ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 10| Issue: 2| February 2024|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2024: 8.402 || ISI Value: 1.188

ARDUINO-BASED IOT SYSTEM WITH INFRARED SENSORS FOR REAL-TIME VEHICLE SPEED DETECTION

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ABSTRACT
The integration of Internet of Things (IoT) for the detection and monitoring of vehicle speeds represents a significant leap forward in improving road safety. This innovative approach not only enhances the efficiency of traffic management but also empowers authorities with the tools needed to make data-driven decisions for creating safer and more resilient urban environments. This study is an attempt for the development of a system that utilizes the power of IoT to detect and monitor the speed of vehicles on the roadways. The system comprises of a speed sensor that captures the speed of the vehicle and sends the data to a microcontroller, which in turn sends the data to a cloud-based platform through an IoT gateway. The cloud-based platform processes the data and generates real-time insights on the speed of vehicles. This work aims to provide effective and economical solutions for monitoring vehicle speeds on roadways, catering to the needs of traffic management, law enforcement, and road safety. The system can also be integrated with other IoT devices and systems to enhance its functionality and enable intelligent and streamlined traffic management practices.

KEYWORDS: *Internet of Things (IoT) , Arduino, microcontroller, IR sensors, road safety, cloud-based platform.*

I. INTRODUCTION

The increasing number of accidents in recent years on highways has emerged as a significant social issue. Although there are several reasons, most accidents are due to over speed. Highway roads typically show signboards indicating the maximum permissible speed limits for driving, emphasizing safety. Unfortunately, a large number of individuals fail to adhere to these speed limits, leading to a increased risk of accidents.

Car speed detection using IoT is a study that involves the use of Internet of Things (IoT) technology to measure the speed of a moving vehicle. This study is designed to monitor and measure the speed of a car and send the data to a central location for processing and analysis. The study consists of a hardware device that is placed at the

side of the road to detect the speed of the car as it passes by. The device is equipped with sensors and microcontrollers that enable it to detect the speed of the car and transmit the data through wireless techniques to a cloud-based platform for analysis.

This study is important because it can be used to monitor traffic flow and detect speeding vehicles, which can help reduce accidents and improve road safety. The use of IoT technology makes it possible to collect and analyze data in real-time, which can be used to make informed decisions about traffic management and road safety. Overall, this study demonstrates the potential of IoT technology to improve transportation and make our roads safer.

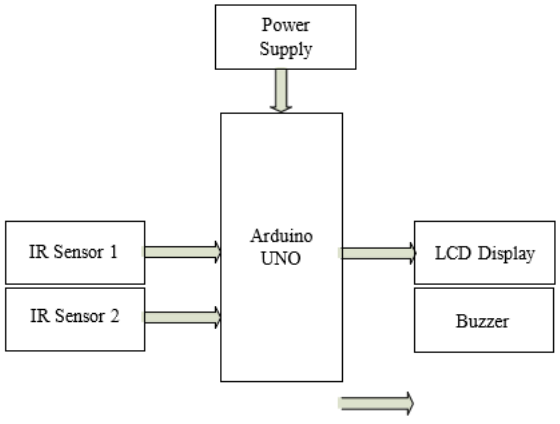

Figure.1 Block diagram of the Proposed System

II. LITERATURE SURVEY

Vehicle speed detection using Arduino and IR sensors is a prominent area of research in the realms of transportation engineering and computer science. Here are some of the notable studies and research papers related to this topic:

Vishal Pande et.al [1] has proposed a framework for

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autonomous speed control of over speedingvehicle using

Radio Frequency to design a controller to control vehicles speed and display to monitor the zones which can run on an embedded system platform.

Monika Jain [2] presented a device to detect the rash driving and alerts the traffic authorities incase of any violation. This frame of reference intends to design a system aimed at early detection and alerts vehicles driving patterns which is related to rash driving. The speed limit is by the police at very location who uses the system depending on the traffic. This device reports, displays and data base system for over speed violation management.

Ni Hlaing et.al [3] designed a system that detects the speed of the vehicle in the roads, main highways and the places where the drivers over speed. If the speed exceeds the limit, the information will be sent to PC (Personal Computer) which starts the camera which capturesthe vehicle of over speed.

Amarnarayan et.al [4] developed speed estimation system that alerts drivers about driving conditions,robust and reliable and helps to avoid joining traffic jams is an important problem that has attracted lots of attention recently.

A novel RF-based vehicle motion and speed detection system which can detect vehicle motion estimates the vehicle speed in typical streets were introduced [7,14,15].

The authors [6,9] presented the design and implementation of an automatic vehicle speed detection system using Arduino Uno and IR sensors. The system was tested on a real road and was found to be accurate and reliable.

Overall, these studies demonstrate the potential of using Arduino and IR sensors for vehicle speed detection and control. The results suggest that these systems can be effective in improving road safety and reducing accidents caused by speeding vehicles.

III. EXISTING SYSTEM

The existing system for vehicle speed detection using Arduino and IR sensors typically consists of one or more IR sensors that are placed on the road, and an Arduino microcontroller that is connected to the sensors. When a vehicle passes over the sensors, they detect the change in the infrared light and send a signal to the Arduino. The Arduino then calculates the speed of the vehicle based on the time it takes for the vehicle to travel between the sensors [17] and displays the speed on an LCD screen or sends it wirelessly to a remote device.
System for vehicle speed detection using Arduino and IR sensors was studied by authors [10,13,16]. The system use two IR sensors that are placed on the road, and an Arduino Uno microcontroller that is connected to the sensors. When a vehicle passes over the sensors, they detect the change in the infrared light and send a signal to the Arduino. The Arduino then calculates the speed of the vehicle and displays it on an LCD screen.

Another example is the "Vehicle Speed Measurement Using Arduino Microcontroller and Ultrasonic Sensor" developed by N.S. Yadav, M. Jain, and A.K. Patel. This system uses an ultrasonic sensor and an Arduino microcontroller to measure the speed of a vehicle. The ultrasonic sensor is placed on the road, and the Arduino is connected to the sensor. When a vehicle passes over the sensor, it sends a signal to the Arduino, which calculates the speed of the vehicle and displays it on an LCD screen.

Overall, these existing systems [5,8,11,12] demonstrate the effectiveness of using Arduino and IR sensors for vehicle speed detection. Even though they can provide accurate and reliable speed measurements, these systems implementations are relatively expensive which not makes them a popular choice for traffic management and road safety applications.

IV. PROPOSED WORK

A proposed work for vehicle speed detection using Arduino and IR sensors could involve the following steps:
Design and construction of the hardware: The first step would be to design and construct the hardware components of the system. This would involve selecting the appropriate IR sensors, Arduino board, and other necessary components, and assembling them together to create a working system.

Calibration of the sensors: Once the hardware is constructed, the next step would be to calibrate the IR sensors to ensure that they are accurately detecting changes in the infrared light as vehicles pass over them. This calibration process may involve adjusting the sensitivity and threshold of the sensors.

Programming the Arduino: The Arduino board would need to be programmed to receive signals from the IR sensors, calculate the speed of the vehicle, and display the results on an LCD screen or send them wirelessly to a remote device. The programming would need to take into account factors such as the distance between the sensors and the processing time of the Arduino.

Testing and evaluation : After the system is constructed and programmed, it would need to be tested and evaluated in real-world conditions to ensure that it is accurate and reliable. This may involve conducting tests on a real road with different types of vehicles and under different weather conditions.

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Improvement and optimization: Based on the results of the testing and evaluation, the system may need to be improved and optimized to enhance its accuracy and reliability. This could involve adjusting the placement of the sensors, fine-tuning the programming of the Arduino, or selecting different types of sensors or components.

Overall, the proposed work for vehicle speed detection using Arduino and IR sensors would involve designing, building, testing, and optimizing a system that can accurately and reliably detect the speed of vehicles on the road. The final product could be used for a variety of applications, including traffic management, law enforcement, and road safety.

Components

a) ARDUINO UNO

The most popular physical computing platform and interactive development environment is Arduino. It is a stand-alone platform that communicates with computer-based Arduino software. The Arduino software includes an integrated development environment (Arduino IDE). Programming is done using the Arduino IDE. Despite not being the first board on the market, the Arduino Uno is the development board that is used the most commonly. A microcontroller called Arduino Uno is based on the ATmega328p. It has a voltage regulator, crystal oscillator, communication protocol, etc. It features 14 digital input/output pins, 6 of which are PWM-capable and 6 of which are analogue.

b) IR Sensor

An IR transmitter and receiver, an Opamp, a variable resistor (trimmer pot), and an output LED make up the majority of the IR sensor module. IR LED transmitter. IR LEDs are used to create infrared-frequency light. We cannot see IR light because it has a wavelength between 700 nm to 1 mm, which is substantially longer than visible light.

c) Buzzer

A piezoelectric diaphragm serves as the basic sound source of a piezoelectric sound component. A piezoelectric diaphragm is made up of a metal plate (such as brass or stainless steel) and a piezoelectric ceramic plate with electrodes on both sides. Adhesives are used to join a piezoelectric ceramic plate to a metal plate. The piezoelectric effect results in mechanical distortion when D.C. voltage is applied between the electrodes of a piezoelectric diaphragm.

d) Display

The liquid crystal display (LCD) is a crucial component of embedded systems. It gives the user a great deal of versatility because he can display any data he needs.16 characters per line by 2 lines, or 116*2, means. On LCD, the vehicle's speed will be shown.

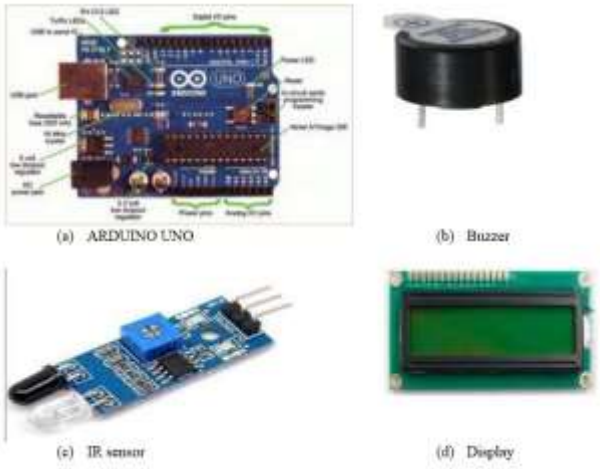

Figure 2: Design components and ARDUINO UNO

V. IMPLEMENTATION

The goal of the study on Vehicle speed detection using Arduino and IR sensors was to use IR sensors to detect the vehicle's speed, monitor that speed on an LCD display, and activate a buzzer if the speed was too high.

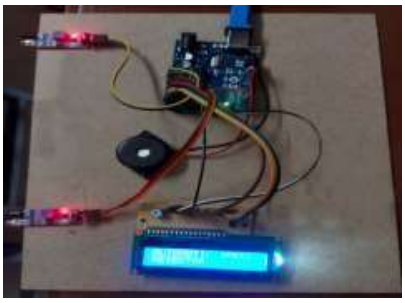

Figure 3: The prototype

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