ISSN: 2455-2631 © March 2021 IJSDR | Volume 6, Issue 3

An Investigation of Smart Traffic System Optimization through IoT-based Simulation in MATLAB

[1]**Sakshi Kathuria,**
Scholar Ph.D. Scholar
Department of Computer Science
Sunrise University, Alwar, Rajasthan

[2]**Dr. Sanjay Pachauri**
Professor and Dean R&D
IIMT College of Engineering. Greater Noida

***Abstract*: The advancement of hardware components into the Internet of Things (IoT) has permitted Smart Traffic Management to become more convenient. Traffic stream processing involves linking everything the differing time accessible to traffic flow rate of available vehicles on a highway and intelligent traffic platform allocation of that uses traffic signals in real time. Another traffic management system, called smart traffic control, was created to cope with issues of pollution and to further optimize traffic flow on roads.This study describes a method for the substantial growth of traffic flow as well as well as conventional device alternatives that are capable of meeting traffic needs that works well in major cities, but isn't flexible enough to cope with the new needs. Traffic management techniques proposed using the state-of-the-art methodology are focused on keeping an eye on the overall road infrastructure stability rather than on only individual behavior. Traffic intensity is able to adjust the timing of the signal according to the specific location of the roadside, rendering traffic control feasible, and even by interacting with the local system more accurately than ever before. And in the event of a local computer or server outage, the device is able to function as a little more effectively with a decentralized method. This research has ultimate goal to illustrated the traffic pattern study and simulate it in the time domain to analysis the real time traffic situation.**

***Keywords*: Internet of Things, Smart Traffic Management, traffic flow rate, smart traffic control, Traffic intensity**

I. INTRODUCTION

An emerging development that draws global attention from transportation experts, the automobile sector, and government decision-makers is intelligent transportation networks. Intelligent Transport Systems (ITS) are linked to advanced networking, information and electronic infrastructure innovations(Yang, 2020) to resolve transportation problems such as traffic congestion, protection, transport quality and preservation of the environment and are defined.

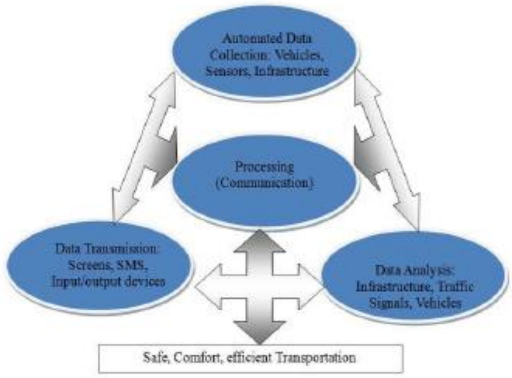

Fig. 1 Architecture / Overview Structure of ITS

The Fig.1 ITS components can be described as above according to the figure it is automated processing of data - With professional hardware and software, these needs detailed and precise strategic preparation. Automatic detection of cars, a car locator focused on GPSChen &Xu (2020), cameras, sensors, etc. This is some of the data processing devices used. Analyses such as traffic count, tracking, transport speed, time, location, pause, etc. may be conducted for this vast volume of data.

Data Transfer: In integrating smart transportation networks, it is a crucial feature of providing quick and real-time details. The details can be conveyed to the passenger via an advertising connected to traffic through SMS, the Telephone, on-board cars, etc.

Data processing: Involves adaptive logic analysis, correction of errors, data cleaning, and snapper of data. To forecast the traffic situation, the processed data was further analyzed. Details in real time, such as drive time, disruptions, traffic collisions, shifts in lanes, workplace, detours, etc. That is the advantage since the data is processed.Smart transportation networks cover virtually all facets of transportation engineering and simplify them with the related points above. There are many intelligent auxiliary transportation networks, and the following are among the most relevant and most used around the world to solve the issue of traffic and transport.

Fig. 1 Subsidiaries of ITS

Advanced Traveler Information System (ATIS): The Advanced Traveler Information System(ATIS) includes a broad variety of technology, such as the Internet, telephones, mobile phones, Cable, radio, etc. To support passengers and drivers in making educated choices regarding flightdepartures, best routes and availability.

1.1 Methods of Transport

Advanced Traffic Management System (ATMS): It is used as a mechanism for traffic management and regulation by the Traffic Police Force and Traffic Regulatory Authority by tracking traffic movement and making necessary decisions at the right moment. By leveraging real-time information to interfere and change signals, such as road signs, to enhance traffic flow, traffic management systems maximize vehicle travelde Souza (2017).

Advanced Public Transit System (APTS): seeks to increase the operating performance of all forms of public transport and to improve the state of the transport system by rendering it more efficient. The way public transportation systems act and the nature of transport facilities that public transportation systems can offer are evolving with the aid of APTS.

Emergency Response System (EMS): The Intelligent Transportation System is the newest field of study (Chen, , 2009). In order to build a transport infrastructure that can offer assistance in emergency circumstances, EMS is primarily concerned with the implementation of different intelligent transport system technology.

1.2 Intelligent Transport System Architectures

The notion of Intelligent Transportation Systems (ITS) began in late 1970s before the development of digital technology and the availability of networks to interchange data produced or absorbed by these devices. ITS is a broad variety of private and commercial transport systems defined by an improved and safer range of technology, systems and services for transportation. Based on a comprehensive literature review for existing ITS methods, this part presents a debate; compare them and deal with the disparity between these structures and their practical implementation (Min 2011).

A new area of smart technology integration has been created by ITS systems, resulting in several new possibilities for developing a secure, efficient and flexible transport infrastructure. ITS is a complicated structure composed of a collection of several planning areas connected to related attendant human resources. Any of the major categories for ITS introduction are:

- Department of Public Transport
- Individual and industrial car fleet control schemes
- Integration of Intelligent Technology
- Electronic systems of payment
- Creation of intelligent cars
- Department of Defense

The ITS framework comprises of different components of software and hardware and the relationship between them. The interfaces between components of these ITS systems need to be established such that interactions between them can be standardized. A structure that is used to prepare, identify, execute and incorporate IT structures is given by the coordination and interaction between the different components of ITS. Usually, this architecture describes functional entities: workflows to connect these entities and resources that are delivered to the consumer by ITS systems and applications. Usage resources include: travel details, control of different traffic situations, data collection to optimize efficiency, driving change, driving behavior analysis, crash response management, and automobile fleet management in public and private settings. If we take the example of the bus system, these customer systems are introduced with the help of many companies.Such as riders, taxis, garages, bus maintenance operators, transport firms, and the numerous devices and applications with which the system communicates (Luca & Tarik, 2011).

1.3 Advantages of ITS System Architecture

The preceding section describes how the frame design may assist to improve the integration of desirable characteristics into a complex and changing framework like ITS. The ITS framework may provide numerous more advantages. The following benefits are provided by ITS Architectures:

- Provide a foundation for the development of the vision for smart national and regional frameworks transport systems.
- Provide advice on the design of new components or the expansion of existing components and formal interface standards.
- Create a framework that satisfies compatible, expandable and interoperable system criteria that facilitate future growth and expansion.

1.4 Data Challenges in an Intelligent Transport System

The processing of data relies on how fast information is accessible from storage, but also on the technology or method utilized for data processing. Data from intelligent transport systems originate from many different sensors and before using a formal analytical technology(Javed, 2019), numerous problems must be overcome. Some of the following difficulties are listed:

- For inaccurate items in the dataset, the data must be cleansed in order for these inaccurate entries not to affect the outcome.
- Data from diverse sources should be merged so that the influence of various aspects may be analyzed in order to examine the link between various aspects within the same or between separate data sources.
- A number of value sets in a complicated system such as the ITS may be exponential, since there are millions of mishaps, such as bus arrival occurrences.
- The amount and frequency of data on hundreds of roads from thousands of cars, which results in hundreds of thousands of arrival, departure and location events, making it more difficult to cope with the first three criteria.
- Processing this data in real time as soon as it is ready for analysis.
- Real-time presentation of predictive analytical findings, so that predictive analysis may be employed efficiently.

II. REVIEW OF LITERATURE

Mausam *(*2018) proposed a technique that uses inlarge population development country, it has become a big challenge to track and manage traffic congestion. The rise in the number of cars contributes to several issues, such as unnecessary time, wasted gasoline, contamination of Sound and air and even death from jamming in an emergency vehicle. Real time traffic management (TMS) system using the Internet of Things (IoT)(Louis Coetzee, Johan Eksteen, Hua-Dong Ma, 2011) and data analytics is introduced in this paper.

Ghazal (2016) They suggest a device based on a PIC that uses infrared sensors to measure traffic intensity and gain complex time slots at various stages. A handheld controller is often meant to address the question of rescue vehicles stranded on busy highways. The problem of traffic lights is obviously a critical issue for people and governments to be worried with. The economic, welfare, financial and environmental areas are impacted by the effects of a conventional, low-efficiency traffic system. Advances in control units, home appliances and sensors technology and miniaturization have provided the power to create intelligent and intelligent lightweight structures to solve human challenges and promote lifestyle.

Baldassarre (2018) Within this paper, they provided our personal insight by exposing students to the usage of cloud-based systems within a project-based software quality training course undertaken with fourth-year undergraduates at the University of Alberta to build and organize teamwork.

Balid (2016) This article provides information on designing innovative, cost-effective and intelligent real-time traffic monitoring systems using wireless smart sensor networks. Computationally reliable and efficient algorithms have been developed for vehicle calculation and velocity estimation.

Dash (2018) In reality, their objective is to create a new technology or methodology that will solve the problems described above and bring improved outcomes within the defined time period. A modern methodology called radio frequency identification (RFID) has emerged to solve the problems. The proposed model intelligently incorporates transportation scheduling resources and strategies for the future to categories action packages that will help achieve targets such as preventing road fatalities, lowering pollution, enhancing mobility and growing economies around the globe.

Omar & Sakran (2015) The paper proposes an architecture that combines IoT with proxy technology into a single framework where efficient communications and interfaces between a large number of heterogeneous, highly distributed, and decentralized IoT devices are handled by proxy technology. The architecture advances the usage of active radio frequency identification (RFID), wireless sensor technology, networks for custom objects, and Internet-based information structures for representing, monitoring, and querying separate traffic objects. Over the network immediately. For an IoT traffic management framework utilizing mobile proxy technologies, this paper offers a summary of the distributed traffic simulation paradigm inside NetLogo, a proxy-based environment. In order to address the issue of real-time automobile tracking and regulation, this paper includes a collection of real-time traffic details and monitoring device design.

Masoud (2019) It can be learned from this study that the suggested system offers a very powerful and convenient way to cope with the parking movement that people face every day in their lives, as well as saving time and money. In addition, to be more accurate in the future, the functionality should be enhanced, the option of reserving a parking spot via a smartphone application and other features can be quickly applied to the framework.

III. METHODOLOGY

3.1 Traffic Detection

The overarching aim of this study is to establish a robust traffic control scheme in a metropolitan environment(Tizghadam & Leon-Garcia, 2008). By combining two separate components, namely the traffic detection and routing framework, this system was created. In Figure3 a standard workflow is shown.

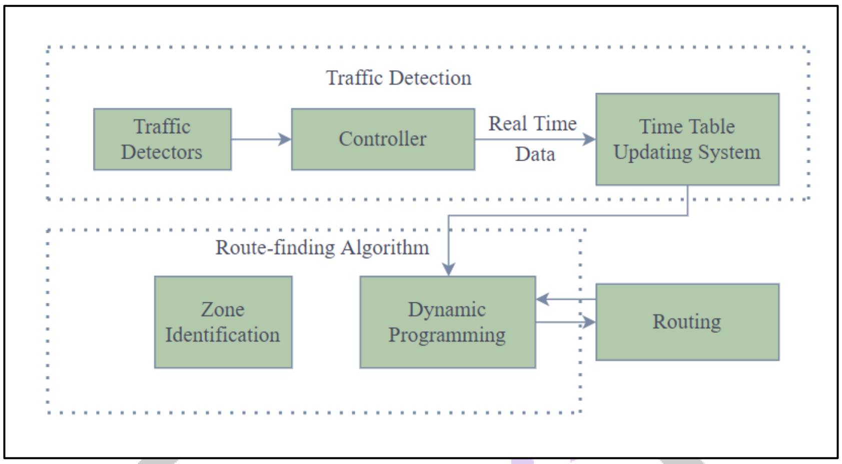

Fig. 3 Standard Workflow of Identification and Direction Scheme

Dynamic data showing the condition of traffic flow is used to guide traffic inside a city to be reached by detectors placed on all potential roads within the street network. Different types of traffic detectors operate, advocates for this idea say including will not increase traffic (Mimbela et al, 2000)

Device for inductive loop detection:
Inductive component is the loop wire. a little dripof ring inductance happens as a vehicle crosses over the ring. The detector senses an inductance shift and triggers the electronic device to transmit a pulse, signaling the vehicle's existence or passage, to the control unit.

Video image recognition system:
The linearity feature enables the customer to choose a limited range of linearity road detecting areas within the video camera's field of view. As a car enters one of these zones, it is calculated by observing, in the absence of an object, shifts depending on the status of the pixels the speed of the vehicle is then derived from the calculation.Calculates the time taken for a given vehicle to cross the known duration detection field.

Microwave radar traffic monitoring system:
transmits energy to the road field and, as the vehicle crosses the road, some of the energy that is transferred is reflected back to the receiver. Measuring the volume, distance, duration and occupancy of the vehicle is covered in this system.

GPS dependent vehicle monitoring system:
To regularly obtain positioning data from the vehicle, a GPS data logger may be used. There are typically three sections of a GPS data logger, Such things as GPS receivers, data storage medium, and power supply systems.

Acoustic Traffic Detection System:
Tests the traffic, presence and velocity of automobiles by detecting acoustic energy or acoustic noises originating from vehicle traffic from a range of sources inside each vehicle and from vehicle tire contact with the lane.

Infrared Traffic Monitoring System:
Sense's variations in temperature due to vehicles' existence.

Magnetic Traffic Detection System:
magnetic sensors are passive sensors, as they have no active elementsexistence of a metallic material, detect changes in the magnetic field.To measure the time each vehicle requires to cover a given path, both of the above detection systems will include the size of vehicles and the speed of each vehicle are also factors in how many cars. Ring reagents are now the prevalent reagents in usage at present, since they come at a base price, whereas alternate reagents are not owing to the poor history of these reagents

(Lees, 2008). The inductance loop detectors are therefore believed to be located in each street segment in this research analysis. The following parts comprise the loop detector seen in Fig. 4:

- ✓ One or two independent loop wire rotations wrapped in the dock through a shallow threaded hole.
- ✓ An input cable to the control cabinet from the curbside throwing box.
- ✓ Electronic device of detection (DEU) in the control unit.

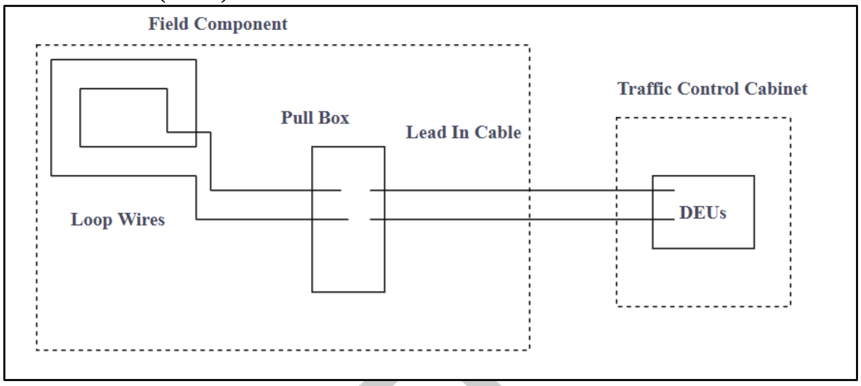

Fig. 4 The Components of a Loop Detector

For each 20-second time period, the inductance loop detector can calculate two significant parameters, namely:

- Occupation; Vehicle time ratio for beginning the cycle (sec.)
- Number of vehicles (vehicles / 20 seconds / ln) approaching (I) or exiting (E) portion of the street

3.2 Numerical Methods of Optimization for Implementation of Node Selection

There is a numerical value of x that raises or reduces the function f (x) (Gordon, 1998). Some optimization strategies often used include:

a. **This linear programming:**A case study where the objective function f is linear and where linear equality and inequalities are used to evaluate category A (A is the field of the design variable).
b. **Proper programming:** Research linear systems in which any or more of the variables are confined to integer values.
c. **Quadratic programming:**Can only be used if the goal function has quadratic terms. Linear equality and inequalities should be defined for group A.
d. **Nonlinear programming:**A general case study of which nonlinear sections form the objective function, constraints, or both.
e. **Stochastic programming:**A case study in which random variables rely on certain constraints.
f. **Mutual optimization:**Deals with difficulties when there is no agreement on the range of possible solutions.
g. **Dynamic programming:**The use of an optimization strategy in which sub-problems overlap but do not include one another. In this study, dynamic programming was employed to calculate the shortest route issue.

IV. SIMULATION AND OUTCOMES

The setup has been implanted in MATLAB. The front GUI has been created with MATLAB GUIDE. The Smart Traffic System Optimization through IoT gathered data has been constructed (Lecue, 2011). It will be used to locate cars that may be carrying contraband or in a wreck as a result of high-speed driving. The genetic algorithm was developed to collect data from all locations around the intersection and is currently used to analyses one position and therefore designs in several directions.Below the figure which has been take through screen sort of running simulation of traffic light having three plan 1, plan 2 and plan 3. This simulation also provides the spending time for specific traffic test with two situations as statics and dynamics.

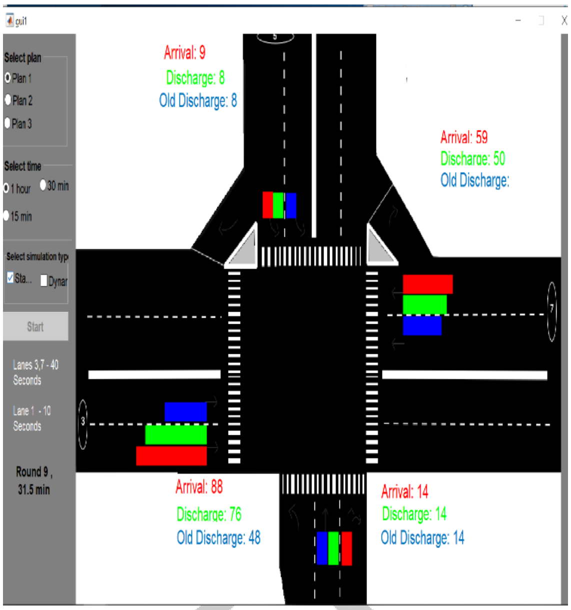

Fig. 5 Plan 1 -1 Hour - Simulation Static

As the above figure come out after the simulation execution as arrival, discharge and old discharge has been planned 1 in selected time 1 hours. As the above figure has static option on in GUI. There are four sections as one (top left) has 9-arrival, 8-discharge and 8-old discharge, second (top right) has 59-arrival, 50-discharge and 0-old discharge, third has 88-arrival, 76-discharge and 48-old discharge and the last one has 14-arrival, 14-discharge and 14-old discharge.

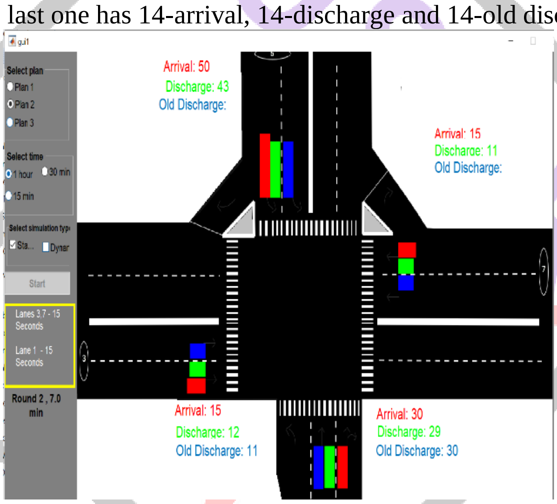

Fig. 6 Plan 2- 1 Hour- Simulation Static

V. CONCLUSION AND FUTURE SCOPE

In order to use multi functionality of components in IoT, the intelligent traffic management system was created. Traffic optimization is accomplished by IoT framework to efficiently use all traffic signal times according to the number of vehicles present on the path. Smart Traffic Management System is designed to address congestion issues effectively and redirect at crossings on a route.This study provides an effective remedy for the exponential growth in traffic flow of big cities in particular, which increases day by day, whereas conventional systems are not efficiently managed. Considering the cutting-edge solution. The best solution for traffic control systems would be a smart traffic management framework. Efficient and more reliable tracking of road traffic circumstances. This intelligently adjusts the signal timing on the individual roadside due to the traffic level and controls traffic movement by coordinating more efficiently than ever with local servers. The centralized solution improves and operates when the framework functions even though a local node or central server fails.This research is working toward one goal: Showing how traffic patterns may be modelled and simulated, which might then be used to get better insight into the current traffic conditions. This paper shows at the Nodes Selection Algorithm, which has been mathematically laid out in this paper and the formulation has been encapsulated in MATLAB to create the GUI.

Reference

Balid, W., Tafish, H., Refai, H. (2016). Versatile Real-Time Traffic Monitoring System Using Wireless Smart Sensors Networks. *IEEE Wireless Communications and Networking Conference (WCNC 2016).*

Dash, A., Dash, P. & Mishra, B.K. (2018). An Innovation Model for Smart Traffic Management System Using Internet of Things (IoT). *Cognitive Computing for Big Data Systems Over IoT, Lecture Notes on Data Engineering and Communications Technologies.* 355-370.

Ghazal, B., EIKhatib, K., Chahine, K. & Kherfan, M. (2016). Smart Traffic Light Control System.140-145.

Ghazal, B., ElKhatib , K., Chahine, K. & Kherfan, M. (2016). Smart Traffic Light Control System. 161-166.

Hasan Omar Al-Sakran, “Intelligent Traffic Information System Based on Integration of Internet of Things and Agent Technology” (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 6, No. 2, 2015.

Masoud, A.R., Kazmi, S.I.A., Pandey, J. & Hinai, S.A. (2019). IoT based Smart Parking and Traffic Management System for Middle East College.

Mausam, A.K.M., chy, K.A., Rahman, I., Uddin, M.N. & Azam, K.I. (2018). An Internet of Things (IoT) based Smart Traffic Management System: A Context of Bangladesh. *Innovations in Science, Engineering and Technology (ICISET).* 418-422.

Muhannad Al-Jabi, Nablus, “Toward an IoT-Enabled Adaptive Interactive Bus Transportation system”, IT-DREPS Conference, Amman, Jordan Dec 6-8, 2017

Namje Park, and Hyo-Chan Bang, “Mobile middleware platform for secure vessel traffic System in IoT service environment”, Security Comm. Networks. 2016 Security and Communication Networks.

Nidhi D. Agrawal, Amit Sahu, “Intelligent Real Time Traffic Controller Using Image Processing – A Survey”, International Journal of Science and Research (IJSR), Volume 4 Issue 4, April 2015.

Omar Abdulkader, Alwi M. Bamhdi, Vijey Thayananthan , Kamal Jambi , Muasaad Alrasheedi

Omar, H. & Sakran, A. (2015). Intelligent Traffic Information System Based on Integration of Internet of Things and Agent Technology. *(IJACSA) International Journal of Advanced Computer Science and Applications. (6), (2).*

Wortmann, F. & Fluchter, k. (2015). Internet of Things Technology and Value Added. 222-224.

Wu, Y., Wu, Y., Guerrero, J. M., Vasquez, J. C., Palacios-Garcia, E. J., & Li, J. (2020). Convergence and Interoperability for the Energy Internet: From Ubiquitous Connection to Distributed Automation. *IEEE Industrial Electronics Magazine*, *14*(4), 91-105.

Xiao, L. & Wang, Z. (2011). Internet of Things: a New Application for Intelligent Traffic Monitoring System. *Journal Of Networks.* (6), (6), 887-894.

Yang, C., Zha, M., Wang, W., Liu, K., & Xiang, C. (2020). Efficient energy management strategy for hybrid electric vehicles/plug-in hybrid electric vehicles: review and recent advances under intelligent transportation system. *IET Intelligent Transport Systems*, *14*(7), 702-711.