

## Advanced Traffic Administration System using Internet of Things and Data Analytics.

Thakker Yakshap Rajesh<sup>1</sup> and Prof. Shaikh Mohammad Bilal Naseem<sup>2</sup>

<sup>1</sup>Department of Computer Science  
Somaiya Vidyavihar University  
Mumbai, India

<sup>2</sup>Department of Computer Science  
Somaiya Vidyavihar University  
Mumbai, India

<sup>1</sup>[yakshap.t@somaiya.edu](mailto:yakshap.t@somaiya.edu) , <sup>2</sup>[mohammadbilal@somaiya.edu](mailto:mohammadbilal@somaiya.edu)

### Abstract

*In the modern world, the number of vehicles on road has increased dramatically, but on the contrary, the capacity of our roads and transportation systems have failed to improve and as a result, they are failing to achieve efficiency with the increasing number of vehicles. This results in a lot of problems like traffic jams and accidents. Considering the advent of Internet of Things, Data Analytics and their operations, there is an opportunity to create a complete platform to deal with road-related problems, which gives an opportunity for the development of Advanced Traffic Administration Systems. The proposed system deals in solving many challenges considering the aspects of traffic management, in terms of providing the optimal route, reducing delay, traffic jam, travelling costs and the amount of air pollution. In addition, the proposed system comes up with the idea of a green corridor, where emergency vehicles are permitted to complete their journey without facing any type of traffic congestion and at maximum speed.*

**Keywords:** Advanced Traffic Administration System, Traffic Management System, Smart Cities, Internet of Things.

### 1. Introduction

In the modern world, traffic administration has become one of the most important concerns of an urban city. Recently, there has been a sudden increase in the number of vehicles, which in turn has led to the problem of traffic congestion. Increasing infrastructure growth is a possible solution but this could be costly as it would cost investment of time and effort. Many countries are looking forward to building more efficient traffic administration systems through technology. The onset of the Internet of Things and the high capacity of Cloud resourcing with real time Data Analytics help us to create optimized routes and improve the use of existing infrastructure. [3] This results in the implementation of an Advanced Traffic Administration System(ATAS). Advanced Traffic Administration System is a system in which traffic flow is calculated and regulated using sensors and in response to the real time number of vehicles and thus, it helps to ease congestion of vehicles.[8] The other functionalities of an Advanced Traffic Administration System include accident detection and optimal route detection.

The lack of a traffic management system can result in increasing traffic congestion, road accidents, and pollution levels. As a result, most of these problems are commonly observed in most of the urban cities all around the world. Most cities have implemented traffic laws and regulated them in order to have control over the traffic management. But as the number of vehicles are increasing at a very quick rate, it is quite difficult to have

complete control over the entire system. Hence, there is a requirement of the Advanced Traffic Administration System.

## 2. Problem Definition

### 2.1. The Problem Statement

To be able to solve the problems related to road traffic by integrating all systems into an Advanced Traffic Administration System. To provide the optimum route to the end user from the source to the destination. To provide a separate corridor for the passage of emergency vehicles in an emergency.

### 2.2. Existing Problem

Currently, most of the urban cities in the world are facing road management and traffic related problems. Traffic congestion results in many urban problems like higher infrastructure costs and maintenance, wear and tear of vehicles, rising pollution levels, global warming, etc.

In the US alone, congestion cost \$305 billion last year, an increase of \$10 billion from 2016.[10] Traffic and congestion problems are increasing at an alarming rate every year causing huge losses to the world economy. Traffic congestion can be stated as one of the most crucial problems arising in major cities all around the world.

## 3. Literature Survey

**Table 1. Literature Review**

Sr. No.	Paper	Author	Advantages	Disadvantages
1.	“Automatic Road Traffic Management System in a City”	Roychowdhury, Priyankar & Das, Sarjo.(2014)[1]	Signal light control, automatic detection of vehicles violating traffic rules, real time traffic density.	Over speeding of vehicles is not allowed. Accident detection is not observed.
2.	“Smart Traffic Management System”	Lanke, Ninad & Koul, Sheetal.(2013)[2]	Regulation of traffic flow, automatic detection of speed limits, automatic toll collection.	Algorithms take time adapting for vehicles plying above & below the speed limits.

As shown in Table 1, Roychowdhury, Priyankar & Das Sarjo(2014) in “Automatic Road Traffic Management System in a City” proposed a system that automates the traffic management process in a city using a method which involves combinations of algorithms and communication networks.[1]

Lanke, Ninad & Koul, Sheetal(2013) in “Smart Traffic Management System” explained a system which controls and regulates the traffic with the help of Radio Frequency Identification (RFID).[2]

#### 4. Proposed System

The main functionality of the Advanced Traffic Administration System includes regulation of the flow of traffic, based on real time traffic data, accident detection and creating a green passage corridor for emergency vehicles during an emergency. The proposed system could be developed using the mechanisms developed through Internet of Things, Cloud Computing and integration of real time Data Analytics.

Sensors today are used in a variety of different areas such as surveillance, industrial automation and home appliances. Such a network chain of sensors is capable of mapping the entire city and collecting very small details in less time and at a lower cost. It has become easier to share the location and tracking of sensor nodes via IP address as IPv6 (Internet Protocol version 6) can accumulate and transfer this information easily and quickly.[4] The traffic administration system enables the usage of such sensor nodes to collect real-time data regarding traffic conditions such as vehicular movement, traffic congestion, etc. These sensors are also successful in determining various factors such as vehicle speed, count and classification.[5] The data collected and transmitted in the sensors is unique in form. Using machine learning and its algorithms, the system can predict traffic congestion and flow in a particular area or a city.

The algorithm can accurately reflect traffic patterns and suggest steps that can be taken by the authorities to prevent traffic related issues. This model suggests a major route that takes into account parameters such as travel distance, travel costs (fuel used) and total travelling time. Machine learning algorithms are also used to predict levels of traffic flow and congestion at various times. Green corridor is one more major benefit of the Advanced Traffic Administration System as it facilitates faster movement of emergency vehicles by creating a free passage till its destination

##### 4.1. Need for Advanced Traffic Administration System

A survey was conducted with 77 participants to know their views on the requirement of a traffic management system. Few questions were asked and the following pie charts display the analytical data and the answers given by the participants.

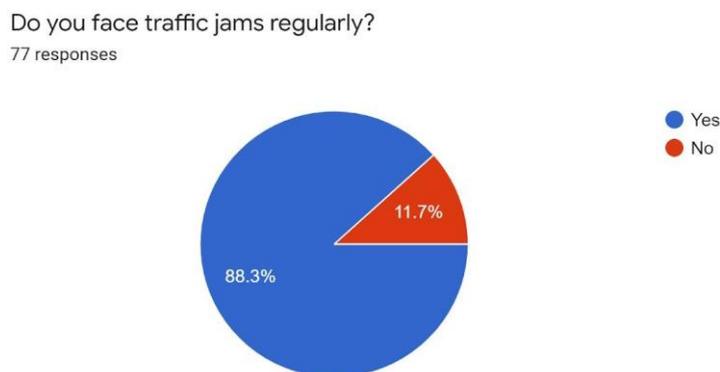
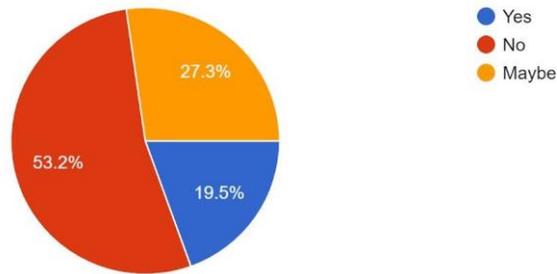


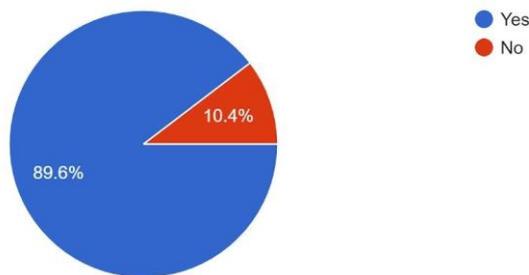
Figure 1. Do you face traffic jams/ congestion regularly?

Does traffic police always help to reduce the traffic congestion?  
77 responses



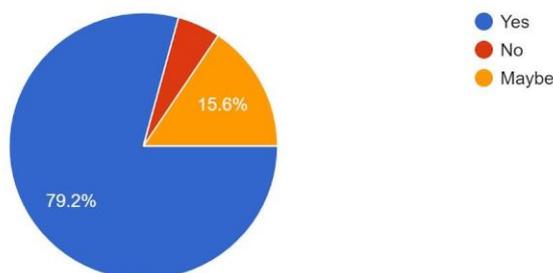
**Figure 2. Do you think traffic police are always successful in dealing with traffic congestion in the case of an accident?**

Have you seen emergency vehicles stuck in the traffic due to jams/ accidents?  
77 responses



**Figure 3. Have you seen emergency vehicles stuck in traffic due to accidents/ traffic congestion?**

Do you feel the need to have separate corridors for emergency vehicles in case of an emergency?  
77 responses



**Figure 4. Do you feel the need of having an Advanced Traffic Administration System to ease traffic flow and problems related to it?**

The survey report from the above pie charts clearly state that most of the participants in the survey face traffic and road management issues. To cater and solve the problem, a traffic management system must be created and maintained.

## **5. Proposed Methodology**

This section is about the proposed Smart Vehicle Management Program with all the various factors creating it. The Smart Vehicle Management Program is the base of the traffic management system and reflects all the elements that make up the core of the proposed system based on the introduction of the best route followed by traffic limitations.

### **5.1. Design Objectives**

1)Traffic Surveillance: It can be considered one of the most important features of a smart city. Traffic Surveillance allows local authorities to keep a track of the movement of vehicles related to a particular area, route or road. It helps to monitor traffic coming from neighbouring cities on certain days or at certain time intervals of the year. Historical traffic monitoring data can be of great help while planning the infrastructural development of a city.

2)Path Optimization: Recently, it has been observed that a shorter route does not always appear to be more considering the time taken to travel, fuel consumption, and average waiting time. In such cases, the optimal route can be considered the best way to reach the destination, considering factors such as traffic congestion, distance travelled, total travel time, and fuel consumption. An optimum route is the route which is designed by keeping the above aspects in consideration and should enable minimum travel time, fuel burn and waiting time.

3)Green Corridor: Due to the rising traffic congestion levels, it is very important to enable smooth and efficient journeys for emergency vehicles. Such a passage is called a green corridor. It is a passage from the source to the destination that contains a variety of road signals all with a green sign. The green corridor is used by the emergency vehicles during an emergency and it facilitates by allowing the emergency vehicles to reach their destinations with minimum waiting time and at high speeds.

4)Mishap Detection: Overcrowding of vehicles result in a large number of accidents. Mishap Detection is an important part of the traffic administration system as it not only informs paramedics to take care of accidents but also contributes in detecting traffic congestion in a particular region.

5)Pollution Prevention: Rising pollution levels threaten the environment and have an adverse effect on human health and well-being. The amount of pollution caused by vehicles is directly proportional to the size of the traffic congestion. Long lines of vehicular congestion lead to excessive emissions resulting in increased temperatures, rainfall, respiratory problems, etc.

6)Congestion: Preventing traffic jams and reducing waiting times are two major aspects of an effective vehicle and traffic administration system.

7)Vehicle Tracking: It helps the local administration authorities to keep a record of vehicles and track them according to their destination, travel time, speed, visiting locations and vehicle type.

### **5.2. Layered Architecture**

1)Traffic Administration Controller (TAC): The aim of the controller is to supervise the entire system.[7] The controller configures and integrates the operation of all application modules and organizations within the system. The controller is the core of the cloud and

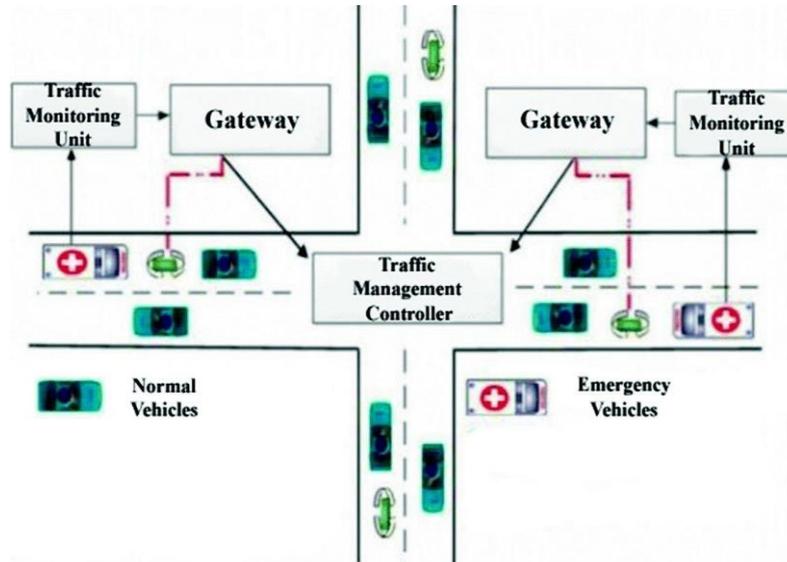
contains precise information regarding each vehicle, road signal, gateway, sensors present on the roads and traffic surveillance module. This information is reserved and processed by the controller to create well-designed routes between the given source and destination. The controller generates interactive connections with all the mentioned systems and regulates all its commands through it. It is the controller that creates predictive data related to traffic congestion levels at different times. The Traffic Administration Controller uses the hop counter-based flood algorithm to broadcast alerts about mishaps, route changes and average waiting time. The alert about emergency vehicles and creation of green corridors is also managed by the Traffic Administration Controller.

2) Gateway: All information that has been accumulated by the sensors on the street is transmitted to the gateway.[6] The gateways serve as a common communication point where different types of information are received from different types of sensors. Gateways use greedy algorithms to collect data from various data sources. The transaction of data from any source to a gateway or vice-versa is carried out using IPv4 addresses [8]. Each gate is provided with a coverage area, where each sensor and vehicle vertex are assigned an IP address thus facilitating effective identification of objects in that area. The gateway also keeps track of its neighbouring gateway and the total number of vehicle nodes moving in its area. Finally, the gateway transmits all kinds of random and unstructured information to the traffic administration controller.

3) Traffic Surveillance Module (TSM): This works as a mediator between On Road Sensors and Gateways. The objective of adding a Traffic Surveillance Module is to increase the efficiency of the system. The Traffic Surveillance Module acts as the central manager of the system and provides a link between Traffic Administration Controller and the rest of the system, thereby increasing the overall performance of the system.[8] Any information from sensors on the road or in a non-vehicle area is addressed to the Traffic Surveillance Module which will notify the regulator and other devices on the network. All information related to vehicular movement and sensors on the road is collected and managed by the Traffic Surveillance Module. It is the Traffic Surveillance Module that regularly updates the traffic controller for details related to every organization involved in the system.

4) On Road Sensors (ORS): The sensors are major components of the system as they recognize and observe the occurrence of events, the environment around it and transmit the detailed information. The function of on-road sensors is to audit and detect events on the road. The On Road Sensors can be categorized on the basis of three parameters namely, type of sensor, methodology and sensory parameters. The type of sensor refers to the type of sensor that is, whether it is a homogenous or heterogenous sensor or it is a single dimensional or multidimensional sensor. The methodology of action refers to the way the sensor collects information [9]. Sensors can be classified on the number of objects it can detect. The sensors used in the system can either detect one or multiple objects and they are placed accordingly on the nodes of the road. Each sensor node is assigned an IP address that assists in its unique identification. Every sensor transmits all its sensor data at the corresponding gateway. The following functionality is provided by Sensors:

- Vehicle Count
- Vehicle Speed
- Vehicle Classification
- Vehicle Identification



**Figure 5. Advanced Traffic Administration System Architecture**

5) Vehicle Vertex Module: This module is developed for a vehicle travelling through the path and it is designed to provide a seamless and easy navigation experience. It can also be seen as a moving sensory node that continuously receives and transmits information while on the go. Each vertex of the vehicle is assigned an IP address that assists in its unique identification. The sensors collect and transmit data to the next gateway. Every transport vehicle in the proposed system would contain a built-in LED indicator that updates the driver regarding the optimal route and changing levels of information such as traffic congestion and accidents based on real time data received from other vehicles. The notifications regarding the same are displayed on the built-in LED indicator.

## 6. Conclusion

The Traffic Administration System is one of the most important advantages of a Smart City. The proposed system is an answer to many of the current problems related to traffic management in smart cities. Advanced Traffic Administration is a system that supports traffic management via a network of sensors, Internet of Things, Cloud Computing and Data analytics. The system provides the advanced route options to the end users. The optimal route turns out to be better and more efficient than the shorter route in most cases in terms of fuel burnt and total travel time. This system succeeds in creating an optimal route and also addresses mishaps and other incidents and then adapts according to the traffic flow in the region. Accident detection, the concept of a green corridor, providing optimal route keeping in track of travel time, fuel consumption and thereby reducing pollution levels are the most prominent features of the Advanced Traffic Administration System.

## 7. Acknowledgment

I wish to sincerely thank my Guide Prof. Mohammad Bilal Shaikh for his guidance and support in carrying out this work.

## 8. References

### 8.1. Journal Article

- [1] Roychowdhury, Priyankar & Das, Sarjo. (2014). “Automatic Road Traffic Management System in a City.” 38- 46.
- [2] Lanke, Ninad & Koul, Sheetal. (2013). “Smart Traffic Management System. International Journal of Computer Applications.” 75. 19-22. 10.5120/13123-0473.
- [3] Yu, M., Zhang, D., Cheng, Y., & Wang, M. (2011, May). “An RFID electronic tag based automatic vehicle identification system for traffic IOT applications.” In Control and Decision Conference (CCDC), 2011 Chinese (pp. 4192- 4197). IEEE
- [4] Zhou, J., Leppanen, T., Harjula, E., Ylianttila, M., Ojala, T., Yu, C., & Yang, L. T. (2013, June). “Cloudthings: A common architecture for integrating the internet of things with cloud computing. In Computer Supported Cooperative Work in Design.” (CSCWD), 2013 IEEE 17th International Conference on (pp. 651-657). IEEE.
- [5] Zhou, H., Liu, B., & Wang, D. (2012). “Design and research of urban intelligent transportation system based on the internet of things. Internet of Things.” 572-580.
- [6] Khanna, A., & Anand, R. (2016, January). “IoT based smart parking system.” In Internet of Things and Applications (IOTA), International Conference on (pp. 266-270). IEEE.
- [7] Kyriazis, D., Varvarigou, T., White, D., Rossi, A., & Cooper, J. (2013, June). “Sustainable smart city IoT applications: Heat and electricity management & Eco-conscious cruise control for public transportation.” In World of Wireless, Mobile and Multimedia Networks (WoWMoM), 2013 IEEE 14th International Symposium and Workshops on a (pp. 1-5). IEEE.
- [8] Khanna, A., & Tomar, R. (2016, October). “IoT based interactive shopping ecosystem.” In Next Generation Computing Technologies (NGCT), 2016 2nd International Conference on (pp. 40-45). IEEE.
- [9] Fore, V., Khanna, A., Tomar, R., & Mishra, A. (2016, November). “Intelligent supply chain management system.” In Advances in Computing and Communication Engineering (ICACCE), 2016 International Conference on (pp. 296-302). IEEE.

### 8.2. Internet Article

- [10] <https://rb.gy/i6gzce>

cience, Somaiya Vidyavihar University, Mumbai, India.