

SMART TRAFFIC MANAGEMENT SYSTEM USING IOT

Abstract

India's biggest issues with traffic congestion are primarily related to one or more of the following, such as poor traffic management practices, insufficient law enforcement, and signal failures. There shouldn't be any traffic jams because it greatly slows the speed of freight vehicles, lengthens lines at checkpoints and toll booths, costs untold numbers of productive man-hours in lost travel time, and causes physical and emotional exhaustion in people. Aside from that, the vehicles stuck traffic problems results in roughly 40% higher pollution than individuals who regularly travel on roadways by way of additional fuel being consumed and therefore causing far too much carbon dioxide emissions, which would necessitate periodic maintenance. Our trials based on current data show that the suggested strategy can shorten the consumer's travel and waiting times. To address the sub risks to humanity, we devised a technical work around employing IoT.

The proposed system integrates real-time data collection, communication, and intelligent decision-making to enhance the efficiency and safety of urban traffic systems. IoT devices, such as sensors and cameras, are strategically deployed throughout the road network to collect data on traffic flow, vehicle density, and environmental conditions. The collected data is transmitted to a centralized control system, where it is processed and analyzed in real-time.

Keywords: Smart, IOT, Traffic Congestion, Traffic Management, Sensors

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I. INTRODUCTION

Most of the time, there is uneven traffic coming from all directions to a junction. The majority of nations use fixed-time signals to control traffic, however some developed nations' main cities employ centralised management systems. Events that are unpredictable but frequently occur, such as accidents, vehicle problems, improperly timed signalized intersections, special occasions like massive social gatherings and political rallies, bad weather, etc. are all variables that contribute to numerous types of traffic capacity problems.

On the other hand, macro level factors, such as trends in property use, profiles of employment, trends of income, trends of vehicle ownership, designs of infrastructure investment, trends of regional economic factors, etc., may indeed lead to congestion. Traffic management systems have used the Internet of Things (IoT) concept. In this framework, we are putting forth a potent method by which radio wave flagging tactic can be used to identify these cars. The crisis cars will be identified and incorporated in a system that emits a Sensor Observation Service (SOS) signal. A sign detection unit can detect this signal, and it will then send a crisis trigger to the traffic executive's system. The criticism and the methodology presented could be handy for analogous developing nations.

Problem Description: Traffic lights in Bangalore run in a methodical manner, which occasionally results in significant delays for drivers. Without taking into account the present jam in each lane, it gives a particular duration for each direction. The goal is to integrate traffic lights with a smart system to regulate time. The amount of the traffic jam at the inroad intersection is not documented by the Bangalore Municipality. Therefore, it will be challenging to determine which intersection requires a bridge replacement. Utilising intelligent devices can improve the quality of the road.

II. LITERATURE REVIEW

1. Literature Survey: In [1] the Authors Gustav Nilsson, GiacomoComo presented a system in which the use of Advanced Traffic Management System (ATMS) can minimize traffic congestion, with the issues on the research route being identified after data collection and the execution of a road side discussion, a spot speed analysis, and a vehicular traffic study. Utilising traffic volume surveys at intersections and roadside interviews throughout the research route, it is possible to compute the volume/capacity ratio while learning more about the actual traffic-related difficulties. By implementing an Advanced Traffic Management System, an intersection's Quality of service and ability (LOS) can be improved (ATMS).

Mohammed Khaliland In order to provide better service, Abida Sharif describes a low-cost future STS that will use traffic quick updates. Instantaneous collection and distribution of public traffic data for data processing are made possible by the Internet of Things (IOT). Utilising a number of analytical texts, predictive analytics can be utilised to monitor traffic density and provide solutions.

In [2] The authors M.N.V.M. SaiTeja, N.LasyaSree, LasyaHarshitha, and P.Venkata Bhargav have suggested a system in which the green signal is typically triggered for a comparable time span on two lines without taking traffic load into consideration, stretching the wait for vehicles in other lanes. In order to solve many of

these issues caused by traffic congestion, we developed an algorithm that can shorten wait times by anticipating the amount of vehicles and adjusting the signal accordingly.

In [3] Authors P Indhiradevi, P Saravanakumar, R Varsha, S Sahithya have suggested a system where the area's traffic flow is governed by sensors and centrally controlled traffic signals. CCTV cameras have been installed for surveillance purposes to record the movement of vehicles on the road. CCTV cameras can help with image processing, making it successful. This enables prompt and accurate vehicle monitoring. Using a sensor, a modified image is sent to VMS (variable message sign) displays. Transportation users will be able to discover the path that is void of traffic and change their direction accordingly.

In [4] For the delivery and direct collection of traffic data for analysis, Rizwan and Suresh suggest a network that uses the Internet of Things (IoT). Big data analysis are also offered, in addition to real-time streaming data. There are several analytical methods.

In [5] The author Septia Redisa Sriratnasari recommended using ITS in the form of Bus Rapid Transit (BRT), the Bus Information Management System (BIMS), which is disseminating accurate bus arrival statistics Agency (BPTJ), the Advanced Traffic Signal Control Systems (ATSCS), a device that controls dynamic traffic indicators in real time, the Electronic Toll Collecting System (ETCS), specifically the implementation of toll bills using a special On-Board Unit (OBU) device.

In [11] within the framework of this paper, the authors introduce an Internet of Things (IoT) system. This system functions by collecting data from both the vehicle's immediate surroundings and its internal environment. To achieve this, embedded sensors, a wireless sensor network, and internet connectivity are utilized. By harnessing this amalgamation of technologies, the system provides drivers with pertinent contextual information. This information empowers drivers to make well-informed and timely decisions, consequently fostering a safer and more seamless driving experience.

In [12] the authors delve into the realm of security breaches within the domain of smart residences, meticulously assessing their repercussions on the overarching system security. The paper analysis encompasses the discernment of essential security prerequisites and corresponding remedies germane to the smart home milieu. Furthermore, authors endeavor to proffer resolutions addressing specific quandaries related to authentication.

- 2. Comparative Analysis of the Related Work:** The Table 1 discusses the comparative analysis of the current systems in light of the suggested proposal.

Table 1: Comparative Analysis

| Sl. No | Author(s) | Algorithms/Techniques | Performance Measures |
|--------|-------------------------------------------------------------------|----------------------------------------------------|----------------------|
| 1. | Gustav Nilsson, Giacomo | Advance Traffic Management System(ATMS) | Accuracy |
| 2. | N.LasyaSree, LaSyaHarshitha, and Venkata Bhargav, M.N.V.M.SaiTeja | Real Time traffic Control Algorithm for congestion | Accuracy |
| 3. | P Indhiradevi, P Saravanakumar, R Varsha, S Sahithya | Image Processing Techniques | Accuracy |
| 4. | Rizwan and Suresh | Big data and IoT Techniques | Accuracy |
| 5. | Septia Redisa Sriratnasari | ATSCS Technique using IoT | Accuracy |

3. Summary: These were the research papers that we studied which on implementation reduced traffic volume is reduced about 16% in NH 209 Coimbatore to Sathyamangalam. Better results can be obtained by widening the road in future which would be more effective. The traffic in SH 80 is also declined by 20.5% as compared to early cases. This process is carried out in particular area of Annur town as the traffic is very heavy in peak hours at morning and evening. Initiating this process in every place where traffic congestion is heavy and the road is narrow gives better result in monitoring and controlling of the traffic in cost effective way. It mainly results in fuel consumption which will enrich our economy.

III. PROBLEM FORMULATION

1. Problem Statement: Network traffic forecasting is a crucial management and operational task for any data network. It serves a crucial role in the networks of today, which are become more complicated and diverse. Network traffic prediction is more essential for IoT networks to guarantee dependable connectivity. With significant success, traffic predictions have been made using artificial neural networks (ANN). In this study, we employ a multistep ahead prediction method to forecast IoT traffic time series utilising Time Series NARX Feedback Neural Networks. The performance functions MSE, SSE, and MAE have been used to assess the estimation error of a prediction strategy. The mean absolute percent of error has also been used as a measure of prediction accuracy. 2019 (Ali R Abdellah).

Network traffic forecasting is a crucial management and operational task for any data network. It serves a crucial role in the networks of today, which are become more complicated and diverse. Network traffic prediction is more essential for IoT networks to guarantee dependable connectivity. With significant success, traffic predictions have been made using artificial neural networks (ANN). In this study, we employ a multistep ahead prediction method to forecast IoT traffic time series utilising Time Series NARX Feedback Neural Networks.

The spread of the automobile and the concomitant motorization are notably linked to congestion, which has raised the need for transportation infrastructure. The availability of transport infrastructure, however, has frequently been unable to keep up with the rise of mobility. Specifically as traffic numbers approach a road's capacity, traffic congestion difficulties include incremental delays, vehicle operational costs including fuel consumption, pollution emissions, and stress that results from interference among vehicles in the traffic stream. In cities everywhere, more people are sitting in traffic jams for longer stretches of time than ever before. Traffic congestion happens when demand exceeds the capacity of the roads. There are various factors that contribute to congestion; the majority of them diminish the road's capacity at a certain location or over a specific distance, such as when people park on the road or when the number of vehicles increases. Traffic congestion also occurs due to traffic signal. At traffic signal when road traffic density is low signal still shows the same traffic time due to which other lane traffic increases which result in traffic congestion.

2. Objectives of the Present Study: The objectives of the proposed project are as follows

- To study and analyze the related work on Smart Traffic Management System and avoid congestion in traffic.
- To design a Smart Traffic Management System that is effective.
- To implement the proposed system using IOT.
To detect and classify vehicles for traffic controls.

3. Summary: The system gives a brief overview of the persistent problem of traffic congestion in several Indian towns. The main causes of India's traffic congestion include one or more of the following: ineffective traffic management techniques, insufficient law enforcement, and signal malfunctions. There shouldn't be any traffic jams because they significantly reduce the speed of freight vehicles, prolong the queues at checkpoints and toll booths, cost countless hours of lost productivity due to travel time, and wear out individuals physically and psychologically. In addition, traffic jams caused by backed-up automobiles produce about 40% more pollution than those who routinely use the roads due to increased fuel consumption and excessive carbon dioxide emissions, which calls for routine maintenance.

IV. REQUIREMENTS AND METHODOLOGY

1. Hardware Requirements: The hardware requirements for the proposed project are depicted in Table 2.

Table 2: Hardware Requirements

| Sl. No | Hardware/Equipment | Specification |
|--------|--------------------|-------------------------------------|
| 1. | Graphics Card | Intel 621 Graphics card or 2GB |
| 2. | RAM | 4GB or above |
| 3. | Arduino Uno | Microcontroller based on ATmega328p |

2. Software Requirements: The software requirements for the proposed project are depicted in Table 3.

Table 3: Software Requirements

| Sl. No | Software | Specification |
|--------|-------------|---------------|
| 1. | Windows OS | 64 bit |
| 2. | Arduino IDE | 64 bit |

3. Methodology Used: The proposed model is implemented using the following steps:

- **Data Acquisition:** The sensor gathers information on the current vehicle density on the route.
- **Data Storage:** The sensors' data is gathered and kept on the cloud.
- **Data Computation and Processing:** The microcontroller uses this data to decide how to modify the signal.
- **Data Delivery:** Data is delivered immediately to the microcontroller in an emergency, which ends the preceding loop and promptly changes the signal.
- **Models to generate better predictions,** identify items, or comprehend the system to model. Models with clean data and a thorough knowledge of the content.

V. SYSTEM DESIGN

1. Architecture To Proposed System: Figure 1 shows the architecture of the proposed system.

The architecture of Smart Traffic Management System model is depicted in figure. The first step is to collect suitable information using Cameras etc in the data Acquisition and Collection Layer. The Collected data is then fed to the Data Computation and Processing Layer. The Computed data in the computation layer outputs the suitable change in the traffic signal using certain congestion control techniques thus causing the changes in an application as shown in the figure.

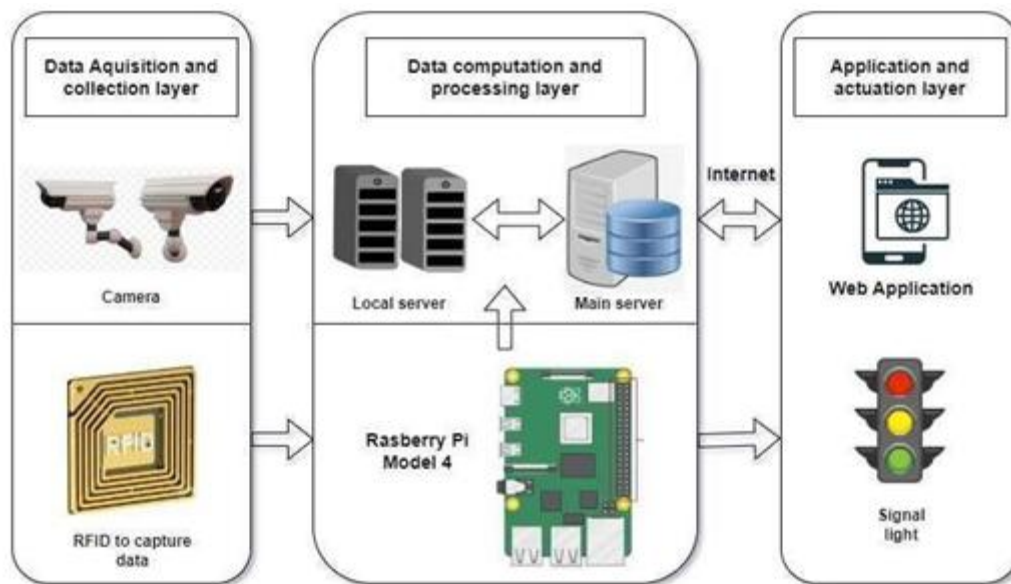


Figure 1: Architecture of the Proposed System

2. System Flowchart: The flowchart of Smart Traffic Management System is depicted below. The standard real time for traffic change is taken and suitable signal change is calculated based on congestion in the traffic.

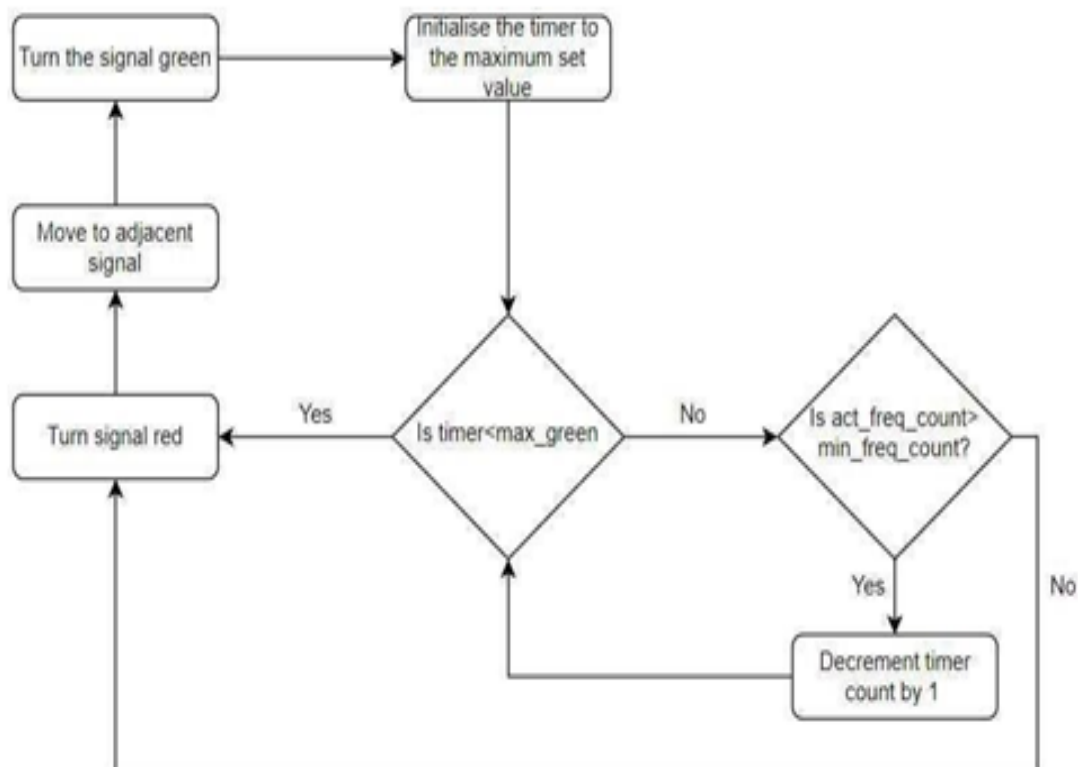


Figure 2: System Flowchart

VI. SYSTEM TESTING, RESULTS AND DISCUSSION

1. System Testing

Table 4: Unit test cases

| Test case number | Input | Stage | Expected behavior | Observed behavior | Status P=Pass F=Fail |
|------------------|--------------------------------------------------|------------------------------------------------------|--------------------------------------------------------|-------------------|----------------------------|
| 1 | Working of all the LEDs | Detection using suitable connection with Arduino | If detected, the led blinks | As expected | P |
| 2 | Working of Arduino board corresponding the board | Detection using power supply and suitable connection | The status led of Arduino glows alongside all the LEDs | As expected | P |

Table 4 shows results of the test conducted using the proposed model. As we conducted several test and our model is responding properly to required output. In First test case we detected the working of all LED,s via suitable connections to the Arduino. In Second test case we detected the working of arduino to the relative code via suitable connections.

2. **Result Analysis:** Figure 3 shows the overall assembly of the smart traffic management system where all the LEDs and microcontroller board are assembled in a systematic way.

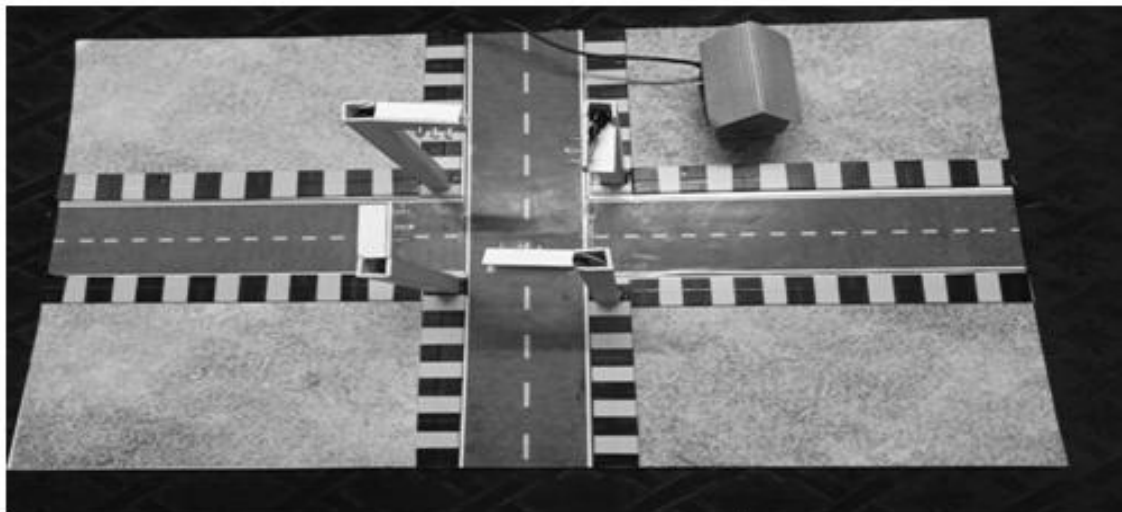


Figure 3: Overall architecture of Smart Traffic Management System
Figure 4 shows the Arduino connectivity to the various LED's

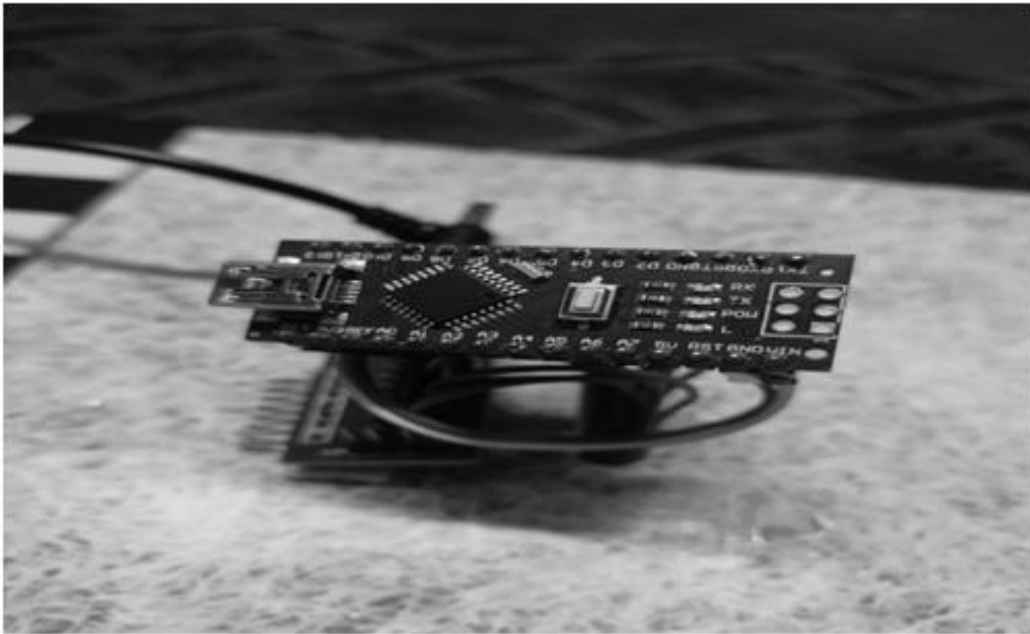


Figure 4: Arduino Connectivity to LED's

Figure 5 shows the connection of Cable to Stabilizer and further connections to Arduino board.



Figure 5: Connections to Stabilizer

Figure 6 shows the working of four way traffic control system with suitable traffic control signal.



Figure 6: Four Way Traffic Control System

Figure 7 shows the working of Green light when other lights are turned red.



Figure 7: Working of Green Light

Figure 8 shows the working of white light before turning red.



Figure 8: Working of Green Light

Figure 9 shows the working of red light for a proposed time.



Figure 9: Working of Red light

VII. CONCLUSION

By anticipating a large number of cars, our study proposes a real-time traffic information gathering and monitoring system to address the issue of real-time monitoring and controlling road vehicles through traffic signals. The lifestyle of individuals living in metropolises with dense populations is equally impacted by a variety of application and service systems. As a result, the majority of cities are converting to smart cities by using automated technologies across all industries. In light of the aforementioned, we have created an algorithm that minimizes waiting times and traffic to get you where you need to be as quickly as possible.

VIII. SCOPE OF FUTURE WORK

The goal of the study is to examine the potential benefits of STMS adoption in different countries. This paper also looks into the possible positives of utilizing STMS. Additionally, this section examines the technical barriers.

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