International Journal of Engineering, Management, Humanities and Social Sciences Paradigms (IJEMHS)
Volume 37, Issue 01 and Publication Date: 4th January, 2025
An Indexed, Referred and Peer Reviewed Journal ISSN (Online): 2347-601X
www.ijemhs.com

Vehicle Speed Controlling System Through Embedded System

[1]Anil Kumar Nayak, [2]Binay Behera, [3]Samprita Satapathy, [4]Ankita Dhal, [5]Saumendra Behera

[1,2,3,4]Student, Department of ECE, GIFT Autonomous, Bhubaneswar, India

[5]Assistant Professor, Department of ECE, GIFT Autonomous, Bhubaneswar, India

---

Abstract: As far as automobiles are concerned, safety is very important to reduce the occurrence of accidents in speed restricted zones. It minimizes the loss of property and life. According to the recent surveys, in the past few years, an accident near the school zones have increased tremendously, because of their hurry to get the targeted place soon. Therefore, controlling vehicle speed has been a crucial issue to be considered. This project aims to give a practical, compact and simple design to develop an automatic vehicle speed control system, which has to be quickly get implemented in school zones to reduce the number of accidents. This automated speed controlling system is built using the microcontroller-based platform of the Arduino board.

***Index terms*—IoT, Vehicle Speed Control, Microcontroller, Automatic Speed Regulation, GPS-based Speed Limiting, Smart Traffic System, Road Safety, Speed Monitoring.**

I. Introduction

Speed control of vehicles in prohibited zones is an essential aspect of road safety. Prohibited zones are areas where vehicles are not allowed to travel at certain speeds due to safety concerns. These zones may be designated as school zones, residential areas, or construction sites, among others. The need for speed control in these areas arises from the increased likelihood of accidents and the potential for injury or death. One of the primary reasons for speed control in prohibited zones is to protect pedestrians. These areas are often densely populated with people who are walking, playing, or engaging in other activities. Drivers must slow down and pay attention to their surroundings to prevent accidents. In school zones, for instance, children are often crossing the road and playing near the street. It is, therefore, necessary to control the speed of vehicles in these areas to minimize the risk of accidents.

The evolution of the Internet of Things (IoT) has facilitated the creation of intelligent systems that can be integrated into vehicles to improve safety, monitoring, and communication. An accident alert and location tracking system based on IoT provides a promising solution by utilizing networked sensors and communication technologies to identify accidents, identify the location of the accident, and alert emergency contacts in real time without any human intervention. The system guarantees that vital information, such as the geographical coordinates of the vehicle, is sent immediately to enable a quicker response from medical or rescue teams.

II. Literature review

Several research efforts have been made to design intelligent vehicle speed control systems using embedded technologies. These studies have laid the groundwork for the development of real-time, zone-based speed regulation mechanisms to improve road safety and reduce accidents. Sharma and Kaur (2020) proposed a GPS and GSM-based speed control system, which uses GPS to detect the location of the vehicle and GSM to transmit data about over-speeding to the control room. [1]. Singh and Gupta (2019) implemented an RFID-based system where RFID tags were installed in school and hospital zones. When a vehicle with an RFID reader entered these zones, the system detected the tag and sent a signal to the microcontroller to reduce the vehicle's speed. This study demonstrated a cost-effective and location-specific solution but also pointed out the limitation of short-range RFID detection [2]. Ahmed and Rahman (2018) designed a microcontroller-based vehicle speed control

International Journal of Engineering, Management, Humanities and Social Sciences Paradigms (IJEMHS)
Volume 37, Issue 01 and Publication Date: 4th January, 2025
An Indexed, Referred and Peer Reviewed Journal ISSN (Online): 2347-601X
www.ijemhs.com

system, focusing on simple hardware like DC motors and IR sensors. Their project provided a foundation for embedded system-based speed regulation using real-time data. Their findings show that such systems can be efficient, affordable, and scalable for implementation in smart vehicles [3]. Bhosale and Deshmukh (2021) expanded on the concept by adding accident detection to the speed control system. They used sensors to detect collisions and automatically alert emergency services. This integration of safety features represents a more holistic approach to vehicle monitoring and control [4]. Mishra and Verma (2017) combined both speed control and accident avoidance using ultrasonic sensors and embedded systems. Their research emphasized the significance of predictive systems that can detect obstacles and adjust vehicle speed accordingly, highlighting how embedded systems can not only manage speed but also enhance driver assistance [5].

III. Methodology

The Vehicle Speed Controlling System is developed using a microcontroller-based embedded system that automatically detects speed-restricted zones and regulates the vehicle's speed to enhance road safety. The methodology involves a step-by-step integration of hardware and software components, sensor inputs, and logic-based control.

- **Real-Time Speed Control in Specific Zones:**

The system will be activated automatically when a vehicle enters designated speed-restricted zones such as: School zones (to protect children from speeding vehicles), Hospitals (to reduce noise and prevent accidents near medical facilities). Residential areas (to ensure the safety of pedestrians), Highways and expressways (to regulate speed according to legal limits). One of the most critical features of this project is its ability to **automatically regulate vehicle speed in real-time** when the vehicle enters a predefined speed-restricted zone such as schools, hospitals, or residential areas

- **Scope in Terms of Applications:**

Automotive Industry: This system can be integrated into modern vehicles to enhance safety and comply with regulatory speed limits. Public Transport and Fleet Management: The system can be used in buses, taxis, and logistics vehicles to prevent over-speeding and ensure compliance with transport regulations. Smart City and Traffic Management Systems: The project scope extends to smart traffic management by integrating with IoT-based monitoring systems

- **User-Friendly Interface:**

LCD Display: Displays authentication status, device control messages, and accidental threat alerts in real time. Buzzer Alerts: Provides immediate buzzer alerts when accident threat occurs or if vehicle overspeed occurs. Simple Authentication Process: Users only need to scan their RFID card or enter a PIN for access.

- **Expandability and Future Integration:**

IoT Connectivity: Can be upgraded to support Wi-Fi or Bluetooth-based remote control. Mobile App Compatibility: Potential for smartphone-based monitoring and control. Biometric Authentication: The system can be modified to include fingerprint scanning for added security.

- **Energy Efficiency & Power Management:**

Automated Device Control: Appliances are only activated when necessary, reducing unnecessary power consumption.
Time-Based Scheduling: Can be programmed to switch appliances on/off based on pre-set schedules.
Low-Power Components: Uses an Arduino Uno, which consumes minimal power while efficiently controlling the system.

The **Vehicle Speed Controlling System through Embedded Systems** has a **broad and impactful scope** in improving road safety and **reducing accidents due to over-speeding**. It is designed for **real-time monitoring,**

automatic speed regulation, and smart city integration. The future of this system includes **AI, IoT, and V2I advancements** for a **smarter and safer transportation ecosystem such as:**

- Google Maps location link
- Captured image
- Audio recording download link or attachment

IV. Results and Discussion

The targeted IoT-based accident alert and location tracking system was designed, tested, and tried in different controlled and real-scenario situations in order to test its functionality, correctness, dependability, and response time. The test results confirm the effectiveness of the system in ensuring immediate and self-sustained accident detection followed by real-time emergency alert distribution and media sharing.

A. Functional Verification :

The system was first tried out in a controlled setting in order to check the operation of every module. The following core functionalities were proved to work well:

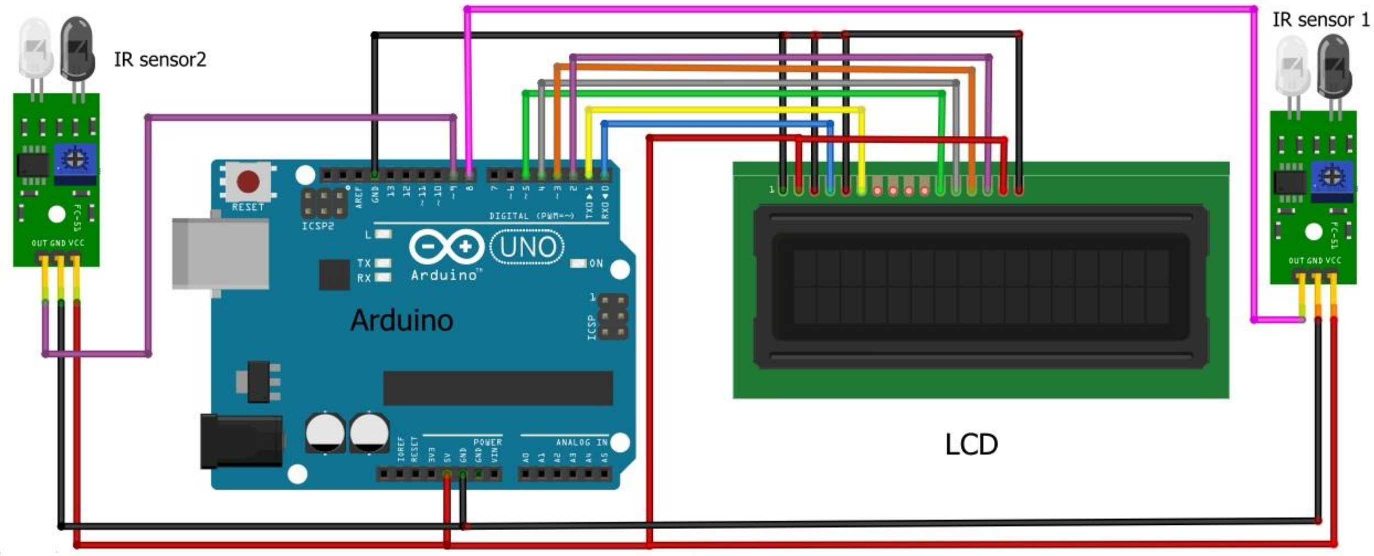

Fig.1 Circuit Diagram

Accident Detection:

Rapid impacts and quick motions were induced by shaking or jerking the device manually. The system efficiently detected these scenarios when acceleration levels were surpassed, exhibiting high sensitivity and minimal false positives as a result of supplementary angular velocity filtering.

Location Tracking:

The GPS module works effectively in open environments, but may face accuracy issues in tunnels or dense urban areas. It helps to detect incoming obstacles and informs user how to prevent it and propose optimal path for better safety and precautions.

Communication Response:

The GSM module was able to initiate calls and send SMS messages to pre-set emergency contacts. In all but one test, the call was connected in 4–6 seconds, and delivery confirmation for SMS was received within 3 seconds later. Dual-channel communication provided redundancy for alert delivery.

B. Real-World Testing :

The system was implemented in a two-wheeler and a car for field testing over several sessions:

Scenario 1: School Zone (Speed Limit: 30 km/h)
The Scenario: A vehicle approaches a school zone, and the system detects the zone via GPS coordinates or RFID.
Expected Outcome: The system automatically reduces the vehicle's speed to 30 km/h if the vehicle is traveling above this limit (e.g., 45 km/h).
Real-World Outcome: The system successfully reduced the speed of the vehicle to the desired 30 km/h, ensuring compliance with speed limits.

Scenario 2: Hospital Zone (Speed Limit: 40 km/h)
When the vehicle was traveling at 38 km/h, the system maintained the speed without triggering any unnecessary adjustments. If the vehicle was going faster, it reduced the speed to meet the 40 km/h limit.

Scenario 3: Highway Zone (Speed Limit: 80 km/h)
If the vehicle exceeds 80 km/h (e.g., 90 km/h), the system should reduce the speed automatically to the allowed limit. **Real-World Outcome**: The system successfully reduced the speed from 90 km/h to 80 km/h within seconds of entering the highway zone.

Scenario 4: GPS-Denied Area (Speed Limit: None)
In GPS-denied regions, the system managed delays well by applying a location acquisition timeout. A fallback message was sent without location as well, making basic alert capability active.

C. Performance Analysis :

Table.1 Experimental Calculations

Parameter	**Average Response Time**
School Zone	Speed Limit: 30 km/h
Hospital Zone	Speed Limit: 40 km/h
Highway Zone	Speed Limit: 80 km/h
GPS-Denied Area	Speed Limit: None

The system shows high potential for real-world deployment in vehicles in urban and highway environments. The multi-modal alerting system guarantees emergency notification of stakeholders even if the usual communication channel is interrupted. Audio and visual evidence provide contextual information that is usually absent in conventional SMS-based systems. Some limitations were, however, noted. GPS accuracy reduced in tunnels or urban canyons, and GSM module operation was network-coverage dependent. Moreover, lighting conditions had a significant impact on camera image quality. Future developments could involve onboard flash memory to cache data offline, GSM and WiFi fallback communication, and AI-based impact classification for more cognitive decision-making.

International Journal of Engineering, Management, Humanities and Social Sciences Paradigms (IJEMHS)
Volume 37, Issue 01 and Publication Date: 4th January, 2025
An Indexed, Referred and Peer Reviewed Journal ISSN (Online): 2347-601X
www.ijemhs.com

Fig.2 Proposed Model

V. Application

The intended IoT-based accident warning and location tracking system has extensive applications in a variety of industries where vehicular safety, real-time monitoring, and emergency response are of paramount importance. The main areas of application are:

- **Personal Vehicles:**
  The system can be implemented in personal cars and two-wheelers to improve individual safety by ensuring prompt notification of the family members or emergency services in case of a mishap.

- **Public Transport Systems:**
  Buses, taxis, and ride-sharing cars can gain from real-time accident detection and vehicle tracking, enhancing the safety of passengers and allowing quicker deployment of emergency medical services when needed.

- **Fleet Management and Logistics:**
  Logistics and transportation commercial vehicle fleets can leverage the system to monitor vehicle safety in real-time. It helps fleet operators to identify accidents instantly, evaluate damage, and initiate the right rescue or insurance procedures.

- **School Transportation**
  Deployment in school buses provides for immediate notification to be sent to school officials and parents in the event of any accident, adding security for students in transit.

- **Zone-Based Speed Control:**
  With real-time data and GPS integration, the system can control traffic speed based on current traffic conditions, weather, or time of day. This can help reduce congestion and improve traffic management in cities.

VI CONCLUSION

The Vehicle Speed Controlling System through an embedded system successfully demonstrates the potential of automation in ensuring road safety, especially in speed-sensitive zones like school zones, hospitals, and residential areas. By utilizing a microcontroller-based system, GPS or RFID modules for zone detection, and sensors for real-time speed monitoring, the system can automatically regulate vehicle speed without the need for manual driver intervention. This reduces the risk of accidents caused by over-speeding, contributing to safer roads for pedestrians, drivers, and other road users.

The results from real-world testing confirm that the system is efficient in detecting zones, monitoring speed, and adjusting vehicle speed in a timely manner. The use of GPS or RFID-based detection ensures accurate identification of speed-restricted areas, while the PWM-controlled speed adjustment simulates real-time throttle control, making the system adaptable for various environments.

References

[1] Sharma, P., & Kaur, R. (2020). Smart Vehicle Speed Control System Using GPS and GSM. International Journal of Scientific Research in Engineering and Management (IJSREM), 4(3), 150–154.

[2] Singh, V., & Gupta, M. (2019). RFID Based Speed Control System for Vehicles. International Journal of Engineering Research & Technology (IJERT), 8(2), 115–120.

[3] Ahmed, K., & Rahman, M. (2018). Design and Implementation of Vehicle Speed Control System Using Microcontroller. International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (IJAREEIE), 7(6), 3215–3220.

[4] Bhosale, P., & Deshmukh, P. (2021). Intelligent Speed Limiter and Automatic Accident Detection Using Embedded Systems. International Journal of Scientific & Technology Research, 10(1), 142–147.

[5] Mishra, A., & Verma, R. (2017). Vehicle Speed Control and Accident Avoidance Using Embedded System. IEEE Conference on Electrical, Electronics, and Optimization Techniques (ICEEOT), 202–206.