International Journal of Engineering Sciences & Emerging Technologies, Oct. 2023.
ISSN: 22316604 Volume 11, Issue 2, pp: 307-316 ©IJESET

INTELLIGENT TRAFFIC LIGHT COLOR BASED SPEED SUGGESTION SYSTEM FOR VEHICLES THROUGH OBD TRACKER

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ABSTRACT

ESP32, GSM808 for GPS, RTC Module DS3231 for current time, and HTTP Methods are used in this project to create a Traffic Light Color Based Speed Suggestion System. Based on the car's location and the current time, the system uses a pre-made CSV file that is stored on a server and queried via HTTP protocols to determine the color of the traffic light. When a traffic signal is green, the ESP32 microcontroller analyses this data and recommends the fastest possible speed for a vehicle to arrive, enhancing traffic flow and lowering fuel usage.

KEYWORDS: *GPS Module, ESP32 microcontroller, Arduino, OpenCV.*

1. INTRODUCTION

Urban regions frequently experience traffic congestion, which increases fuel consumption, creates air pollution, and wastes time in traffic. Ineffective timing or red-light running by vehicles can cause further delays and congestion, despite the fact that traffic lights are necessary instruments for controlling traffic flow at crossings. The use of technology to improve traffic flow and traffic light timing has gained popularity in recent years.

Utilizing real-time information from moving cars, such as their location and speed, to calculate the ideal moment to turn on traffic lights is one method of streamlining traffic signal timings. Traffic signals can adjust to the actual traffic circumstances on the road using this method, known as vehicle-to-infrastructure (V2I) communication, which minimizes unnecessary stops and delays.

In this project, we present a traffic light color-based speed suggestion system that makes use of real-time GPS location data from moving vehicles to advise the best speed to go when a traffic light is green, thereby enhancing traffic flow and easing congestion.

The project uses a GPS module, an RTC module, and an ESP32 microcontroller to gather and process data. The ESP32 is a potent microcontroller with integrated Wi-Fi and Bluetooth that can connect to the internet and communicate with a server. While the RTC module makes sure the system runs with precise timekeeping, the GPS module gives accurate real-time position data for the car. In order to retrieve and update data, the project additionally communicates with a server using HTTP techniques. The project's objective is to optimize traffic signal timings and lessen unneeded stops and delays for vehicles by combining real-time GPS location data with traffic light color data from a prepared CSV file. This can result in better traffic flow, lower fuel consumption, and less air pollution, all of which help to make urban transportation more effective and sustainable.

2. LITERATURE REVIEW

In order to understand the development of research in autonomous driving in the last years, it is important to conduct a literature review to understand the different fields of application through which autonomous driving has evolved a well as to identify research gaps. Therefore, in the next sections the research process, methodology, and findings of the literature review are presented.

In India's and other countries' main developing and developed smart cities, traffic congestion has been a key source of problems and failures. The typical traffic light sequence relies on a precise switching of the red, green, and yellow lights in a specific manner with a set amount of time, regardless of the situation or hour with the most traffic. This makes the typical traffic light sequence method ineffective for the current situation, where the density of traffic is increasing exponentially over time. In this work, we create and propose a design for an intelligent traffic light control system to regulate the flow of traffic in real-time [1]. Traffic congestion is a significant issue in India's transport industry that affects everyone on a daily basis. The management of traffic flow is becoming increasingly difficult as a result of the constant increase in the number of cars on the road. The goal of the current study is to investigate the need for significant innovations and improvements to the current traffic signaling system. Current traffic light systems do follow a specific cycle when switching from one signal to another and use a predetermined time delay for distinct traffic directions This results in unwelcome peak-time congestion, man- hour losses, and finally a drop in production. This study place Strong emphasis on offering a simple fix for the congestion problem. Advancing the study's component that addresses ambulances issues [2].

One of the main issues, which spreads to many other issues affecting health and social life, is traffic congestion at junctions. By using the available tools and technology, this issue can either be completely or partially resolved. In this article, we provide a brand-new framework for smart traffic lights (STL) that will allow traffic lights to be managed and controlled dynamically. According to the level of traffic congestion, as determined by processing images from the long-range digital cameras using fog computing that are deployed at the intersection, the suggested adaptive method establishes priority. RFID and sensor networks can also be used to count the number of automobiles. In comparison to conventional approaches, analytical derivation, and simulation show that STL offers an effective solution and improvement for managing traffic at intersections [3].

One of the main issues is traffic congestion at junctions which leads to numerous additional issues that have an influence on social life and health. Applying the available techniques and technologies will either completely or partially address this issue. In this project, we present a traffic light color-based speed suggestion system that makes use of real-time GPS location data from moving vehicles to advise the best speed to go when a traffic light is green, thereby enhancing traffic flow and easing congestion [4].

The motorist who disobeys traffic laws, whether on purpose or accidentally, while driving a car with advanced technology and comforts is increasingly common in modern times. The standard traffic management system needs to be upgraded in this case so that it can be made vehicle-assisted by utilizing the Internet of Things (IOT). So, leveraging the Internet of Things, this article suggests a unique intelligent traffic light control system. The suggested solution enables cloud-based communication between the traffic light color delays (.csv file) and the vehicle [5].

Traffic congestion is a very prevalent problem that affects many cities worldwide, especially those where a large percentage of people own cars. In addition to increasing commuting times and wasting fuel, traffic congestion significantly limits the amount of available work time. For the reasons listed above, it is necessary to control and lessen traffic congestion. The traffic light is the most often used technique of traffic control, although most traffic lights are now in use are designed based on the predefined interval, which cannot adequately handle changes in traffic flow. In order to supplement standard traffic lights, Internet of Things (IOT)- based or adaptive traffic lights have been created recently.

The adaptive traffic signal can be created utilizing either vehicle-to-vehicle or vehicle-to-infrastructure communication or by analysing the existing traffic scenario. This research proposes a new design for an adaptive traffic light that is based on fuzzy logic and uses a volunteer IOT agent approach to produce more accurate outcomes [6].

Finding any temporary shelters that can be visited first and visiting them is one technique to deal with waste and rubbish concerns. Finding the distance between the driver's location and the closest suitable temporary shelter is important to ascertain this.

Figure 1. Semantic Segmentation.

The Haversine formula, which may yield a distance between two places on the surface of the earth, is used in this study to determine the distance between the position of drivers and temporary shelters. In order to conduct the study, coordinate coordinates representing the locations of drivers and temporary shelters were used. From these positions, a distance was calculated between the drivers and temporary shelters, and the results of this calculation were compared.

The study's findings are a table of drivers and Temporary Shelters' separations from the smallest order. It is anticipated that drivers will be able to reduce costs and travel time by prioritizing visits from the nearest distance before continuing on to Waste End Processing Sites.

Only the acquisition of distance between two points on the surface of the globe, measured as a big circle based on longitude and latitude, is covered in this paper. It is not taken into consideration how accurately the distance measured on the surface of the earth compares to the actual distance that the driver must travel through the road.

Table 1. Literature Study & Findings

STUDY	DESCRIPTION	METHODOLOGY	FINDINGS
Pala Gireesh Kumar & Gudimetla Likhitha et al. (2022)	Proposed an intelligent traffic control system with speed control mechanism	Created a system based on an Arduino that uses ultrasonic sensors to measure distance and speed.	Based on the color of the traffic light, the system was able to adjust the vehicle's speed.
Manish Gupta & Divesh Kumar et al. (2021)	Proposed a smart traffic light system with speed and distance control mechanism	Used microcontrollers to regulate the car's speed and ultrasonic sensors to measure the distance between the vehicle and the traffic signal.	Based on the color of the traffic light, the system effectively managed the vehicle's speed and distance.
Tan D., Zhang, Y., Zhang,	Developed a smart traffic light system with	Using moving vehicle's real- time GPS location	The technology accurately and

L. & Zhang, H, (2020)	speed control mechanism	information to determine the ideal speed	successfully suggests the vehicle's speed based on the color of the traffic light.
Rezania Azdy & Febriyanti Darnis (2020)	Developed a study aims to find the distance the location of driver and temporary shelter	Using Haversine formula in finding distance between temporary shelter and waste End processing sites	This research only examines the measurement of distance between two spots on the surface of the globe using longitude and latitude to create a huge circle of distance
Anushree Jain & Yashwini Nathwani (2019)	Proposed a smart speed control system based on traffic light color	Created a GPS-based microcontroller system that measures distance and speed.	Proposed a clever speed control system based on the color of the traffic light. Based on the color of the traffic light, the system was able to adjust the vehicle's speed.
Awad Alharbi & George Halikias et al. (2017)	Developed a smart traffic light system with speed recommendation mechanism	GPS module and Raspberry Pi were used to identify and classify vehicles and determine their speeds	Based on the traffic light's .csv file, the system was able to advise the motorist of the speed limit

3. Problem Statement

In addition to being a nuisance, traffic congestion at junctions places a heavy financial strain on society. Traffic congestion delays and inefficiencies can result in missed appointments, decreased productivity, and higher costs for both individuals and organizations. Additionally, idling automobiles at junctions increases fuel consumption and air pollution, which can be harmful to the environment and public health.

Urban regions are particularly plagued by the issue of traffic congestion at crossroads because of the high population density and amount of traffic there. In urban areas, traffic jams at junctions can account for up to 30% of all delays, according to a report by the National Institute of Standards and Technology, with a yearly cost of $160 billion in lost time and fuel. Although efforts have been made to employ traffic signal optimization to solve this issue, the efficacy of these methods has been limited. Traditional traffic signal systems frequently employ predetermined timing schedules that are unresponsive to on-the-spot traffic conditions, which results in less than ideal traffic flow and more congestion.

4. Presently Available Solutions

There are now a number of solutions to the problem of traffic congestion at intersections. Implementing intelligent traffic signal systems, which use cutting-edge algorithms and sensors to react to real-time traffic conditions, is one of the most popular alternatives. These systems improve traffic flow by adjusting the length of red, yellow, and green lights based on how much traffic is present. Utilizing smart intersections, which integrate a number of technologies to enhance traffic flow and safety, is another option. These technologies enable the collection and processing of data in real-time and include sensors, cameras, and communication systems. The timing of traffic signals is thus optimized, real- time and include sensors, cameras, and communication systems. The timing of traffic signals is thus optimized, accidents are avoided, and drivers are given real-time information using this data. Finally, traffic congestion at intersections is anticipated to be significantly affected by the development of autonomous vehicles and linked vehicle technology. By enabling automobiles to interact with one another and traffic signal systems, these technologies have the potential to enhance traffic flow, lower accidents, and increase fuel efficiency. These technologies might be a workable answer to the issue of traffic congestion at intersections when they evolve further.

5. PROPOSED SYSTEM

We suggest an improved version of the Intelligent Traffic Signal Control System (ITSCS) that includes speed optimization based on real-time GPS data to address the issue of traffic congestion at intersections and increase traffic flow efficiency. This method recommends the fastest speed for cars to arrive at a traffic light while it is green in order to minimize pointless pauses and delays. The proposed system operates as follows:

5.1. Real-Time GPS Data Collection

Equip vehicles with GPS modules that can deliver precise real-time location data for real-time GPS data collection. The GPS module sends information about the vehicle's location, speed, and direction to a centralized control system continuously.

5.2. Traffic Light Data Integration

Data from traffic signal systems should be included into the centralized control system. The positions, times, and color states of traffic lights are among the details contained in this data, which can be collected through sensors or pre-existing equipment.

5.3. Centralized Control and Data Processing

Establish a centralized control system that collects and analyses real- time GPS data from moving cars as well as data from traffic lights. The technology uses an intelligence algorithm to analyse the data and decide the fastest possible speed for cars to arrive at a green traffic light.

5.4. Speed Suggestion and Display

Once the ideal speed for getting to a green light has been determined, the system conveys that information to the car using an interface. An in-car display or a mobile application could serve as this interface. The recommended speed is conspicuously indicated so that the driver can change their pace as necessary.

5.5. Integration with Existing Traffic Management Systems

Integrate with current traffic management systems, like the ITSCS, to ensure compatibility and interoperability. The technology can further improve the effectiveness of traffic flow and ease congestion by integrating speed optimization with general traffic signal control.

5.6. Haversine Formula (Speed calculative Formula)

The great-circle distance between two places on the surface of a sphere, such as the Earth, can be calculated using the Haversine formula. Given two places' latitude and longitude coordinates, it delivers an exact computation of the separation between them on the surface of the Earth while also accounting for the curvature of the planet. The distance between a car and a traffic light in this project can be calculated using the Haversine formula, which is frequently used in GPS applications to measure distances between two GPS positions. For small distances, the formula approximates the shape of the Earth as a sphere, and therefore provides accurate distance calculations for specific geographic regions [7]

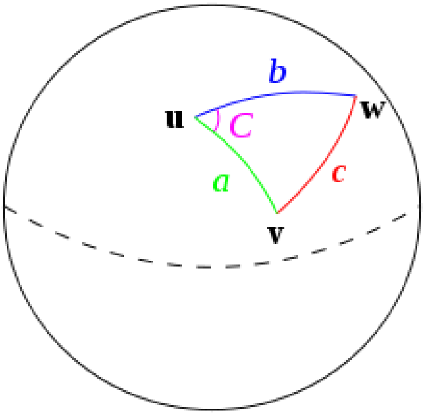

Figure 2. Spherical Triangle solved by the law of haversine

$$float\ dlong = long2 - long1;$$

$$float\ dlat = lat2 - lat1;$$

$$float\ ans = pow(\sin\left(\frac{dlat}{2}\right), 2 + \cos(lat1) * \cos(lat3) * pow\left(\sin\left(\frac{dlon}{2}\right), 2\right);$$

Where φ_1, φ_2 are the latitude of point 1 and latitude of point 2,

λ_1, λ_2 are the longitude of point 1 and longitude of point 2.

TABLE 2. (ACTUAL & THEORY)

S.No.	Fixed Latitude & Longitude	Lat2,Long2	Distance between points(Km)	Theory	Device
1	28.8793,78.73941(PVR Cinema)	28.86841,78.74669(Himgiri Colony)	1.40314	54.19	53
2	28.8793,78.73941(PVR Cinema)	28.8555833,78.7530626(Indian Oil Petrol Pump)	2.91	36.16	37
3	28.8793,78.73941(PVR Cinema)	28.0965278,78.7597296(Kundan Sweets)	4.146	40.6	42

6. Hardware Used

6.1. CIRCUIT DIAGRAM

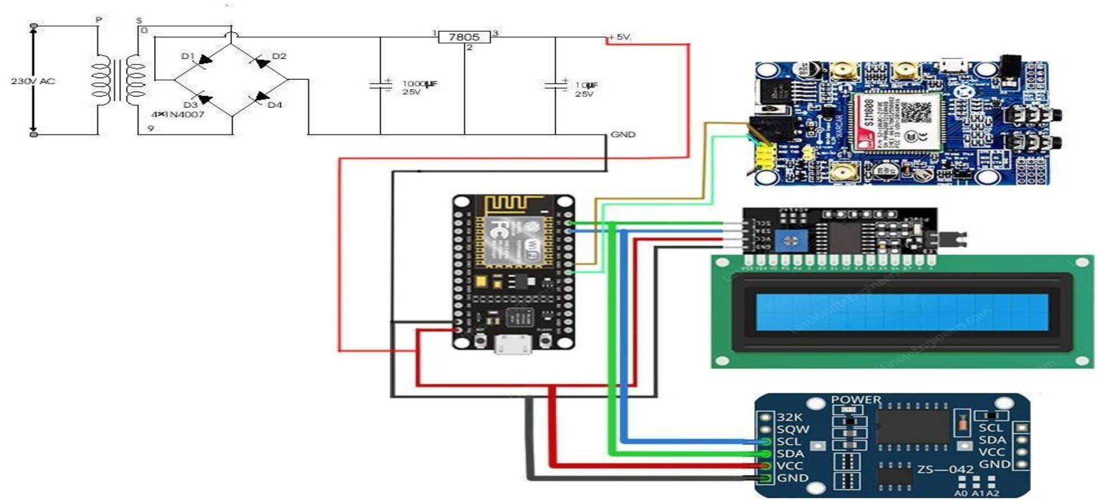

Figure 3. Circuit Diagram

6.2. ESP32 Micro Controller

A dual-core Xtensa LX6 MCU with clock rates of up to240 MHz powers the ESP32 module. It has enough processing power and memory to execute complicated apps and manage numerous tasks at once.

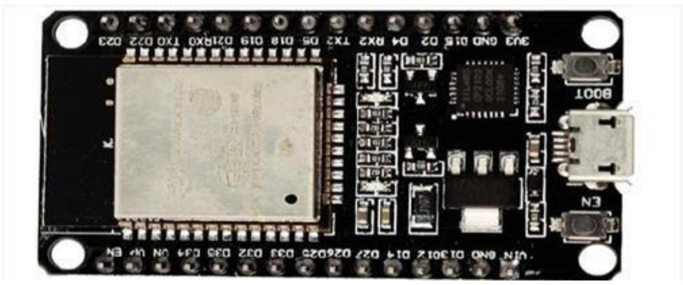

Figure 4. ESP32 MicroController

6.3. SIM808 Module

A development board is the SIM808 Bluetooth Compatible GSM/GPRS/GPS Development Board with GPS Antenna (compatible with Arduino and Raspberry Pi). Includes a SIM808 module that enables GSM connectivity and GPS capability on your Arduino or Raspberry Pi. You are able to send and receive SMS with this module. Additionally, you can create your own cell phone and track locations. His SIM808 module on the card serves as both a GPS and GSM communicator. It is a 5-26V power supply module. 9V is needed if the power source is less than 2A. Directly. Street power connector for a second lithium battery that can operate between 3.5 and 4.2 volts. USB - TTL computer debugging is doable. Quite portable. GPS and GSM antennae are provided through two pairs of SMA antenna connectors.

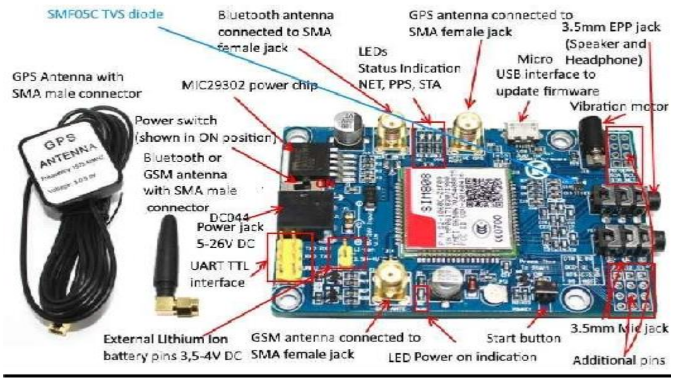

Figure 5. SIM808 Module

6.4. RTC Module DS3231

A low-cost, extremely accurate I2C real-time clock (RTC) with an integrated temperature-compensated crystal oscillator (TCXO) and crystal is the DS3231 RTC Module Precise Real-Time Clock Module. Even if the main power supply to the gadget is interrupted, the device has a battery input and continues to keep precise time. The production line's part count is decreased and the device's long-term precision is increased thanks to crystal integration. The 16-pin, 300 mil SO packaging of the ds3231 Arduino is available in industrial and commercial temperature ranges.

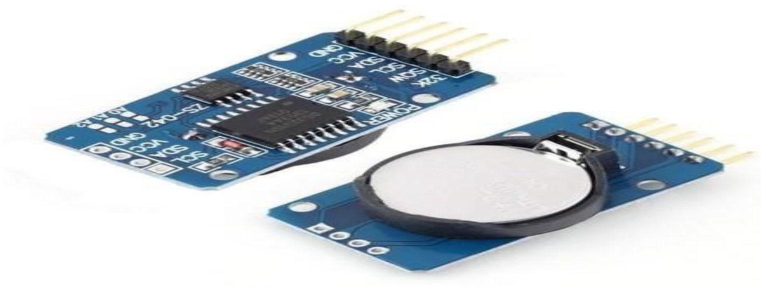

Figure 6. RTC Module DS3231

6.5. 16*2 LCD DISPLAY

These days, we frequently utilize LCD-equipped devices like CD and DVD players, digital watches, PCs, etc. In the screen industry, they are frequently utilized to replace the use of CRTs. Compared to LCDs, Cathode Ray Tubes (CRTs) consume a significant amount of power and are bulkier and heavier. These gadgets use a lot less power and are thinner as well. The basic idea behind LCD 16x2 is that it blocks light instead of letting it escape. An overview of the LCD 16X2's pin configuration and operation is covered in this article.

Figure 7. 16*2 LCD DISPLAY

7. CONCLUSION

The traffic light color-based speed suggestion project, which is presented as a conclusion, offers a novel method for enhancing vehicle speeds based on real-time traffic light data. The project aims to recommend appropriate speeds to drivers so that they can arrive at traffic lights when they are green, thereby reducing traffic congestion and improving traffic flow. To achieve this, it makes use of GPS coordinates, an RTC module, HTTP methods for data retrieval, and a pre-made CSV file of traffic light colors.

The project may result in a number of advantages, such as shortened travel distances, increased fuel economy, and a reduction in greenhouse gas emissions. By encouraging drivers to obey traffic light signals and refrain from abrupt stops or speeding to beat red lights, it can also help to promote road safety.

However, it's vital to take into account the project's constraints and difficulties, such as reliance on GPS accuracy, a lack of data from traffic lights, dependency on internet access, system complexity, safety dangers, and legal and ethical issues. To ensure the project's efficacy and security, these restrictions should be thoughtfully addressed during its development and operation.

In general, the traffic light color-based speed suggestion project shows promise as a potential remedy to increase traffic management and optimize vehicle speeds. To fully grasp the system's viability, effectiveness, and practical applicability, additional study, testing, and refining are required.

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