VEHICLE SPEED CONTROL BASED ON ZONAL IDENTIFICATION

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ABSTRACT: **The project develops a vehicle speed control system using electronic components and microcontroller technology. A DC motor simulates the vehicle's motion, with a motor driver module regulating speed. Zigbee modules enable communication between the vehicle and zone stations. Audible alerts via buzzers and visual feedback through LEDs activate when speed thresholds are breached. An LCD displays data for user interface, and four-pin switches define zones, such as school zones, with real-time mapping from an RTC DS1307 module. Push-button switches configure school zone timings. The Arduino UNO coordinates system functions, ensuring speed regulation and safety compliance in sensitive areas. An additional switch allows vehicle speed increment.**

Keywords: Arduino UNO, Zigbee Module, RTC DS1307, DC Motor, Motor Driver, LCD Screen, LED, Buzzer, Push Button Switch.

INTRODUCTION

The proposed vehicle speed control system addresses the urgent need for effective speed regulation, particularly in critical zones like school areas, due to rising vehicular accidents and safety concerns. This project integrates electronic components and microcontroller technology, including DC motors, Zigbee modules, buzzers, LED indicators, and an Arduino UNO, to create a robust solution for real-time monitoring and control of vehicle speeds in designated zones. By enhancing road safety and ensuring compliance with speed regulations, the project underscores its significance and sets the stage for detailed exploration of its design and implementation.

PROBLEM STATEMENT

The project addresses the ongoing challenge of maintaining safe vehicular speeds in critical areas like school zones, where pedestrian safety is crucial. Existing speed control measures, such as static signage and intermittent enforcement, often fail to consistently deter speeding. School zones, in particular, need targeted surveillance during specific periods, but current systems control vehicle speeds continuously, even when the school is closed. This lack of real-time information and the potential for system failures impact the effectiveness of these measures, highlighting the limitations of existing solutions in real-life scenarios and previously proposed systems.

LITERATURE SURVEY

The proposed vehicle speed control system, based on zonal identification, builds on previous research in enhancing road safety through intelligent traffic management. Studies like Kucharski et al. (2019) have demonstrated the effectiveness of real-time monitoring in reducing speeding violations[14], while Kumar et al. (2018) emphasized dynamic speed control in high-risk zones like school areas[16]. The system integrates Zigbee communication technology for seamless vehicle-infrastructure interaction and utilizes microcontroller-based control systems, echoing the findings of Sathiskumar S et al. (2020)[1]. This project aims to offer a comprehensive solution for improving road safety through dynamic vehicle speed control.

PROPOSED METHOD

The proposed system for controlling vehicle speeds based on zonal identification utilizes an Arduino UNO microcontroller to manage various components, including a motor driver module that regulates a DC motor simulating vehicle motion. Zigbee modules enable communication between the vehicle and zone stations[1], while buzzers and LED indicators provide real-time speed monitoring with alerts for deviations. Four-pin switches define distinct zones, like school zones, with real-time mapping by an RTC DS1307 module, and push-button switches allow configuration of school zone timings. This integrated approach effectively enhances road safety by dynamically adjusting speed limits based on specific zones and times.

BLOCK DIAGRAM

For Transmitter

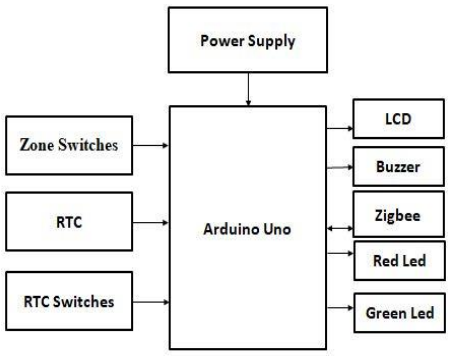

Figure 1: Block Diagram of Transmitter

For Reciever

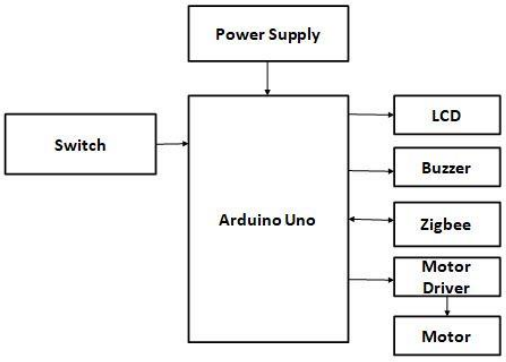

Figure 2: Block Diagram of Reciever

PROCEDURE OF WORKING

The proposed system ensures round-the-clock surveillance in normal zones like hospitals, business zones, and highways, and time-specific surveillance in school zones. In normal zones, a Zigbee transmitter at the zone's start communicates with a Zigbee receiver in the vehicle, which includes an Arduino Uno, DC motor, L293D motor driver, and LCD display.

The system displays the vehicle's speed and automatically reduces it if it exceeds the predefined limit. In school zones, surveillance is active only during specified times, controlled by an RTC module and push-button switches for setting ON/OFF times. Additionally, an alerting system with red/green lights and a buzzer warns people if a vehicle is overspeeding. If the system fails to control the speed, the alert system ensures continuous warnings for safety.

RESULTS AND DISCUSSION

After implementing the proposed system, vehicle speed is automatically controlled to the set speed limit, significantly improving the success rate of preventing accidents due to overspeeding compared to the existing system. For instance, in hospital zones where the speed limit is 40 km/h and in school zones with the same speed limit, the proposed system ensures compliance at all times. The school zone particularly focuses on the safety of students and teachers during peak times: mornings from 8:30 AM to 9:00 AM and evenings from 4:30 PM to 5:00 PM, with the standard limit applying from 9:00 AM to 4:30 PM and from 5:00 PM to 8:30 AM. This demonstrates the proposed system's enhanced capability to adapt to specific safety requirements effectively.

Table 1 : Comparision of results given by an existing system and proposed system under different scenarios.

S.NO	NORMAL ZONES		SCHOOL ZONE FROM 8:30 AM TO 9:00 AM AND 4:30 PM TO 5:00 PM		SCHOOL ZONE FROM 9:00 AM TO 4:30 PM AND 5:00 PM TO 8:30 AM	
	EXISTING SYSTEM	PROPOSED SYSTEM	EXISTING SYSTEM	PROPOSED SYSTEM	EXISTING SYSTEM	PROPOSED SYSTEM
1	10 kmph	10 kmph	10 kmph	10 kmph	10 kmph	10 kmph
2	20 kmph	20 kmph	20 kmph	20 kmph	20 kmph	20 kmph
3	30 kmph	30 kmph	30 kmph	30 kmph	30 kmph	30 kmph
4	40 kmph	40 kmph	40 kmph	40 kmph	40 kmph	40 kmph
5	40 kmph	40 kmph	40 kmph	40 kmph	40 kmph	50 kmph
6	40 kmph	40 kmph	40 kmph	40 kmph	40 kmph	60 kmph

Here, In the Normal Zone, both the Existing System and the Proposed System control vehicle speed when it exceeds the allowed limit. In the School Zone, from 8:30 AM to 9:00 AM and 4:30 PM to 5:00 PM, both systems control overspeeding. From 9:00 AM to 4:30 PM and 5:00 PM to 8:30 AM, the Existing System continues to control speed

regardless of school presence, while the Proposed System does not control speed when the school is closed or empty, benefiting travelers during off-hours, particularly at night.

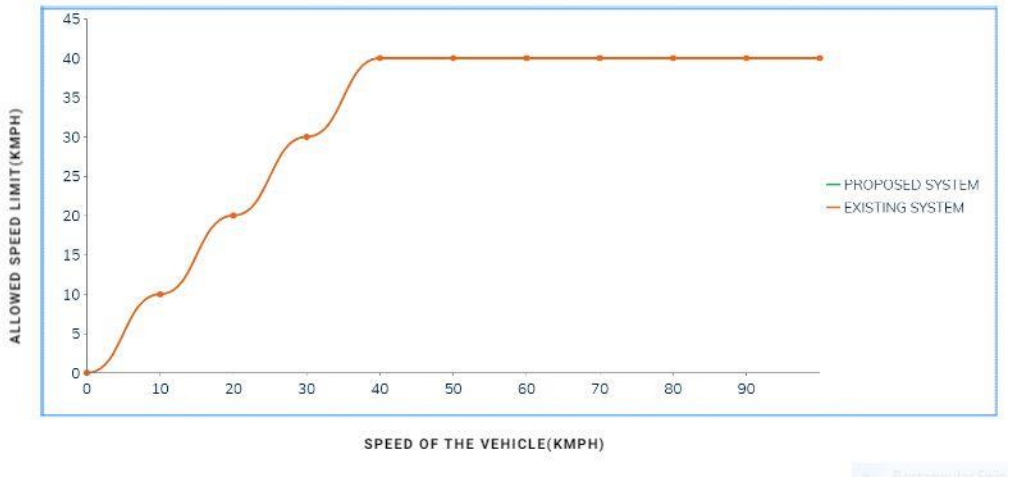

Figure 3 : Graph for Normal Zone

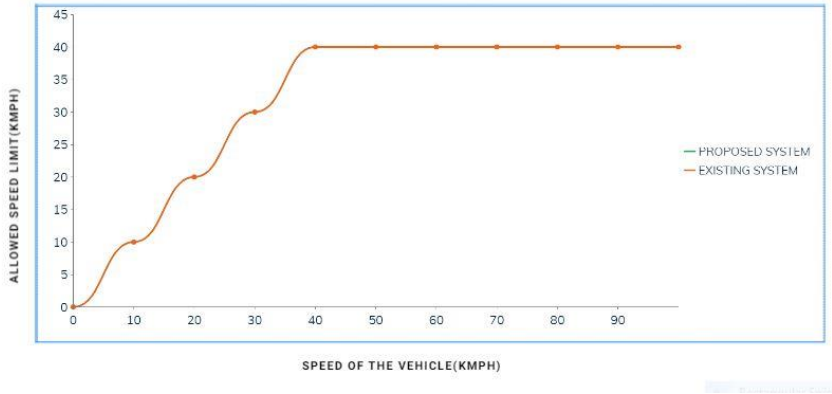

Figure 4 : Graph for School Zone from from 8:30 AM to 9:00 AM and 4:30 PM to 5:00 PM

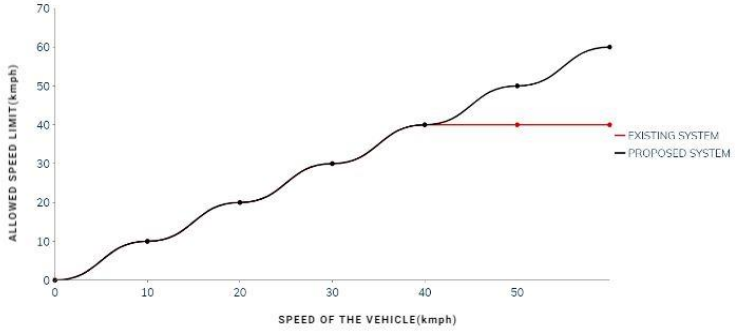

Figure 5 : Graph for School Zone from from 9:00 AM to 4:40 PM and 5:00 PM to 9:00 AM

PROPOSED SYSTEM OUTPUT

Now,Let's see the outputs of our proposed system under different zone conditions.

Normal Zones

Our proposed system operates effectively in various zones such as hospital, business, and highway zones, ensuring round-the-clock surveillance. In a business zone with an 80 kmph speed limit, if a vehicle enters at 120 kmph, the transmitter detects this by comparing the vehicle's speed with the cutoff limit. Upon detecting overspeeding, the system activates an alert.

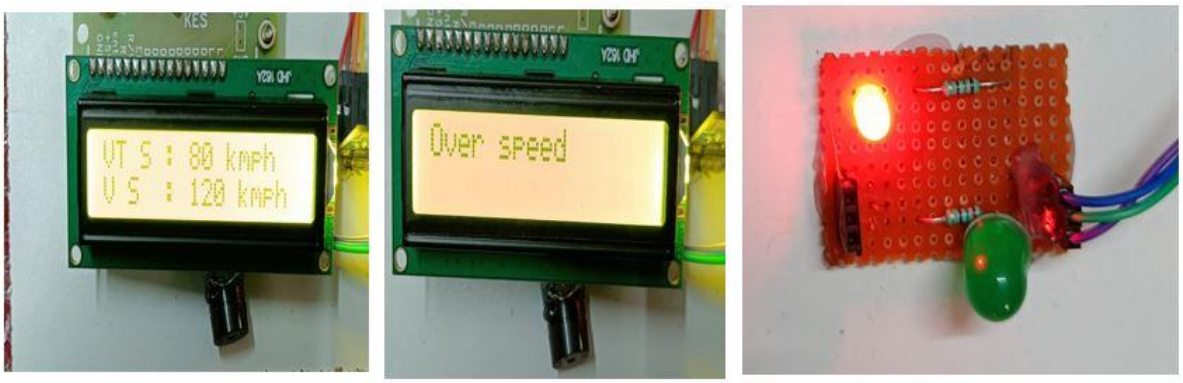

Figure 6 : Overspeed Detection and Alerting at Bussiness Zone

Now the vehicle speed gets controlled automatically to 80 kmph and alerting system will become normal represents vehicle is controlled to allowed speed limit.

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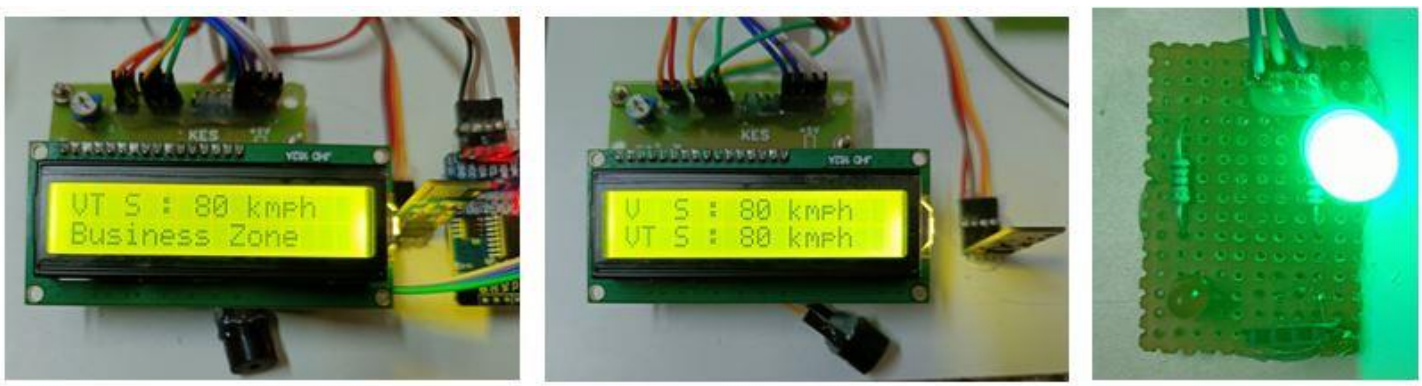

Figure 7 : Vehicle speed is controlled and alerting system became normal

School Zone

In the School Zone, where the speed limit is 40 km/h, speed control measures are implemented only during specific intervals. These intervals are set as follows: from 1:21 PM (ON) to 1:22 PM (OFF), and from 1:23 PM (ON) to 1:24 PM (OFF). Outside of these times, speed control measures are inactive, but within the specified intervals, drivers must adhere to the designated speed limit diligently.

Figure 8 : School Zone 1st ON-OFF Time

Figure 9 : School Zone 2nd ON-OFF Time

If the vehicle enters into school zone with speed 80 kmph and between 1st ON and OFF time or 2nd ON and OFF time the transmitter detects overspeed and activate alerting system.

Figure 10 : Overspeed Detection and Alerting at School Zone

Then transmitter will controls the vehicle speed to allowed speed limit and alerting system will become normal.

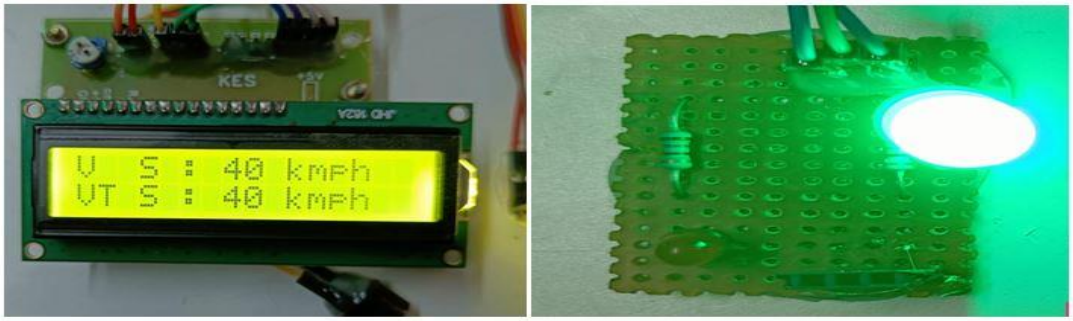

Figure 11 : Vehicle speed is controlled and alerting system became normal

If the setted time intervals are expired i.e. after between 1st OFF time and 2nd ON time and between 2nd OFF time and 1st ON time.then the transmitter will not control the speed of the vehicle to cut-off speed limit.

Figure 12 : System after 1st OFF time

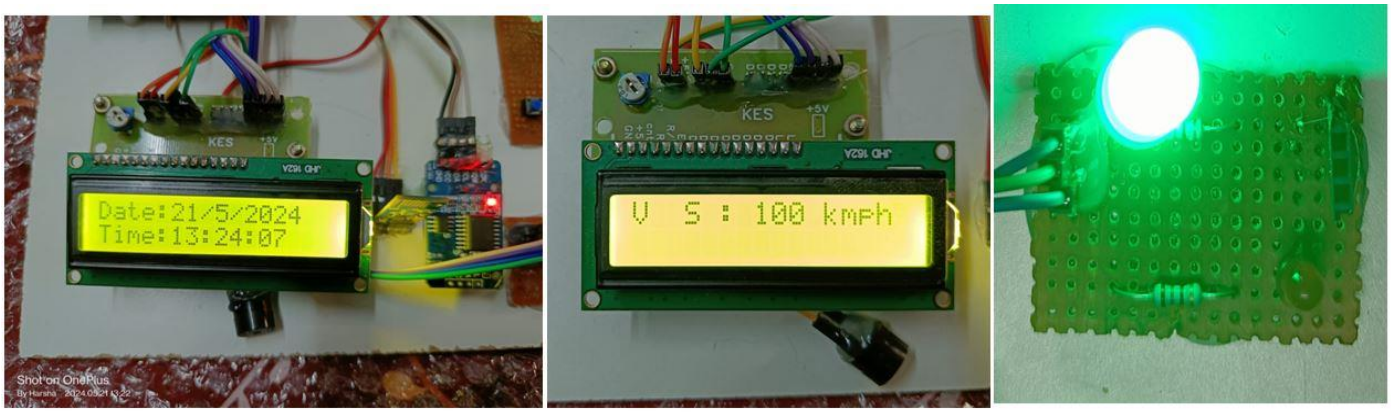

Figure 13 : System after 2nd OFF time

CONCLUSION

The proposed vehicle speed control system based on zonal identification offers a significant advancement in road safety and traffic management. By utilizing electronic components and microcontroller technology, it dynamically regulates vehicle speeds within designated zones, prioritizing critical areas such as school zones. Through real-time monitoring

and adaptive control, authorities can enforce speed regulations and reduce accident risks, benefiting pedestrians and road users. Its versatility extends from urban roads to rural highways, contributing to transportation infrastructure and smart city initiatives. Future enhancements could include integrating with vehicle ECUs for direct speed control, utilizing GPS for precise location mapping, and implementing advanced communication for two-way vehicle-to-infrastructure interaction. Additionally, improvements in zone management, user interfaces, integration with ADAS, and predictive analytics could further enhance its effectiveness in promoting safer roads.

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