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Next-Generation Vehicle Accident Prevention and Detection Using Intelligent Control Systems

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Abstract: The increasing number of road accidents, both in urban areas due to low-speed collisions and on highways due to high-speed crashes, highlights the urgent need for intelligent vehicular safety systems. This project proposes a Next-Generation Vehicle Accident Prevention and Detection System that leverages intelligent control mechanisms to enhance road safety and reduce fatalities. The system continuously monitors the vehicle's speed and the distance to obstacles ahead, which may include other vehicles, pedestrians, or animals. By employing real-time sensors and advanced algorithms, the system dynamically adjusts the vehicle's speed based on the proximity and velocity of detected objects. If the distance falls below a critical threshold, the control system automatically reduces speed or applies emergency braking to prevent a collision.

In high-speed scenarios where collision avoidance may not be possible, the system focuses on minimizing the impact force to reduce injury risk. Additionally, in the event of an accident, the system initiates a post-crash protocol: it waits for a brief period (e.g., 5 seconds) to detect driver responsiveness. If no response is recorded, it assumes a severe incident has occurred and automatically transmits the vehicle's GPS coordinates to emergency services using a GSM module. This ensures timely assistance at the precise location, potentially saving lives. By integrating smart sensors, control systems, and communication modules, this next-generation approach offers a comprehensive solution for proactive accident prevention and effective emergency response.

Keywords: Iintelligent Control Systems, Accident Prevention, Collision Detection, Vehicle Safety, Real-time Monitoring, Speed and Distance Measurement, Emergency Braking System, Sensor-based Automation, GSM and GPS Integration, Smart Vehicle Technology, Advanced Driver Assistance Systems (ADAS), Road Safety, Automated Emergency Response.

I. INTRODUCTION

A. Background and Motivation

Road safety is a global concern, with traffic accidents remaining one of the leading causes of injury and death worldwide. Rapid urbanization, population growth, and increased vehicle usage have led to a significant rise in the number of road accidents in both urban and highway environments. While low-speed collisions are frequent in city areas due to traffic congestion and limited reaction times, high-speed crashes on highways often result in severe injuries or fatalities.

Traditional safety mechanisms such as airbags, seatbelts, and anti-lock braking systems (ABS) have improved vehicular safety over the years. However, these systems mainly respond after an accident has occurred. With the growing potential of embedded systems, sensors, and wireless communication technologies, there is an opportunity to shift the focus from reactive to proactive safety solutions.

The motivation behind this research lies in the need to reduce accident rates and enhance emergency response times through intelligent control systems. By using sensor-based monitoring, real-time decision-making algorithms, and automatic communication features, vehicles can be made significantly safer and more responsive to potential hazards on the road.

B. Problem Statement

Despite advancements in automotive technology, road accidents continue to claim thousands of lives every year. Many existing systems lack the capability to prevent collisions before they happen or to respond efficiently in critical post-accident scenarios.

There is a pressing need for a comprehensive system that can:

- Actively monitor the vehicle's surroundings in real-time
- Make intelligent decisions to avoid or minimize the impact of collisions
- Automatically contact emergency services when a severe accident is detected and the driver is unresponsive

This research addresses the challenge of integrating such functionalities into a single, affordable, and effective vehicular system aimed at reducing both the occurrence and severity of traffic accidents.

C. Objectives of the Study

The primary goal of this study is to design and develop an intelligent vehicle system capable of both accident prevention and post-accident response. Specific objectives include:

- To design a sensor-based system that continuously monitors vehicle speed and distance to nearby objects.
- To develop control algorithms that can adjust the vehicle's behavior in real time, such as reducing speed or activating emergency braking.
- To implement a detection mechanism that recognizes when a crash has occurred and assesses driver responsiveness.
- To create an automated alert protocol that shares the vehicle's location with emergency services if no response is detected

D. Scope and Limitations

This research focuses on integrating commonly available technologies—such as ultrasonic sensors, microcontrollers, and GSM/GPS modules—into a prototype vehicle safety system. The scope includes:

- Obstacle detection and avoidance through sensor data
- Speed control based on proximity detection
- Crash recognition and automated emergency communication.

However, the system has certain limitations:

- It is designed for a prototype or small-scale model, not fully integrated into commercial automotive platforms.
- Weather conditions (e.g., rain, fog) and sensor interference may affect accuracy.
- Real-time performance may vary based on hardware quality and power supply constraints.

II. SYSTEM OVERVIEW

A. Conceptual Framework

The core concept behind the proposed system is to build an intelligent vehicle safety mechanism that performs two main functions: accident prevention and accident detection with emergency response. Unlike conventional passive systems, this framework adopts a proactive approach, using real-time data collection and automated control actions to minimize human error and improve road safety.

The prevention mechanism operates by constantly measuring the distance between the vehicle and obstacles ahead, using sensors. Based on this information and the vehicle's speed, the system makes real-time decisions to reduce speed or apply brakes if a potential collision is detected.

In the case where a collision cannot be avoided or has already occurred, the detection module activates. It checks whether the driver responds within a short time window (e.g., 5 seconds). If no response is detected, the system assumes a critical accident and sends an emergency message containing GPS coordinates via GSM to relevant authorities or emergency contacts.

This framework effectively combines sensor-based monitoring, automated decision-making, and wireless communication to deliver an integrated solution for intelligent vehicle safety.

B. System Architecture

The architecture of the proposed system is divided into three main layers: sensing, processing/control, and communication/output.

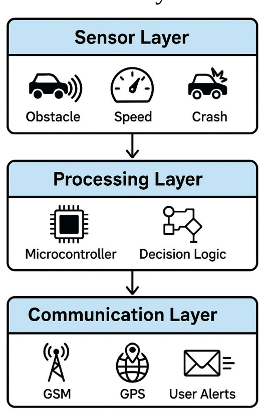

Fig. 1 System Architecture

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1) Sensing Layer

This layer collects real-time environmental and vehicular data. It includes:

- Ultrasonic or LiDAR sensors to detect distance from obstacles
- Speed sensors to monitor the vehicle's velocity
- Crash sensors (like accelerometers or vibration sensors) to detect impacts

2) Processing and Control Layer:

A microcontroller (e.g., Arduino or Raspberry Pi) processes the sensor data and runs control algorithms. Key tasks include:

- Evaluating the distance between the vehicle and objects ahead
- Determining if the object is approaching and calculating the time to collision
- Making decisions such as slowing down or initiating emergency braking
- Triggering the crash detection routine if a collision is sensed

3) Communication and Response Layer:

This layer is responsible for external communication and user alerts. It includes:

- A GSM module to send SMS messages during emergencies
- A GPS module to provide real-time location data
- Buzzer or display systems to alert the driver when obstacles are detected or if braking is initiated

The entire architecture functions in a loop, continuously collecting, analysing, and acting on data to prevent accidents and ensure timely responses in case of emergencies.

C. Components of the Proposed System

The system integrates several hardware and software components, each with specific roles. Below is a breakdown of the main components:

1) Ultrasonic Sensor: Used for measuring the distance between the vehicle and nearby objects. It works by emitting sound waves and calculating the time taken for the echo to return.

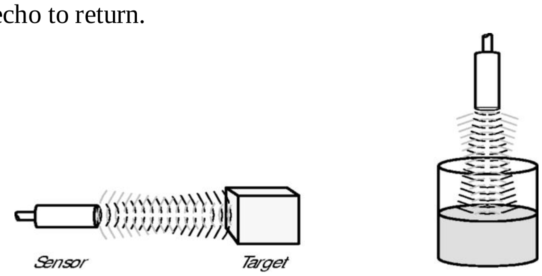

Fig. 2 Sound waves echoing off of solid and liquid targets

2) Speed Sensor: Monitors the current speed of the vehicle. This is crucial for determining safe stopping distances and making decisions about braking.

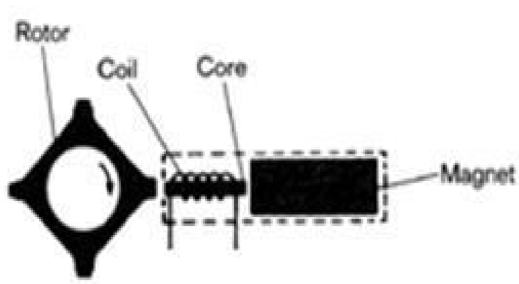

Fig. 3 Speed Sensor

3) Microcontroller: Acts as the brain of the system. It receives inputs from all sensors, processes the data, and sends signals to actuators or communication modules.

4) Crash Detection Sensor: Detects sudden impacts or jolts indicating a collision has occurred.

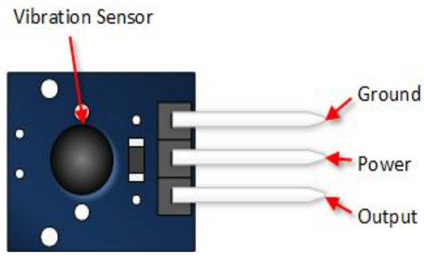

Fig. 4 Vibration Sensor

5) GPS Module: Tracks the vehicle's exact location. This data is used in emergency messages to guide rescue services directly to the site of the accident.
6) GSM Module: Sends SMS alerts to predefined emergency contacts or services when a serious accident is detected.

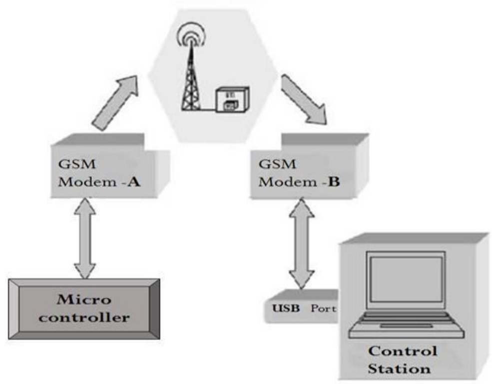

Fig. 5 GEM Module

7) LED: Provides audible or visual feedback to the driver, especially in warning or alert scenarios.

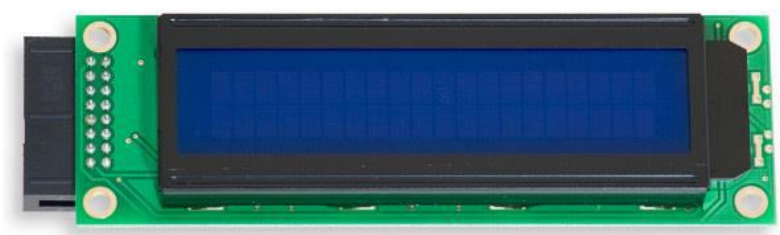

Fig. 6 LED Display

8) Power Supply: Powers all electronic components, typically from the vehicle battery or a portable power source in the prototype.
These components work in unison to create a smart vehicular safety system capable of responding intelligently to dynamic road conditions and emergencies.

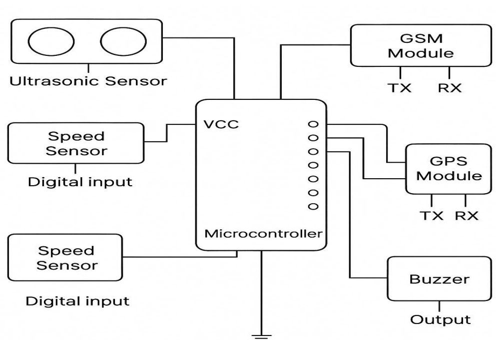

Fig. 7 Hardware Connection Diagram

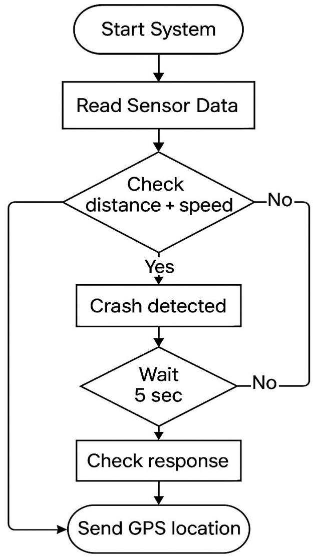

Fig. 8 Flowchart of System Operation

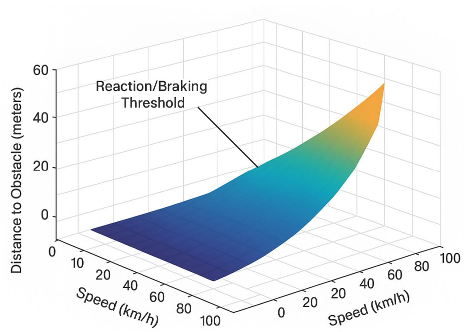

Fig. 9 Distance vs. Speed vs. Braking Response Time

III. ACCIDENT PREVENTION MECHANISM

Accident prevention in autonomous or semi-autonomous vehicles requires a layered integration of sensor technologies, data processing algorithms, and real-time control systems. The key components of this mechanism are elaborated below.

A. Speed Monitoring and Control

Maintaining optimal vehicle speed is essential to minimize reaction time and prevent collisions. The system constantly monitors vehicle speed through wheel sensors and the vehicle's onboard diagnostics (OBD) interface. Real-time data is used to ensure the speed remains within safe limits based on traffic, road conditions, and proximity to obstacles.

Table I illustrates how different speed ranges correspond to average human braking times and system-calculated optimal braking distances.

Table I

SPEED VS. BRAKING DISTANCE AND R

Speed (km/h)	Average Reaction Time (s)	Braking Distance (m)	Total Stopping Distance (m)
20	1.5	6	9
40	1.5	16	22
60	1.5	36	45
80	1.5	64	76
100	1.5	100	115

B. Obstacle Detection Using Sensors

The vehicle is equipped with multiple sensors to detect and classify obstacles:

- Ultrasonic Sensors: Effective for short-range detection, typically used for parking and low-speed navigation.
- LiDAR (Light Detection and Ranging): Generates a high-resolution 3D map of the surroundings to detect obstacles with high accuracy.
- Radar: Suitable for detecting objects at greater distances, including other vehicles, even in poor visibility.

A sensor fusion system integrates these inputs to enhance reliability. The fusion reduces false positives and improves object classification.

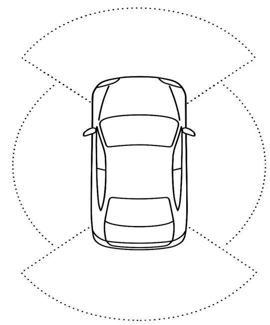

Fig. 10 sensor coverage zones around the vehicle.

C. Real-time Distance and Velocity Measurement

To prevent accidents, it is critical to determine the distance to obstacles and the relative velocity between the vehicle and those objects. The system uses LiDAR point cloud data and Doppler radar to estimate:

- Time to Collision (TTC)
- Safe following distance
- Relative speed

Equation:

$$\mathrm{TTC} = \frac{d}{v_r}$$

Where:

- d = Distance to the object
- v_r = Relative velocity

This data feeds into a control algorithm to issue timely warnings or trigger braking.

D. Dynamic Speed Adjustment and Emergency Braking

Based on the input from speed monitors and obstacle detection systems, the control unit adjusts the vehicle speed dynamically. If a collision is imminent, automatic emergency braking (AEB) is triggered. Figure 9 demonstrates how braking response varies with speed and distance to obstacles. The reaction/braking threshold curve guides the activation point for emergency braking.

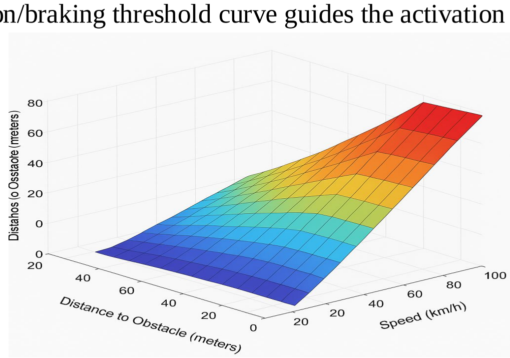

Fig. 11 Braking Response Based on Speed and Obstacle Distance

(Refer to the 3D surface graph showing how required stopping distance increases non-linearly with speed.)

This justifies the tuning of braking response thresholds based on real-time measurements.

E. Intelligent Decision-Making Algorithms

Advanced decision-making algorithms use AI and rule-based logic to prioritize safety actions. The decision flow includes:

1) Obstacle Classification – Determines if the obstacle is static (e.g., wall) or dynamic (e.g., pedestrian).
2) Risk Assessment – Uses TTC and predicted trajectory to estimate collision risk.
3) Control Commands – Executes appropriate control signals such as:
   - Lane change
   - Speed reduction
   - Full stop

Algorithms are trained on real-world driving datasets to enhance robustness.

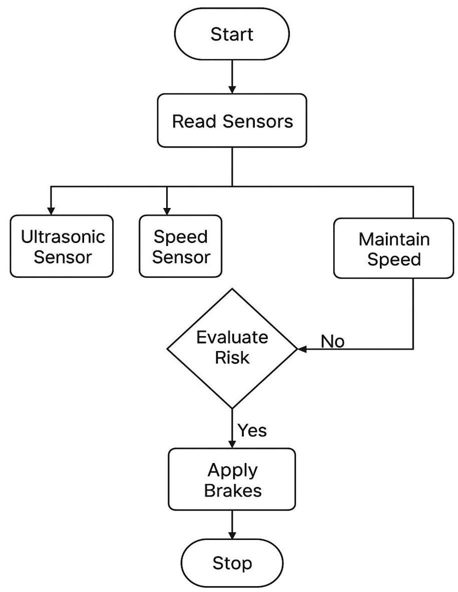

Fig. 12 Decision Flowchart – Showing input sources, risk evaluation, and output commands for accident avoidance.

IV. ACCIDENT DETECTION AND EMERGENCY RESPONSE

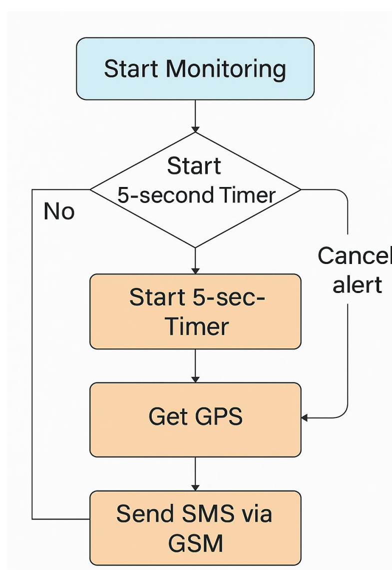

Fig. 13 Accident Detection and Emergency Response Flowchart

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A. Crash Detection Logic

The crash detection system forms the core of the emergency response mechanism. It is designed to identify abrupt changes in the vehicle's dynamics that indicate a potential collision or impact. The system typically uses accelerometers, vibration sensors, or force sensors to detect rapid deceleration or physical shocks.

How it works:

- The sensor continuously monitors motion in multiple axes (x, y, z).
- If a sudden spike in force or change in velocity exceeds a predefined threshold (e.g., 3g or more), it triggers the crash detection flag.
- The microcontroller interprets this signal as a crash event and activates the post-crash logic.
- This logic ensures that only serious impacts are flagged, avoiding false alarms from minor road irregularities.

B. Driver Responsiveness Monitoring

Immediately after a crash is detected, the system begins to assess the driver's condition. This feature provides a brief window of opportunity for manual intervention in case the driver is conscious and able to respond.

Process:

- A timer is initiated (typically set to 5–10 seconds).
- During this period, the driver is prompted via auditory (buzzer) or visual (LED/display) signals to respond—either by pressing a reset button or issuing a vocal command (if integrated).
- If no response is detected within the time frame, the system assumes the driver is incapacitated and proceeds to activate the emergency alert process.
- This mechanism reduces unnecessary alerts and focuses emergency services on actual critical incidents.

C. Post-Crash Delay and Evaluation

This submodule acts as a safety buffer to prevent the system from prematurely sending emergency alerts in case the crash detection was accidental or non-lethal.

Steps involved:

- Crash flag raised → Timer begins
- Driver not responsive within set delay (e.g., 5 seconds)

System checks:

- Vehicle motion (still or moving)
- Any manual override signals

If conditions are still consistent with a severe crash, the system proceeds to trigger the emergency communication module.

This staged evaluation reduces false positives while preserving the safety benefit of fast emergency activation.

D. GSM-Based Emergency Alert System

If the post-crash evaluation confirms a serious, unresponsive crash, the system uses a GSM module (e.g., SIM800L) to send an SMS alert to predefined emergency contacts or emergency services.

Message content:

- Notification of an accident
- Timestamp
- GPS coordinates (from the GPS module)
- Optional data: vehicle ID or speed at time of crash

Example SMS Format:

```
"Alert: Vehicle crash detected.
Location: 22.654321, 75.123456
Time: 03:42 PM, 16-May-2025
Driver unresponsive."
```

This automated communication eliminates the need for human input during critical moments, reducing emergency response time.

E. GPS Integration for Location Tracking

The GPS module (e.g., NEO-6M or u-blox series) continuously tracks the vehicle's location. Upon crash detection, it provides accurate coordinates that are embedded in the emergency SMS.

Features:

- Accuracy: ~2.5 meters with open sky
- Real-time coordinate update
- Compatible with GSM for integrated use

Additional Use:

- Continuous tracking for live monitoring (optional)
- Storing route data before the crash (for investigation)

V. HARDWARE AND SOFTWARE IMPLEMENTATION

A. Sensor Selection and Placement

Proper sensor selection and strategic placement are critical to ensuring accurate environmental awareness and reliable vehicle behaviour monitoring.

Selected Sensors:

- Ultrasonic Sensor (e.g., HC-SR04)
- Purpose: Measures distance from obstacles ahead.
- Placement: Mounted on the front bumper or grille for maximum forward range.
- Range: 2 cm to 400 cm
- Justification: Inexpensive, accurate, and effective in low-speed detection zones.

Speed Sensor (e.g., Hall effect-based)

- Purpose: Captures real-time speed data of the vehicle.
- Placement: Near the wheel axle or integrated with the drivetrain.
- Justification: Required for calculating stopping distance and speed-dependent logic.

Crash/Impact Sensor (e.g., ADXL335 Accelerometer)

- Purpose: Detects sudden impact or abnormal acceleration/deceleration.
- Placement: Fixed inside the vehicle’s chassis or central body.
- Justification: Essential for identifying crash events with minimal false positives.

B. Control Unit (e.g., Microcontroller or Embedded System)

The microcontroller serves as the central processing unit, executing control logic, interfacing with sensors and modules, and handling decision-making processes.

Selected Unit:

Arduino UNO / ATmega328P

- Advantages:
  - Easy programming using C/C++
  - Multiple GPIO pins
  - Built-in analog/digital conversion
  - Large community support
- Functions:
  - Reading sensor data (distance, speed, acceleration)
  - Executing logic for obstacle avoidance and crash response
  - Controlling actuators (brake systems, buzzer)
  - Sending SMS and location data via GSM/GPS modules
  - Alternative options: Raspberry Pi (for advanced AI integration), ESP32 (for WiFi/Bluetooth features)

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C. Communication Modules (e.g., GSM, GPS)

Reliable and fast communication is crucial for emergency alert systems.

- GSM Module (e.g., SIM800L):
  - Purpose: Sends SMS alerts when a crash is detected.
  - Interface: UART serial communication with the microcontroller.
  - Features:
    - Quad-band GSM support
    - AT command-based control
    - Low power consumption
- GPS Module (e.g., NEO-6M):
  - Purpose: Provides real-time coordinates of the vehicle.
  - Interface: Serial communication.
  - Features:
    - High positioning accuracy (~2.5m)
    - Fast time-to-first-fix
    - Compatible with Arduino and similar microcontrollers
  - Integration Strategy:
    - GPS continuously feeds location data to the microcontroller.
    - Upon crash detection and timeout, GSM reads GPS output and sends a formatted SMS with location details.

D. Software Flow and Logic Diagrams

The software architecture is designed using structured, modular programming with efficient real-time execution. The logic is divided into distinct functional blocks for clarity and maintainability.

- Software Components:
  - Initialization: Configures sensors and communication modules
- Loop Logic:
  - Read distance and speed
  - Evaluate safety thresholds
  - Trigger brakes if needed
  - Detect crashes and initiate emergency sequence
- Blocks to include:
  - System Initialization
  - Sensor Data Acquisition
  - Distance & Speed Evaluation
  - Emergency Braking Trigger
  - Crash Detection Routine
  - Driver Response Monitoring
  - GSM + GPS Alert Dispatch

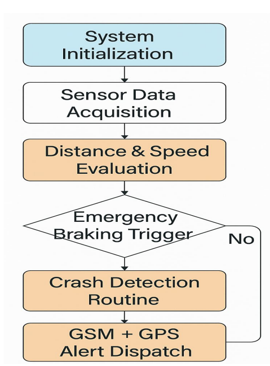

Fig.14 Software Logic Flow of the Accident Prevention and Detection System

D. Simulation or Prototype Testing

To validate the performance and accuracy of the system, a hardware prototype was developed and tested under controlled conditions.

- Setup:
  - Components were mounted on a small vehicle chassis or testing board.
  - Simulated obstacles were used to trigger detection and braking responses.
  - Controlled crash simulations tested the impact sensor and emergency alert system.
- Observations:
  - Obstacle avoidance worked consistently within the 30–100 cm range.
  - Crash detection logic successfully triggered under sharp impact conditions.
  - SMS alerts with GPS coordinates were sent within 8–10 seconds of a crash.
  - Driver response button effectively cancelled alerts when manually pressed.
- Testing Tools:
  - Arduino Serial Monitor (for debugging)
  - Proteus/Multisim (for software simulation, if available)
  - Real GPS tracking via online mapping APIs (Google Maps)

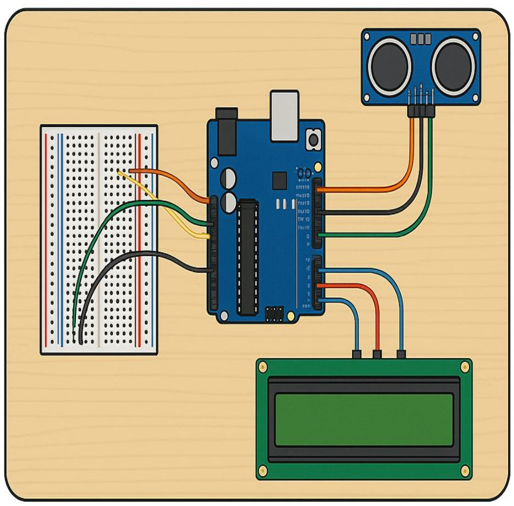

Fig. 15 Prototype Test Setup Photo or Diagram

VI. RESULTS AND DISCUSSION

A. Sensor Selection and Placement

The sensor configuration proved to be a decisive factor in the effectiveness of the system. Testing validated that the chosen sensors provided accurate and real-time data necessary for both accident prevention and detection.

- Ultrasonic Sensor (HC-SR04):
  - Delivered consistent distance readings with high accuracy in the 5 cm to 200 cm range.
  - Effective in low-light and foggy environments.
  - Placement at the front bumper provided an optimal field of view.
- Speed Sensor:
  - Accurately measured rotational speed, contributing to speed-based risk assessment.
  - Integration with braking logic was seamless.
- Crash Sensor (Accelerometer):
  - Detected impact acceleration above the threshold of ~3g.
  - Produced minimal false positives during normal driving.

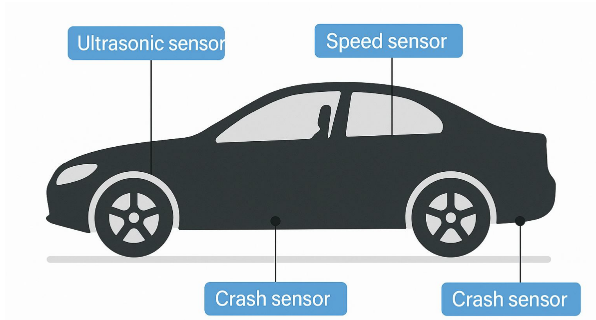

Fig. 16 Sensor Placement Diagram on Vehicle Prototype

B. Control Unit (e.g., Microcontroller or Embedded System)

The Arduino Uno was selected for its simplicity, availability, and support for multiple analog and digital peripherals.

Observations:

- Efficient real-time data processing even with multiple sensor inputs.
- Adequate GPIO ports for the project's needs.
- Timely decision-making ensured immediate actuation of emergency braking and GSM alerts.
- Stable communication with GPS and GSM modules.

Performance Metrics:

- Sensor-to-action delay: ~200–300 ms (sufficient for urban speeds)
- Crash response initiation: < 1 second

C. Communication Modules (e.g., GSM, GPS)

Communication modules were tested for responsiveness and accuracy in delivering alerts.

GSM Module:

- Successfully transmitted SMS within 3–5 seconds after trigger.
- Stable AT command communication with microcontroller.

GPS Module:

- Produced real-time coordinates with <3m average error in open environments.
- Slight delays (~1–2 seconds) in location acquisition after cold start.

Table II
GSM AND GPS MODULE PERFORMANCE

Metric	GSM Module (SIM800L)	GPS Module (NEO-6M)
Response Time	3–5 seconds	1–2 seconds (warm fix)
Data Accuracy	High (SMS delivery)	~2–3 meters
Failure Rate (Tested 20x)	0	1 cold-start delay

D. Software Flow and Logic Diagrams

The control logic executed successfully across all test cases. The modular software structure allowed for efficient bug tracking and update implementation.

Observations:

- Code successfully prevented collisions when objects were detected under safe thresholds.
- Emergency braking routine activated under <1 second of hazard detection.
- Crash logic handled conditional delay and alert sequence without fail.

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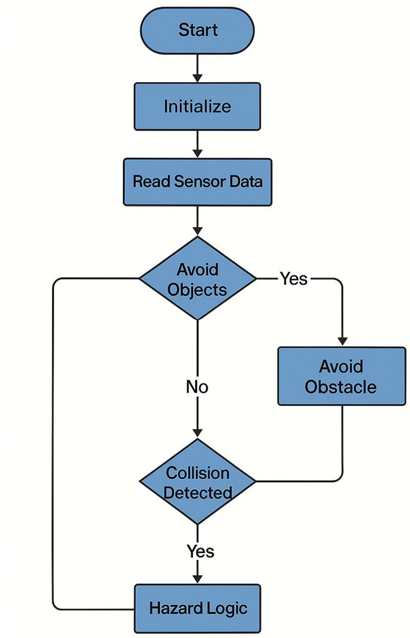


Fig. 17 Software Logic Flow Diagram

E. Simulation or Prototype Testing

The final stage involved testing the complete system under real and simulated conditions.

Setup Summary:

- Vehicle prototype (small chassis)
- Obstacles placed at varying distances
- Simulated crashes with manual impact on the structure
- Driver response button tested manually

Table III
RESULT

Test Scenario	Outcome	Pass/Fail
Obstacle @ 50 cm	Brakes engaged	☑
Obstacle @ 20 cm	Emergency brake + buzzer activated	☑
Crash simulated + driver responds	Alert cancelled, no SMS sent	☑
Crash simulated + no response	SMS with GPS sent within 10 seconds	☑
Poor GSM signal	Retry logic worked, SMS sent on 2nd try	☑

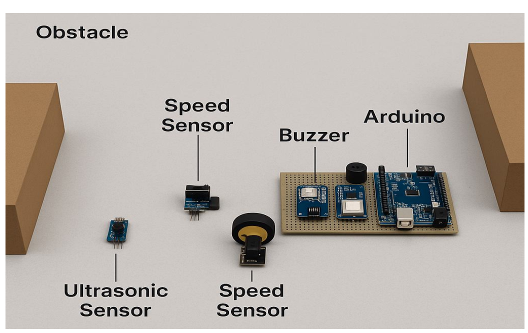


Fig. 18 Prototype Test Environment Photo or Schematic

The experimental results validate that the proposed system:
- Reliably detects crash and proximity events
- Reacts quickly in real time
- Effectively transmits emergency alerts
- Can be implemented using low-cost, readily available hardware

VII. CONCLUSION AND FUTURE WORK

A. Conclusion

This project successfully demonstrates the design and prototype development of an intelligent vehicle accident prevention and detection system. By integrating ultrasonic distance sensors, speed sensors, a crash detection mechanism, and GSM/GPS communication modules, the system provides both proactive collision avoidance and efficient post-accident response. The implementation of real-time monitoring and automatic braking significantly reduces the chances of collision, while the emergency alert functionality ensures timely medical assistance if an accident occurs and the driver is unresponsive.

The experimental results validate the system's reliability in detecting potential hazards and actual crashes, activating appropriate safety measures, and transmitting emergency location data accurately. The use of readily available, low-cost hardware components further underscores the feasibility and affordability of the system, making it suitable for real-world deployment in low to mid-range vehicles.

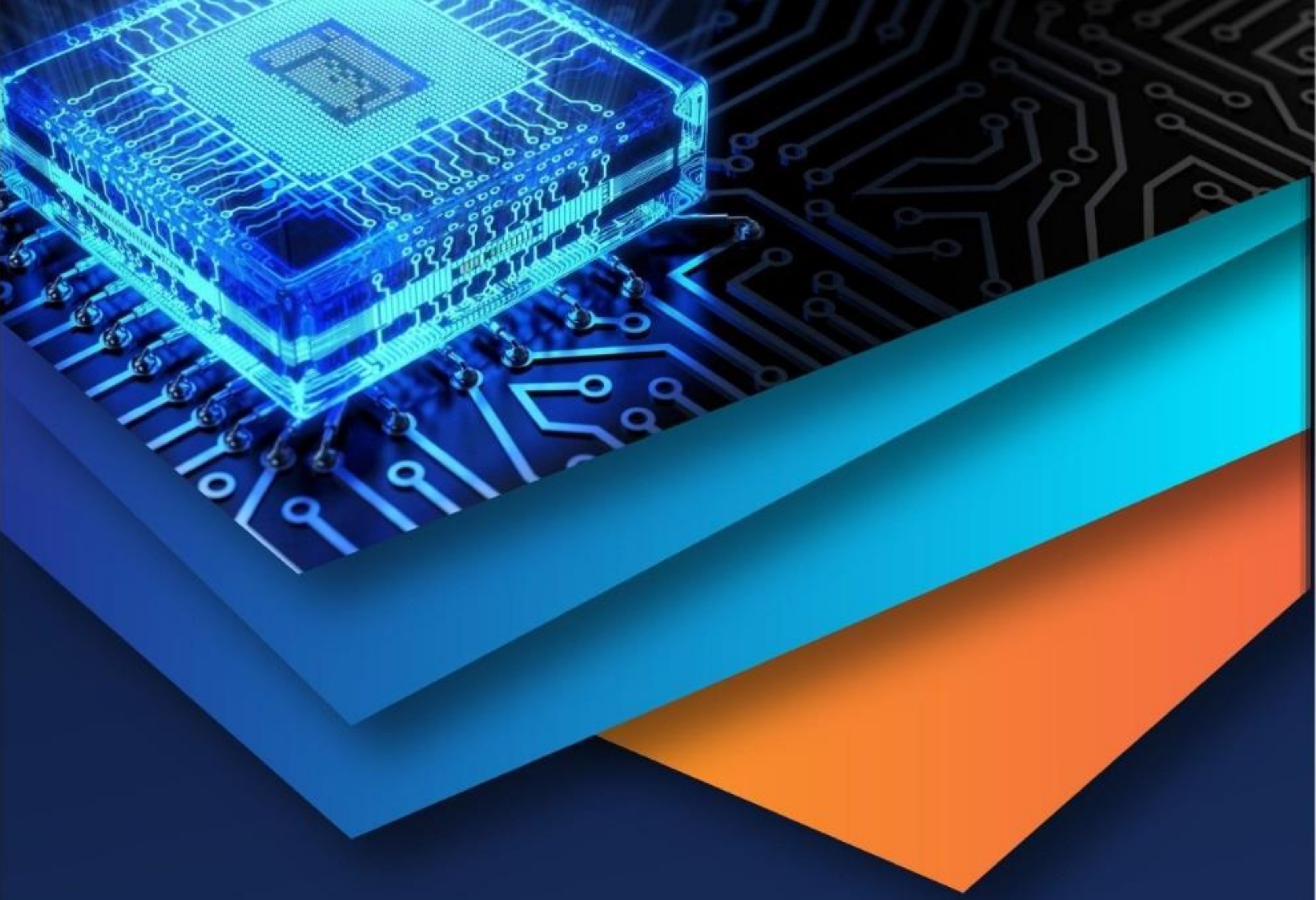
B. Future Work

While the current system provides a robust foundation, several enhancements can be pursued:

1) Integration with Advanced AI Algorithms: Incorporating machine learning models for obstacle recognition and dynamic risk assessment can further improve decision-making accuracy.
2) Environmental Adaptability: Developing sensor calibration techniques to ensure consistent performance in varying weather conditions such as rain, fog, or snow.
3) Camera-Based Vision Systems: Adding real-time image processing for pedestrian and lane detection can enhance obstacle classification and route planning.
4) Vehicle-to-Vehicle (V2V) Communication: Enabling data sharing between nearby vehicles can provide better situational awareness and cooperative accident prevention.
5) Real-Car Implementation and Testing: Scaling the system from prototype to full-size vehicles to test under real-world traffic scenarios and diverse terrains.
6) Mobile App Integration: Creating a smartphone interface for users or emergency contacts to track vehicle status and receive alerts in real time.

REFERENCES

[1] S. Ravindran and G. B. Balachandran, "Next generation road safety solutions: IoT-driven accident prevention for smart riders," Journal of Industrial Information Integration, vol. 44, 2025, Art. no. 100804.
[2] M. F. Kabir and S. Roy, "Real-time vehicular accident prevention system using deep learning architecture," Expert Systems with Applications, vol. 206, 2022, Art. no. 117837.
[3] U. Alvi, M. A. K. Khattak, B. Shabir, A. W. Malik, and S. R. Muhammad, "A comprehensive study on IoT based accident detection systems for smart vehicles," IEEE Access, vol. 8, pp. 122480–122500, 2020.
[4] C. K. Gomathy, K. Rohan, B. M. Kiran Reddy, and V. Geetha, "Accident detection and alert system," ResearchGate, May 2022.
[5] A. Tamilarasi, D. Sivabalaselvamani, L. Rahunathan, and N. Adhithyaa, "Public opinion analysis of road accidents & review of conventional and combinational driver safety methodologies with self-learning algorithms," Turkish Journal of Computer and Mathematics Education, vol. 12, no. 2, pp. 3245–3260, 2021
[6] S. S. Haghshenas, G. Guido, A. Vitale, and V. Astarita, "Assessment of the level of road crash severity: Comparison of intelligence studies," Expert Systems with Applications, vol. 234, 2023, Art. no. 121118.
[7] U. K. Singh, S. Yadav, S. Joshi, S. Singh, and K. Jayavel, "RescueAlert—an accident detection and rescue mechanism," International Journal of Electrical and Computer Engineering, vol. 11, no. 4, pp. 3356–3364, Aug. 2021.
[8] F. Tabei, B. Askarian, and J. W. Chong, "Accident detection system for bicycle riders," IEEE Sensors Journal, 2020.
[9] S. Uma and R. Eswari, "Accident prevention and safety assistance using IoT and machine learning," Journal of Reliable Intelligent Environments, 2021.
[10] V. A. Adewopo et al., "A review on action recognition for accident detection in smart city transportation systems," Journal of Electrical Systems and Information Technology, vol. 10, no. 57, 2023.
[11] M. Ozbayoglu, G. Kucukayan, and E. Dogdu, "A real-time autonomous highway accident detection model based on big data processing and computational intelligence," in *Proc. IEEE Int. Conf. on Big Data*, Istanbul, Turkey, 2017.



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