Vehicle Accident Detection and Alert System

Group Number:22

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Introduction

- Road accidents are one of the leading causes of injury and death globally, often exacerbated by delayed emergency responses. In many cases, victims fail to receive timely medical assistance due to the absence of automated alert systems. With the rapid growth of embedded systems and IoT technologies, there is an increasing need for intelligent, real-time vehicle safety mechanisms.
- This project, titled **"Vehicle Accident Detection and Alert System,"** is designed to address this issue using an **ESP32 microcontroller** as the central unit. It detects accidents through an **accelerometer or vibration sensor**, retrieves the **real-time GPS coordinates**, and sends **SMS alerts via a GSM module** to preconfigured emergency contacts.
- Additional components include a **manual SOS button** for non-collision emergencies, a **buzzer and vibration motor** for immediate alerts, and an **LCD**
- **display** for system status. The system is built to be **compact**, **energy-efficient**, and **easily deployable in any vehicle**, regardless of type.

Problem Statement & Objectives

- Road accidents often result in severe injuries or fatalities due to delays in emergency response. Many vehicles lack automatic alert systems to notify nearby help or family in the event of an accident. Manual reporting can be impossible if the victim is unconscious. There is a critical need for a cost-effective, real-time accident detection and alert system that can operate independently and immediately notify emergency contacts.
- Objectives:

- To **automatically detect accidents** using a vibration sensor or accelerometer.
- To **fetch real-time GPS coordinates** of the accident location.
- To **send SMS alerts** using the GSM module to pre-configured emergency contacts.
- To **display system status** and messages using an LCD display.
- To **trigger audible and vibration alerts** using a buzzer and motor.
- To **include a manual SOS button** for triggering alerts in non-collision emergencies.
- To design a **cost-effective and portable embedded system** that can be installed in any vehicle.
- To provide a system that can be later **extended with real-time tracking, mobile apps, or cloud integration.**

Hardware Used

Component	Specification	Purpose / Role in System
ESP32 Development Board	Wi-Fi & Bluetooth-enabled MCU	Acts as the main controller to process sensor data and control output devices like GSM, GPS, buzzer, etc.
NEO-M8N GPS Module	Real-time GPS data, UART interface, 3.3–5V	Captures precise latitude and longitude of the vehicle's location.
SIM800L GSM Module	Quad-band GSM, AT command support	Sends SMS alerts with location info to emergency contacts.
GY-61 Accelerometer (ADXL335)	3-axis analog accelerometer, ±3g range	Detects sudden motion or collision using change in acceleration.
I2C 1602 LCD Display	16x2 characters, I2C interface	Displays system status messages like accident alert or GPS lock.
Electronic Buzzer	5V active buzzer	Produces an audible sound during an alert event.
DC Motor with MOSFET Driver	3–6V DC motor + IRFZ44N	Provides vibration as physical feedback during alert activation.
Push Button	Tactile switch, digital input	Manual trigger to send an SOS alert when pressed.
Li-Ion Battery + Voltage Regulator	3.7V 1500mAh + 5V boost converter	Portable power source for the entire system.
Miscellaneous Components	Resistors, capacitors, jumper wires	Supportive circuit components for stable and reliable operation.

Block Diagram

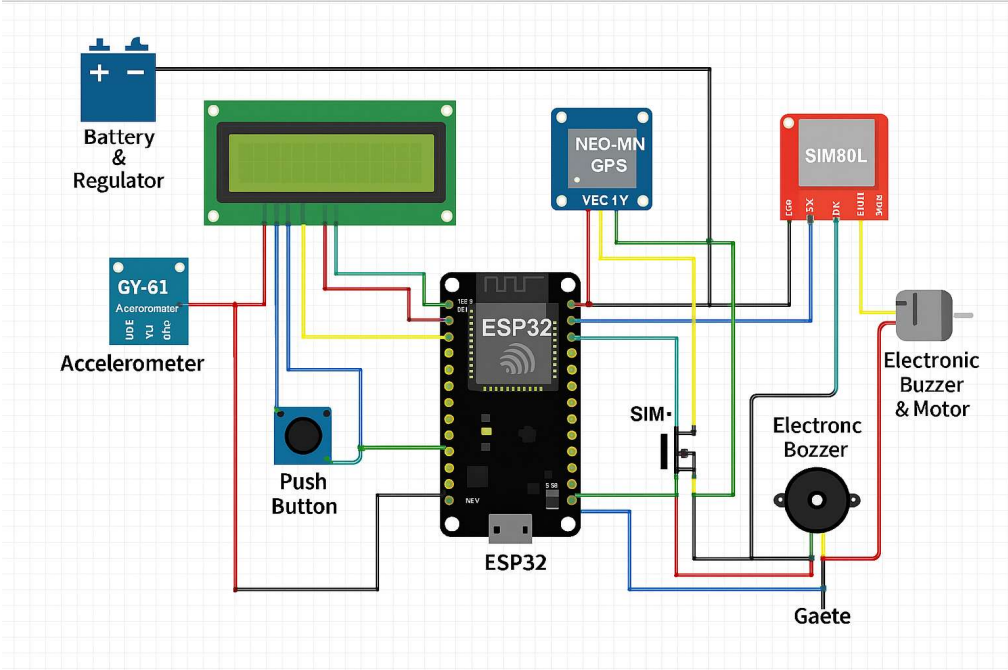
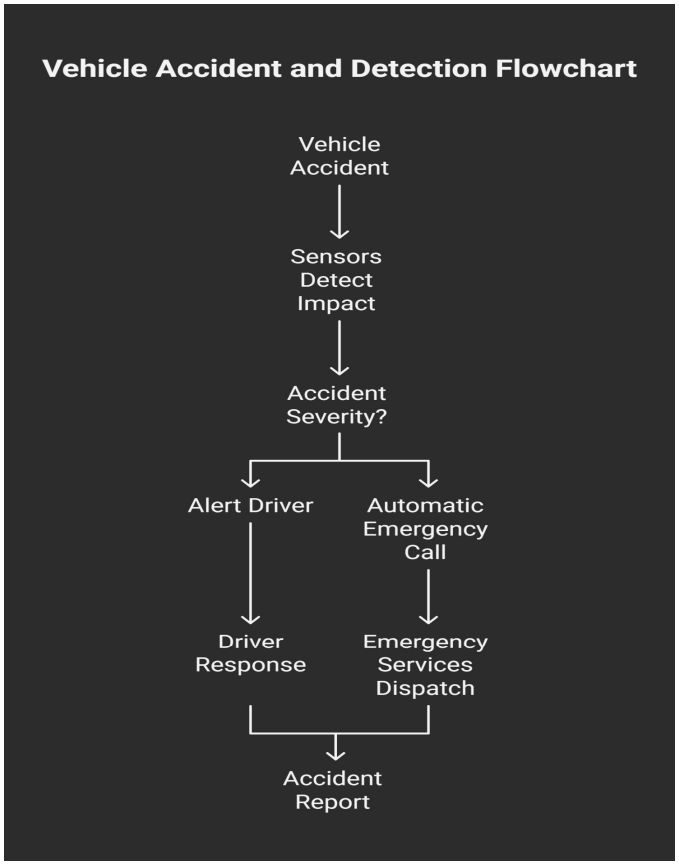
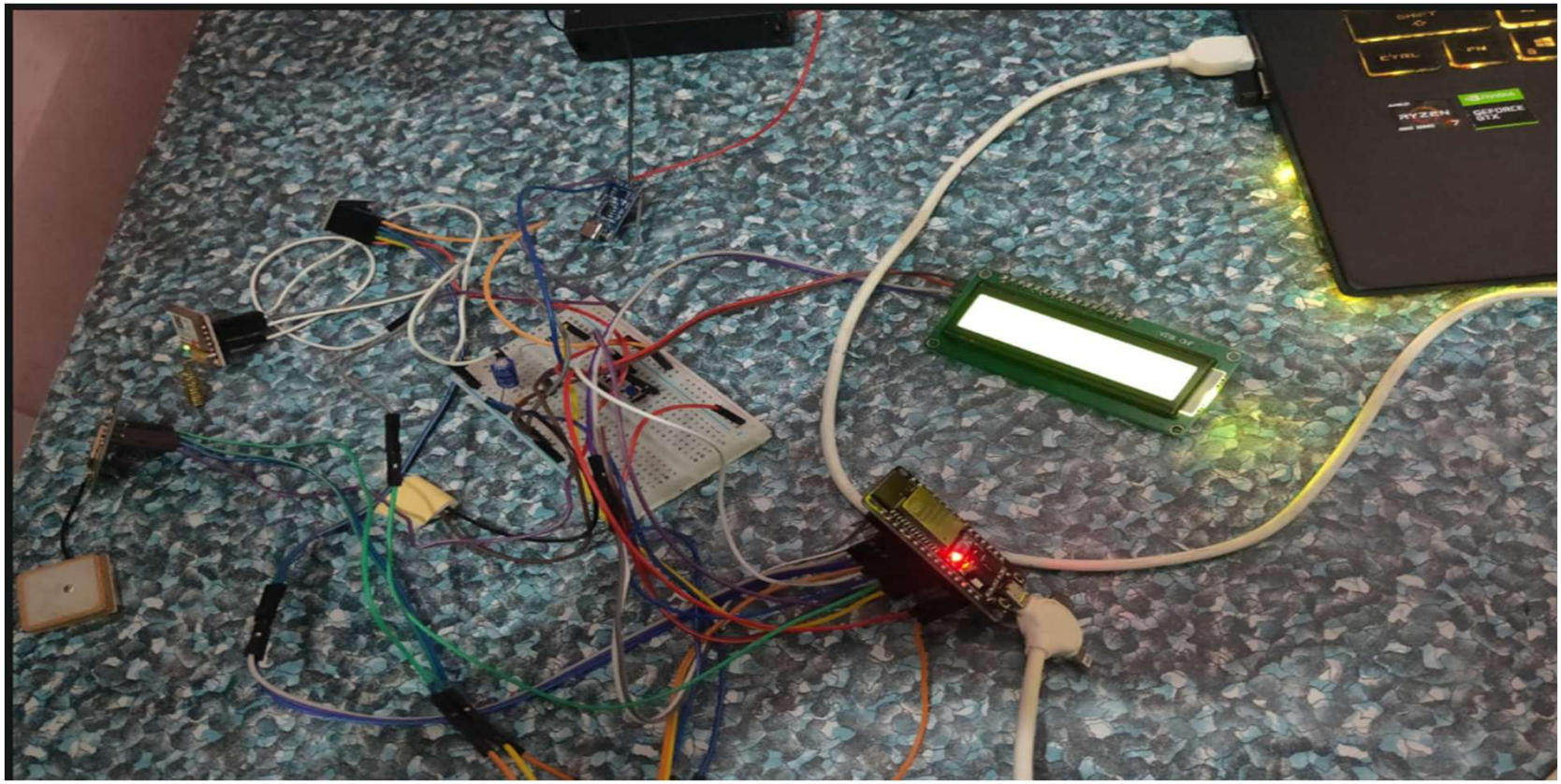


Fig1: Block diagram of the circuit

Flowchart & Detection Cycle



Circuit Design & Simulation



Results & Testing

1. All hardware modules were tested individually before final integration.
2. The accelerometer accurately detected sudden impacts with calibrated threshold levels.
3. GPS module successfully retrieved real-time location with stable signal.
4. GSM module sent SMS alerts promptly to predefined contacts during test scenarios.
5. Manual SOS button functioned reliably, allowing alerts without collision.
6. Debouncing and delay logic reduced false triggers and improved response accuracy.
7. The complete system operated smoothly under real-world test conditions, validating its reliability.

Applications

1.Personal Vehicles:
Enhances driver safety by automatically notifying emergency contacts during accidents, especially in remote areas.

2.Commercial Fleets:
Useful for logistics, delivery, and transport companies to monitor driver safety and respond quickly to accidents.

3.Public Transport Systems:
Can be installed in buses or taxis to ensure passenger safety and real-time tracking in case of emergencies.

4.Emergency Response Vehicles:
Helps dispatch teams receive instant location alerts, reducing response time and improving coordination.

5.Student and Employee Transport Services:
Increases accountability and security during transit, especially for school buses and company cabs.

Future Scope

1.Cloud Integration:

Real-time data can be uploaded to cloud servers for centralized monitoring, data logging, and analytics.

2.Mobile App Interface:

A companion app can be developed for users to receive alerts, track the vehicle, and update emergency contacts.

3.AI-Based Accident Prediction:

Machine learning models can be integrated to predict potential accidents based on driving patterns.

4.Camera Integration:

Dashcam footage capture during impact for post-accident analysis and insurance claims.

5. Voice-Based Emergency Assistance:

Integration of voice commands or voice-based alerts for hands-free emergency response.

References

- https://chatgpt.com/c/687d2eef-3c7c-800c-a84b-a5a6c323307f
- https://link.springer.com/article/10.1007/s11036-011-0304-8
- https://www.researchgate.net/profile/Ahmed-Al-Gburi/publication/376178467_Enhancing_Vehicle_Safety_A_Comprehensive_Accident_Detection_and_Alert_System/links/656e8610a760eb7cc749751f/Enhancing-Vehicle-Safety-A-Comprehensive-Accident-Detection-and-Alert-System.pdf
- https://ieeexplore.ieee.org/abstract/document/5609617/