Smart Zone Based Vehicle Speed Control Using RF andObstacle Detection and Accident Prevention

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Abstract: **- This research article proposes a new strategy for managing vehicle speed using RF (radio frequency) technology paired with an advanced obstacle detection and accident prevention system. When a vehicle enters a designated smart zone, its speed is automatically limited by receiving signals. Upon entering the zone, the vehicle's speed is decreased to a predetermined cut-off point and maintained at a steady level until it exits the zone. Once beyond the zone, the car resumes its usual acceleration. Additionally, the system effectively detects obstructions and implements procedures to prevent accidents by instantly stopping the car.**

Keywords: **- IOT, RF, ultra sonic sensor.**

I. INTRODUCTION

Metropolitan cities suffer a tremendous rise in population, particularly at key sites such as schools, malls, and hospitals, which are commonly positioned along roadways. Ensuring vehicle speed control in these regions is vital to preventing accidents. The bulk of incidents occur due to excessive speeding on local roadways. Therefore, there is a need for studies on controlling vehicle speed in specified zones. Identifying obstructions is also an important component of guaranteeing pedestrian safety, especially for youngsters and senior citizens. Several research proposals have been offered to automatically stop automobiles and monitor speeds at certain spots. However, these systems have shown poor performance in terms of limiting vehicle speed and providing information to authorized users. Existing systems largely focus on stopping vehicles when an object is spotted, but there is a shortage of systems that restrict speed in designated zones using Internet of Things (IoT) technology. Hence, this study proposes to create a hardware prototype that securely monitors and controls automobiles in certain zones using IoT, solving this gap in the existing research.

This research provides sophisticated technology that successfully controls vehicle speed in designated zones while automatically identifying impediments and giving continual updates to the traffic control unit. The proposed hardware prototype offers excellent security and dependability for the benefit of society.

To enable real-time applications, this study leverages state-of- the-art hardware that enables quick implementation without any substantial delays. Leveraging technical breakthroughs and the computational powers of computers, the hardware prototype, in the shape of a robot, achieves high-speed control, resulting in excellent performance for practical scenarios. Pulse width modulation (PWM) is often applied in digital systems to permit smooth transitions between on and off conditions, boosting the overall efficiency of the system. The technical advancements involve intelligent robots for accurate speed control, enhanced motor drivers for wheel rotation, and superior algorithms system.

By upgrading the automated system, this research proposes an economically viable approach for regulating cars within particular zones. The succeeding portions of this work are organized as follows: Section II presents an overview of existing automated systems for vehicle control; Section III outlines the improved automation system along with its advanced methodology; Section IV presents the results and corresponding discussions; and finally, Section V concludes the paper, summarizing the findings and contributions.

II. RELATED WORK

Because of exceeding the speed limit when driving, India is among the nations with the highest number of traffic accidents worldwide. Due to the increase in traffic brought on by domestic roads' high speeds, activities to monitor and limit vehicle speed are needed. With the goal of alerting security authorities, Khan and Khan [1] propose a method to identify over speed up vehicles. The over speed detectors and information storage systems built into smart vehicles allow them to share the same information with the appropriate authorities. A GPS module, and sensors make up the smart car over speed system, which recognises safe zones as a result. GPS maps are used to correctly identify the speeding car. On the other hand, when there are barriers, the over speed detecting system is powerless to prevent accidents. In response to the issue of signal interference caused by a rising number of vehicles on the road, an RFID-based vehicle control

system is presented in [3]. This technique addresses the problem by eliminating signboards in selected areas. It utilizes RF transmitters and receivers positioned at both ends of the restricted area, with the speedometer loading the vehicle's journey through the cloud. Simulation results demonstrate greater performance methodologies.

In [4], John and Nishanth offer an autonomous accident prevention system that focuses on speed control and accident avoidance. To determine the accident location, they created an automated method utilizing an ATmega328P controller. GPS and GSM modules are used to find and report the accident information to the necessary authorities. Additionally, the system features a MQ3 sensor to detect alcohol concentration in the driver. The automatic algorithm correctly detects the accident location. Nevertheless, the system's cost increases due to the participation sensors.

Another idea by Taher et al. [5] combines smart traffic signals and smart automotive technologies to reduce accidents. The smart traffic signalling system is made using a microprocessor and RF transmitter, while the automotive system consists of a sonar sensor, microcontroller, and RF module. This integrated technology successfully manages vehicle speed when it exceeds the limit in certain areas. Furthermore, a switch is fitted in thecar to restrict speed during crises, and vehicle information is relayedsegments.

Overall, these research initiatives provide unique ways for managing vehicle speed and preventing accidents. However, difficulties relating to hardware implementation and higher costs need to be solved in order to produce practical and cost-effective solutions for real-world deployment.

The primary purpose of putting a sonar sensor in the system is to enhance vehicle safety and prevent accidents in certain zones. However, the cost of building this hardware system increases due to the inclusion of a controller and the sonar sensor.

To solve the obstacles associated with real-time implementation of the hardware for smart zone-based vehicle speed control, this study suggests an IoT-based solution utilizing an Arduino Nano controller with pulse width modulation (PWM). The use of Arduino Nano, together with a decreased number of sensors, attempts to cut hardware expenses without affecting the reliability of the system. This strategy ensures a cost-effective solution while preserving the high reliability essential for the system's successful operation.

III. PROPOSED SYSTEM

The suggested system offers considerable advantages in terms of accident prevention in high-traffic areas and reliable communication with authorized personnel during emergencies. When a vehicle enters a protected zone, the vehicle's transmitter transmits a signal to the receiver, permitting seamless communication and ensuring the safety and security of the environment.
The project comprises various important modules to ensure its functionality. These modules comprise RF transmitter and receiver modules for establishing wireless communication, DC motors responsible for regulating the vehicle's movement, and an IR sensor that detects obstructions in its surroundings.

At the core of the system lies a microcontroller, which serves as the controlling device. The microprocessor connects with the RF receiver module and DC motors through a motor driver. It carries out critical activities such as data processing and decision-making by deploying an embedded program developed in the C programming language. This program allows the microcontroller to assess the supplied data and execute suitable actions on the electric DC motors depending on the processed information.

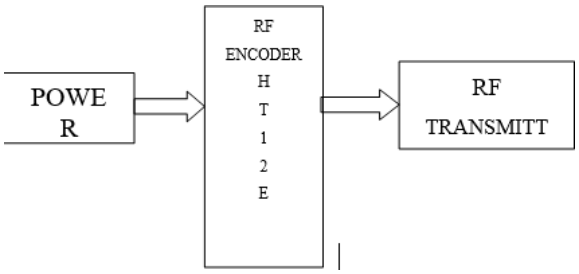

fig: Transmitter

When the vehicle reaches the transmitter zone, the microcontroller receives the signal transmitted by the RF module. Subsequently, the vehicle's speed is managed, ensuring it is dropped to a predetermined cut off point. The speed remains constant until the vehicle travels out of the transmitter zone, allowing the vehicle to restart self-acceleration. This technique aids in keeping safe speeds within the authorized zone, lowering accidents.

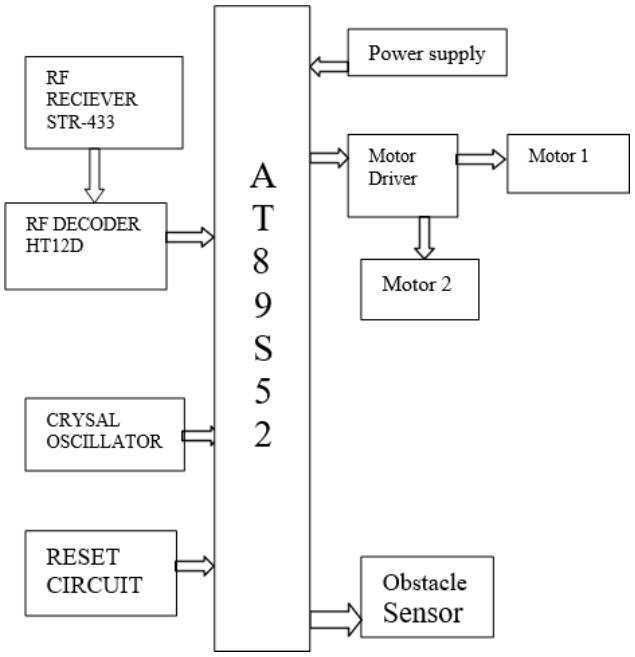

fig: Block diagram

The IR sensor plays a significant role in obstacle detection. It continuously examines the vehicle's surroundings and detects any possible obstructions that come within its range. Once an impediment is discovered, the IR sensor instantly delivers the necessary information to the microcontroller. This information serves as critical input for the microcontroller to take proper action to avert mishaps. The microprocessor, in collaboration with the motor driver IC, ensures that the vehicle adjusts its path crashes.

In summary, the integration of RF transmitter and receiver modules, DC motors, an IR sensor, and a microcontroller programmed in embedded C provides a comprehensive system that effectively controls vehicle speed, detects obstructions, and takes proactive actions to prevent accidents.

IV. METHODOLOGY

The methodology adopted in the project "Smart Zone-Based Vehicle Speed Control Using RF and Obstacle Detection and Accident Prevention" can be outlined as follows: Firstly, wireless communication is established using RF transmitter and receiver modules. The system utilizes a microcontroller as the central control device, which connects with the RF receiver module and DC motors through a motor driver. Through the execution of an embedded program written in embedded C, the microcontroller processes the received data and successfully controls the electric DC motors accordingly. As the vehicle enters the transmitter zone, the received signal causes a reduction in speed to a predetermined cutoff point. Simultaneously, an IR sensor identifies obstructions and communicates the information to the microcontroller. The microprocessor then communicates with the motors via a driver IC, ensuring suitable directions are taken to prevent accidents.

V. RESULT

An IoT based smart zone system for speed control is developed in Arduino integrated development environment (IDE). It usually connects to the Arduino nano and Genuine hardware to upload programs and communicate with them to processing of tasks for certain application.

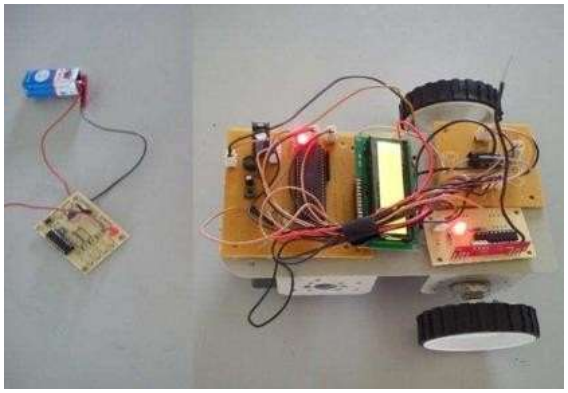

Fig. depicts the entire smart zone-based speed control of the vehicle which is composed of both transmitter and receiver sections. From fig., it is cleared that the connections of schematic circuit is directly connected thereby simple to design entire system. The encoder is directly connected to RF transmitter with shown connected wires whereas in receiver, decoder and motors are connected with Wi-Fi for IoT.

VI. THE CONCLUSION

In conclusion, the project of smart zone-based vehicle speed control using RF, obstacle detection, and accident prevention has shown promise for a safer and more efficient transportation system. By merging RF technology, obstacle detection, and accident prevention methods, this novel system offers a comprehensive framework for managing vehicle speed within authorized zones. With its unique blend of technology, it paves the way for increased road safety and improved traffic management without compromising on comfort or reliability.

VII. FUTURE SCOPE

In the future, the project of smart zone-based vehicle speed control employing RF, obstacle detection, and accident prevention holds great potential for additional developments. Potential areas of investigation include applying machine learning algorithms for more precise obstacle identification, integrating advanced sensors for increased accident avoidance, and improving the system's capabilities to assist autonomous cars. These innovations would usher in a new era of intelligent transportation systems, providing safer roads and efficient trafficmanagement.

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