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Real Time Path Planning using Intelligent Transportation System for Hybrid VANET

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Abstract— **Real-time path planning can preciously alleviate traffic congestion in a civic environment. Although, it is very arduous to have a profitable path planning method to accomplish an altogether optimal vehicle traffic control problem. In this paper, it establishes a intelligent transportation system (ITS), i.e., a hybrid-VANET-enhanced ITS, which make use of both vehicular ad hoc networks (VANETs) and cellular systems of the common transportation system to authorize real-time communications in the midst of vehicles, Road Side Units (RSUs), and a vehicle-traffic server in an efficient way. So, this proposed real-time global path-planning algorithm, establish a communication between RSU and On Board Unit(OBU) in the vehicle which not only reforms the overall geographical fulfillment of a road network but diminish the normal vehicle travel cost for evading vehicles from baffling in congestion as well as it address the worldwide optimal path-planning issue . The system-level simulation implemented in NS2 which demonstrates the planned path-planning method exceeds the conventional disseminated path planning in the rate of balancing the spatial exercise. This proposed method sublimates throughput and slow down the delay in the VANET posture. Real-time path planning can preciously alleviate traffic congestion in a civic environment. However, it is very arduous to have a profitable path planning method to accomplish an altogether optimal vehicle traffic control problem. In this paper, it addressed a hybrid intelligent transportation system (ITS), i.e., a sublimated intelligent transportation hybrid-VANET, which make use of the combination of vehicular ad hoc networks (VANETs) and cellular systems of the universal transportation system altogether, to consent the real-time communications in the midst of vehicles, roadside units (RSUs), and a vehicle-traffic server in a proficient way. So, this proposed real-time path-planning algorithm, not only reforms the overall geographical fulfillment of a road network but diminish the normal vehicle travel cost for evading vehicles from baffling in congestion as well. The system-level simulation implemented in NS2 demonstrates that the proposed path-planning method exceeds the conventional distributed path planning in the rate of balancing the spatial exercise. This method focused on mitigates the occurrences of congestion in intelligent transportation systems and analyzed the throughput and delay attributes of the hybrid VANET.**

Keywords— Hybrid VANET, On Board Unit, Road Side Unit, Global path planning algorithm, Vehicle Traffic Server.

1. Introduction

In this hectic world there is a chance to bump into congestion due to hefty traffic. Eventhough certain route implying algorithm existing, which is inadequate to give an enhanced solution altogether. In a VANET environment an OBU on the vehicle have a communication with an another OBU installed in the nearest vehicle spontenously as well as the RSU on the road side have a communication with another RSU. But in a hybrid VANET the communication will be established between RSU to OBU and viceversa as well[1,2]. Figure 1 demonstrates the hybrid VANET

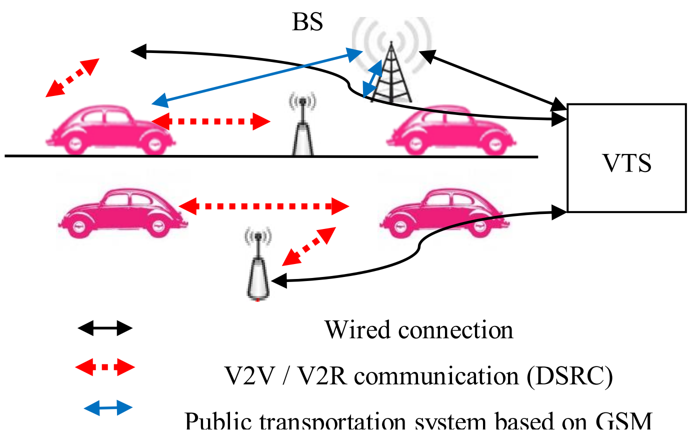

Figure 1 Hybrid VANET Architecture

The major downside of the accessible intelligent transportation system (ITS) is that they use traditional techniques like Global Positioning System, Wireless internet, mobile networks and so on. Almost all these techniques lead to very expensive and imprecise when natural calamity occurs. Nevertheless these conventional systems are accomplished by providing substitute paths, which may respond slowly since it does not has any real-time traffic information. The major challenge is to prevail over the inadequacy of the conventional intelligent transportation systems. One of the best elucidation for this problem is the usage of vehicular ad hoc networks (VANETs) with an ITS system with better communication techniques in a cost effective way. So it sets up a Vehicle-to-Vehicle (V2V) and vehicle-to-roadside-unit (V2R) communications [3] which permits the transfer of real-time traffic information among vehicles and a vehicle and road side units (RSUs) [4]. This data may be used to discover

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real-time traffic congestion. So it is a chance to determine an alternate path for the vehicle.

Many algorithms have been used to recognize a correct path in reply to the real-time traffic information established by VANETs [5] [6]. But these techniques generate congestions when it is not realized preciously. One more in-effective path planning algorithms is not considered about the privileges of the drivers. In most cases, the algorithms set its main aim are to evade the congestion rather than identifying an optimal path for individual road users. Since, there might be an extra cost to those who travel in a lengthy path. Therefore, algorithms must be designed to collectively take into account of the network traffic balance and the lessening of typical vehicle travel cost. This proposed a real-time global path planning algorithm exploits VANET communication ability to elude vehicles from congestion even in an urban atmosphere. Both the network spatial consumption and vehicle traffic cost are conceded to balance the overall network smoothness and the drivers' preferences. This paper organized as follows: initially discussed about the literature survey in the genus of VANET transportation system followed by proposed method and simulations bear out the effectiveness and competence of the proposed path planning algorithm.

2. Literature Survey

E.Premkumar et.al.,[7] introduced digital driving and automated breaking system to elude collusion of vehicles. In this proposed method, a sensor is used to determine the static and dynamic hastening during the movement of the vehicle. Also this proposed method is efficient to diminish the accidents due to human errors by alerting the drivers in advance. Tibor Petrova et.al., [8] propounded a IEEE WAVE protocol to provide a vehicle to vehicle and vehicle to infrastructure modeling communication which reduces the end to end delay and information disseminate time. So by using this method, traffic congestion have been reduced.

Zubaida Alazawia et.al.,[9] articulated intelligent disaster management system based on emerging ICT(intelligent Communication technology) which plays an important role in reverberated in urgent crisis and even hurricane disaster. Mayada Abdelgadir et.al.,[10] analyzed and evaluated the occurrences of various routing protocols such as Ad hoc On Demand Vector, Dynamic Source Routing, Destination Sequence Distance Vector in the real environment. In this method, even though the number of nodes increases rapidly these three algorithms gradually slow down the occurrences of congestion in a vehicular ad hoc environment. Imran Raza.et.al[] presented game theory based trust model for VANETs. This method works based on attacker and defender identification and frustrate the attacker nodes which create any malfunctioning activities in the VANET posture. Then by using this method, the outcome of the game method has been evaluated by the game matrix which comprises payoff values for conceivable action- reaction combination.

E. A. Feukeu.et.al[12] proposed a method to extend strategies and algorithms to facilitate inter vehicle communication to avoid public accident. In addition to this an unbeaten message transmission can be afford when the transmission channel is collision free. Under the supervision of an intelligent transportation system, a cooperative messages have to be transmitted. A distributed congestion control mechanisms have been proposed for congestion avoidance. But under heavy density node these mechanisms become impertinent and drastically contribute to the deterioration VANET environment. Junling Shi.et.al [13] advertised a social based routing scheme to establish the prominent and successful message transmission among the commuters. In this method, the commuters are divided into different group by using k-clique evaluation algorithm.

Rene Oliveiraa.et.al [14] addressed an adaptive data dissemination protocol to enable reliability for data transmission in a competent way. This method uses various methods to cooperate with the vehicular nodes in an ad hoc fashion to reduce the number of messages and eliminate a vital node from the network. Dahlia Sam.et.al [15] provided a solution by developing a pilot model fully automated time synchronized hybrid vehicle control system. This system has been modeled using a hybrid VANET which take into account of a pedestrian body unit. The pedestrian unit emits signals to the vehicular nodes via VANET. The signal received by the vehicular unit subjected as an input into the Time Synchronized Hybrid (TSH) vehicle monitoring system. The TSH system utilizes this information and frisks the possibility of occurrences of a mishap. It then passes a control signal to the automated breaking system to select a suitable response. When the vehicle control takes over this method, it controls even a very high speed.

Xuanxia Yao.et.al[16] introduced a dynamic entity centric trust model according to its types and authority level. It provides an enhancement to the security of the VANET protocol also this method accommodate itself to the dynamic VANET environment by introducing a dynamic factor to maintain its stability for the direct trust and recommendations. Mehdi Sharifi Rayeni.et.al[17] analyzed and applied dynamic partitioning scheme which plays both dense and light traffic scenarios. This proposed method reveals an outstand performance of five number of broadcasting protocol in VANET pertained to delay and emergency in urgent message broadcasting.

Xuejiao Liu a.et .al[18] introduced a secure and efficient dissemination scheme to construct a decryption of cipher text policy attribute based encryption to afford a differentiated access control services which makes the vehicle user to estimate the nearest RSU. Zongjian He.et.al[18] investigated that the data collection issues in the VANET in the rapid developing traffic conditions. This method may select or forward the data packet with respect to the traffic information. The main aim is to optimize the communication overhead in the network while gratifying the data collection. It organizes the data collection issues as a scheduling optimization problem and demonstrates it using NP complete. Felipe Cunhaa.et.al[19] has given a review, focused on their communication and application challenges.

The drawback of this legacy system throws a shadow on the relevance of cellular systems and loop detectors. For cellular

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systems, though the traffic data collections are not dedicated, its services will be very expensive, and the high volume of traffic data may cause congestion for the remaining cellular services. For the loop detectors, the deployment outflow will be more. Moreover, the imprecision for the measurement of its position becomes a problem for short-distance transmissions. The drawback of this existing system reveals that, it cannot make rapid response to a natural disasters or congestion due to an impetuous incident as well as not appropriate for traffic data collection and it consumes high cost for data collection. From the aforementioned survey, it is observed that the existing path planning algorithm and its solution were not enough for the hybrid VANET environment.

3. Proposed System

In a VANET environment, all the vehicles movement have been monitored by a Vehicle Traffic Server (VTS). The role of this VTS is to gather the information from the vehicle about the occurrences of a mishap. If there were any collision occurred then the OBU on the vehicle propagate that information to the VTS. This VTS transmits the collected information to the RSUs deployed on the road side. The OBU of the vehicle on the same lane received the information from the RSU and alert the driver to choose an optimal path for smooth transmission. The underneath figure 2 diagram explored the concept of this proposed method.

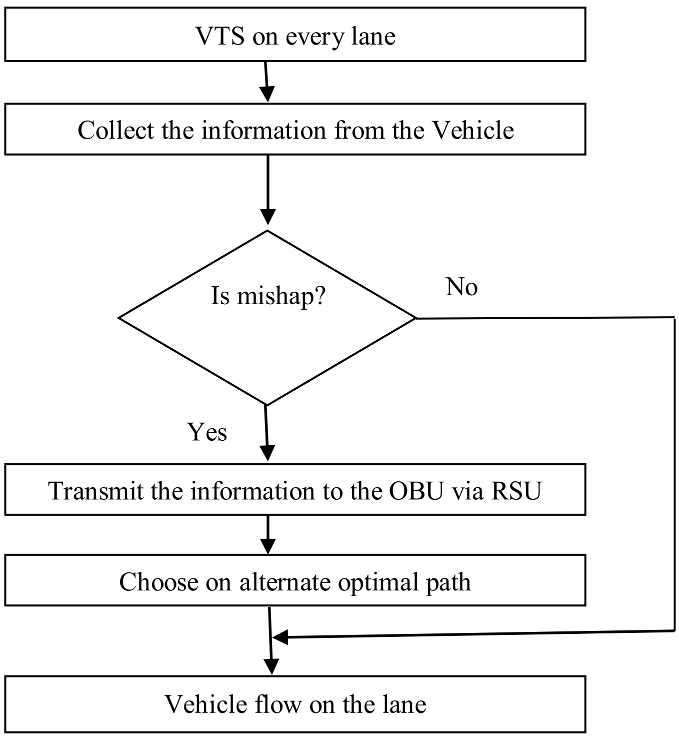

Fig.2 – Block diagram of the proposed work

A. On Board Unit :

OBU is data gathering and preprocessing unit which is reserved in vehicle. It is observed across a bestowed microcontroller boards acquiring inputs from the sensors. It is also accountable for combining and transitorily storing the recovered data. According to this proposed system, the OBU must be installed in every system. The OBU comprises an accelerometer to sense some large scale vibration in the vehicle and detects coincidence. On receiving this information, the microcontroller inspects them against their doorstep values. If the acquired data value above the doorstep values then the controller will alert the driver.

Figure 3 comprises RSUs, Cellular base stations and a vehicle traffic server. The RSU has two associate systems one is for accessible traffic system and another one for smart traffic control unit. The traffic control system consists of smart traffic control unit which frisks and controls all the traffic and gives privilege to crisis care vehicle.

So, it will not have the values up to the intersection points for a while. The smart traffic controller unit comprises two units; Junction Unit(JU) and Repeater Unit(RU). The RU has to be placed so long away from the JU which has traffic unit at its junction. When a crisis care vehicle with an RF transmitter moves forwards to this Repeater unit, it transmits this information to JU.

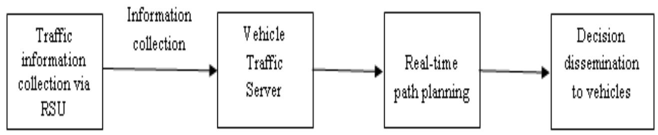

Figure 3 – Overview of Vehicle Transportation System

All the vehicles have been installed with on onboard unit which provides a vehicle to vehicle communication used to deliver the intermittent vehicle information. When vehicles detect coincidence related to congestion, an alert message will be generated to alert the development of accident information and disseminate with all other vehicles with the nearest RSU through V2R Communication. In addition to this, it involves a pure VANETs and cellular communication sets up the functions such as mobile tele-monitoring and management system for within the coverage area open transportation. So that all type of vehicles can upload and receive the messages from the nearest cellular base station (BS) in a forthright manner. So, the BS will dispose the message to the vehicle traffic server. RSUs have been organized.

Vehicles have been installed with on onboard units that facilitate a multi hop vehicle to vehicle communication. It bears a consistently update the intermittent location and density vehicle information. When a vehicle initiates an alarm message regarding any collusion, then it will broadcast the information among all the vehicles as well as the closest RSUs via Vehicle to Roadside Communication. The vehicles always give more privilege to directly upload the alert messages to the closest cellular BS and the BS transmits the information to the vehicle traffic server.

B. Road Side Units(RSU)

RSUs are deployed on the road to grasp the cardinal information about the vehicular traffic. RSU on the

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roadside may confabulate with the nearby RSU through wireless communication. If RSUs are deployed at the traffic circle then the traffic information may captured by the camera connected with a RSUs. Otherwise, traffic flow information will be noticed by the closest RSUs with respect to the information gathered from the VANETs. An RSU can stake its own gathered information with other RSUs and vehicle traffic server. Whenever any mishap happened using all the flock of information the vehicle traffic server may choose an optimal path for travelling.

In this paper, a widespread optimum path planning method has been proposed for vehicles to elude traffic bottleneck in a suburban environment. With agglomeration of instantaneous traffic statistical information and outcome yielded by a hybrid VANET enhanced network. The road network suppliers have been fully utilized and the normal travel cost of vehicles is gradually reduced. Moreover an influence of a real time path planning algorithm has been used to establish an intelligent transportation system to have a real time path planning. So, initially to stabilize an application of real time path planning it offers a hybrid VANET ITS framework to make use of both the VANETs and the public transportation system. Second, it designs an actual global path planning algorithm as well as diminishes the average travel cost. Figure 4 demonstrates the optimal path planning method for smoothening the vehicle transmission.

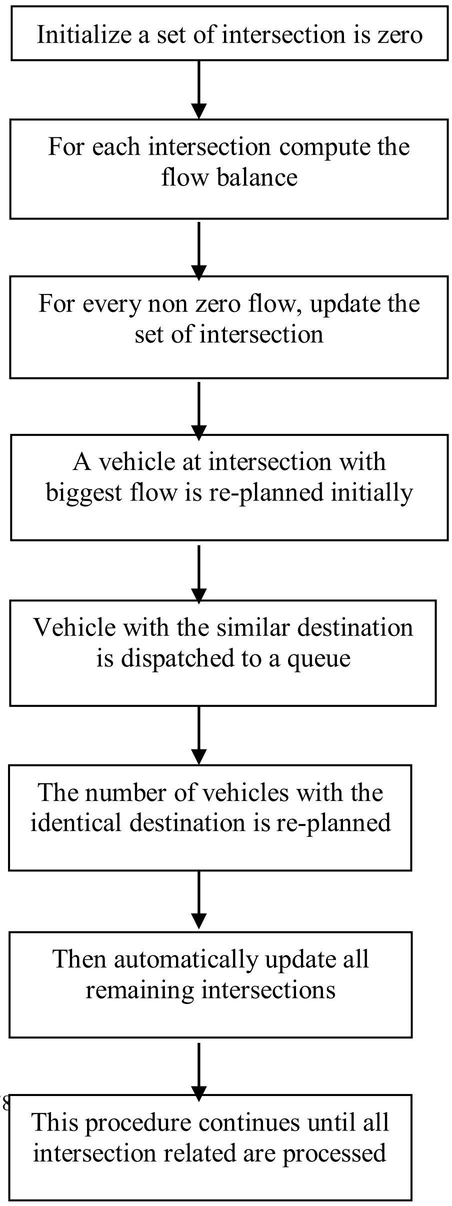

Figure 4- Optimal path planning algorithm

4. PERFORMANCE EVALUATION

...ken into account to implement the proposed system in NS2. Initially certain nodes have been deployed in the network environment and enabled communication with all the nodes. When there is a collision occurs then it established a communication from the OBU on the vehicle to the VTS and RSU. So, to measure the performance of this proposed system the parameters throughput and delay have been considered. In the existing method demonstrated minimum level of throughput with maximum delay. But this proposed method overhauls the performance of the existing system by improving the throughput level gradually and lessening the delay.

Figure 5 shows the deployment of nodes. Node 0, 1,2 represents RSUs and 3 represents BS and 4 represents vehicle traffic server have been deployed in figure 6. VANETs also offered vehicles to unite to Roadside Units (RSUs). RSUs sustain supportive and dispersed applications in which vehicles and RSUs work altogether to manage actions and to distribute process with nearest RSUs. All the Vehicles have been installed with onboard units which provide multi-hop V2V communication to deliver intermittent information.

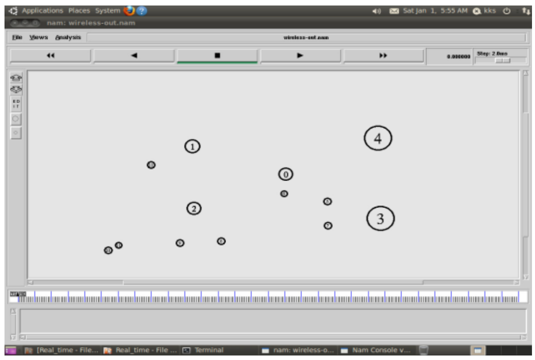

FIGURE 5. NODE DEPLOYMENT

The aforementioned diagram exhibited the deployment of several nodes and identifying the different units

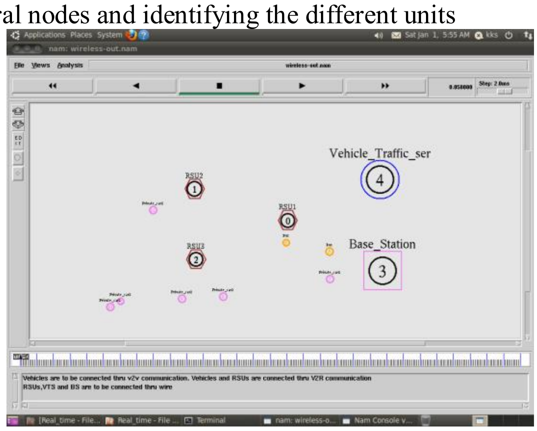

Figure 6. Identification of BS, OBU, RSU and VTS

Figure 6 indicates the node deployment and identification of BS, OBU, RSU and VTS with certain distances. So based on these communication would happen between the vehicular nodes.

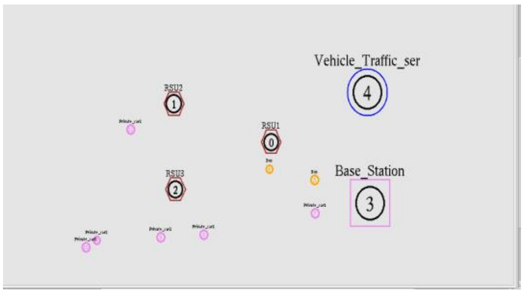

Figure 7. Communication between Nodes

Figure 7 shows the deployment of RSUs and OBUs installed on the vehicles and communication between both the units. When a vehicles subjected into an accident then the OBU on the vehicle convey this information to the nearest RSUs. So, the RSU may propagate this information to either the nearest RSU or to the Base station. So the base station or the RSU may transmit this message to the OBU on the vehicle which comes to its transmission range. So, it alerts the driver to choose an alternate optimal path.

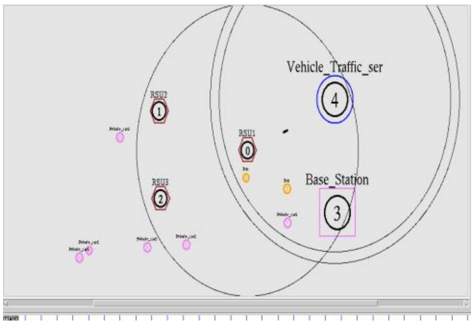

Figure 8. Detection of Congestion

Figure 8 reveals that when RSU Detects congestion in the traffic it reports to the base station as well as vehicle traffic server. Both the vehicle traffic server and the base station record its information and deliver it to the vehicle when the vehicle arrives in its transmission range.

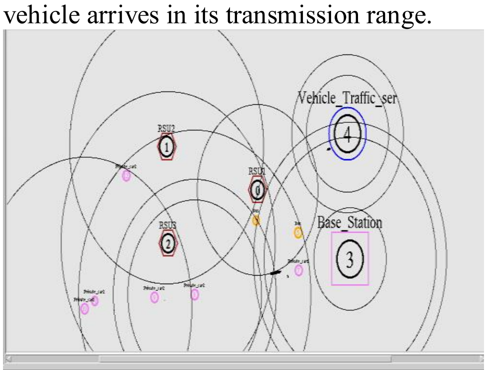

Figure 9.Communication between RSU and BS as well as VTS

When the vehicles were connected with each other in an exactly with the cellular systems as well as all the RSUs strongly connected with each other through wireless link then all the vehicles can directly transfer the received data and alerting message to the proximate BS. The BS may proliferate this message to the vehicle traffic server. Figure 9 illustrates that when collision occurs then the base station receives this information from the OBU on the vehicle and propagate it into VTS. The RSU nearest to the VTS may receive this information and enable other RSU to pass this message to the faraway vehicle OBU. This OBU might alert the driver to choose an optimal path for smooth transportation.

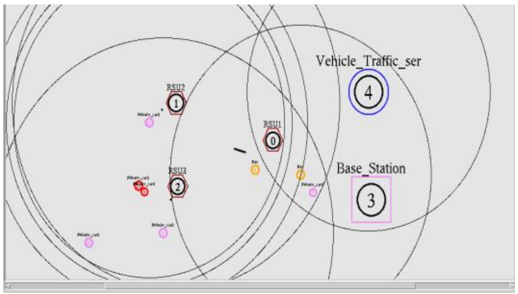

Figure 10. Congestion Avoidance

Figure 10 expressed that all the vehicles on the same lane aware about the congestion prevailed in one location, then with an assist from RSUs and OBUs it might alert the driver and discover the shortest path for travel using this proposed method. The vehicles discover traffic snarl the alert message about the congestion will be disseminated to all the vehicles through the closest RSUs and V2R communication. An RSU may disclose its gathered information with other RSUs and the vehicle traffic server. If any mishap happens with respect to all the unruffled information the vehicle traffic server is adapted to perform real time path planning to give a widespread optimized travel path for all the vehicles. If any congestion occurs then the path planning running algorithm and the vehicle traffic server has to take an onerous responsibility to choose an optimal shortest path for the vehicles.

Figure 11 and 12 depicted the performance assessment of the existing system represented by red line with the proposed system represented by green line. In Fig 11 demonstrates when the number of nodes increases then the throughput of the proposed system gradually increased than the existing method. In this proposed method, all the vehicles on the lane get over the traffic snarl and have a smooth transportation and provide a better transportation path for all the vehicles.

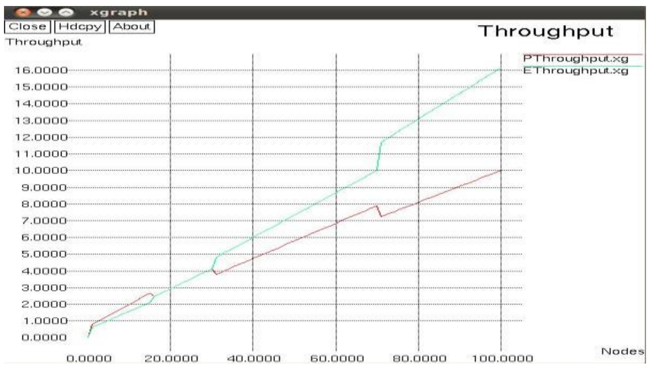

Fig 11 Throughput analysis

Fig 12 illustrates the assessment of delay time with respect to the proposed system. In the existing method, when the number of nodes increases the time delay also gradually

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increased. But according to the proposed method the delay times satiated certain level and retain the same. So, this proposed method slows down the network traffic and diminish the transportation delay. This proposed method is very efficient method for transportation systems in the real world compare with an existing method.

Figure 12 Delay analysis

5. CONCLUSION

The existing system has an enhanced hybrid VANET ITS framework with real time traffic information performances. It comprises both V2R as well as V2V Communications in VANET and cellular communication in common transportation method. This proposed system exhibits a real time path planning to elude congestion in ITS. A globally optimal real time path planning algorithm has been designed to enrich the wide range of geographical exertion and depreciate the vehicle travel cost. In this work, it administered a new route when there would be a traffic snarl in the route. Also it establishes a new route when there is need for emergency based on the sort of vehicle.

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