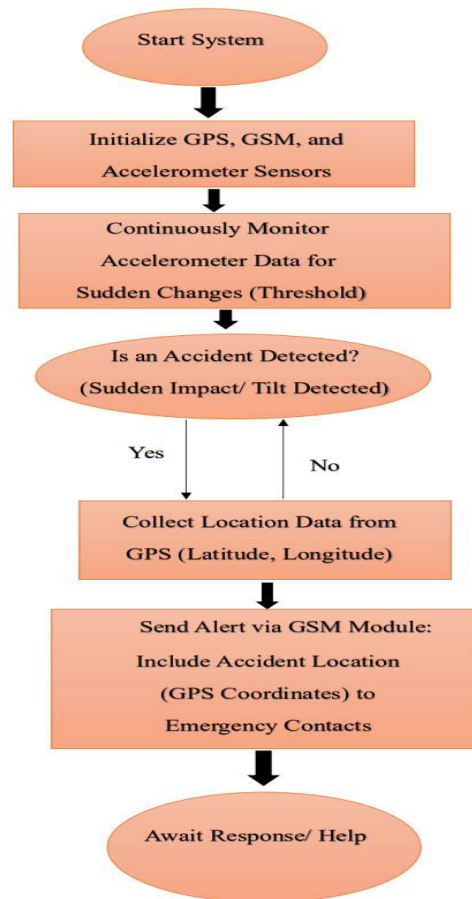
Accelerometer (e.g., ADXL345): For detecting abrupt changes in vehicle speed or orientation, indicating a possible accident.

3.7 V Chopper (DC-DC Converter): as per [Fig 3] For stepping down the vehicle's battery voltage (12V) to a stable voltage (3.7V or 5V) to power the Arduino and other components.

Power Supply (12V Battery): Usually the vehicle's battery, which powers the entire system.

Software: Arduino IDE: For writing and uploading the code to the Arduino microcontroller.

Embedded C or C++: Programming language to write the code for the system.



AT Commands for GSM Module: Used to control the GSM module for sending SMS.

Fig 2. Project Methodology.

2. System Design and Architecture

The design of this system involves hardware setup, sensor integration, and system communication. The accelerometer monitors the vehicle's movements, detecting significant changes in acceleration that indicate an accident. The Arduino code sets threshold values, and if the measured acceleration exceeds this threshold, the system assumes an accident has occurred. Once an accident is detected, the GPS module retrieves the current location in latitude and longitude. The Arduino uses the GSM module as per [Fig 5] to send a pre-configured SMS to emergency contacts with GPS coordinates and a brief message about the accident. The system is implemented by connecting the accelerometer, GPS module, and GSM module to the Arduino, regulating power from the 12V car battery, and connecting an LCD display or emergency button for manual accident alerts.

3: Software Development

Programming the Arduino: The system consists of key functions such as an accelerometer detection logic, GPS data retrieval, and GSM communication. It is tested in a controlled environment to ensure accurate detection of sudden deceleration and triggers alerts. The GPS module retrieves location data after an accident, and the GSM module sends SMS alerts to emergency contacts. Real-time data is displayed on an LCD during testing. The threshold value is adjusted to differentiate between actual crashes and normal driving conditions. The system is also simulated by creating rapid deceleration to ensure appropriate system response.

Field Testing: Test the system in real-world driving conditions to ensure reliability and robustness. Check that the SMS is sent even in low GSM signal areas and that the GPS location is accurate.

4. Optimization and Improvements

Reduce False Positives: Use advanced signal processing or machine learning algorithms to analyze accelerometer data and reduce false positives caused by minor impacts or sudden braking.

Power Management: Implement low-power modes to reduce the system’s energy consumption when the vehicle is idle or parked, especially for electric vehicles.

Integration with Cloud or IoT Platforms: Consider integrating the system with an IoT platform or cloud database to store and analyze accident data for predictive analysis and improved accident response times. The process of deploying an accident detection unit in a vehicle involves verifying its functionality, installing the accelerometer, and powering it from the vehicle's battery using a 3.4 V chopper. Users, such as drivers, are trained on the system's operation, maintenance, and emergency button trigger

V. CIRCUIT DIAGRAM.

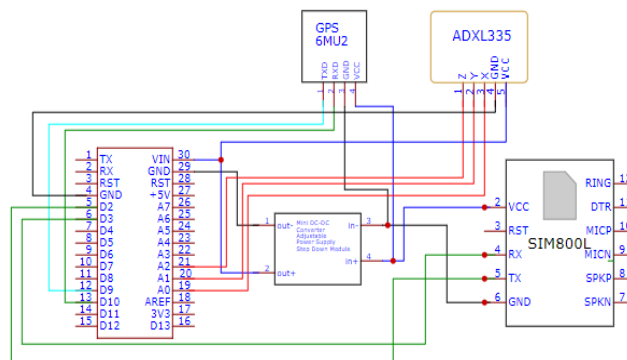


Fig 3. Circuit Diagram

To implement a Car Accident Detection System using GPS & GSM with the components mentioned, here’s how you would connect each component to an Arduino Nano:

Components:

- Arduino Nano
- 3.4V DC-DC Chopper (Buck Converter) for powering SIM800L module
- GPS Module (GPS6MU2) for location tracking
- Accelerometer (ADXL355) for accident detection via motion sensing
- GSM Module (SIM800L) for sending emergency messages

SIM800L GSM Module:

- VCC: Connect to the 3.4V output of the DC-DC chopper (not directly to Arduino Nano as it needs lower voltage).
- GND: Connect to the common ground.
- TX (Transmit): Connect to Arduino Nano’s RX (D0) pin.
- RX (Receive): Connect to Arduino Nano’s TX (D1) pin.
- The GSM module sends the emergency message with GPS coordinates to predefined phone number.

VI.PROJECT VIEW

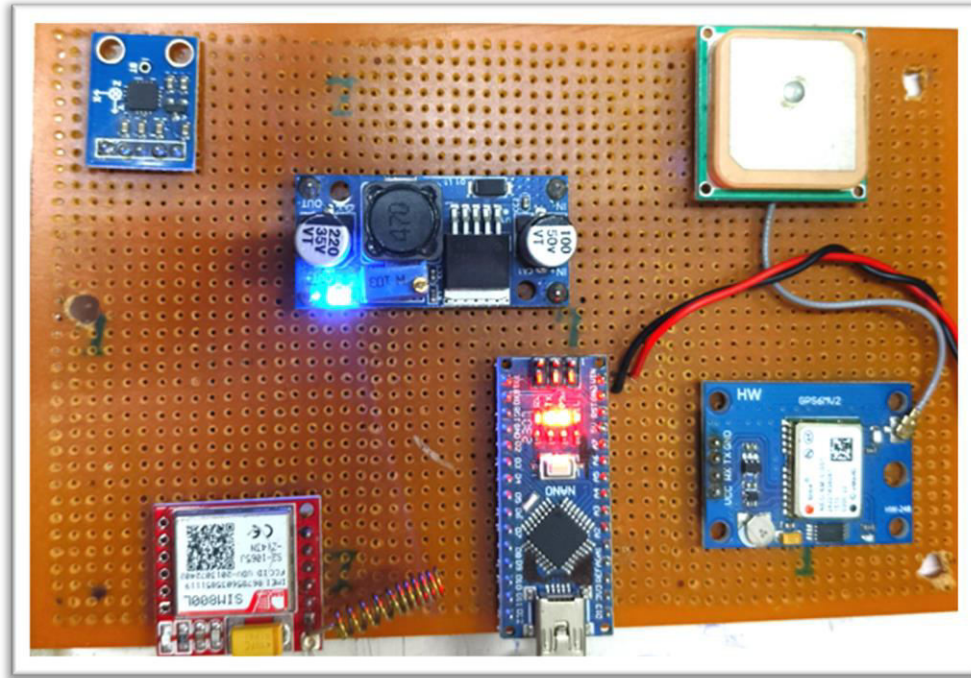


Fig No - 4

VII. PROJECT OUTCOME

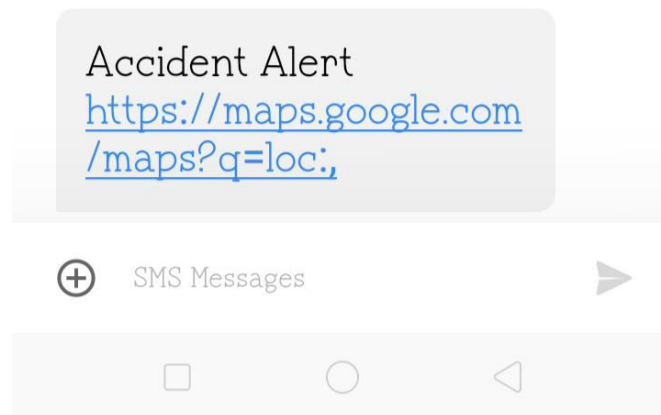


Fig No-5

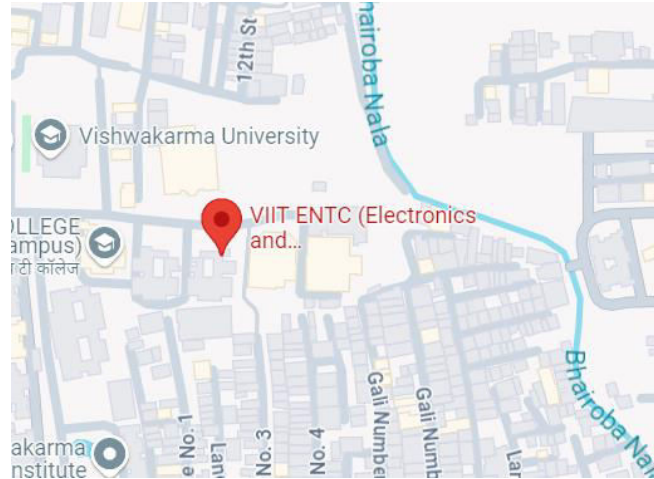


Fig No-6

VIII. CONCLUSION

The implementation of car accident detection using GPS and GSM technology represents a significant advancement in automotive safety and emergency response. This system leverages GPS for accurate location tracking and GSM for real-time communication, enabling swift notifications to emergency services and designated contacts in the event of an accident. The primary advantage of this technology is its potential to reduce response time, which is critical in emergencies. By automatically sending alerts with precise location coordinates, the system minimizes delays associated with manual reporting, thereby enhancing the chances of timely medical assistance for accident victims. Moreover, the integration of such systems can lead to improved data collection on accident patterns, facilitating better road safety measures and urban planning. The system's user-friendly interface and automation can also alleviate the stress for drivers during critical situations. However, challenges such as reliance on network coverage, potential system malfunctions, and privacy concerns must be addressed to ensure effective deployment. Future developments could include integrating advanced sensors for detecting impact severity and vehicle orientation, further improving response strategies. In conclusion, car accident detection systems using GPS and GSM not only enhance road safety but also represent a proactive approach to emergency management, ultimately aiming to save lives and reduce the consequences of road traffic accidents.

IX. FUTURE SCOPE

The future scope of car accident detection using GPS and GSM technology is promising and multifaceted. As vehicular technology continues to advance, integrating GPS and GSM systems can lead to more accurate real-time monitoring of vehicle locations and conditions. Enhanced algorithms utilizing machine learning can improve the detection of accidents, reducing false positives and enabling quicker response times. Additionally, integrating these systems with smart city infrastructure can facilitate better traffic management and emergency services coordination. With the rise of connected vehicles and the Internet of Things (IoT), the potential for vehicle-to-everything (V2X) communication will further enhance safety measures. Overall, these technologies can significantly reduce response times, enhance driver safety, and contribute to better accident management strategies.

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11. International Journal of Computing and Digital Systems ISSN (2210-142X) Int. J. Com. Dig. Sys. 10, No.1 (Aug2021)E-mail:archana.ratnaparakhi@viit.ac.in, pallavi.deshpande@viit.ac.in, gauri.ghule@viit.ac.in <http://journals.uob.edu.bh> A Framework for Segmentation and Classification of Arrhythmia Using Novel Bidirectional LSTM Network Archana Ratnaparkhi1 , Pallavi Deshpande1 and Gauri Ghule1



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