

Automatic Vehicle Speed Control

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Abstract – Vehicle safety in locations where there is a strict limitation on speed, including near schools and hospital areas, poses a significant challenge. Drivers tend to go above the limit, endangering pedestrians, while traffic authorities' monitoring is not always possible continuously. This project presents an automatic speed control system that assists vehicles in sticking to speed limits without depending on the driver. A transmitter placed at a restricted area's entrance sends signals to a receiver in the vehicle. The microcontroller within the vehicle picks up the signal upon entering the zone and automatically adjusts the speed. This system raises safety standards, lowers the risk of accidents, and promotes uniform compliance with speed limits in sensitive areas.

Index Terms: Automatic vehicle speed control, Microcontroller, Road safety, Restricted zones, IR communication, Traffic management, Accident prevention.

I. INTRODUCTION

Maintaining road safety in locations where speed is tightly regulated, like school areas, hospital surroundings, and suburban neighborhoods, has taken on a greater degree of significance. In spite of having traffic rules, drivers regularly overspeed, posing a threat to pedestrians, bicyclists, and other road users. Conventional methods of monitoring, through traffic police or fixed speed cameras, are constrained by manpower, coverage, and instantiveness. Full-time monitoring of all such vital areas is not practicable and financially viable, resulting in gaps in the enforcement and leaving communities open to unwarranted danger.

To counter these issues, auto vehicle speed control systems pose a potential solution. Combining microcontroller-based technology with wireless signaling, cars can regulate their speed independently

when approaching specified restricted areas without any driver intervention. In the system, there is a transmitter placed at the boundary of a restricted area that sends signals which are received by a receiver fitted on the car. When the signal is received, the microcontroller converts it and automatically adjusts the speed of the vehicle within the specified limits, allowing safe travel through security zones.

This approach not only enhances public safety but also minimizes the risk of accidents due to overspeeding. Further, it provides an effective solution for traffic authorities, as it minimizes the necessity of continuous monitoring and enforcement. By robotizing speed adjustment in high-risk areas, the system guarantees uniform adherence to traffic regulations and better road safety. The introduced method offers a scalable and effective model that can be deployed in different high-risk regions, leading to safer roads and more accountable driving habits.

II. PROBLEM STATEMENT

Existing traffic control within speed-limit zones, e.g., schools, hospitals, and residential districts, is largely dependent on manual observation by authorities or fixed speed enforcement. The strategies are challenged by a number of factors: there is a need for continuous human oversight, which is time-consuming and usually not feasible, vehicles regularly overspeed despite rules in place, and available systems lack real-time response to avert overspeeding. Pedestrians and other road users are therefore still exposed, and accidents in sensitive regions continue to arise.

There exists a definite requirement for an automated system that is capable of dynamically regulating vehicle speed in restricted areas, independent of reliance upon driver cooperation or constant human monitoring. By integrating a microcontroller-based system, which talks

to transmitters placed at strategic points, vehicles can automatically recognize speed limits and vary their speed as per the limits. This method overcomes the drawbacks of traditional approaches, improves safety, allows for consistent enforcement of traffic regulations, and offers a scalable model for road safety management in high-risk regions.

III. RELATED WORK

Automatic speed control of vehicles in sensitive areas has been an area of focus for many research studies over the last decade with focus given on microcontroller-based systems, sensors, and driver-independent control. These studies provide useful information on system design and implementation as well as areas needing improvement

Kumar and Sharma designed an IoT-based speed control system automatically for sensitive areas such as schools and hospitals. Kumar and Sharma implemented a design with transmitters placed at the entrance of zones and receivers on vehicles, enabling a microcontroller to control speed automatically. The method was efficient in controlling overspeeding but merely addressed hardware functionality without thorough analysis of scalability or integration into larger traffic networks.

Gupta and Singh experimented with a geofencing-based speed limiter system, using GPS information to identify prohibited zones and regulate vehicle speed based on that. Although the system effectively detected zones and managed speed, its dependency on GPS leaves it exposed in low-signal environments or urban canyon areas.

Verma and Patel proposed an intelligent speed adaptation system for urban roadways, combining traffic information with adaptive control algorithms in order to improve speed compliance. While this approach enhanced overall traffic flow, it relied extensively on centralized communication and is therefore not well-suited to fully autonomous vehicle control in remote restricted areas.

Li and Wang introduced an advanced driver assistance system (ADAS) with adaptive speed control for safety. Their system was successful in controlling vehicle acceleration and braking but was intended for normal

driving situations and not specifically for targeted speed limit areas.

Kumar and Singh emphasized speed control with microcontrollers and optical sensors, which was very similar to the approach of our project. Their implementation provided quick response times to car entrance into prohibited areas, although the testing only involved controlled environments and did not investigate multi-zone capability.

Gupta and Verma suggested an embedded speed control system in restricted regions, with a focus on accurate placement of sensors and microcontroller programming. Although sound technically, the research had not included wireless signaling and real-time performance testing under different traffic conditions.

Rahman and Chowdhury explored wireless speed control with IR sensors, demonstrating the feasibility of adjusting vehicle speed remotely without driver involvement. Nonetheless, the experiment was constrained in operating distance and did not extend to multiple vehicles or zones.

From this review, it is evident that microcontrollers integrated with optical or IR sensors provide a viable and consistent method for automatic speed regulation. However, there are still issues of practical application, multi-zone scalability, and compatibility with larger traffic management systems. Following on from these earlier works, our research project has the objective of developing a complete, functional, IR-based vehicle speed control system that is real-time, scalable to different restricted zones, and can be applied to multiple vehicles without a high degree of human intervention.

IV. PROPOSED METHODOLOGY

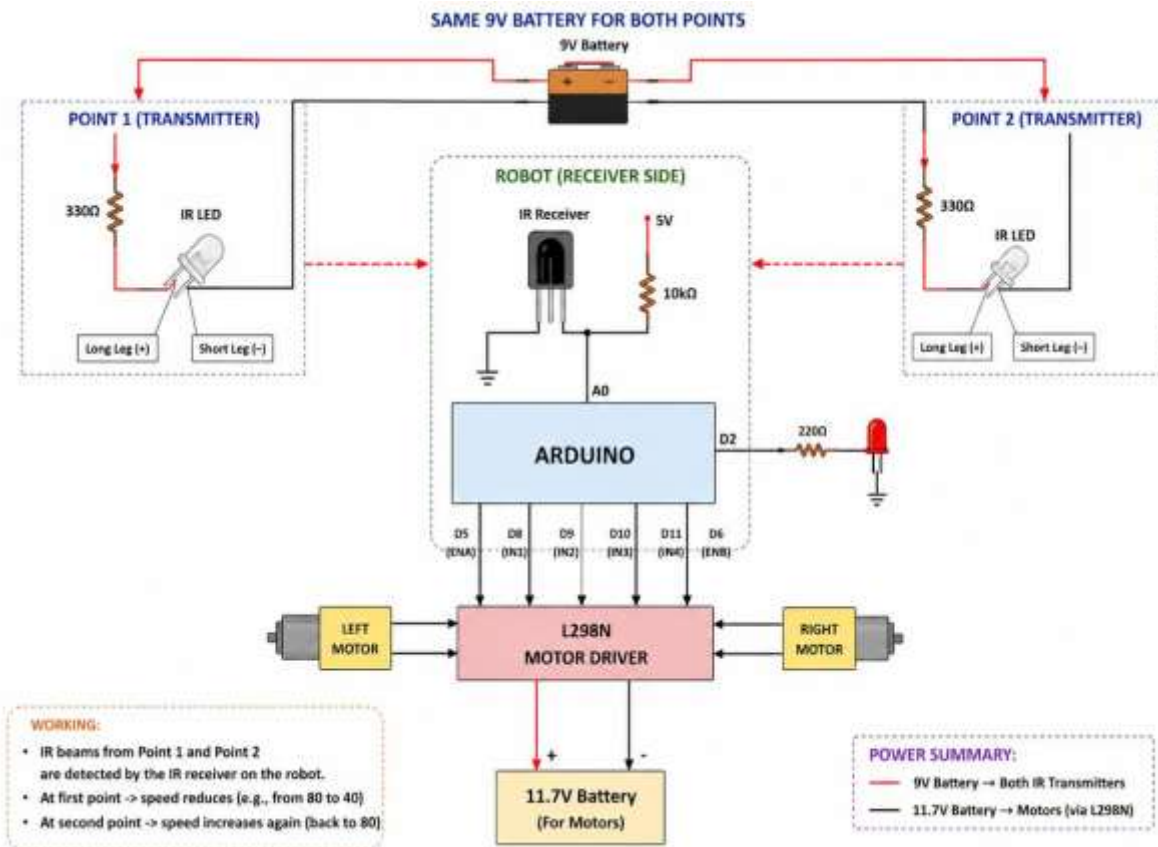


FIGURE 1: Proposed Architecture

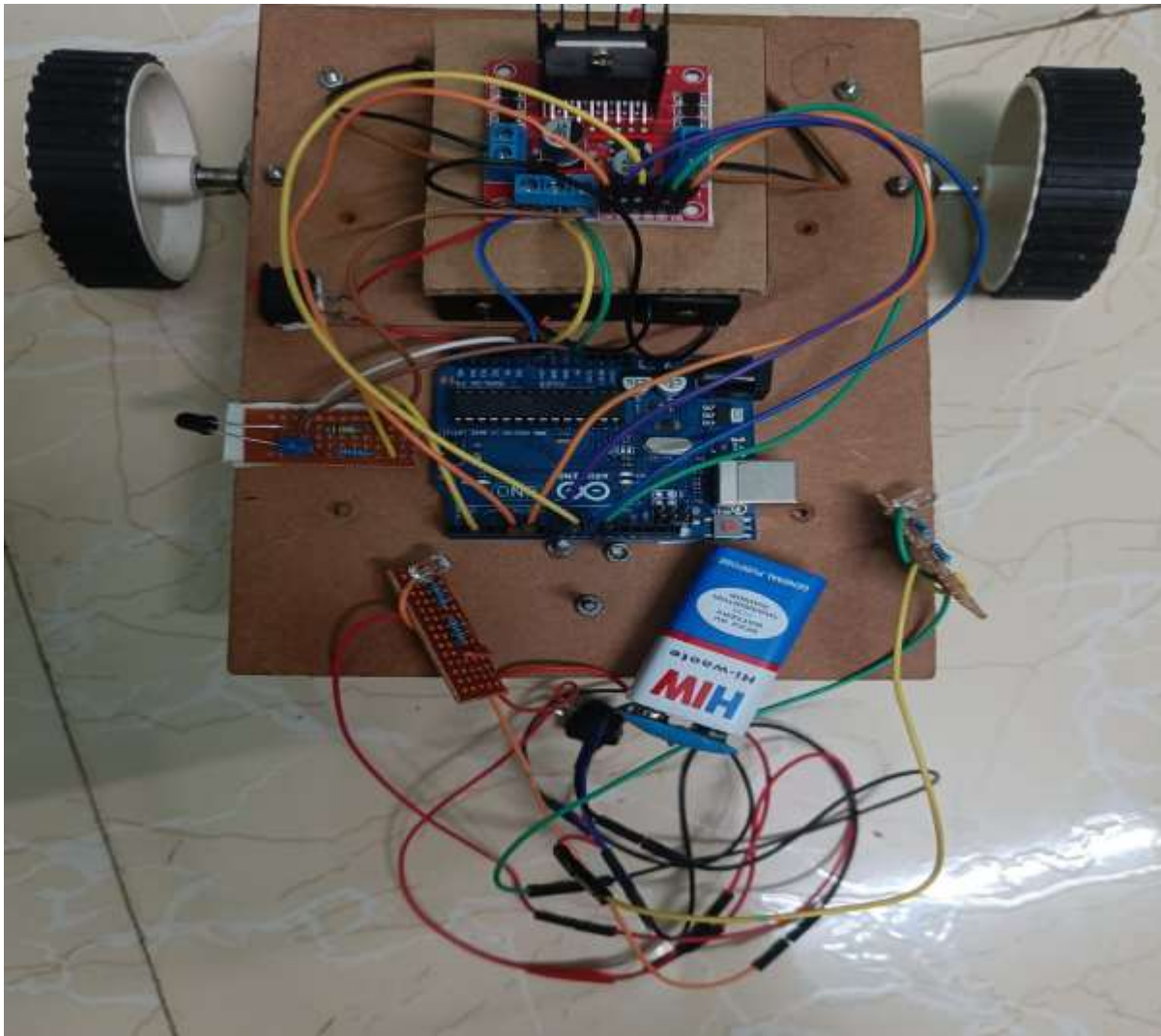


FIGURE 2: System Architecture

A. Zone Detection and Monitoring

1. Two IR transmitter modules are placed at Point 1 and Point 2, while an IR receiver is mounted on the robot.
2. The transmitters continuously emit infrared rays powered by a 9V battery.
3. When the robot reaches Point 1, the IR receiver detects the IR beam and sends the signal to the Arduino.
4. The Arduino identifies the control point and initiates the speed reduction process.

B. Signal Processing by Arduino

1. The Arduino acts as the central controller of the system.
2. It continuously monitors signals received from the IR receiver connected to pin A0.

3. Upon detecting the signal from Point 1, the Arduino executes the programmed speed-reduction logic.

4. Upon detecting the signal from Point 2, the Arduino restores the motor speed and updates the status LED.

C. Motor Speed Control

1. The Arduino sends PWM-based control signals to the L298N motor driver.
2. When Point 1 is detected, the PWM value is reduced to decrease motor speed.
3. The motor driver supplies the required current to both DC motors for smooth operation.
4. When Point 2 is detected, the PWM value is restored, bringing the motors back to normal speed.

D. Motor Driver and Robot Operation

1. The L298N motor driver interfaces the Arduino with the left and right DC motors.
2. Control pins (IN1–IN4) and enable pins (ENA, ENB) manage motor direction and speed.
3. The driver ensures smooth transitions during speed reduction and speed restoration.
4. This allows the robot to automatically adjust its movement according to the detected IR zones.

E. Power Supply and Overall Function

1. A 9V battery powers both IR transmitter modules located at Point 1 and Point 2.
2. An 11.7V battery supplies power to the L298N motor driver and the DC motors.
3. The Arduino continuously processes signals from the IR receiver and controls motor speed accordingly.
4. As a result, the robot slows down at Point 1 and returns to normal speed at Point 2 automatically.

V. Algorithm

Input: IR signals from Point 1 and Point 2

Output: Automatic reduction and restoration of robot speed

1. Start the system.
2. Initialize Arduino pins, IR receiver, LED, and L298N motor driver.
3. Set the motors to move at normal speed (e.g., PWM = 80).
4. Continuously monitor the IR receiver connected to pin A0.
5. If the IR signal from Point 1 is detected:
6. Turn ON the indicator LED.
 - >Reduce motor speed (e.g., PWM from 80 to 40).
7. Continue moving at the reduced speed.

8. Monitor the IR receiver for the next transmitter signal.
9. If the IR signal from Point 2 is detected:
10. Increase motor speed back to normal (e.g., PWM from 40 to 80).
11. Continue normal robot movement.
12. Repeat the detection and speed-control process continuously.
13. Stop only when power is removed.

Result: The robot automatically reduces its speed at Point 1 and restores normal speed at Point 2 using IR-based zone detection and Arduino-controlled motor speed regulation.

VI. RESULTS AND DISCUSSION

The suggested automatic vehicle speed control system was effectively tested with a microcontroller (8051/Arduino), IR transmitter-receiver modules, and a motor driver for controlling vehicle speed. The following were the outcomes during testing:

1. Vehicle Entry Detection

When vehicles reached restricted areas, the IR receiver on each vehicle picked up signals broadcast from an IR module placed at the area entrance. Upon picking up the signal, the microcontroller directly activated the speed control mechanism. Detection was always accurate, taking around 0.5 to 1 second, which made it timely enough for speed adjustment before the vehicle had fully entered the sensitive zone.

2. Automatic Speed Regulation

After the vehicle entry was detected, the microcontroller controlled the vehicle speed automatically using the motor driver circuit. Vehicles rolled down to the set speed limit without any intervention from the driver. Efforts to speed up manually were overridden effectively, such that the vehicle remained in line with speed limits set in each zone.

3. System Performance

The system revealed excellent responsiveness, with the IR detection and speed control process taking around 1 second. The vehicles sustained the desired speed along the duration of the restricted areas, and the system produced trustworthy results for several entering cars sequentially. Furthermore, the design's low power

demand enabled continual operation without repeated battery exchanges or maintenance actions.

4. Discussion

The results indicate that a microcontroller-based speed control system with IR sensors provides an effective, independent, and real-time solution for the enforcement of speed limits in sensitive areas. In contrast to traditional traffic enforcement through human observation or static cameras, the system operates round-the-clock and autonomously. Through its ability to automatically control vehicle speed, it minimizes the possibility of accidents and improves safety for pedestrians and other users. The low power consumption and independence from drivers make the system acceptable for permanent use in real-world deployment.

A few limits were observed during testing. Environmental conditions like strong sunlight, blocking, or interference might intermittently interfere with IR signal detection. High-speed vehicles at a very high speed might need calibration for proper response time reduction. Deploying the system over multiple zones would require additional transmitters and precise coordination between microcontrollers to provide consistent performance.

Barring these limitations, the system has a strong and scalable solution for controlling vehicle speeds in controlled zones. It offers an affordable and effective substitute to manual traffic control and enhances road safety around schools, hospitals, and other important zones.

VII. CONCLUSION

The proposed automatic vehicle speed control system demonstrates an efficient and independent way of implementing speed controls in sensitive zones. By integrating microcontroller-based control with IR sensor sensing, the system automatically detects vehicles entering prohibited areas and controls their speed without any intervention by the driver. Not only does this enhance road safety by reducing accidents but also guarantee standardized compliance with traffic laws. The system is energy efficient, deployable in real scenarios, and scalable for applications across several zones, providing a reliable and cost-efficient solution compared to conventional traffic monitoring techniques.

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