International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048
Volume 8, Issue 3, pp 310-314, March-2024
https://doi.org/10.47001/IRJIET/2024.803047

Automated Real-Time Intelligent Traffic Control System

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***Abstract* - The project's goal is to create a density-based dynamic traffic signal system, in which a junction's traffic density will be detected and used to automatically adjust the signal's timing. Since most cities in the globe suffer greatly from traffic congestion, it is essential to switch from more human or fixed timed modes to automated systems that can make decisions. The current traffic signaling system is time-based, which can become ineffective if only one lane is used at a time. We have developed a framework for an intelligent traffic control system in order to optimize this problem. There are instances when a junction's increased traffic density necessitates a longer green time than the usual amount of time. Thus, we describe here a process that assigns the green light and red light times based on the volume of traffic at that particular moment. By using IR (infrared sensors), this is accomplished. The microcontroller (Arduino) is used to determine the green light's glowing period after the density has been determined. The roadside sensors pick up on the presence of moving cars and relay that information to the Arduino microcontroller, which determines when to switch on the signal lights or how long a flank will be open. The process of this framework has been explained in more detail in the sections that follow.**

Keywords: Traffic Signal, Traffic Density, IR sensors, Arduino, etc.

I. INTRODUCTION

One of the numerous issues we deal with in modern life is the daily worsening of traffic congestion. The primary causes of the growing traffic bottleneck are allegedly the large number of vehicles, the poor infrastructure, and the illogical allocation of development. The main factor causing traffic congestion is the large number of vehicles, which is a result of population growth and economic expansion. Automatic traffic signal controllers are required to reduce traffic delays and travel times due to the rapid development in urbanization and traffic congestion, particularly in emerging nations. The existing poor state of road infrastructure and the expanding number of transportation options will inevitably lead to a far wider increase in traffic difficulties. Many academics are working in this topic because of the idea of efficiently operating traffic lights in real time. The ultimate goal is to create an automatic tool that can evaluate traffic congestion and vary the traffic signal based on this variable.

Traffic police officers employ a system of hand signs, traffic lights, and markings to control traffic in the current circumstance. Every traffic control device is subject to design and usage guidelines. This identification and choosing the best course of action are aided by the standard use of colors and shapes. Currently, traffic lights are programmed to turn on in separate directions with a defined delay, following a specific cycle when changing signals, and causing unnecessary and wasteful congestion in one lane while the other lanes are left empty. Our suggested system will offer the answer to this issue.

The model operates on the basis of modifying traffic signal delays in response to a vehicle approaching a designated area of the route. A four-way road has four sensors positioned at its four corners that detect any vehicle approaching the sensor-covered area. Here, we are designing a density-based traffic signal system by replacing the traffic control system with infrared sensors. An infrared sensor is a device that is both an infrared transmitter and a photodiode. At a specific distance, this infrared transmitter and receiver will be installed on opposite sides of the street. When the car passes by these IR sensors, the sensor will recognize it and communicate the information to the microcontroller. After receiving a signal from the sensor, the microcontroller will determine the number of vehicles and give the LED a lighting time. The LED will glow longer than usual on the lane or road with higher density, or vice versa. At first, the traffic lights operate with a fixed delay of 6000 milliseconds. That intersection is where the complete embedded system is located. LEDs and infrared sensors are interfaced with microcontrollers.

II. LITERATURE REVIEW

Amit Kumar Bhakata. (2016), Published paper "Density Based Dynamic Control System", He aimed at designing a "Density Based Dynamic Control System" where

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the timing of signal will change automatically on sensing the traffic density at any junction. Traffic congestion density, speed, and flow are the three critical parameters for road traffic analysis. High-performance road traffic management and control require real-time estimation of space mean speed and density as input for large spatial and temporal coverage of the roadway network. This article studied about the dynamic traffic control system and based on radio propagation model for predicting path loss &link. The author suggests in concluded destination information for calculating load traffic on road for reducing the conjunction on road. The general belief was more difficult to estimate and predict traffic density than traffic flow. [2]

Jan St Tulsiramji Gaikwad-Patil (2019), Published paper on "Density Based Traffic Control System with Priority, For in that system time manipulation was used for controlling Traffic Light. This system Controls Traffic over multiple intersections, such as, it is becoming very crucial to device efficient, adaptive and cost-effective traffic control algorithms that facilitate and guarantee fast and smooth traffic flow that utilize new and versatile technologies. In a dynamic vehicle detection method and a signal control algorithm to control the state of the signal light in a road intersection using the Wireless sensor networks (WSNs) technology was proposed. Traffic light controlling or optimization is a complex problem. With multiple junctions, the problem becomes even more complex, as the state of one light agree the flow of traffic towards many other traffic lights. The complication is the fact that flow of traffic frequently changes, depending on the time. In this paper, an intelligent traffic light control system based on WSN is presented. The system has the potential to revolutionize traffic surveillance and control technology because of its low cost and potential for large scale deployment. This system gives priority to the emergency vehicles such as ambulance. [3]

Saiba Afeefa Aruna (2017), Published paper on "Density Based Traffic Signal System Using PLC and Microcontroller", In Traffic System track traffic density at junctions using Road Side Unit (RSU) and control the traffic signals Red &Green indication. The delay given for Red or Green Signal at a square will dynamically determine traffic density by communicating with the vehicles Road Side Unit (RSU). The uniqueness of our work is that the control is not just based on traffic density calculation but also priority. The Improved Priority Based Signal Management in Traffic system is capable enough to track multiple priority based vehicles. Vehicular Ad Hoc Network (VANET) is a network in which each node represents a vehicle equipped with wireless communication technology and can communicate with other nodes like other vehicles or Road Side Units. [4]

Gerard P. Michon (1985), Published paper on "Priority Based Traffic Management Systems", The main goal of VANET is to provide safety and comfort for passengers on road. A Road Side Units (RSUs) is an access points, used together with the vehicles, or collect count of the traffic from no of vehicles to allow information dissemination in the roads. The concern data can be used to create Priority Based Traffic Management Systems, which can automatically update traffic light delay. Congestion in road traffic is a serious issue and timing of traffic light is pre-defined or fixed in the traffic light and it is independent on traffic density. [5]

Satya Priya Biswas (2017), Published paper on "Intelligent Traffic Monitoring System through Auto and Manual Controlling using PC and Android Application", Priority Based Signal Management in Traffic System will calculate the density of vehicle on the road for flow traffic smoothly without conjunction. The system also proposes the Priority Based traffic light signaling which helps to assign the priority to the lanes with highest traffic density as per demand in order to control the traffic smoothly. To reduce the wastage of time, we can implement the system that controls the traffic based on the heavy flow of vehicles at any particular side. With this system, we shall count the number of vehicles at each side at the junction and give the path to the particular side which has heavy flow of vehicles and keep remaining stop position, so that for this to count the number of vehicles at side of the junction.[6]

III. PROBLEM STATEMENT

There are a number of issues and restrictions with the algorithm used in the time-based traffic control system; it wastes time, energy, and vehicle fuel energy. All of these restrictions are removed and a smooth traffic flow is provided by our project density-based traffic control.

1. Problems connected with population growth

These days, there is a significant increase in air pollution, fuel consumption, traffic congestion, and excessive delays caused by traffic signals. Additionally, our nation's roadways are overcrowded, particularly in the cities.

2. Traffic at intersection

The majority of junctions are connected to a highway that has little traffic because most vehicles in small cities operate in areas with high vehicle traffic volumes. When all of these roads lead to a single point, however, the traffic volume beneath that point is very high, which presents the main issue when only one lane has heavy traffic due to high population density?

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3. Time Based algorithm for traffic

The issue with the traffic system is that there will be a lot of traffic at the 4-way intersection every minute, which means that the traffic lights will need to be moved to each side for a certain amount of time. The traffic signals will glow red for the predetermined amount of time even when there are no cars on that specific side.

IV. OBJECTIVES

- The goal of our initiative is to minimize traffic jams and unwarranted delays during traffic light changes, particularly during periods of low traffic.
- To lessen traffic at these intersections, it is intended to be deployed in areas close to the locations where traffic signals are positioned.
- It monitors the number of cars on each road and modifies the timing of each traffic light signal accordingly.
- The higher the number of vehicles on the road the longer will be the time delay allotted for that corresponding traffic light signal.
- The main purpose of this project is, if there will be no traffic on the other signal, one shouldn't wait for that signal. The system will skip that signal and will move on the next one.

V. METHODOLOGY

- An Arduino and an infrared sensor work together to produce a traffic signal control system that is more effective and efficient. the intention of improving the traffic signal system, lowering traffic jams, and thus getting rid of problems like energy and fuel waste, pollution, and time waste.
- On both sides of roads are infrared transmitters and receivers that make up the system.
- The IR system is activated when a car moves between the IR transmitter and the IR receiver on the road.
- The microprocessor, which is activated when cars pass in front of the sensors, controls the infrared system.
- The microcontroller uses a variety of vehicle concentrations to decide how long the traffic light will flash.
- There are three sections to the methodology.
- The design structure is covered in the first section, then the hardware description, and finally the programming design.
- After, all three components were put together; tests were run to construct the system.

VI. SYSTEM DESIGN

Here, we're designing an intelligent traffic management system by replacing the system with infrared sensors. An infrared sensor is a device that is both an infrared transmitter and a photodiode. At a specific distance, this infrared transmitter and receiver will be installed on opposite sides of the street. The IR sensor will detect the car as it passes through these sensors and provide data to the microcontroller. Depending on the density of vehicles, the microcontroller will count the number of vehicles and adjust the pronging time to LED. LEDs will glow longer than normal if the density is higher, or vice versa. Initially, the traffic lights operate with a set delay of 5 seconds, resulting in an overall delay of 20 seconds. That intersection is where the complete embedded system is located. LEDs and infrared sensors are interfaced with microcontrollers.

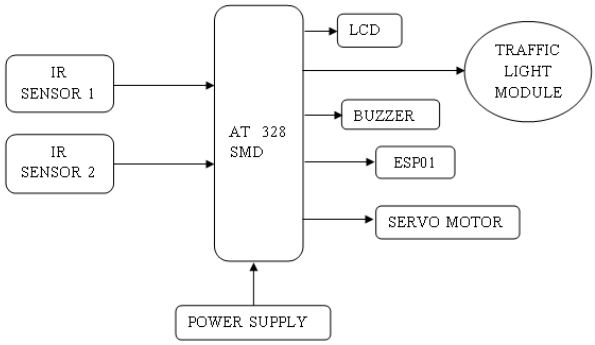

Figure 1: Block Diagram

As a result, these are linked to any two microcontroller ports. An infrared sensor is employed, together with an IR transmitter and receiver pair. The output voltage in relation to the separation between an object comparator and a set of reference values. A variable resistance is used to set the reference based on the necessary sensing range.

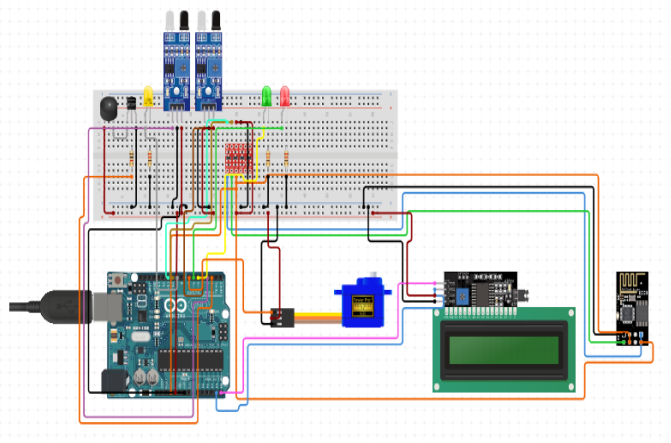

Figure 2: Circuit Diagram

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VII. RESULT AND DISCUSSIONS

- The ATMEGA 328 Microcontroller is used in the embedded system arena to design and build the Internet of Things-based electricity theft detection system being shown in this project.
- A great deal of care has gone into the experimental work.
- The outcome confirms that employing an embedded technology does lead to increased efficiency.
- A year of research and implementation culminated in the project. While the circuits operate as intended when constructed separately, the output varies and exhibits a distinct reaction each time the circuits are integrated. One possibility is that the internal wiring of the bread board being utilized, or loose connections between the wires. This study assesses if concepts and methods to solutions suggested in research are satisfied by the practical implementation by compiling a list of the outcomes obtained from the practical activity.
- From the series of experiments, we have conducted the following results were obtained:
  - Traffic can be cleared without any irregularities.
  - Time can be shared evenly for all intersections.
  - Effective time management.
- Also, the message is shown on LCD by the system.
- The diagram below illustrates the proposed system's hardware configuration:

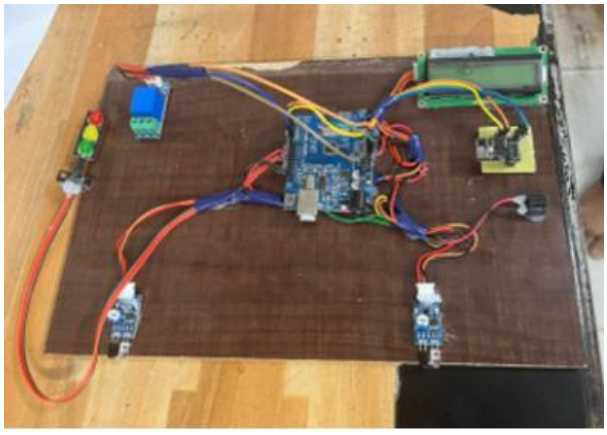

Figure 3: Result of Hardware

VIII. CONCLUSION

Due to the traffic incidents that occur in India each day, an effective traffic management system is desperately needed. In this project, a sophisticated technology is devised to lessen traffic congestion and unneeded delays. By allocating time slots according to the merit of the vehicle load in certain lanes of multi-junction crossings, the oppressive chaos of traffic can be efficiently controlled through the field use of this technique.

We have put the prototype into practice effectively and achieved amazing results at the laboratory scale.

The next stage is to apply this schema in a real-world setting to get firsthand feedback before applying it as broadly as possible. We think that this could result in a dramatic shift in the way that traffic management systems are applied in real-world settings.

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Citation of this Article:

Vaishnavi Patil, Dnyanesh Mahajan, Raj Chauhan, Prof. Dr. Shaveta Thakral, "Automated Real-Time Intelligent Traffic Control System", Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 8, Issue 3, pp 310-314, March 2024. Article DOI https://doi.org/10.47001/IRJIET/2024.803047

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