

# Study of IOT Based Smart Traffic Management System

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**Abstract—** One of the significant challenges faced by major cities today is traffic management. The possible reason for this can be increasing number of vehicles, lack of proper infrastructures, improper roads, growing population etc. Increased accidents and pollution levels have been observed as most common problems in major cities. All this gives rise to the need of IOT based Traffic control system which continuously detects, monitors, and adjusts traffic signal timings according to traffic load. This paper describes Study of different methods for controlling and monitoring traffic.

**Keywords—** Smart Traffic management, Traffic Congestion, Internet of Things, Infrared Sensors, Traffic sensors, Traffic Density, Intelligent Signals.

## I. INTRODUCTION

[1] [2] Today, Traffic Congestion in modern cities is a serious issue. Traffic congestion occurs due to number of vehicles exceeding the road capacity. Traffic Jams, accidents and increased pollution levels has been observed as most common problems in major cities. Well-Organized traffic management may result into a convenient flow of traffic and may reduce congestions. The existing method of traffic system is outdated in which signals are allotted with specific predetermined timings. Each lanes are allotted Signals with fixed time and the signals switches automatically depending on these fixed timer values. This traditional method is not sufficient enough to meet the requirements of a growing traffic related problems. All this gives rise to the need of IOT based Traffic control system which continuously detects, monitors, and traffic signal

timings according to traffic load. [3] On the Other Hand, It has been observed that Emergency vehicles are stuck at lanes due to heavy traffic due to scheduled traffic signal, Which in turn results in delay for the emergency vehicles to move . Emergency vehicles needs to be prioritized before any other vehicles. Delayed arrival of emergency vehicles to destination may cause a problem. So, the lane through which emergency vehicles will be approaching can be made free by halting the traffic light for vehicles in other lanes. This may minimize the delays and help during emergency situations. [4] The implementation of Internet of Things is a far better alternative Solution in solving the congestion issues that many urban areas are facing today. With the popularity of internet, cities can be more developed to resolve traffic related problems. With the help of Internet of things, the updated system may help resolve many challenges related to traffic daily by predicting the minimum route the vehicles can take, reducing the waiting time, less congestion, reducing travel cost, eliminating the need of Traffic Police., etc. So in order to get rid of all these problems, there becomes a need to implement newer scheme by using sensor based automation technology in the field of existing traffic signaling system.

## II. LITERATURE REVIEW

Shashank S [5] proposes a Time Based Smart Traffic Management system which utilizes data from camera, Communication and algorithms. The system focuses mainly on the timings of traffic signal. The primary element used is



Camera, which interacts with physical conditions by monitoring the presence and absence of vehicles. These camera sends data to the processor which processes and analyzes data. Then the resultant data is sent to the controller through the connectivity medium (Wifi , Internet) which makes use of the data, that is collected for the performance of Traffic Routing algorithm. System makes use of a database to predict the timing control of the signals. The algorithm then makes the comparison between the calculated and current actual timings of signal light. Based on this, the processor then makes the decision. For eg: The decision of increasing the timings for green signal is made, if the current timings of signal is less than the calculated timings, Otherwise, decreasing the green signal timings.

Priyanka Sharma [6] Proposes a PLC (Programmable Logic Controller) based traffic diversion system to reduce heavy traffic and congestion. The primary aim of this method is to cut down the vehicular traffic to the half by using PLC Technology. This method includes sensors which will sense the weight and the data will be fed to PLC. This weight data is then used by the PLC to figure out the route having maximum number of vehicles. The Arduino Board will make the comparison with each routes and will allow the route having highest number of vehicles to pass through. The weight sensors are placed at key locations under traffic circle which will sense the weight and will send the data signals to PLC. Arduino board compares the data arriving from each route and will check for the higher weight. Using this data the PLC will work accordingly and will halt all the routes except for the route having highest weighted data.

NinadLanke [7] Used RFID as a primary element in his method. It consists of: RFID Controller: An RFID interrogator, that is used for communication with the RFID tag, is part of the RFID controller. RFID receives data/signals from the interrogator. Message interference is used for sending commands and data messages to the controller components. RFID Tag: RFID tags are wireless devices that transmit data via radio frequency electromagnetic fields, which are used for object identification and tracking. Controller core is present inside RFID Controller. RFID tags can be installed in each vehicle which stores all information regarding vehicles, vehicle number etc. This will help identify each vehicle uniquely and can be helpful for drivers with some important traffic related messages. The RFID controller can be used in conjunction with the current signaling system. Each signal has data on every car that passes by it, so when one passes by, the signal keeps track of how many vehicles have passed by it and assists in identifying traffic congestion. Each signal is stored with threshold value for red signal and green signal. The timer can now be dynamically controlled depending on the frequency of vehicles passing the traffic light every second. Each signal's controller needs to have a minimum value saved for the frequency of cars passing by the signal. The signal is controlled dynamically when this minimum frequency reaches its required value, at that point the controller should order the signal to become red.

R Srinivasan [8] The processing of signals is used in image processing, with a picture or video frame as the input and an image or a set of attributes for an image as the output. An algorithm is developed to control and process the

images that are received from the cameras. Standard signal processing techniques are used to interpret the image as a two-dimensional signal. Brightening, edge enhancement and image enhancement is extracted using binary digital data of the image. Image capture, preprocessing, density estimation, and effective moving object identification are all included in a shared traffic control architecture. Installing cameras at every junction and roadside is crucial for improving the adaptability and effectiveness of this system. This will assist in managing traffic light timings and analyzing traffic buildup from start to finish. In addition to localized congestion, synchronizing many traffic signals is intended to reduce backlog for unimpeded traffic movement over wide regions. It will also be advantageous to develop algorithms for image processing methods that can identify emergency vehicles and prioritize their movement.

Abubakar Muhammad [9] The model proposed in this paper for connecting vehicles to intersection control stations is based on client-server communication. Here, the main control station acts as a server node, while the vehicles act as client nodes. Each vehicle sends job requests to the job queue that need to be processed when it passes through the intersection. Each vehicle has an DBTL (Dashboard Traffic Light) system. It helps the user to visualize the color of the signal on the screen itself as well as the countdown timer. The vehicle connects to the intersection system when it enters the area of intersection. A request message will be issued, when a vehicle is connected to the intersection system. After this the control system sends response to the requested message. It would get one of two responses: 1) a green light with a countdown timer, or 2) a red light with a countdown timer. 3) Two timer message one for red and one for green. After leaving the intersection, the automobile will then send an exit message to the intersection control system along with the lane it is currently in.

Harsha. J [10] This paper tries to propose an idea which will help in easy mobility of vehicles. In this every side of the intersection is given a calculated amount of time whereas the system which is in work right now has 0 to less amount of intelligence. The current system does not change dynamically based of density of traffic. The system proposed by the author uses sensor to determine the density of traffic. The system uses ultrasound sensor and it also uses image processing and it works on Raspberry Pi. It calculates vehicle density based upon the sensors used and it dynamically calculates the allotted time to the signal. This reduces the waiting time of vehicles and it proposes an effective management of traffic. If any of the sensing devices malfunction, this information can be utilized to understand the signal duration and for future study. This system calculates the vehicle density and allots time based on the same utilizing an ultrasonic sensor, image processing and a raspberry pi.

In the below table we've compared six authors who have proposed their idea for Smart Traffic Management System. Each has a different approach for has received different results using different methods and components. Author Shashank S has used Camera Module as his primary element and has calculated the traffic congestion based on time. Using this method traffic optimization can be achieved. Cameras during night time surveillance may need proper street lighting and this is one of the limitations of using this method.

TABLE I. COMPARISON OF EXISTING TRAFFIC MANAGEMENT SYSTEMS

| Sr.No | Name of author        | Primary Element Used                         | Output/ Visualization                                                                                                                                                                                                                                                                                                                          | Advantages                                                                                                                                                                                                                                                | Limitations                                                                                                                                                                                                                                                                                                                 |
|-------|-----------------------|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.    | Shashank S [5]        | Camera<br>(Time based method)                | The system optimally controls the duration of green or red signal by comparing current signal time with expected calculated signal time with the help of algorithm and then switches the signal accordingly.                                                                                                                                   | 1) Traffic optimization is achieved.<br>2) Efficient utilization of timing to all traffic signal.<br>3) Real-time Monitoring of vehicles and traffic.                                                                                                     | 1) Shadow overlapping cannot be handled.<br>2) Cameras during night time surveillance may need proper street lighting.<br>3) Cameras may fail to capture images during heavy rain and fog.                                                                                                                                  |
| 2.    | Priyanka Sharma [6]   | PLC, Weight sensors<br>(Weight based method) | The Vehicles of the lane whose weight data will be higher as compared to other lanes, will be made pass through. The weight data is checked whether it crosses the threshold value or not. If it is, then the signals will be switched accordingly.                                                                                            | 1) Traffic monitoring by recording in motion traffic data including the pedestrians.<br>2) Other than traffic data it can also help detecting overloaded vehicles which will protect road infrastructure and increase safety.                             | 1) Maintenance cost of sensors becomes high since it needs to be deployed in rugged external conditions.<br>2) Weighing method may lead to limited accuracy due to vehicles in motion.<br>3) This method can be suitable for vehicles in steady and slow speed, but in case of vehicles moving with fast speed it may fail. |
| 3.    | Ninand Lanke [7]      | RFID<br>(RFID Controller, RFID Tag)          | An RFID tag will be attached to every vehicle .As a result, whenever a car passes a signal, the signal will automatically keep track of how many cars are passing by it and assist in the detection of traffic congestion. The timer can now be dynamically adjusted based on the frequency of the vehicles passing by the signal each second. | 1) Dynamic management of the signal helps to cut down on time wasted.<br>2) By giving priority to a road with heavy vehicular traffic, this also aids in preventing traffic congestion.<br>3) This method assists in the early detection of traffic jams. | 1) RFID systems are often more expensive than barcode systems.<br>2) Sometimes not as accurate or reliable as barcode scanners.                                                                                                                                                                                             |
| 4.    | R Srinivasan [8]      | Image Processing                             | A common architect of traffic control will be incorporated by using image acquisition, preprocessing and density calculation and efficient detection of moving objects.                                                                                                                                                                        | 1) It is a real time monitoring system and gives quick solutions.<br>2) It is the only method that can give us the visuals of the current traffic system                                                                                                  | 1) A long debugging time is required to acquire the same position before and after loading .<br>2) Acquired images may be blurred making it difficult to identify.<br>3) It is a resource intensive methodology and thus is not cost-efficient.                                                                             |
| 5.    | Abubakar Muhammad [9] | Client-server<br>(Communication Based)       | The algorithm used by the system SPF. It makes a calculated decision about whether or not to let the vehicle pass based on various data such as position, speed, etc.                                                                                                                                                                          | 1) Waiting time of the vehicles is reduced<br>2) Due to the less waiting time the fuel consumption of the vehicles is reduced<br>3) Due to the less waiting time the CO2 emission is also reduced                                                         | 1) Every vehicle should be equipped with DBTL<br>2) Every vehicle needs to send its details to the intersection control system leading to breach in privacy of that vehicle.                                                                                                                                                |
| 6.    | Harsha J [10]         | Data Analysis                                | This system uses ultrasonic sensor and image processing and it using raspberry pi to calculate the vehicle density and allots time based on the same                                                                                                                                                                                           | 1) It measures the vehicle density and allots the signal countdown accordingly leading to less waiting time per vehicle<br>2) Provides accurate data for detection most of the time.                                                                      | 1) Less use of newer technology<br>2) Some sensor are sensitive to change in temperature leading to false detection of vehicle.<br>3) Can only be used for small areas.                                                                                                                                                     |



Our second author Mrs. Priyanka Sharma uses PLC & weight-based sensors as her primary element. The Vehicles of the lane whose weight data will be higher as compared to other lanes, will be made pass through. Other than traffic data it can also help detecting overloaded vehicles which will protect road infrastructure and increase safety.

Our third author Mr. Ninad Lanke uses RFID as his primary element. An RFID tag will be attached to every vehicle. As a result, each time a car passes a light, the signal will automatically count the number of vehicles that pass by it, helping to identify when there is a traffic jam. Now, based on the frequency of the vehicles passing by the signal once every second, the timer can be dynamically changed.

Next Mr. R Srinivasan uses Image Processing to calculate traffic congestion of different lanes. It is a real time monitoring system and gives quick solutions, but it is a resource intensive methodology and thus is not cost-efficient.

Further we have Mr. Abubakar Muhammad who uses Client-Server Communication based model to calculate the traffic of each lane and compare it. The algorithm used by the system SPF. It makes a calculated decision about whether or not to let the vehicle pass based on various data such as position, speed, etc. This method helps waiting time of the vehicles to be reduced. And lastly author Harsha J performs Data Analysis for congestion control. It provides accurate data for detection most of the time.

After the research and comparing various papers on IoT-based smart traffic management systems, it is evident that this technology is a great solution for solving challenges of urban congestion and transportation inefficiencies. Each study highlights the potential benefits of integrating IoT devices, real-time data collection, and intelligent algorithms to optimize traffic flow, reduce commute times, and enhance overall road safety.

### III. PROPOSED SYSTEM APPROACH

- To Eliminate the problems faced in current system, an IOT based system needs to be implemented for monitoring and controlling the signal timings.
- According to the traffic densities, system will smartly allocate the time period of the traffic lights for each road.
- The traffic signals are adjusted according to the previous data provided by the IOT sensors and the time is calculated based on the count of vehicles present in particular lane.
- To calculate the traffic density, IR sensors will be mounted at strategic places on the roads wherever traffic signals are present.
- Based on data received from IR sensors the timing of the signals will be intelligently decided.
- According to the rush hours and density of traffic in the lane the system changes dynamically.
- Thus the duration of red-lights and green-lights will be adjusted on the basis of real-time monitoring.

- Manual control of the traffic signals will also be provided through the control room to handle emergency situations.

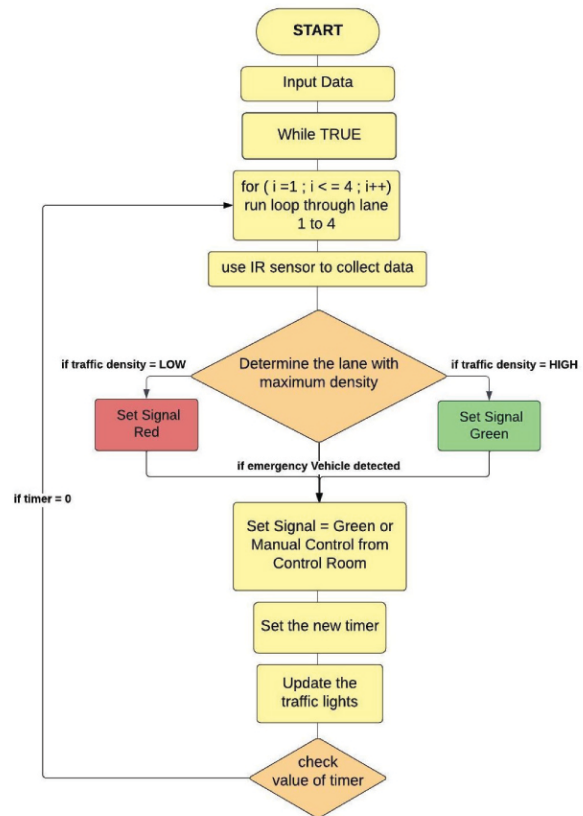


Fig. 1. Flow Chart

### IV. CONCLUSION

To tackle the shortcomings of current traffic situations, an implementation of updated system to control and monitor signal timings according to traffic densities will allocate the time period of traffic lights to each road smartly. It will rely on prior information provided by sensors and other automated techniques. Current systems are not capable enough to overcome the growth of traffic on road networks. Sometimes, lane having higher traffic congestions needs longer green signal as compared to current fixed timings. Use of IOT technology and collected information from multiple sources will help predict high traffic junctions and manage traffic congestions. Reduction of average waiting time, prioritizing emergency vehicles, less congestion, travelling cost etc are some parameters which will help achieve goals of urban traffic management.

### ACKNOWLEDGMENT

We would like to thank our mentors from Thakur College of Engineering and Technology for sharing their Knowledge and expertise in our research and project. This study and research would have been impossible without the guidance and assistance of our mentors. We would also like to extend our gratitude to all the faculties of our department and also the faculties of our college and industry experts for supporting us for this project.



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