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Car Speed Detector Using Arduino and IR Sensors

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Abstract: *Road accidents caused by over-speeding vehicles have become a major concern worldwide. Monitoring vehicle speed and enforcing speed limits are essential for improving road safety. This research presents the design and implementation of a low-cost Car Speed Detector using Arduino and infrared (IR) sensors. Two IR sensors are placed at a fixed distance apart to detect the movement of a vehicle. The time taken for a vehicle to pass between the sensors is measured by the Arduino microcontroller, and the speed is calculated using the distance-time relationship. The calculated speed is displayed on an LCD screen. If the detected speed exceeds a predefined threshold, an LED indicator and buzzer alert are triggered to warn the driver or monitoring authority. The system is simple, economical, and suitable for educational projects and small-scale traffic monitoring applications.*

Keywords: *Arduino, Vehicle Speed Detection, IR Sensors, Traffic Monitoring, Embedded Systems*

I. INTRODUCTION

Vehicle speed monitoring is an important aspect of modern traffic management systems. Over-speeding vehicles often lead to road accidents and threaten public safety. Traditional speed detection systems such as radar-based speed guns and camera-based systems are effective but costly and complex. Therefore, there is a need for a simple and cost-effective system that can measure vehicle speed accurately for educational and experimental purposes.

This paper presents a Car Speed Detector system based on Arduino and infrared sensors. The system uses two IR sensors placed at a known distance apart. When a vehicle passes through the first sensor, the timer starts, and when it passes through the second sensor, the timer stops. Using the measured time and known distance, the speed of the vehicle is calculated.

The proposed system is useful for demonstration in academic projects, smart traffic systems, and basic vehicle monitoring applications.

II. LITERATURE REVIEW

Vehicle speed detection has been widely studied as part of intelligent traffic management systems. Various technologies such as radar sensors, camera-based systems, and infrared sensors have been used for monitoring vehicle speed and improving road safety.

Zhang et al. proposed a traffic monitoring system using embedded devices to measure vehicle speed and detect traffic violations. Their system utilized electronic sensors to capture vehicle movement and analyze traffic flow. The study demonstrated the importance of automated monitoring systems for improving road safety and reducing human intervention in traffic enforcement.

Wegmuller et al. discussed high-resolution measurement techniques for detecting moving objects using optical sensing technologies. Their research highlighted the significance of accurate timing and sensing mechanisms in determining motion parameters such as speed and distance. Although their system was designed for fiber optic sensing, the principles of time-based measurement are applicable in vehicle speed detection systems.

Several researchers have also explored the use of microcontroller-based systems for vehicle monitoring applications. Arduino-based embedded systems have become popular due to their low cost, flexibility, and ease of programming.

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These systems are widely used in educational and prototype-level projects for implementing traffic monitoring solutions.

Infrared sensors have been widely adopted for object detection due to their simplicity and affordability. In many traffic monitoring prototypes, two IR sensors are placed at a known distance apart to measure the time taken by a vehicle to travel between them. Using the distance-time relationship, the speed of the vehicle can be calculated effectively.

The proposed system in this paper builds upon these concepts by implementing a simple and low-cost car speed detection system using Arduino and IR sensors. The system focuses on providing a practical solution suitable for academic demonstrations and small-scale traffic monitoring applications.

III. SYSTEM DESIGN AND METHODOLOGY

A. System Overview

The proposed system consists of an Arduino microcontroller, two infrared sensors, a 16×2 LCD display, an LED indicator, and a buzzer. The IR sensors detect the presence of a vehicle at two different points along the road. The Arduino measures the time interval between these detections and calculates the vehicle speed.

B. Working Principle

The system operates based on the fundamental relationship between distance, time, and speed.

Speed is calculated using the formula:

Speed = Distance / Time

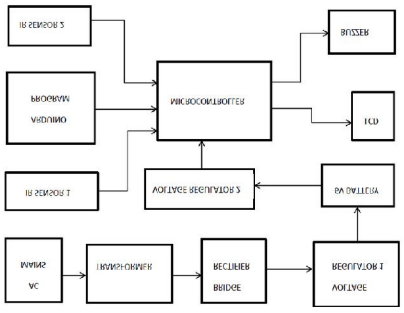
Where

Distance = distance between two IR sensors

Time = time taken by the vehicle to travel between sensors

The calculated speed is displayed on the LCD screen. If the speed exceeds the predefined speed limit, the LED and buzzer provide an alert.

Block Diagram



IV. HARDWARE COMPONENTS

A. Arduino Uno

Arduino Uno is a microcontroller board based on the ATmega328P microcontroller. It is used as the central processing unit of the system to read sensor data, calculate speed, and control output devices.

B. Infrared Sensors

IR sensors are used to detect the presence of the vehicle. Two sensors are placed at a fixed distance apart. Each sensor generates a signal when a vehicle interrupts the infrared beam.

C. LCD Display (16×2)

The LCD display is used to show the calculated vehicle speed in real time.

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D. LED Indicator

The LED serves as a visual indicator that turns on when the vehicle exceeds the speed limit.

E. Buzzer

The buzzer provides an audible alert when over-speeding is detected.

Sr. No	Component	Specification	Purpose
1	Arduino Uno	ATmega328P Microcontroller	Main controller for processing sensor data
2	IR Sensor Module	3–5V operating voltage	Detects vehicle movement
3	LCD Display	16×2 I2C LCD	Displays vehicle speed
4	LED	5mm Red LED	Visual alert for overspeed
5	Buzzer	5V Active Buzzer	Audio alert
6	Breadboard	Standard 830 tie points	Circuit prototyping
7	Jumper Wires	Male-Male / Male-Female	Electrical connections
8	Power Supply	5V USB	Powering the system

V. EXPERIMENTAL SETUP

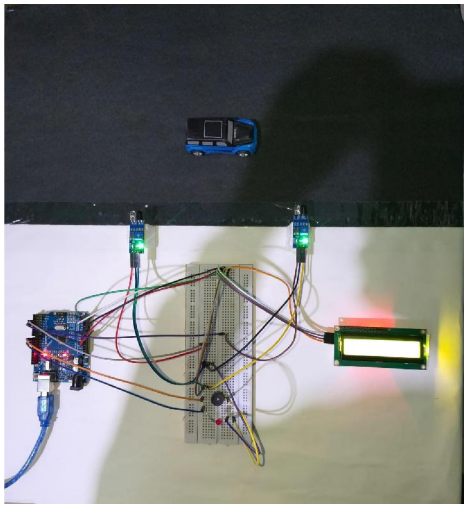
The system was implemented using a foam board base to simulate a miniature road environment. Two IR sensors were mounted 15 cm apart along the road path. A toy car was used to simulate vehicle movement. The Arduino board was connected to the sensors and LCD display through jumper wires and a breadboard.

When the toy car passes through the sensors, the system measures the time interval and calculates the speed. The result is displayed on the LCD screen, and the alert system activates if the speed exceeds the set threshold.

Arduino Pin Connections

Component	Arduino Pin
IR Sensor 1 OUT	D2
IR Sensor 2 OUT	D3
LED	D9
Buzzer	D8
LCD SDA	A4
LCD SCL	A5
Power (VCC)	5V
Ground	GND

Miniature Setup



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VI. RESULT AND DISCUSSION

The system successfully detected the movement of the toy vehicle and calculated its speed based on the measured time interval. The LCD display showed the calculated speed accurately. The LED and buzzer alert system worked correctly when the speed exceeded the predefined limit.

The experimental setup demonstrated that the system can measure speed with reasonable accuracy in a controlled environment. The use of simple components makes the system economical and easy to implement.

Example Speed Calculation

Distance Between Sensors	Time Taken	Calculated Speed
0.15 m	0.50 s	0.30 m/s
0.15 m	0.40 s	0.37 m/s
0.15 m	0.30 s	0.50 m/s

Formula used:

$$Speed = \frac{Distance}{Time}$$

VII. CONCLUSION

This research presented the design and implementation of a Car Speed Detector using Arduino and IR sensors. The system provides an efficient and cost-effective solution for measuring vehicle speed in small-scale applications. The use of Arduino simplifies the design and allows easy programming and customization.

The developed prototype successfully demonstrated the working principle of speed detection using distance and time measurement. Future improvements may include integrating wireless communication, camera-based number plate detection, and cloud-based data monitoring for smart traffic management systems.

VIII. ACKNOWLEDGMENT

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Authors:

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