Traffic Management for Smart Cities using Traffic Density and Swarm Algorithm to Inform Diversion Route

Mary N Peter, M. Pushpa Rani

Abstract: Number of vehicles increasing day by day in the world which results in traffic, air pollution, delay in reaching designation. Traffic density is increased in the roads, especially in the signals. The traffic congestion has negatively affected the efficiency, aggressiveness, and financial development of a nation. Thus, congestion control of traffic has become a significant zone of research, and a substantial number of answers for this issue left different research endeavors in the said field in recent decades. The traffic volume changing after some time, and in this way, long traffic lines are produced at the street intersections. Consequently, the Intelligent Transport System answers these related issues. It has incredible possible and ability to make transportation systems safe and smart efficiently. ITS provides the accessing and driving services of effortlessly participating transportation systems in a smart city. Traffic congestion can be managed in a proper manner by using time estimation and other route diversion in a pre-informed way. For this, we have to calculate the values of traffic congestion density and find the neighboring route. Density algorithm and distance measure algorithm were used to find the traffic density, and the Swarm algorithm was used to find the nearby path.

Keywords: IoT, Traffic analysis, Congestion control, Density Algorithm, and Swarm Intelligence

I. INTRODUCTION

The transportation system is essential in everyone's life. Traffic congestion is a significant issue in our daily life. There are many explanations behind the sudden flow in the traffic, in numerous regions. The reason behind this is the increase of the population, and it turns into the rise in the number of vehicle usages by the user. And also, they are many other reasons for the traffic congestion that is inadequate infrastructure, ineffective management of capacity (i.e., poor traffic timing), work zone, special events, emergencies, unconstraint demands, etc. [1]. Hence the transportation structure in the urban regions was, for the most part, soaked because of the nonattendance of land assets and increment in the number of vehicles in the street.

As of this limit, many traffic-related issues have been detonated in the urban zones where individuals need to travel extremely fast, starting with one zone or spot then onto the next. One of the significant issues with the open transportation system in progressing time is traffic congestion. The traffic congestion expands fuel utilization as well as the danger of cardiovascular failures. Additionally, the traffic congestion defer severely influences human exercises and hence, hinders the profitability, intensity, and by and significant development of a nation. A very notable procedure to solve the congestion issue is including a new foundation by developing new streets just as improving the current framework by spreading the roads. In the previous hardly any years, advancement in wireless correspondence innovations and the improvement of vehicular system measures tiled the route for the usage of ITS (Intelligent Transportation Systems) [2]. The idea of ITS has been acknowledged by society and has been applied widely. Simultaneously, the issues of intelligent transportation are rising, and the Internet of Things (IoT) gives another heading to its advancement. The smart traffic study is one approach to take care of the issue of city traffic. In this way, ITS is defined as the arrangement of utilizations that are advance and plan to apply intelligent data and correspondence progresses to offer organizations to transport and traffic the board. ITS has an immediate effect in diminishing various issues like air sullying, long travel time, fuel use, traffic congestion, and accidents, which have been extended due to improvement in people. Building up an intelligent traffic system reliant on IoT has different benefits such as improvement of traffic conditions, decline traffic jams, and the board costs, steady high quality, traffic security, and self-rule of atmospheric conditions.

Retrieval Number: C5929029320/2020©BEIESP
DOI: 10.35940/ijeat.C5929.029320
Journal Website: www.ijeat.org

3166

Published By:
Blue Eyes Intelligence Engineering
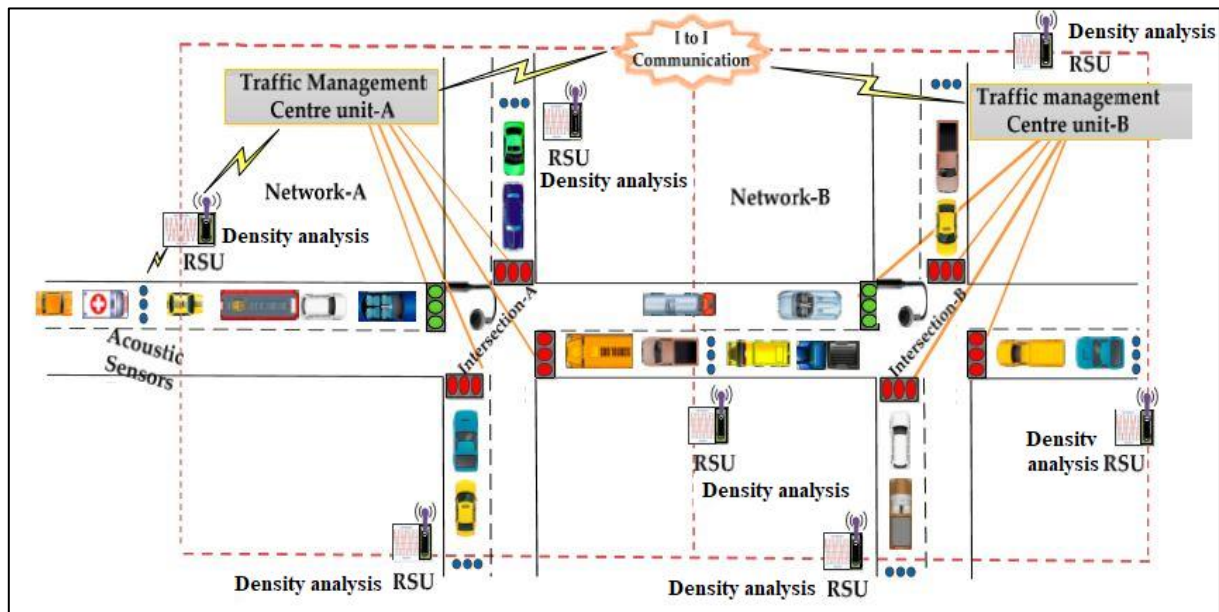*& Sciences Publication*

Fig 1: Traffic Management System using Density Analysis

Traffic monitoring and controlling it challenge on numerous urban communities of our nation. Most metro urban communities on the planet are as yet experiencing traffic congestion and related issues [3]. It makes various issues, for example, the voyaging time delay between two significant urban areas, Fuel wastage at the crossing point, air contamination because of emanation, demise on streets due to mishaps, and many transport-related issues. An ITS application must recognize, control, and lessen Congestion dependent on online data that depicts traffic examples, for example, density, speed, travel time, the geographic situation of vehicles, and the present time. To achieve this objective, in any case, the first test is how to gauge congestion and re-course vehicles suitably by considering the time sway on future traffic in a region of intrigue. Deficient limit or density and excessive interest are interconnected; however, signal postponements are hardcoded and don't rely upon the measure of traffic density. Like this, there is a need to improve the traffic control system and make it increasingly powerful to suit the fluctuating traffic density [4, 5]. The street intersections in the more significant part of the nation's still used traffic signaling systems stacked with statically count fixed action time, which can't manage the traffic volume fluctuating after some time. Therefore long traffic lines are made at the road convergences [6]. We, subsequently, propose in this paper an IoT based intelligent traffic congestion control system to address the recently referenced issue. Our proposed traffic congestion control system, at first, tries to measure the density of traffic congestion and give a backup course of action redirection in pre educated way. So, the client can deal with the class without traffic. This paper organizes as follows. In section 1 provides the introduction about our concept, Section 2 holds a literature review section, it shows various authors approaches, in Section 3 discussed about problem statement from existing work, in Section 4 provided about our proposed approach, in Section 5 recommended work experimental result and finally, Section 6 contains the conclusion about this paper.

II. LITERATURE REVIEW

N. B. Soni; Jaideep Saraswat [7] dissect the traffic congestion has expanded dangerously fast, particularly in metropolitan urban communities. Traffic congestion prompts increment in clamor contamination, voyaging time, contamination, and fuel wastage, and so forth. There are present moment and long-term reasons for traffic congestion. Transient causes incorporate traffic signal disappointments, inefficient law requirements, insufficient road foundation, mishaps, and so forth. Long term causes are credited to the financial development of the general public, changes in the way of life of individuals, and so on. Thus, traffic the board has gotten one of the indispensable zones to be investigated. It incorporates observing traffic density, correspondence, rerouting of traffic to stay away from the further postponement. Web of things can help in smooth execution of traffic the board system. There are various strategies for traffic the executives - video examination, wireless sensor arranges, versatile traffic control systems that intently weave around IoT devices.

Varsha Sahadev Nagmode et al. [8] Find traffic congestion is a significant issue in our nation, which influences present-day city's day by day life routine and upset environments. Because of the increment populace, the size of urban communities extends, consequently several vehicles increments in the significant scale on roads. There are numerous issues, for example, travel time delay, fuel wastage, air contamination, and make issues identified with transport. So, traffic checking and controlling is the most significant test on traffic the executive's specialists. We plan and create a system for constant traffic, observing utilizing the Internet of Things (IoT) stage, and detecting innovation. In this system, Ultrasonic sensors are used to recognize vehicle traffic levels at the paths; this data is gotten at the controller and transmitted to the web server through a Wi-Fi module. The checked information is put away and broke down in the server. Here traffic is constrained by traffic signal control strategy, which relies upon recognizing traffic levels at the paths.

If any path gives a high traffic level, at that point, it gives the most noteworthy need to passing vehicles. RF handsets used to impart the principle system to need a system that gets and transmits the traffic-related message. This system is given at the convergence of paths, which is solid, basic, and minimal effort. Omid Avatefipour et al. [9] address this traffic issue, various examinations have been directed that have brought about some prominent enhancements; for example, assigned paths for crisis vehicles in urban zones. Notwithstanding, even with these paths, regularly, the perfect objective times for crisis vehicles to arrive at their goals is difficult to accomplish. Another strategy that tries to address this issue is called the Intelligent Transportation System (ITS). This technique can help take care of the issue by incorporating existing innovation with the present foundation. In this paper, we will probably analyze various techniques for overseeing traffics, to be specific TLS Static and Dynamic TLS, RFID, and the Internet of Things (IoT). In the last strategy, traffic data are immediately gained and sent to Big Data for preparing and versatile applications AKA User Interface (UI) to gauge traffic density in different zones to propose elective approaches to lighten traffic

Pampa Sadhukhan et al. [10] Find Traffic congestion is one of the significant issues with the open transportation system in late time. Among these, vehicle-to-vehicle (V2V) correspondence-based strategies can't exactly assess the density of traffic congestion. Of course, the traffic signaling systems having fated fixed movement time can't manage the traffic volume changing after some time, and as needs are, long traffic lines are made at the street crossing points. To address the recently referenced issue, this paper proposes a trap of-things (IoT) based intelligent traffic congestion control system that effectively sets the signal action time subject to the intentional estimations of traffic congestion density. Likewise, a novel strategy for assessing the density of traffic congestion made at the street convergences is also shown in this paper. Satbir Singh, Baldev Singh et al. [11] For a keen city, the executives, efficient treatment of road traffic is one of the key perspectives. Traffic congestion can be overseen adequately if the quantities of vehicles that are to go through a jam-packed intersection can be pre-evaluated in time. The proposed technique exhibits a structure, which has the capacity to pass on the vehicle constantly include and produce a caution if there should be an occurrence of enormous vehicle social affair to the controlling station in the Chandigarh or the same urban Indian urban areas. The number of vehicles going through an area a long time before the necessary traffic intersection can be assessed utilizing the assistance of picture handling methods. Further, the checking subtleties can be shared with a removed controlling focus arranged anyplace in the city through web utilization. The performed examinations show the adequacy of this Internet of Things (IoT) based innovation. Fenghua Zhu et al. [12] present dreams and wears down organizing the artificial intelligent transportation systems and the real intelligent transportation systems to make and improve "information" of IoT-enabled ITS. With the extending ubiquitous and significant identifying breaking point of IoT-enabled ITS, we can quickly make artificial transportation systems similar to physical transportation systems in PCs, and like this have parallel intelligent transportation systems, for instance, the real intelligent transportation systems and artificial intelligent transportation systems. The improvement strategy of the transportation system is thought about in the viewpoint of the parallel world. We can use incalculable long-term iterative amusement to envision and separate the typical eventual outcomes of exercises. Like this, truly convincing, and shrewd ITS can be orchestrated, organized, created, worked, and used. The foundation of the parallel intelligent transportation systems relies upon the ACP speculation, which is made out of artificial social requests, computational tests, and parallel execution. We furthermore present some logical investigations to show the reasonability of parallel transportation systems.

III. PROBLEM STATEMENT

With an expanding number of vehicles out and about, traffic congestion and transportation postponements are expanding worldwide. ITS is identified with cutting edge communication, data, and hardware novelty to care for transport issues, for example, traffic congestion, security, transport efficiency, and environmental protection. In many existing works, they center around the ITS, however, bombed by and large given increment of traffic and vehicle density increments. It is utilized by traffic police office and traffic guideline specialists as an instrument to oversee and control traffic by monitoring the flow of traffic and settling on proper choices in a timely way. For the most part, the issue of vehicle tallying is done utilizing conveying inductive circles. These circles give high precision yet are extremely upsetting at the roadway, that is the reason it accompanies high upkeep cost. There is a significant issue with blended vehicles (for example, autos, bike, substantial vehicle, and so forth) traffic flow that must be handled. To improve security and efficiency, many research gatherings concentrate on developing advancements as a doable choice to tackle the traffic issue. Therefore, the issues of traffic congestion and traffic jams have expanded manifolds.

IV. PROPOSED WORK

A wireless sensor network is a promising advancement that offers a response for the arrangement and improvement of a conventional course of action of traffic control system applications. The sensor system contains a sensor and entry center points. The commitment of the senior center is to screen traffic in an assigned region, utilizing different devices that can measure a couple of physical traffic parameters like the stream, density, volume, progress, holding uptime, throughput, similarly as pollution. The entryway center assembles the traffic data from all of the center points and aides the equal to the base station. Traffic congestion is a devouring issue in various urban territories due to an exponential improvement of running vehicles. There are fundamentally two kinds of traffic congestion. The first one is repeating traffic congestion, which shows up at a similar spot during a similar time each day. The subsequent one is non-repeating traffic congestion, which happens arbitrarily like a spontaneous occasion. This non-repeating impact can cause an abrupt traffic volume increment. Recognition of non-repeating traffic congestion is contrasted with the repetitive kind since it requires continuous traffic data and assessment thereof with fitting traffic the executive's choices.

A WSN based Traffic Management System comprises of 4 portrays data gathering, data conveyance, data handling, and actualize the procedure. In the first model of data assembling here, the TMC (Traffic Management Center) accumulates the data, investigates the traffic limits, and later sends it to the traffic signal switch module of the TMC. From the second model sends the data to the controller system for further procedure, in the third model, it assesses the data and takes intelligent choices. The last model it gives a specific activity dependent on the checked data and examines further procedure.

a. Congestion analysis

Road congestion is one of the significant problems with the open transport system in late time. The traffic congestion negatively affects the efficiency, aggressiveness, and financial development of a nation. Subsequently, traffic congestion control has developed a significant zone of research, and an important number of answers for this issue left different research endeavors in the said field in recent decades. Congestion is principally due to the deficient limit of the roads to efficiently move the number of voyaging vehicles on them. This outcome in expanded Congestion along the streets, which likewise brings about significant air contamination, an expanded danger and negatively affects the peoples. Intelligent traffic control systems are a significant element of savvy urban areas and are utilized to both control the flow of traffic to lessen traffic congestion. Individuals need to get any place they need in a timely way; crisis groups need to arrive at their goal desperately. Congestion recognition to give client continuous feed about traffic. Between these, vehicle-to-vehicle (V2V) correspondence-based methodologies can't precisely assess the thickness of traffic congestion. Then again, the traffic signalling systems consuming pre-calculation fixed activity time can't deal with the traffic volume varying after some time and subsequently, extended traffic lines are produced at the street intersections. To address this issue here this paper utilized the Time Analysis based Radio Frequency Identification (TARFID) is utilized. To enact the Congestion, help process, first, we need to determine the wellsprings of the vehicle holding up time from the first vehicle appearance to the last vehicle landing in a similar street to find the congestion flow effectively.

Algorithm: Time Analysis based on Congestion

Input: VT- VehArivalTime, QL- QueueLength : TA TimeAnalysis TD-TrafficDelay

Output: CC- CongestionCount

Step 1: VT ← initializeAllActions()
Step 2: QL ← Count VT++()
Step 3: TA ← initializeTimeActions()
Step 4: for all VT ∈ QL do
Step 5: QL(VT++) ← compuateQueuelength(VT , QL)
Step 6: if QL(VT, TA) ≥ 500 vehicle
Step 7: TA(Delay) find a Neighbor route using Swarm algo
Step 8: end if
Step 9: end for
Step 10: if TA= [] then
Step 11: VT ← No Delay (TA, TD)
Step 12 end if

From this algorithm, the greatest holding up time will be calculated from the first vehicle, which is remained in the street from the beginning position and will find the traffic flow from the last vehicle, so effectively we can ascertain the traffic congestion.

b. Traffic Density Analysis

Traffic density monitoring examination is to gauge the length of traffic line made before signal traverse indicate all together control the density of road congestion (i.e., low, medium, high and so on) what's more, it endeavors to powerfully modify the activity time of traffic signals dependent on the assessed thickness of traffic congestion on various streets associating with the intersections segment to check the Congestion appropriately. It utilizes an ultrasonic sensor to quantify the length of the vehicle line. Traffic Density Analysis (TDA) covers a microcontroller for handling the data gathered from the device hub and a Wi-Fi component for sending data to traffic the board system either straightforwardly on the off chance that it is within the correspondence scope of system or using some other TDA.

The sensor hub occasionally radiates the sound breakers in the scope of $25 - 50$ kHz. It is utilized to distinguish the nearness or nonattendance of close by upended vehicle by estimating the good ways from the distinction of convey time and gathering time of its transmitted signal. In this way, the nearness of the vehicle line is distinguished by TDA if the following ailment is satisfied.

Calculated distance (Cd) < Location distance (Ld), where reference separation is equivalents to the width of the street, and estimated separation is assessed as pursues.

$Cd = S \times (tr - ts)$,

where S is the speed of sound waves and, tr and ts shows the gathering time and transmit time of the discharged signal of sensor individually. TDA is set at certain tallness over the ground with the goal that the sensor can get the immediate impression of its discharged signal on the off chance that the vehicle line has come to or surpassed its position.

c. Provide a neighboring route using Swarm algorithm

Ordinary traffic congestion greater issues are a regular schedule. An Intelligent Traffic Management Framework has been proposed in this segment. We need of IoT to use in the traffic signal monitoring systems and to control it in an advanced controlling system. Any system is planned to act insightfully with higher control features for all of the four side way traffic systems. Every road towards considerable traffics of vehicles in higher checks. We need to define the need level of traffic in our TMS on the reason on which least or most critical need. Traffic the official's system-TMS key mechanical assemblies to direction over traffic as per people of vehicles ID that specific district. Along these lines, each roadway needs an IR sensor to screen and catch data of vehicles incorporate into that way and give a reinforcement approach to go to the customer. In this proposed system depends upon the count of vehicles from the roadway IR sensor data. Swarm Technology is fundamentally a system which chips away at constant conditions, and the individuals in the gathering collaborate in a decentralized way to accomplish a specific goal by means of self - association.

Common models are insect settlements, tutoring of fishes, and so on. Swarm knowledge is a field of artificial insight.

Algorithm: Finding Alternate route

Input: vehicle's count
Output: reduce traffic
Step 1: Find ArivalVeh from the start of vehicle 1
Step 2: If the vehicle has stayed on the road <=5 mins
Step 3: Inform Less traffic and Allow the vehicle on the same road
Step 4: Else IF (ArivalVeh >=30min) cuntVehicle = cuntVehicle +1
Step 5: Traffic Density= cuntVehicle
Step 6: Send message as heavy traffic find a neighbor route using swarm algorithm
Step 7: Initialization of Swarm (Ant colony)
Step 8: Finding a neighbor router
Step 9: Determine Search direction
Step 10: Generate the Route for an alternate way to reach the destination
Step 11: Determine the new route value
Step 12: Determine the new route (Best route without traffic
Step 13: Suggest the new route for upcoming vehicle
Step 14: End IF
Step 15: End IF

The main aim is to execute a system that would follow the movement time of individual autos as they pass the roadside controllers and process a normal outing time utilizing a standards-based system to choose whether the territory is blocked or uncongested. If Congestion is detected, at that point system would control traffic signals/produce programmed re-directing messages to chosen moving toward vehicles.

V. EXPERIMENTAL RESULT

In the experiments, a simulation model was built in NS2 Simulator. Here implement the varying time traffic simulation models, including models of traffic networks, road infrastructures, and density of the traffic flow. Traffic request is given by an inception goal framework where a worth speaks to the hourly traffic request. Traffic conditions may contrast in various kinds of streets. In numerous nations, the base speed of a high way is 60km/h, so we parcel street fragments into two kinds - low-speed streets (constrained speed < 60km/h) and v fast streets.
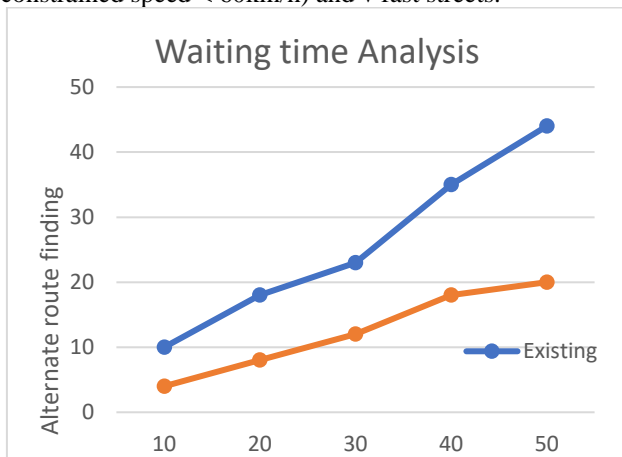

Chart 1: Comparison of waiting time analysis

Travel delay is explained as the variance between the real travel time and extended travel time for finishing a journey.

Travel Time (TTI) is shown as the proportion between travel time (T) through peak hour and the free-hour travel time (FT). Since FT = distance / partial speed; T = distance / travel speed. So TTI can be expressed by travel speed and limited speed as:

$$TTI = \frac{\text{limited speed}}{\text{travel speed}}$$

TTI is a standard principle to specify road congestion. When the directory value is difficult, the traffic congestion is inferior.
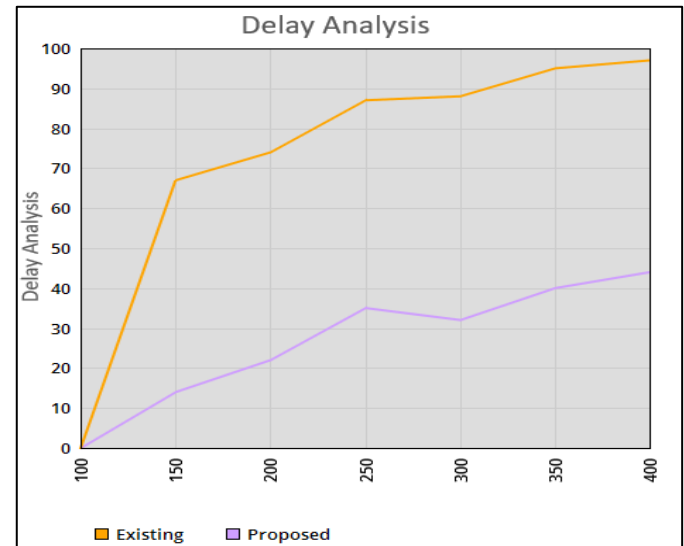

Chart 2: Delay Analysis

The above chart shows the Maximum Waiting Time for a vehicle in every path until their separate reproduction steps, i.e., until that particular path's traffic.

Inputs for several vehicles (Num_Vehicles) were taken, and the comparing times for which the traffic Time was determined. The greatest holding up time (Max_Time) for the first vehicle to stop after the light turns red was additionally registered.
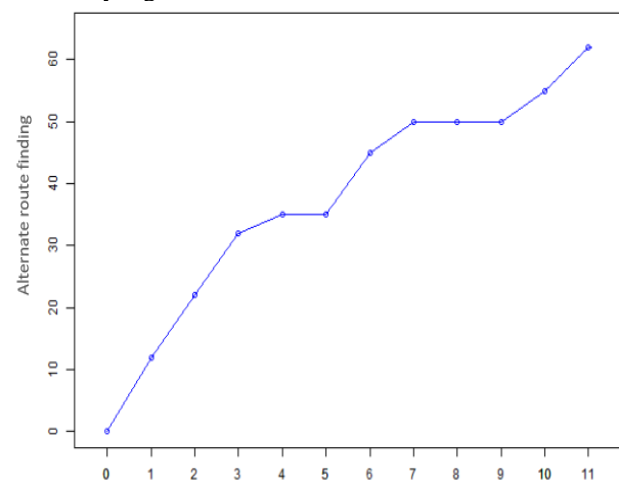

Chart 3: Alternate route-finding analysis

Here the chart 3 shows the alternate route diversion mechanism. Meanwhile, traffic patterns are stochastic, additional simulation experiments with fluctuating inputs of traffic demands were carried out to validate the performance of the multi-objective functions.

VI.   CONCLUSION

In today's world, Congestion in road traffic is one of the significant issues which are produced by the open transportation system of every single creating nation in ongoing time, as it builds the fuel utilization as well as the air contamination just as the danger of respiratory failure. To solve the congestion problem here, this research work shows an IoT congestion control system based on the intelligent traffic, to lessen the congestion delay using backup course of action proposal instrument for traffic-free control in urban areas. The proposed congestion control system produces a dynamic set of routes using the swarm algorithm, which finds the traffic density and allows the vehicle to divert the route, which is less traffic. Our approach is time-based on the assessed traffic density from the source vehicle to the last vehicle so it can easily analyze the traffic density and suggest the alternate route.

REFERENCES

1. Pampa Sadhukhan et al., "An IoT based Intelligent Traffic Congestion Control System for Road Crossings," IEEE, 2018
2. R. Sundar, S. Hebbar and V. Golla Implementing Intelligent Traffic Control System for Congestion Control, Ambulance Clearance, and Stolen Vehicle Detection, in IEEE Sensors Journal, vol. 15, no. 2, pp. 1109-1113, Feb. 2015. DOI: 10.1109/JSEN.2014.2360288.
3. S. Sukude and S. Gite, Vehicle Traffic Congestion Control & Monitoring System in IoT, International Journal of Applied Engineering Research ISSN 0973-4562 Volume 10, Number 8 (2015) pp. 19513- 19523.
4. M. R. Gahrooei and D. B. Work, "Inferring Traffic Signal Phases from Turning Movement Counters Using Hidden Markov Models." IEEE Transactions on Intelligent Transportation Systems", vol. 16, no. 1, pp. 91–101, 2015
5. K. Mandal, A. Sen, A. Chakraborty, S. Roy, S. Batabyal and S. Bandyopadhyay, Road traffic congestion monitoring and measurement using active RFID and GSM technology, 2011 14th International IEEE Conference on Intelligent Transportation Systems (ITSC), Washington, DC, 2011, pp. 1375-1379
6. M. M. Raza and R. R. Rao, "Agent-Based Urban Traffic and Transportation Control with Cloud Computing," International Journal of Computer Trends and Technology, Vol. 3, Issue 1, pp. 120-123, 2012.
7. N. B. Soni; Jaideep Saraswat, "A review of IoT devices for a traffic management system," IEEE, 2017
8. Varsha Sahadev Nagmode et al., "An IoT Platform for Vehicle Traffic Monitoring System and Controlling System Based on Priority," IEEE, 2017
9. Omid Avatefipour et al. "Traffic Management System Using IoT Technology - A Comparative Review," IEEE 2018
10. Pampa Sadhukhan et al., "An IoT based Intelligent Traffic Congestion Control System for Road Crossings," IEEE, 2018
11. Satbir Singh, Baldev Singh, et al., "Automatic Vehicle Counting for IoT based Smart Traffic Management System for Indian urban Settings," IEEE, 2019
12. Fenghua Zhu et al., " Parallel Transportation Systems: Toward IoT-Enabled Smart Urban Traffic Control and Management," IEEE, 2019
13. Naeem Abbas, Muhammad Tayyab and M. Tahir Qadri, "Real-Time Traffic Density Count using Image Processing," International Journal of Computer Applications (0975 – 8887) Volume 83 – No 9, December 2013.
14. T. Thakur, M. Gogate, "Traffic Controlling and Monitoring using Internet of Things," International Journal of Latest Trends in Engineering and Technology (IJLTET), vol. 6, no. 2 November 2015.
15. Misbah Uddin, S., Zubairi, J.A., Saggaf, A., Basuni, J., Sulaiman, A. and Al-Sofi, A. IoT based dynamic road traffic management for smart cities. 12th International Conference on High-Capacity Optical Networks and Enabling/Emerging Technologies, 2015.
16. T. e. a. Osman, "Intelligent traffic management system for a cross-section of roads using computer vision," in Computing and Communication Workshop and Conference (CCWC), 2017 IEEE 7th Annual, 2017
17. David Renfrew, Xiao-Hua Yu -"Traffic Signal Control with Swarm Intelligence" (Department of electrical engineering, California Polytechnic State University San Luis Obispo, CA 93407, USA).
18. Baskan, O., & Haldenbilen, S. (2011). Ant Colony Optimization Approach for Opti- mizing Traffic Signal Timings. Ant Colony Optimization- Methods and Applications, In- Tech, 205-220.

AUTHORS PROFILE

Mrs. Mary N Peter, Assistant Professor in Department of Computer Science, Kristu Jayanti College (Autonomous), Bangalore. She completed MCA from New Horizon College, Bangalore, affiliated to Bangalore University. She has 15 years of teaching experience and is pursuing Ph.D as part-time research scholar in Mother Teresa Women's University, Kodaikanal, Tamil Nadu. Her area of interest lies in Internet of Things for Smart Intelligent Transport System. She has authored two books and has published four papers in UGC indexed journals and one paper in scopus indexed journal in IoT domain

Dr Pushpa Rani is a effervescent teaching professional besides an internationally applauded Researcher whose focus dwells on the Research domains; Gait Analysis, Adaptive Learning Systems and Machine Learning. Dr Pushpa perused her PhD from Madurai Kamaraj University, India, for her innovative research on Gait Analysis. She currently serves as the Professor and Chairperson in the department of Computer Science of Mother Teresa Women's University, India. In addition, she is entrusted with many additional Positions such as University Syndicate Member, Academic council member, Dean of Science, IQAC Co-ordinator, Director & Academic Co-ordinator. She authored five books to her credit, published more than 100 research papers in reputed International Journals, contributed around 85 book chapters and presented at least 150 technical papers in International/National Conferences. Recognizing her Academic & Research caliber, she has been honoured with a number of National and International awards. She has been bestowed with four International Awards; 'Glory of India', 'Best Scientist in Computer Science", 'Distinguished Woman in Science' and 'Research Innovation Award', and 6 National awards including Dr. Abdul Kalam Life Time Achievement Award, Dr. Radhakrishnan award of Excellence, Rashtriya Gaurav Award and Teaching and Research Excellence Award.