Vehicle Speed Control System

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This research presents the design and implementation of a vehicle speed limiter system using Arduino UNO. The system is intended to enhance road safety by monitoring and controlling vehicle speed in predefined zones such as schools, hospitals, or speed-restricted highways. Components used include an Arduino UNO microcontroller, L293D motor driver, Ultra Sonic sensor, RX-TX wireless transmitter/receiver modules, a 16x2 LCD display, and a buzzer. The system uses an IR sensor to detect the vehicle and a transmitter to send speed limit data to the receiver onboard the vehicle. Based on the received data, the Arduino adjusts motor speed via the motor driver and notifies the driver through a display and buzzer. The project proposed allows communication between vehicles and road signs. Allowing communication between the road signs and vehicles is used to convey important information to regulate traffic flow. Such information would be speed limit of the road, weather conditions, congested traffic This is the idea behind an area-based speed control of vehicles using RF transmitter and receiver modules. The transmitter is installed in defined areas where their speed limit of the vehicle has to be controlled. The transmitter will transmit a signal and the receiver has to be installed within the vehicle for speed controlling purposes. Whenever the vehicle enters the mapped area, the speed of the vehicle is decreased to cutoff speed and kept constant until the vehicle leaves that particular area. After that, the vehicle can be controlled by the driver based on standard traffic rules. This is how the project aims at Area based speed controlling system targeting the importance of road safety in the defined areas and alarm messages in case of emergencies. As sustainable solutions for this problem have not been identified yet, this system might be the answer.

Index Terms: Arduino UNO, Motor Driver, RX-TX Transmitter Receiver, Sensor, Lcd Display, Vehicle, Detector.

1. INTRODUCTION

In this evolved planet, where vehicle speed maintenance and control is a major problem, that leads to accidents caused due to rash driving or excessive speed. 'AREA BASED VEHICLE SPEED CONTROL SYSTEM' project is designed to control the speed of the vehicle in different zones.

The line of focus of this project is that, this system is designed in such a way that speed is regulated and confined at the particular mapped area with the help of the RF module. These areas. are mostly to be schools, colleges, educational institutes, medical institutes, hospitals, crowded markets, highways, residential areas etc. These zones have the highest human proximity, crowd, and traffic as far as the road is concerned.

So there needs to be a systematic solution to ensure the utmost safety at such zones in the scope of saving several unnecessary deaths and injuries due to accidents. This is the idea behind an area-based speed control of vehicles using RF transmitter and receiver modules. The transmitter is installed in defined areas where their speed limit of the vehicle has to be controlled. The transmitter will transmit a signal and the receiver has to be installed within the vehicle for speed controlling purposes. Whenever the vehicle enters the mapped area, the speed of the vehicle is decreased to cutoff speed and kept constant until the vehicle leaves that particular area. After that, the vehicle can be controlled by the driver based on standard traffic rules. This is how the project aims at Area based speed controlling system targeting the importance of road safety in the defined areas.

2. OBJECTIVES

Design and implement a cost-effective vehicle speed limiter using Arduino.

Automate speed detection and control within restricted zones.

Provide real-time feedback to the driver via buzzer and LCD.

Promote safer driving practices, especially in sensitive areas.

Enhance Road Safety: Limit the maximum speed to reduce the risk and severity of accidents caused by over-speeding.

Enforce Legal Compliance: Ensure vehicles do not exceed legal speed limits set by traffic authorities, helping drivers follow road regulations.

Protect Lives: Reduce fatalities and injuries by maintaining safer driving speeds, especially in high-risk areas like school zones or urban roads.

Improve Fuel Efficiency: Maintain optimal driving speeds, which can reduce fuel consumption and lower operational costs.

Reduce Vehicle Wear and Tear: Limiting speed helps in reducing strain on vehicle components like the engine, tires, and brakes, thereby increasing vehicle lifespan.

Promote Eco-Friendly Driving: Lower speeds can reduce harmful emissions, contributing to a cleaner environment.

Assist Fleet Management: Enable transport companies to monitor and control vehicle speeds for safety, efficiency, and accountability.

Minimize Traffic Violations: Prevent drivers from unintentionally exceeding speed limits, reducing the risk of fines and penalties.

3. COMPONENTS USED

Arduino UNO: A microcontroller board that serves as the brain of the system, processing inputs from sensors and controlling outputs.

Motor Driver (L293D): A dual H-bridge motor driver IC used to control the speed and direction of the DC motor. Ultra-Sonic sensor: ultrasonic sensors are devices that generate or sense ultrasound energy.

RX-TX Module: Wireless transmitter (TX) and receiver (RX) modules that send and receive data about speed limits.

16x2 LCD Display: Used to display messages, speed zone information, and current vehicle speed.

Buzzer: Provides an audible alert to the driver when entering a speed-limited zone.

DC Motor: Simulates a vehicle's motion and is used for testing speed control.

4. EXPERIMENTAL WORK

The area-based vehicle speed control using RF is designed to limit the over speed on the road and avoid injuries and accidents.

This proposed system consists of RF transmitter and receiver that is within the range of 433MHz which require to sourcing the battery for usage of long period of time. RF receiver is included within the vehicle.

After scanning of the signal at transmitting side, the information is passed to the receiver side and the vehicle receives the signal. In this project, indicates the speeding range limit so these are placed at start and end of the restricted areas with a threshold speed. In transmitter and receiver Arduino with analog to digital conversion and LCD is being used. At the receiver side HT12D is used as decoder and at the transmitter side, HT12E is used as encoder. For the vehicle, prototype DC motor is being used. By default, the speed of the motor is set to cutoff speed, to show over speeding of vehicle, increment switch is used.

1. When the system is on, the transmitter receives the analog signal with the help of RF speeding ranges.

2. The vehicle speed is set using increment switch.

3. If the vehicle is not in the RF range, the vehicle travels according to the drivers"operation and no speed is controlled.

4. If the vehicle is in RF range, the speed is displayed.

5. If the speed is more than the cutoff threshold speed is controlled.

6. If the speed is not more than the cutoff threshold, speed is not controlled and it travels normally.
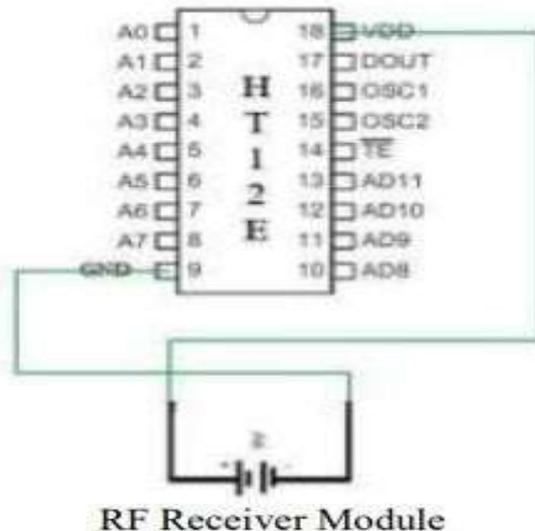
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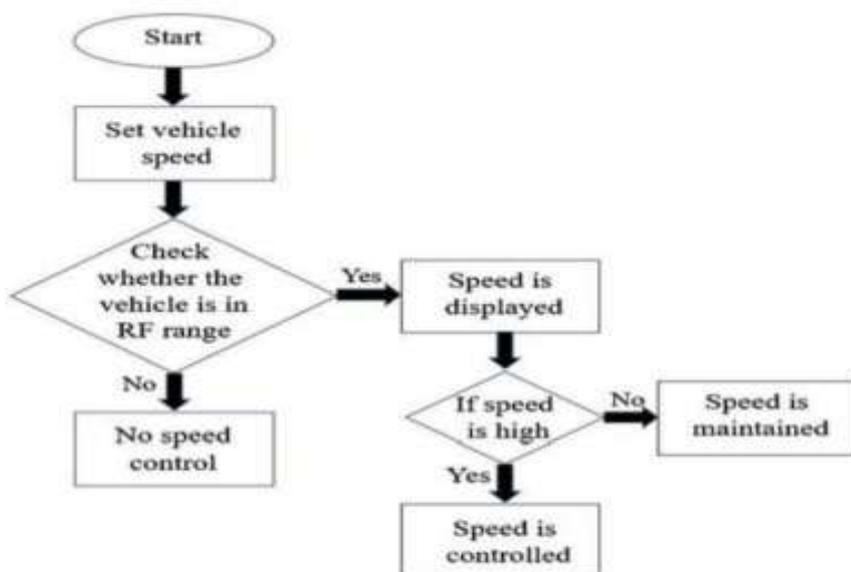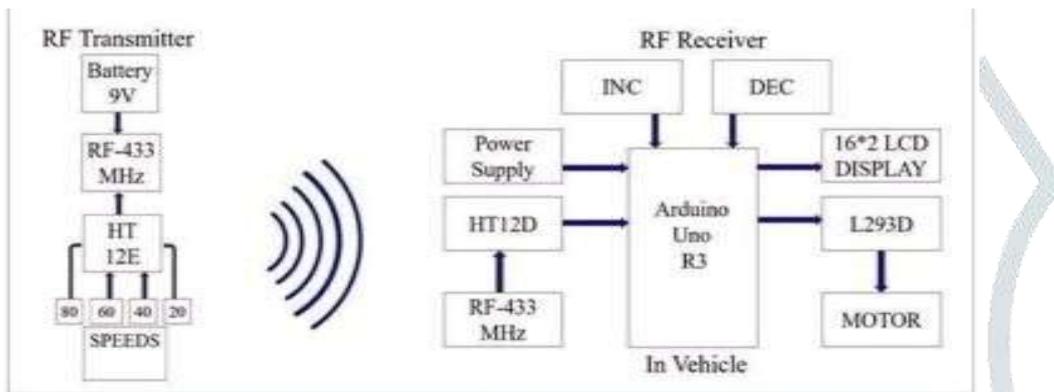
Flow chart of area based vehicle speed control system

5. CIRCUIT DIAGRAM
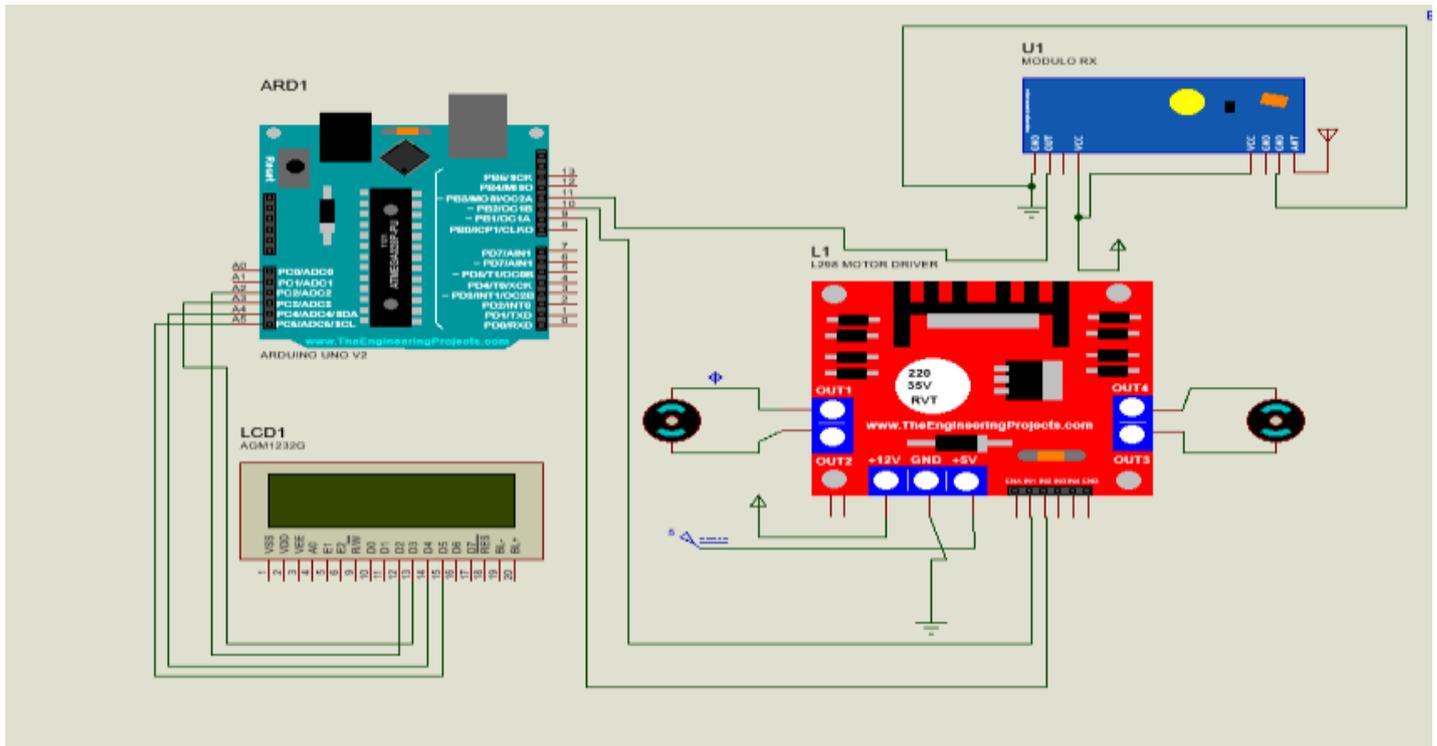
6. PROCEDURE OF WORKING

1. The circuit diagram is divided into two stages: RF Receiver and RF Transmitter.

RF Receiver Module

2. The RF transmitter uses an HT12E as encoder given with an 9V supply. HT12E is an 18 pin IC which consists of 8 address bits from A1- A8 which should be exactly similar in the decoder to pair them. HT12E also consists of 4 data bits from AD0-AD3 and the data sent from transmitter will be decoded at the HT12D decoder sharing the same address bits. Pin numbers 15 and 16 have inbuilt oscillators which can be activated by connecting 1MΩ resistor. Positive pin of the battery is connected to HT12E pin number 18(VDD) and negative is connected to HT12E pin number 9(GND).

3. The RF receiver uses an HT12D as decoder given with an 9V supply. HT12D is an 18 pin IC which consists of 8 address bits from A1- A8 which should be exactly similar in the encoder to pair them. HT12D also consists of 4

data bits from AD0-AD3 that decodes the data sent from HT12E encoder sharing the same address bits. Pin numbers 15 and 16 have inbuilt oscillators which can be activated by connecting $1M\Omega$ resistor.

4. It also consists of a prototype DC motor in order to represent one wheel of the vehicle, which works on the principle of Lorentz law that describes, when a current carrying conductor is kept in magnetic field, it gains torque and develops a tendency to move, it experiences a mechanical force.

5. An L293D motor driver is used to drive DC motors, which is a 16 pin IC in which bidirectional drive currents can be driven up to 600mA at a same time. Hence the positive pin of DC motor is connected to L293D pin number 8 and negative pin is connected to L293D pin number 4.

6. Arduino uno is an 8-bit ATMEGA328 microcontroller. It has 14 digital pins as input or output out of which 6 are PWM outputs and 6 analogies which is utilized as ADC.

7. A 16x2 LCD is used which is made of 1000''s of pixels and pin no 9-12 are given for analogy inputs of Arduino.

8. The RF transmitter (HT12E) is placed at the start of the zone.

9. The RF receiver (HT12D) is placed in the vehicle and consists of an Arduino uno board, DC motor, L293D motor driver, HT12D decoder and an LCD display.

10. The vehicle speed is set.

11. When the vehicle is in the RF range, the vehicle receives the signal from the transmitter about the current speed of the vehicle and is displayed on LCD.

12. If the vehicle speed is high, according to predefined speed then the speed is controlled using RF receiver to the defined speed for that particular area

13. Once the speed is being controlled the drivers'' has no operation of speed.

14. If the cut-off speed and the vehicle speed match then the vehicle will not be controlled within the RF range.

RESULT AND TESTING

The prototype system was tested using a DC motor to represent the vehicle' sengine. When entering a speed zone, the IR sensor triggered the transmitter, which successfully sent the signal to the vehicle-mounted receiver. The Arduino processed this data and adjusted the motor speed accordingly. The buzzer and LCD responded with appropriate messages and alerts. The system demonstrated consistent performance in different simulated speedzones.

8. ADVANTAGES

Improved Road Safety: Speed limiters help reduce accidents by preventing vehicles from exceeding safe speeds.
Fuel Efficiency: Driving at controlled speeds improves fuel economy, saving money and reducing emissions.
Reduced Emissions: Lower speeds typically result in less fuel consumption and fewer harmful emissions.
Extended Vehicle Life: Limiting speed can reduce engine wear and tear, leading to longer vehicle life and lower maintenance costs.
Compliance with Regulations: Many countries require speed limiters in commercial vehicles to comply with safety laws.
Better Driver Discipline: Encourages more consistent and responsible driving behaviour.

9. CONCLUSION

The Vehicle Speed Limiter system using Arduino provides a practical and efficient method to automatically enforce speed limits in designated zones. The use of affordable electronics makes it accessible for large-scale implementation, and the modular design allows for future upgrades. This technology holds great promise in enhancing traffic safety and promoting responsible driving behaviour.

10. REFERENCES

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