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Intelligent IoT Based Automatic Vehicle Speed Control and Alert System

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Abstract: This project introduces an intelligent vehicle safety system designed to enhance road safety through the integration of modern technologies.
Powered by a 12V battery, the system supports a robotic chassis driven by DC motors and managed through a motor driver for smooth and controlled movement. At the core of the system is an Arduino Uno microcontroller, which coordinates all functions and responds to real-time data. A key feature of the system is the use of RSSI (Received Signal Strength Indicator) technology to detect school zones.
When the vehicle enters such a zone, the system automatically reduces speed to ensure the safety of pedestrians, particularly children and high risk zones. This automation reduces the need for manual intervention and increases response speed to environmental cues. An LCD display is included to provide real-time updates on vehicle speed and system status. The integration of these components results in a responsive and adaptive system. By focusing on zone-based speed control, the project promotes safer driving behavior.
The robotic platform allows for flexible deployment and testing. The system is ideal for smart vehicle applications, where automation plays a critical role.
It demonstrates the potential of microcontroller-based systems in real-world safety solutions. This approach minimizes risks in sensitive areas like sharp edges and sudden turns. Overall, the project contributes to building safer, smarter, and more responsive transportation systems.
Keywords:. IoT-Based Vehicle Automation Technology, RSSI, ESP8266, Proximity-speed control using Dc motor, motor driver, Arduino Automation, LED display, GSM Alert System.

I. INTRODUCTION

This project focuses on creating an intelligent vehicle safety system designed to improve safety for both drivers and pedestrians. The system is powered by a 12V battery and uses an Arduino Uno as the central control unit. Built on a robotic chassis, the vehicle is driven by DC motors and managed through a motor driver, allowing smooth and responsive movement. RSSI (Received Signal Strength Indicator) technology is used to detect High risk zones and Sharp edges, automatically reducing the vehicle's speed when such zones are entered. This function also enhances pedestrian safety, particularly in sensitive areas.

The system operates in real time, adjusting vehicle behavior based on environmental input. An LCD display provides continuous feedback, showing critical data such as vehicle speed distance between zone areas. This setup integrates multiple components to create a fully automated safety solution. The system is designed to be scalable and adaptable, making it suitable for personal, commercial, and autonomous vehicle applications. Its compatibility with IoT and smart transport infrastructure enables data-driven responses and improved control.

By leveraging microcontroller-based logic and sensor input, the vehicle becomes more aware of its surroundings and capable of safer operation. This design contributes to the development of intelligent transportation systems, reducing the risk of accidents and improving situational awareness.

The modular nature of the system allows for flexible integration and future enhancements. It represents a significant step toward the automation of road safety functions. The focus on sudden curves speed control makes it especially relevant for high-risk areas. Ultimately, the project aims to support safer roadways and smarter mobility solutions through the use of embedded technology and real-time automation.

II. LITERATURE REVIEW

A. Related Work

1) Enhancing Road Safety with Adaptive Speed Control Using RSSI Technology Author name : Singh, M., & Prakash, R (2024)

This paper presents an adaptive speed control system that leverages RSSI (Received Signal Strength Indicator) technology to enhance road safety by dynamically adjusting vehicle speed based on real-time signal strength. The system improves traffic efficiency and reduces the risk of accidents, particularly in sensitive zones such as school areas. Since RSSI is already a key parameter in wireless communication, its integration into vehicular systems is both practical and cost-effective. Experimental evaluations demonstrate the system's potential in intelligent transportation applications. However, its performance can be influenced by environmental factors such as signal interference and physical obstacles that affect RSSI accuracy. Additionally, effective large-scale deployment requires widespread adoption of RSSI-based infrastructure and compatible systems. While challenges like system responsiveness and reliability remain, the approach shows promise for future scalability with further refinements. Overall, the RSSI-based adaptive speed control system offers a viable path toward smarter and safer roadways.

2) Real-Time AI-Based Driver Monitoring for Accident Prevention Author name : Bose, S., & Karthik, R (2023)

The system uses AI-driven real-time monitoring to reduce human errors and enhance overall road safety. It provides instant alerts, allowing timely interventions to prevent accidents and improve responsiveness. By integrating RSSI technology, it dynamically adjusts vehicle speed based on environmental conditions, particularly in sensitive zones like school areas. RSSI's widespread use in wireless communication supports seamless integration. However, continuous driver surveillance raises privacy concerns. High processing power and advanced hardware requirements may increase implementation costs. Environmental interference can impact RSSI accuracy, affecting system reliability. False positives from AI detection could cause unnecessary actions, disrupting the driving experience. Widespread adoption of compatible infrastructure is essential for full effectiveness. Despite these challenges, the system shows strong potential for scalable, intelligent transportation solutions.

3) Intelligent Vehicle Speed Control Using RSSI and Machine Learning. Author name : Kim, J., Lee, S., & Park, D. (2022)

This presents a machine learning-based approach to dynamic vehicle speed control using RSSI data, aiming to enhance road safety and driving efficiency. The system optimizes speed in real-time, reducing unnecessary acceleration and braking, which in turn improves fuel efficiency and minimizes congestion. It performs effectively within intelligent transportation networks, especially among connected vehicles. Various models are evaluated, showing improvements in traffic flow and overall safety. However, successful implementation requires large datasets for training, posing a challenge in data-scarce environments. Signal inconsistency, particularly in urban areas with interference, can affect system accuracy. High development and hardware costs may limit scalability. The potential for false positives also raises concerns about driver experience. Despite these challenges, the integration of RSSI data with machine learning offers a promising step toward smarter, safer transportation systems.

B. Problem Statement

Despite advancements in vehicle speed control, current systems still have major issues that affect road safety, especially in high-risk areas like school zones, sharp turns, and hilly terrains.

These are the key problems:

1) Dependence on Driver Judgment: Most conventional speed control systems rely on driver awareness to adjust speed based on road signs and signals. However, distractions, poor visibility, and missed signs can result in vehicles entering restricted zones at unsafe speeds, increasing the risk of accidents.
2) Lack of Real-Time Adaptability: GPS-based speed control solutions identify restricted areas but fail to dynamically adjust speed based on real-time road conditions. Signal limitations in urban and remote areas further reduce their reliability, and they do not consider factors like traffic congestion, weather changes, or sudden roadblocks.
3) Absence of Early Warnings: Many existing systems lack proactive alerts before entering restricted zones, leaving drivers with little time to react. This is particularly dangerous in areas with sharp turns, poor visibility, or high pedestrian movement, where sudden braking can cause accidents.
4) Lack of Adaptation to Changing Conditions: Current systems don't respond to real-time road or traffic conditions. They don't account for sudden changes like traffic congestion, weather, or road closures, which can make the system less reliable in quickly changing environments. To overcome these challenges, an automated RSSI-based speed control system is proposed, which detects restricted zones using Wi-Fi signal strength and adjusts vehicle speed without driver intervention. A GSM module sends

early warnings before entering restricted areas, while an LCD display provides real-time speed and zone updates. By integrating wireless communication, embedded control, and automation, this system enhances road safety, minimizes human errors, and ensures efficient traffic management.

III. EXISTING SYSTEM

Existing vehicle systems increasingly utilize proximity-based speed control technologies to enhance road safety, particularly in sensitive zones such as High risk and sharp edges. These systems often employ sensors like radar or ultrasonic detectors to identify when a vehicle enters a predefined restricted area. Upon detection, the vehicle's speed is automatically reduced to align with safety requirements. While this method provides a layer of automation, it tends to operate on static inputs and lacks adaptability to rapidly changing environmental conditions.

For example, temporary road obstructions, unexpected Road constructions, or emergency scenarios may not be effectively recognized or addressed. Moreover, these proximity-based systems typically function in isolation, focusing solely on speed reduction without incorporating other safety mechanisms such as obstacle detection, traffic density analysis, or communication with external infrastructure.

The lack of integration with intelligent technologies limits their overall effectiveness. In modern traffic systems, real-time responsiveness is essential for both proactive and reactive decision-making. These limitations point to a critical need for more comprehensive solutions that fuse proximity detection with advanced data analytics, machine learning, and vehicle-to-infrastructure communication. Such integration could significantly improve road awareness, decision-making accuracy, and overall transportation safety.

A. Limitations of Existing System

Limited Integration of Safety Features: Existing vehicle safety systems often focus on a single function, such as speed control, without integrating multiple critical safety technologies. For example, features like proximity-based speed regulation, real- time monitoring, and alert mechanisms to authorities are typically implemented in isolation.

This lack of interconnected safety measures creates gaps in the overall effectiveness of the system. In situations that require immediate multi-faceted responses—such as a vehicle entering a restricted zone with an impaired driver—single-feature systems may fail to act comprehensively. Without real-time data fusion and automated communication with law enforcement or emergency services.

These systems fall short of addressing the complex nature of on-road safety. A more holistic approach, combining various safety technologies under a unified control system, is essential to ensure robust, intelligent vehicle safety in modern transportation environments.

IV. PROPOSED SYSTEM

To overcome the limitations of traditional water management systems, the Dual Mode Smart Water Supply Measurement and Monitoring System is designed to integrate real-time monitoring, automation, and IoT-based remote access. The proposed system utilizes advanced sensors, microcontrollers, wireless communication, and cloud-based data processing to enhance water efficiency, reduce wastage, and ensure fair distribution.

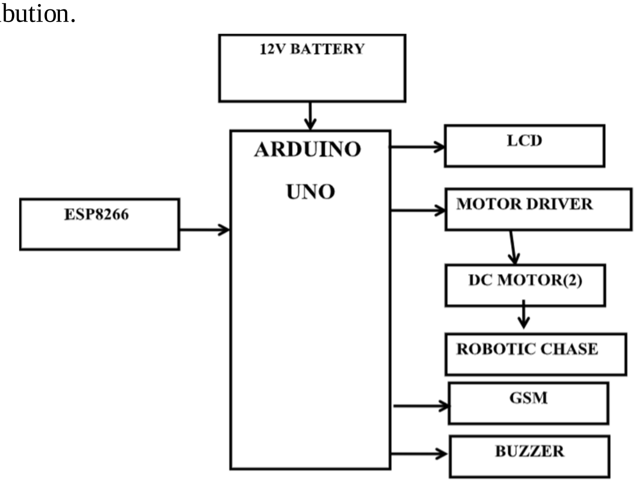

Fig.1. Block Diagram for Proposed System

This project aims to develop an intelligent vehicle safety system that integrates advanced components to enhance road safety, especially in sensitive areas like school zones. The system is powered by a 12V battery, which supplies energy to all hardware modules, including the Arduino Uno microcontroller, which acts as the central control unit. The Arduino coordinates the flow of information and commands between the components. An ESP8266 module is used to receive RSSI (Received Signal Strength Indicator) data, which allows the system to detect when the vehicle enters a school zone. Upon detection, the Arduino initiates an automatic speed reduction protocol to enhance pedestrian safety. A motor driver connected to the Arduino controls two DC motors that drive the robotic chassis, enabling smooth and responsive movement. The motor driver ensures accurate speed regulation based on the input signals from the Arduino. An LCD display is integrated into the system to provide real-time information such as current speed and system status to the user. A GSM module is also included for wireless communication, enabling the system to send alerts or updates when needed. Additionally, a buzzer is connected to deliver audible warnings in case of unsafe or abnormal conditions. This modular setup ensures that each function works cohesively under the Arduino's control. The robotic chassis houses the motors and serves as the vehicle's base, ensuring stability and maneuverability.

The system is fully automated, reducing reliance on human intervention and increasing reliability. Through the integration of wireless sensing, automated control, and real-time feedback, the project enhances the vehicle's awareness and responsiveness. This setup helps prevent overspeeding in restricted zones and promotes safer driving behavior. By combining embedded hardware and wireless communication, the system represents a step forward in intelligent transportation. The project aims to reduce road accidents and improve pedestrian protection through smart, sensor-driven automation. The overall architecture is both scalable and adaptable, suitable for integration into modern intelligent vehicle frameworks.

A. Key Features and Functionalities

The proposed system includes the following key features:

1) RSSI-Based Zone Detection
- Uses ESP8266 to detect Wi-Fi or hotspot signal strength.
- Determines vehicle proximity to restricted/high-risk zones.
- Compares RSSI value against a threshold to confirm zone entry.
- Ensures early response for speed adjustment in sensitive areas.

2) Speed Adjustment via Arduino Uno
- Arduino processes RSSI values in real time.
- Sends control signals to the motor driver based on zone detection.
- Reduces speed when RSSI signal is strong (restricted zone).
- Maintains normal speed in areas with weak RSSI signal.

3) Motor Driver & DC Motor Control
- Receives speed control instructions from the Arduino.
- Regulates power to two DC motors for forward movement.
- Ensures smooth deceleration in restricted areas.
- Provides responsive mobility suited for dynamic road conditions.

4) LCD Display for Real-Time Monitoring
- Continuously displays vehicle speed and RSSI signal strength.
- Shows zone status (normal or restricted) to inform the driver.
- Enhances transparency and awareness of system behavior.
- Assists in manual oversight or debugging if needed.

5) GSM-Based Alert System
- Sends automatic SMS alerts when entering restricted zones.
- Notifies the driver, authorities, or remote monitoring center.
- Enhances safety with timely alerts about speed limits or danger zones.
- Works independently of internet connectivity using mobile networks.

6) IoT Connectivity with ESP8266
- Provides wireless communication between the vehicle and external devices.
- Allows data monitoring and system control via smartphone or PC.
- Enables remote diagnostics and system status updates.
- Adds flexibility to the system for real-time access and alerts.

B. Advantages of the Proposed System:
- The system reduces vehicle speed automatically in high-risk zones. This improves safety without relying on driver action.
- Uses signal strength to detect school zones and sharp turns. It provides a reliable alternative to GPS-based systems.
- The Arduino efficiently processes data and manages all components. It ensures smooth system operation and real-time decision-making.
- Speed adjustments happen automatically based on environment. This minimizes human error and improves driving safety.
- Sends SMS alerts when entering restricted areas. This keeps drivers and authorities informed in real-time.
- Built using affordable hardware like Arduino and DC motors. It's budget-friendly and suitable for widespread use.
- Displays speed, signal strength, and zone status instantly. This helps the driver stay informed at all times.
- Works in tunnels, remote areas, and urban zones with weak GPS. It ensures consistent operation without satellite signals.
- Enables remote monitoring and control using Wi-Fi. Offers convenience and accessibility through smart devices.
- Runs on a compact 12V battery system. It's energy-efficient and suitable for embedded applications.
- Components can be replaced or upgraded easily. This makes the system adaptable and scalable.
- Motor driver regulates speed changes with precision. This allows safe and comfortable vehicle movement.
- Prevents over-speeding in school zones and crowded areas. Reduces chances of road accidents significantly.
- Simple components make the system easy to maintain. Repairs and replacements can be done without high cost.
- Supports automation and real-time decision-making. A good fit for future intelligent transportation systems.

C. Summary of the Proposed System
The proposed vehicle safety system leverages RSSI signals to detect entry into restricted or high-risk zones, enhancing safety through smart automation. An ESP8266 module continuously monitors Wi-Fi or hotspot signal strength to assess the vehicle's proximity to such zones. At the heart of the system, an Arduino Uno microcontroller processes the RSSI data and issues appropriate speed control commands. When a strong RSSI signal indicates the vehicle is entering a sensitive area, the Arduino automatically reduces speed by adjusting the power supplied to two DC motors via a motor driver. This ensures smooth and adaptive motion, particularly important in school zones, pedestrian areas, or accident-prone regions. An LCD display provides real-time feedback on current speed, RSSI signal strength, and zone status, keeping the driver informed. Additionally, a GSM module sends automatic SMS alerts to drivers or authorities when the vehicle enters a designated zone. IoT support through the ESP8266 allows for remote monitoring and control via smart devices, enhancing system accessibility and functionality. Notably, the system functions efficiently without relying on GPS, making it suitable for areas with poor satellite coverage. Overall, it promotes improved road safety through intelligent zone detection, real-time alerts, and automated speed control.

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V. IMPLEMENTATION METHODOLOGY

A. System Components and Functionality
The system consists of the following hardware components, each playing a crucial role in Vehicle speed control and alert System using GSM technology.

1) Power Supply Initialization
The system operates using a 12V battery, which serves as the main power source for all electronic and mechanical components involved. A voltage regulator is employed to convert the 12V supply down to 5V, ensuring compatibility and safe operation of low-voltage modules such as the Arduino Uno, ESP8266, and GSM module. This regulated power prevents damage to sensitive circuitry and maintains stability during continuous operation. The Arduino Uno, functioning as the control hub, also helps manage the power flow to other modules like the LCD display, RSSI sensor, and motor driver. The motor driver then regulates and distributes appropriate power to the DC motors, enabling controlled speed and movement of the vehicle. Meanwhile, the LCD and GSM module rely on the regulated 5V supply for uninterrupted data display and alert transmission. Proper power distribution across the system ensures that no module is under- or over-powered.

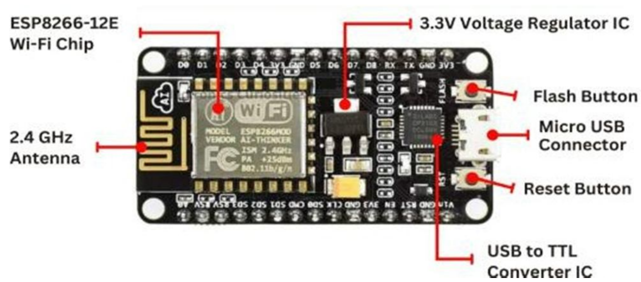
2) Data Processing by Arduino Uno:

The Arduino Uno acts as the central controller of the system, responsible for processing RSSI data received from the ESP8266 module. When the RSSI value is strong, it indicates that the vehicle is near a restricted or sensitive zone.

The Arduino then compares the signal strength against a predefined threshold to make real-time decisions. If the threshold is exceeded, the Arduino sends control signals to the motor driver to reduce the vehicle's speed accordingly. It also communicates with the LCD display to show the current RSSI value and zone status. In addition, the Arduino triggers the GSM module to send alerts to designated contacts and activates a buzzer for immediate audio warning. This multi-module coordination ensures the system remains responsive and informative. The Arduino's logic plays a vital role in enabling safe and intelligent vehicle behavior based on proximity detection.

3) RSSI Signal Detection (ESP8266)

The RSSI module, based on the ESP8266, plays a critical role in detecting the proximity of the vehicle to specific zones. It continuously scans the environment for available Wi-Fi or hotspot signals and measures their signal strength in real-time.



These RSSI values provide an indication of how close the vehicle is to predefined restricted zones such as school areas, accident-prone regions, sharp turns, or hilly roads. As the vehicle gets closer to these zones, the signal strength increases, which is then processed by the Arduino controller. Once the signal crosses a defined threshold, the Arduino interprets this as an alert and activates safety mechanisms. It commands the motor driver to reduce the vehicle's speed, ensuring safe navigation. This proactive response helps prevent accidents and enhances road safety. Overall, the RSSI module acts as a virtual boundary detector, ensuring smarter and safer vehicle operation.

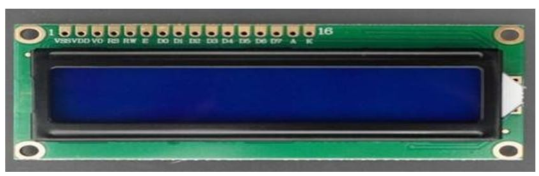
4) Motor Speed Control

The Arduino Uno sends appropriate control signals to the motor driver based on the RSSI values received from the ESP8266 module. Acting as an interface between the microcontroller and the DC motors, the motor driver ensures smooth operation and speed con trol. In this system, the L293D IC is used as the motor driver, which is capable of controlling the direction and speed of the motors. When the RSSI signal is strong—indicating the vehicle is near a restricted zone—the Arduino commands the motor driver to reduce the motor speed. Conversely, if the RSSI signal is weak, suggesting a safe zone, the motor speed remains unaffected. The motor driver regulates the voltage and current supplied to the motors accordingly. This intelligent control ensures safer vehicle movement depending on the environment. Overall, it enables dynamic speed adjustment based on real-time zone detection.

- Strong RSSI signal (restricted zone detected) → Speed is reduced .
- Weak RSSI signal (normal zone detected) → Speed remains unchanged.

5) Real-Time Information Display

The LCD (Liquid Crystal Display) is a widely used electronic display module, commonly found in embedded systems and circuits. A 16x2 LCD, which can show 16 characters per line on 2 lines, is one of the most basic and cost-effective display options. It offers advantages over seven-segment and LED displays due to its programmability and support for custom characters and animations.



Each character on the LCD is formed using a 5x7 pixel matrix, enabling clear and readable output. The LCD has two main registers: Command and Data. The Command register is used to send instructions like clearing the screen or cursor positioning. The Data register holds the actual characters (ASCII values) to be displayed. This makes the LCD both versatile and easy to use in microcontroller-based projects.

6) Alert System via GSM Module and Buzzer

The alert system in this project utilizes both a GSM module and a buzzer to enhance safety and communication. When the vehicle approaches a restricted or high-risk zone, the GSM module automatically sends an SMS alert to predefined recipients such as the driver, nearby authorities, or a remote monitoring system. This ensures that necessary actions can be taken promptly in response to the alert.

Simultaneously, the buzzer produces a loud sound to immediately notify the driver of the approaching restricted zone. This sound acts as a real-time warning, drawing the driver's attention to the need for reduced speed or increased caution. The use of a buzzer adds an auditory layer of safety that operates even without mobile network coverage Together, the GSM and buzzer create a dual-alert mechanism—visual through SMS and audible through sound—ensuring comprehensive awareness. These components are connected to and controlled by the Arduino Uno, which triggers them based on RSSI signal strength. This integrated approach improves road safety by delivering timely and effective alerts.

B. System Workflow and Operation

1) Power Supply Initialization

The system derives its power from a 12V battery, which provides energy to all major components including the Arduino Uno, ESP8266, motor driver, GSM module, and LCD display. Since the Arduino Uno and other sensitive components like the ESP8266 operate at 5V, a voltage regulator is used to step down the voltage safely. This ensures stable functioning and prevents electrical damage. The regulated power supply is critical for the consistent operation of the system. Each module receives power based on its requirement for proper execution. The power system plays a foundational role in overall system reliability.

2) RSSI Signal Detection

The ESP8266 module continuously scans for available Wi-Fi or hotspot signals in the surrounding environment. It measures the signal strength in the form of RSSI (Received Signal Strength Indicator). When the RSSI value is strong, it suggests that the vehicle is approaching a restricted or high-risk zone. A weak signal implies that the vehicle is in a safe or normal driving area. The system uses a predefined threshold value to distinguish between restricted and normal zones. This detection method enables the system to react in advance, improving driving safety.

3) Data Processing by Arduino Uno

Arduino Uno acts as the central processing unit of the system. It receives the RSSI data from the ESP8266 and compares it with predefined threshold values. If the signal strength indicates a restricted area, the Arduino decides to reduce the vehicle speed. It also communicates with the LCD to display the zone status and with the GSM and buzzer modules to send alerts. This multi-functional control allows coordinated responses from different parts of the system. The Arduino plays a crucial role in automating decisions without human interference.

4) Motor Speed Control

The Arduino Uno sends speed control instructions to the motor driver, which in this case is an L293D IC. The motor driver acts as a bridge between the Arduino and DC motors, supplying regulated power to manage speed. If the RSSI signal is strong (meaning the vehicle is near a restricted zone), the speed is automatically reduced. If the signal is weak, the speed remains at normal levels. This automatic adjustment improves both passenger and pedestrian safety. Smooth transitions in speed ensure comfortable and safe vehicle operation.

5) IoT Connectivity

The ESP8266 module also enables Internet of Things (IoT) connectivity, allowing wireless data exchange between the vehicle and external devices. Through Wi-Fi, the system can send and receive updates to smartphones or laptops. This functionality allows remote monitoring, diagnostics, and even control of the system. Users can check real-time values such as speed, signal strength, and zone detection status. This adds convenience and flexibility for both personal and commercial applications.

6) Real-Time Information Display

A 16x2 LCD display is used for monitoring key system data in real time. The display shows information such as the vehicle's current speed, RSSI signal strength, and whether the vehicle is in a normal or restricted zone. This allows the driver to stay informed and react if necessary. It also provides transparency for observers or testers of the system. The LCD is powered through the Arduino and receives data as it's processed. It's an essential part of both system functionality and debugging.

7) Alert System via GSM Module and Buzzer

When the vehicle approaches a restricted zone, the GSM module automatically sends an SMS alert to predefined contacts. These alerts can reach the driver, a traffic authority, or a monitoring center ,depending on the setup. At the same time, a buzzer produces a sound to warn the driver immediately. This dual-alert system ensures that both local and remote parties are notified of the zone change. It adds a layer of safety by reinforcing the vehicle's automated response. The alert system is crucial for communication and compliance with traffic norms.

C. Advantages of the Proposed Implementation Automated Speed Control

1) Detects restricted zones using RSSI signal strength (e.g. Hair pin bends, High risk zones, Sudden turns, Sharp curves).
2) Automatically adjusts vehicle speed without manual input.
3) Minimizes driver distraction and reaction time errors.

4) Enhances safety by enabling early response to environmental changes.
5) Uses Arduino Uno to process RSSI data and control motor speed.
6) Offers smoother transitions in speed compared to sudden braking.
7) Functions without GPS, making it reliable in tunnels or poor signal areas.
8) Ensures consistent speed regulation in both urban and rural zones.
9) Reduces wear on mechanical braking systems.
10) Suitable for future integration in intelligent transportation systems.

Real-Time Alerts and Monitoring

a) GSM module sends SMS alerts when entering high-risk or restricted zones.
b) Enhances decision-making through timely zone-based notifications.
c) LCD displays current speed, RSSI values, and zone status.
d) Keeps the driver constantly informed of the system's operation.
e) Prevents misinterpretation or missing road signs due to poor visibility.
f) Reduces chances of collisions due to better situational awareness.
g) Supports remote monitoring for future smart traffic systems.
h) Operates independently of internet availability, using mobile networks.
i) Builds driver confidence through real-time system feedback and control.

D. Summary

The suggested system is an intelligent alert and speed control system for high-risk or Hair pin bends. In order to determine the proximity of Sharpe Edges, steep curves, or hilly areas, it uses the ESP8266 module to detect signal strength (RSSI) from Wi-Fi or hotspots. The Arduino Uno analyses the data and instructs the motor driver to lower the vehicle's speed when it detects a high RSSI value, which indicates entry into a sensitive area. The power delivered to the DC motors is then modified appropriately by the motor driver (L293D). All parts are powered by a 12V battery, and modules such as the Arduino and ESP8266 have their voltage stepped down by a voltage regulator. To keep the driver informed, the system has an LCD display that shows the current speed, zone status, and signal strength. When entering restricted areas, a buzzer emits sound alerts and a GSM module sends SMS alerts. Wireless monitoring and control via PCs or smartphones made possible by IoT connectivity via ESP8266. The system uses simple electronic components and is economical, modular, and energy-efficient. It guarantees seamless vehicle control and real-time decision-making. Additionally, it requires little upkeep and is perfect for incorporation into upcoming intelligent transportation systems. It operates dependably even in tunnels and places with inadequate satellite coverage, in contrast to GPS-based systems.

VI. RESULTS AND DISCUSSION

The proposed intelligent vehicle speed control system was successfully tested, demonstrating significant improvements in road safety and speed regulation in high-risk zones. The key results are as follows:

1) Automatic Speed Regulation: The system effectively reduced vehicle speed in restricted areas such as Zones like hospitals, residential neighborhoods, and sharp turns using RSSI (Received Signal Strength Indicator) technology. By detecting specific signal thresholds associated with designated safety zones, the system autonomously adjusted the vehicle's speed to predefined safe limits. It also ensured consistent adherence to safety protocols regardless of the driver's awareness or alertness. The system was able to dynamically respond to changes in signal strength, allowing for smooth and gradual deceleration. In areas with poor visibility or high pedestrian activity, this feature significantly enhanced safety. Integration with GPS and real-time mapping further improved accuracy and responsiveness. Additionally, alerts were provided to the driver for situational awareness while maintaining control over the vehicle. Overall, this automation contributes to a smarter and safer transportation environment, particularly in sensitive or accident- prone areas.
2) Real-Time Alerts: The integrated GSM module enabled the system to deliver timely alerts to drivers via an LCD display, ensuring proactive awareness of upcoming restricted or sensitive zones by its Specifying distance. These alerts included information such as approaching accident-prone areas, or construction sites. By receiving notifications before entering such areas, drivers had enough time to reduce their speed and drive more cautiously. The alerts were clear and concise, minimizing distraction while still effectively conveying critical information. The system also supported voice alerts for enhanced safety, especially in situations where visual attention was focused on the road. In case of poor visibility conditions such as fog or

nighttime driving, these alerts became even more vital. The use of GSM ensured reliable and wide-area communication coverage, making the system applicable in both urban and rural settings. This real-time communication greatly reduced the likelihood of sudden braking or last-minute decisions, promoting smoother and safer driving behavior.

3) Proximity Detection with RSSI: The system utilized RSSI (Received Signal Strength Indicator) values from Wi-Fi signals to accurately detect the vehicle's distance from restricted zones. As the vehicle approached a predefined zone, signal strength increased, triggering the system to initiate gradual speed reduction. This real-time response ensured smoother transitions and prevented abrupt braking. The RSSI-based detection allowed for fine-tuned control even in areas without GPS coverage. By continuously monitoring signal fluctuations, the system maintained high accuracy in zone identification. This method also reduced dependency on physical signboards, making the system efficient in dynamic or temporary restricted zones like construction areas. Overall, it significantly enhanced public safety.
4) Enhanced Safety in High-Risk Zones: The system successfully minimized the risk of accidents in sensitive areas, such as pedestrian crosswalks and accident-prone zones, similar to systems deployed in various countries. By automatically adjusting vehicle speed and issuing real-time alerts, it enhanced driver awareness and response time in critical areas. The technology proved particularly effective in areas with heavy foot traffic or limited visibility, reducing chances of collision. Its ability to adapt to both permanent and temporary high-risk zones made it highly versatile. Additionally, integration with urban safety databases allowed for dynamic updates, ensuring timely protection as city layouts and risk patterns evolved.
5) Energy Efficiency: Powered by a 12V battery, the system was designed to be energy-efficient, consuming minimal power while maintaining high performance. This low-power consumption made it ideal for continuous operation without placing a heavy load on the vehicle's electrical system. By promoting smoother acceleration and deceleration through automated speed control, the system helped reduce unnecessary fuel usage. Consistent speed regulation also led to lower emissions, supporting environmentally friendly driving practices. The compact design and efficient circuitry further contributed to its sustainability, making it suitable for both conventional and electric vehicles in green transport initiatives.

VII. CONCLUSION

In conclusion, this project demonstrates a practical and intelligent approach to enhancing vehicle safety through the integration of modern technologies. By utilizing an Arduino Uno microcontroller as the system's brain, it effectively coordinates the operation of key components such as DC motors, an LCD display, and various sensors. Powered by a 12V battery, the system remains energy-efficient while delivering reliable performance. The implementation of RSSI technology enables accurate detection of restricted zones like High risk zones and Sharp Edges, automatically reducing vehicle speed to ensure public safety. The inclusion of GSM-based real-time alerts further empowers drivers by notifying them of upcoming risk zones by its distance, allowing for proactive speed adjustments. The LCD interface provides continuous updates on speed and system status, enhancing situational awareness. The system's adaptability allows it to respond dynamically to both permanent and temporary zones, making it suitable for diverse environments. With its modular and scalable design, it is also well-suited for integration into IoT-based smart city infrastructures. The robotic platform offers a flexible base for testing and deployment, supporting future upgrades and experimentation. The controlled movement enabled by motor drivers ensures smooth navigation, even in complex routes. Moreover, by promoting consistent speed regulation, the system helps reduce fuel consumption and harmful emissions, contributing to greener transportation. It also proves highly effective in high-risk areas like sharp turns and blind spots. The solution mirrors intelligent traffic systems used globally, offering a cost-effective and accessible model. Overall, this project highlights the immense potential of microcontroller-based safety systems in shaping safer, smarter, and more responsive transportation networks, paving the way for the next generation of intelligent vehicles.

VIII. ACKNOWLEDGMENT

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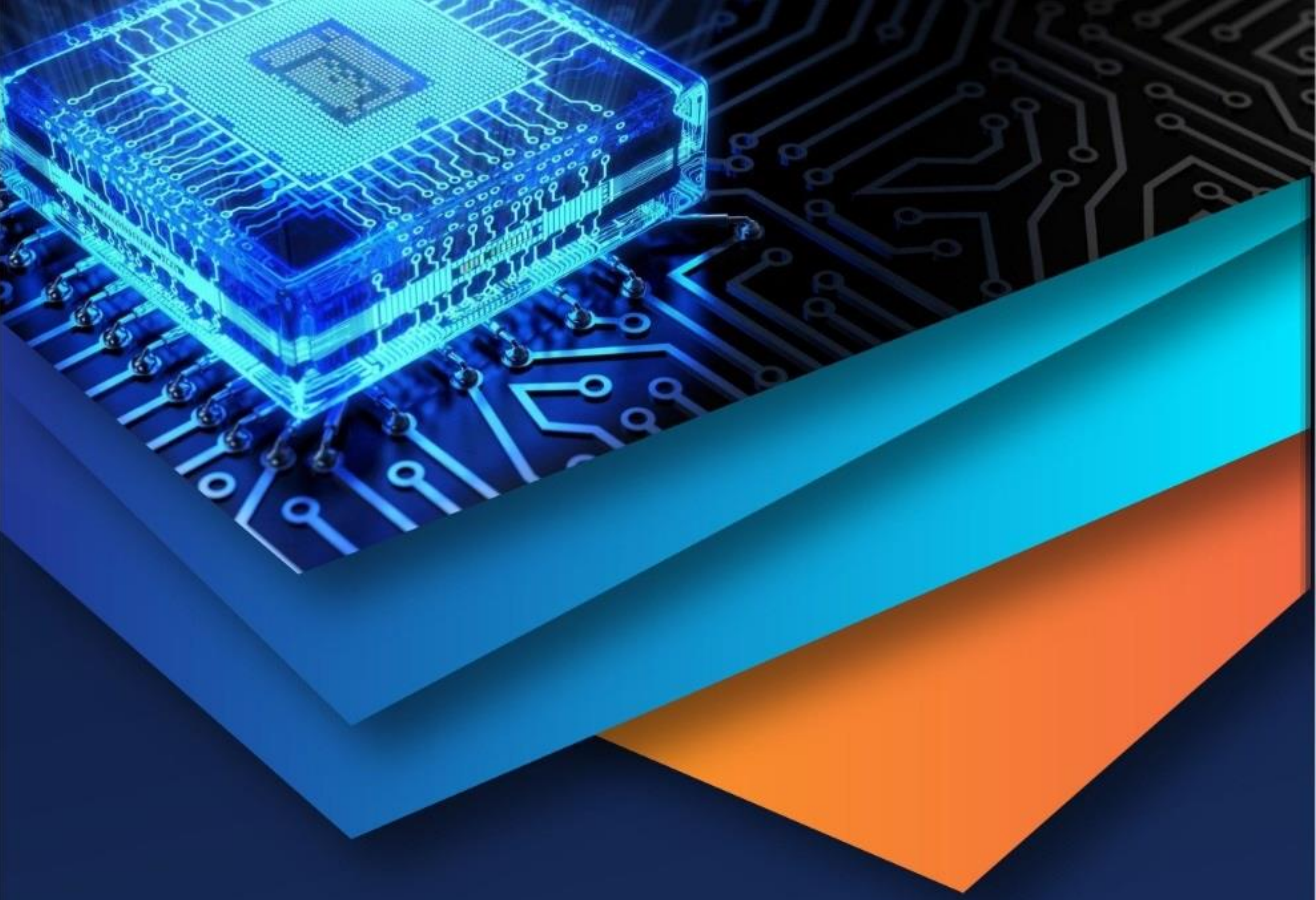

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