Simulation of VANET for Path Planning

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Abstract *:* Vehicular Ad-hoc Networks (VANET) is one among the foremost actual and difficult analysis space in automotive corporations and ITS designers. In general, a VANET is made from variety of vehicles that area unit within the same road to make ad-hoc network. The presence of such these networks opens the manner for a good vary of applications like safety applications, quality and property for each driver and passengers to take advantage of the transport systems in an exceedingly with efficiency and safer manner. For safety applications that area unit a crucial section from VANET, the most effective routing protocol be designated.Indeed, it's necessary and essential to check and measure totally different routing protocols that associated with VANET system before apply them within the real atmosphere which might be done via VANET simulation tools. This project evaluates the performance of 3 totally different routing protocols for VANET system in town. The performance area unit evaluated and compared in terms of PDR, average turnout, delay and total energy. Our objective is to estimate the performance of routing model for town situation. The most goal is to seek out the acceptable routing protocol in an exceedingly high density traffic space in the town for that have to select routing protocols among DSR, AODV and DSDV.

***IndexTerms*- Real-time traffic information sharing mechanism; traveling time estimation; real-time path planning; VANET.**

I.INTRODUCTION

Nowadays, more than one mill human are injured or died because of traffic accidents every year around the world. Studies show that most traffic accidents happen due to the inattention of drivers to the front view and the absence of the immediate warning message for drivers.Vehicular Ad-hoc Networks (VANETs) have become an emerging technology supporting a wide range of applications, including traffic safety warning, transport efficiency and information or entertainment.Vehicular ad-hoc networks (VANETs) technology has emerged as a very important analysis space over the previous few years.Being ad-hoc in nature, VANET could be a kind of networks that's created from the thought of creating a network of cars for a particular would like or state of affairs.VANETs have currently been established as reliable networks that vehicles use for communication purpose on highways or urban environments.Along with the benefits,there arise a large number of challenges in VANET such as provisioning of QoS, high connectivity and bandwidth and security to vehicle and privacy.

A significant problem faced while travelling by road is traffic congestion. Nowadays lot of our precious time were wasted in our daily life because of this and this is most common in countries like India. There are several route suggesting applications available in the market, but most of them are costly or inefficient to solve the problem completely. Many careful analysis and studies unconcealed that traffic jam causes billions of additional travel and additionally the wastage of liters of fuel. The major drawback of the existing Intelligent Transportation System (ITS) is that they use conventional techniques like GPS, Wireless internet, mobile networks etc. Most of the time these techniques area unit price and over that it's inefficient because it typically fails to relinquish a fast response to an emergency created by an accident or disaster. Even though these ancient systems area unit capable of providing alternate methods, they will solely respond slowly as a result of they are doing not have a period of time traffic data.

Intelligent Transportation System (ITS) is a diverse and expanding subject, with some of its constituent parts converging or overlapping.For example, transport and travel info could be viewed below a wise Cities agenda and equally connected cars ar an articulation of Machine-to-Machine (M2M) Communications and therefore the web Internet of Things (IoT), Vehicular Ad-Hoc Network (VANET) networks is usually developed as a part of ITS. ITS ar developing applications that, without embodying intelligence as such, target to provide innovative services relating to different modes of transport and traffic management and enable different users to be higher knowledgeable and create safer a lot of coordinated and 'smarter' use of transport networks.MANET is that the short variety of Mobile AdHoc Network. In ad-hoc networks all the nodes ar mobile in nature and thence they will be interfaced dynamically in capricious fashion. VANET is that the short variety of conveyance Adhoc Network it's taxonomic group of network of painter kind. The routing protocols of MANET are not feasible to be used in the VANET network.VANET is one of the main types of mobile ad hoc networks (MANETs). From the high level perspective, they are the same. However, some characteristics ar specific for the VANETs that create them not almost like the MANETs.Compared with the other classes of mobile ad hoc networks, VANETs have unique characteristics. The main characteristics of the VANETs are as follows: heterogeneous communication range, mobility of the vehicles, geographically constrained topology, time varying vehicle density, frequently disconnected network, dynamic topology and the vehicles being the parts that build the network. Broadcasting in connected and fragmented conveyance accidental networks. The VANET routing protocols need to be designed considering factors such as the security, mobility and scalability of vehicular communication.Overview of routing protocols in VANET. The goal of VANET design is to permit the association between vehicles or between vehicles and glued road aspect units resulting in the subsequent 3 prospects.

II. LITERATURE SURVEY

In this paper[1], Vehicular ad hoc networks (VANETs) have stimulated interest in both academic and industry settings because once deployed, they would bring a new driving experience to drivers. However, communicating in an open-access environment makes security and privacy issues a real challenge, which may affect the large-scale deployment of VANETs. Researchers have proposed many solutions to these issues. We start this paper by providing background information of VANETs and classifying security threats that challenge VANETs. After clarifying the requirements that the proposed solutions to security and privacy problems in VANETs should meet, on the one hand, we present the general secure process and point out authentication methods involved in these processes. Detailed survey of these authentication algorithms followed by discussions comes afterward. On the other hand, privacy preserving methods are reviewed, and the tradeoff between security and privacy is discussed. Finally, we provide an outlook on how to detect and revoke malicious nodes more efficiently and challenges that have yet been solved.

Vehicular Ad-hoc Networks (VANETs) require reliable data dissemination for time-sensitive public safety applications. An efficient routing protocol plays a vital role to achieve satisfactory network performance. It is well known that routing is a challenging problem in VANETs due to the fast-changing network typology caused by high mobility at both ends of transmission. Moreover, under urban environment, there are two non-negligible factors in routing protocol design, the non-uniform vehicle distribution caused by traffic lights, and the network congestion due to high traffic demand in rush hours. In this paper[2], we propose a greedy traffic light and queue aware routing protocol (GTLQR) which jointly considers the street connectivity, channel quality, relative distance, and queuing delay to alleviate the packet loss caused by vehicle clustering at the intersection and balance the traffic load among vehicles. Through performance evaluation, we show that our proposed protocol outperforms both TLRC and GLSR-L in terms of packet delivery ratio and end-to-end delay.

This paper[3] presents a traffic-aware position-based routing protocol for vehicular ad hoc networks (VANETs) suitable for city environments. The protocol is an enhanced version of the geographical source routing (GSR) protocol. The proposed protocol, named efficient GSR, uses an ant-based algorithm to find a route that has optimum network connectivity. It is assumed that every vehicle has a digital map of the streets comprised of junctions and street segments. Using information included in small control packets called ants, the vehicles calculate a weight for every street segment proportional to the network connectivity of that segment. Ant packets are launched by the vehicles in junction areas. In order to find the optimal route between a source and a destination, the source vehicle determines the path on a street map with the minimum total weight for the complete route. The correct functionality of the proposed protocol has been verified, and its performance has been evaluated in a simulation environment. The simulation results show that the packet delivery ratio is improved by more than 10% for speeds up to 70 km/h compared with the VANET routing protocol based on ant colony optimization (VACO) that also uses an ant-based algorithm. In addition, the routing control overhead and end-to-end delay are also reduced.

III. PROPOSED SYSTEM

3.1 Block Diagram

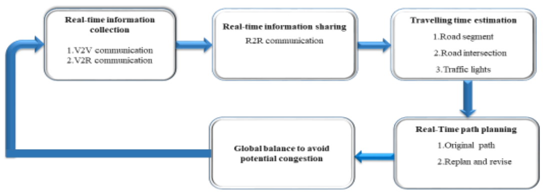

Fig 3.1 Illustration of System Process

To present the process of real-time path planning via a global perspective, propose the network architecture in the intelligent transportation system followed by the definition of road network and basic assumptions.

3.1.1. Transportation Network Architecture

The transportation network architecture is shown in Fig. 1, which contains two layers, including vehicles on the road segments, and RSU deployed at road intersections.

The on board unit (OBU) is equipped on the vehicle aiming to realize the V2V communications with the other vehicles on the road segment and the V2R communications with RSU at road intersection. OBU records vehicle's mobile information, i.e. vehicle's ID, vehicle's position, real-time speed and so on. For instance, the OBU can record the vehicle's realtime speed on road segments. Once it obtains the real-time information about the following road segments from RSU via V2R communication, the vehicle can estimate the traveling time based on the real-time speed on this road segment, which is recorded by its OBU. Once there is a traffic congestion on a specific road segment, such as a traffic jam or a sudden traffic accident, OBU will generate a warning message and sent it to RSU at downstream intersections, containing congestion's road segment ID and the estimated time of releasing the congestion.

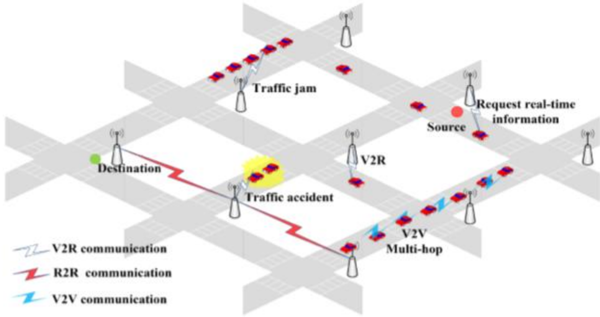

Fig. 3.2: Illustration of the Network architecture.

The rate of connected vehicles in the VANET can influence the performance of V2V communication on road segments. According to different rates of connected vehicles in all vehicles in the road network, different V2V communication mechanisms are used to realize the traffic information sharing. If large parts of connected vehicles are deployed in the road network, the real-time traffic information on the road segments can be shared by V2V communication via multi-hops. Because of large rate of connected vehicles, the source vehicle can find the suitable relay node in its wireless communication range and the realtime information can be forwarded to the relay vehicles by one hop.

3.1.2. Real Time Information Collection

The real-time information can be forwarded along the road segment until the relay vehicle enters the communication range of RSU at road intersection and the RSU at road intersection can obtain the real-time traffic information by V2R communication. Because the delay of multi-hop is much less than the vehicular traveling time in road network, the influence of data delivery delay on the precision of TTE is usually ignored when the connected vehicles are majority. When small parts of connected vehicles are deployed in VANETs, the real-time traffic information on the road segments can be shared by V2V communication via carry-and-forward mechanism. Because of small rate of connected vehicles, the vehicle that has the real-time traffic information cannot find the suitable relay node in its wireless communication range. In this case, the vehicle will carry the real-time traffic information and keep traveling on the road segment. Once the source vehicle finds the suitable relay node, the traffic data will be forwarded. The traffic data is shared along the road segment by continually shifts between carrying and forward until the relay vehicle enters the communication range of RSU at road intersection, the RSU at road intersection can obtain the real-time traffic information by V2R communication. The detailed influence of connected vehicles' rate on precision of TTE is discussed in the following section.

The RSUs, deployed at each road intersection, collect realtime traffic information of connective road segments from mobile nodes via V2R communication in VANETs. The RSUs in the whole of road network are wired connection, realizing the R2R communication by our proposed real-time information sharing mechanism. The cache of RSU stores two categories of traffic information. One is the static data of road network including the length of each road segments in the digital map, the information of road intersection, the capacity of different areas and the signal operation of traffic lights which is acquired by digital map and camera. The static traffic information updates in a certain period which is usually several traffic lights' periods. The other is the dynamic real-time data collected from vehicles via VANETs or traffic infrastructure, e.g. digital camera and detection loop.

The connected vehicles upload the dynamic information such as traffic congestions caused by heavy density and sudden accidents by V2R communication via VANETs. The camera and detection loop at road intersections record the real-time traffic information which contains the road density and the number of vehicles and then upload the traffic data to the RSUs at road intersection. The dynamic traffic information is updated immediately. In our transportation network, the RSU at road intersection covers the road segments. Vehicles arrive at new road segment and request real-time traffic information from RSU via VANETs. RSUs share real-time traffic information by our proposed information sharing mechanism, aiming to acquire the real-time information of entire road network. RSUs receive vehicles' request message and response. Vehicles calculate the traveling time estimation and choose the optimal path from source to destination by real-time path planning algorithm. Once the sudden traffic congestions occur, the real-time traffic information is updated to RSUs and the real-time path planning algorithm can revise the original path. The real-time path planning algorithm dispatches the vehicles backlog based on drift-plus-penalty and back-pressure policies to avoid new congestions generation which is caused by large parts of vehicles same choice for optimal path segments. Fig. 3.2 shows the process of the transportation network architecture.

3.2. Real-Time Information Sharing Mechanism

In this module, proposed that a real-time traffic information sharing mechanism among RSUs at the road intersection. The complexity and redundancy analysis prove that our proposed real-time information sharing mechanism can transmit the real time information efficiently among RSUs.

The traffic information stored in RSUs cache can be classified into two categories. One is the static information, including the length of road segment, the road segments ID and traffic lights status. The vehicle can download the static information via V2R communication. Aiming to reduce the measurement error, the static traffic information is shared among RSUs with a certain period, e.g., several traffic light's periods. For the dynamic traffic information, such as the traffic accident and the traffic congestion, the

RSUs' information sharing mechanism can immediately share these dynamic real time traffic information, rather than the updating frequency.

The information is shared to only two RSUs in each time of sharing which can not only guarantee the coverage but also reduce the packets redundancy. The sharing mechanism combines the TTE and real-time information can be shared to the interested road segments which makes RSU acquire parts of information and avoids the useless information sharing in entire road network. The real-time information sharing mechanism mainly includes four steps.

Step1: Initialize network parameters, define RSUs.

We suppose that each road intersection deploys a RSU to collect the real-time information, which means that there is n×m RSUs in an n×m grid road topology. Mark the number of RSUs in order row by row, which means that the RSUs' ID is from RSU1 to RSUn×m. Define the source RSU as RSUs and the range of s is from 1 to n×m. The beacon message includes the last RSU's ID, the local RSU's ID, the road segment's ID of congestion and the estimated congestion removing time τ.

Step 2: Search the next RSU ID.

The source RSU transmits the real-time information to the four RSUs linked with source RSU. The traditional sharing mechanism uses the broadcast to all directions, which causes the information redundancy. Our real-time information sharing mechanism only transmits the packet in two directions, which realize to expand the information to further circle and offset the missing RSUs in the current circle. Each RSU in the n×m grid topology receives only one real-time information message at most, which reduces the redundancy.

Step 3: Next RSUs' judgments.

1. The next RSU must be in the n×m grid topology, which means the next RSUs are the rim of the road network at least $\exists N_i = RSU_i \in \{I\}$.

2. The traveling time from current road segment to the source road segment is shorter than the traffic congestion removing time, which means that this congestion real time information is useful for the vehicles at current road segment $\sum_{j=s}^{i} TTE_j < \tau$.

3. The candidate of the next RSU's ID has not been appeared in the former transmission. This case aims to reduce the repetitive transmission $N_i = RSU_i \,/\!\in \{N_1, N_2 \ldots N_{i-1}\}$.

Step 4: Repeat the step 2 and step 3 until the remaining RSUs do not satisfy the step 3.

The Fig. 3.3 shows the RSUs' selection in each time of real-time information sharing, which is an example of 5×5 RSUs grid topology.

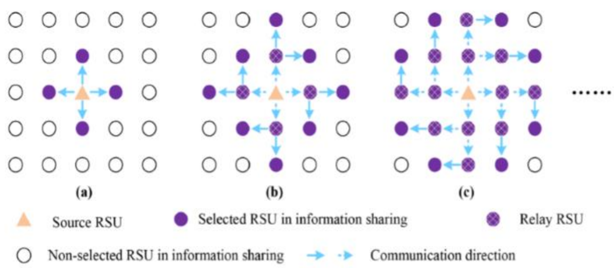

Fig 3.3 Sharing information mechanism in 5×5 grid topology.

(a) The source RSU shares the information to the four RSUs in the first time sharing. (b) The four RSUs share the information to only two directions RSU as the relay in the second time sharing. (c) The third time sharing depends on Step.3 until the real-time information sharing mechanism has completed.

3.3. Traveling Time Estimation

Once a vehicle enters the road segment R_{ij}, it can acquire the real-time traffic information about the downstream road segments from RSU at intersection i based on the RSU realtime information sharing mechanism. In this section, it gives the corresponding analysis and formulae about TTE. The Fig. 4 illustrates the process of the traveling time estimation from intersection i to intersection j.

3.3.1. Straight Road Segment

In traditional method, $t_{ij} = \frac{L_{ij}}{v_{ij}}$ is used for estimating traveling time on road straight segment, where the L_{ij} denotes the length of road segment R_{ij}. However, the formulation does not consider the valid length for vehicles' traveling on the straight road segment, which may be shorten by the waiting queue at road intersection j. Suppose that the length of waiting queue at road intersection j is l_j^q, then the valid traveling time on straight road segment based on real-time information is

$$t_{ij}^{s} = \frac{L_{ij} - l_j^{q}}{v_{ij}}[1 + \alpha(\frac{n_{ij}}{n_{ij}^{\max}})^{\beta}].$$

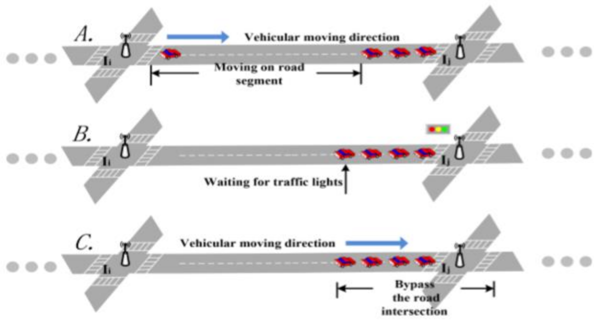

Fig. 3.4. Illustration of traveling time estimation from intersection i to j.

3.3.2. Waiting Time for Traffic Light

Suppose the remaining traffic light time is t_l when the vehicle enters the road segment R_{ij}. and we propose a Boolean function to describe the status of traffic light in downstream intersection j, as shown in Equation

$$\delta(t) = \begin{cases} 0, & \text{green} \\ 1, & \text{red.} \end{cases}$$

3.3.3.1. Real-Time TTE Path Planning

In this Module, the real-time path planning algorithm is first proposed to help vehicles to find the optimal path and the algorithm can revise the path selection according to the realtime traffic information. The potential issue that large vehicles choose optimal road segment cause new congestion is also discussed in detail. Then, the existence and convergence of solution set of our proposed algorithm are discussed.

The real-time path planning algorithm is to revise the current path based on the real-time traffic information and to avoid the congestion on the downstream road segments. In Section V, by considering the traveling time as the performance parameter of real-time path planning. The choice of the optimal path will be updated in each real-time path planning interval and revised in the subset of road segments which have traffic congestions. The interval of path replanning depends on real-time traffic information updating period. The interval of path revising depends on the RSU's real-time information sharing mechanism, which includes the static real-time information and the dynamic traffic information. When sudden traffic accidents and traffic congestions occur on the downstream road segments, the RSU's information sharing mechanism can update these dynamic traffic information immediately and the path planning algorithm revises the original path solution based on the updated real-time traffic information to avoid the traffic accidents and congestions road segments.

When the RSUs' information sharing mechanism updates the static traffic information in a certain period, the path planning algorithm can judge whether the traffic information has been changed. If the static information has been changed, the path planning algorithm revises the solution to find a more suitable path result based on the real-time traffic status. Otherwise, the algorithm will maintain the previous solution. Suppose that the congestion removing time is τ and the dynamic traffic information occurrence interval is t_d.

IV. RESULTS AND DISCUSSION

To collect time-varying traffic-condition information, most works in conventional smart traffic support (STS) system usually rely on cellular systems or loop detectors. Exhaustive Collection of real-time traffic information for traffic forecast or reconstruction in experimental research is done which is shortly described in Table 4.1.

Table 4.1 Traffic Information

Simulation area	1500m x 1500m
Vehicles Cluster Size / lane	150-200
Transmission range	300m
Simulation time	500s
Vehicle velocity	50-60 kmh

In a traffic management system with loop detectors for continuous traffic measurement and monitoring along arterials is introduced. However, inevitable drawbacks forged a shadow on the applying of cellular systems and loop detectors. For cellular systems, as they are not dedicated for traffic information assortment, the collection services can be highly costly and the high volume of traffic data may also cause congestion for other cellular services. For the loop detectors, the preparation expense may be terribly high. The improper distance measurement leads to incorrect path planning. Due to VANETs, V2V and V2R communications can make real-time message delivery much quicker, cheaper and more efficient than the current systems, even for short-distance transmissions in dense networks. Hence, in this method to reduce the end-to-end transmission delay, taxis or buses are considered as super relays to help in delivering the information through the cellular network of public transportation system.

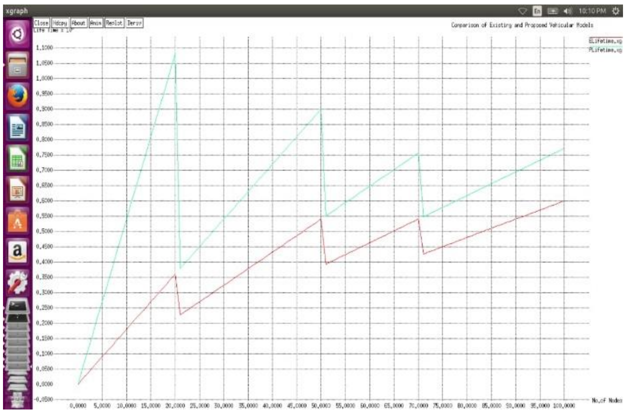

Fig. 4.2 Life time

The fig 4.2 shows the variation in time taken to life time. A study is done to compare the traditional method and STS. It is evident that the designed STS functions better and the time taken to reach the destination is reduced comparatively

Fig. 4.3 Energy Consumption Level

Fig 4.3 shows the Energy Consumption Level of the proposed method. Traffic flow theory refers to the traffic stream variables of speed, flow and concentration. These relationships area unit primarily involved with uninterrupted traffic flow, primarily found on freeways or expressways. In the proposed algorithm, even when the density of the vehicles increases, the congestion is prevented comparatively.

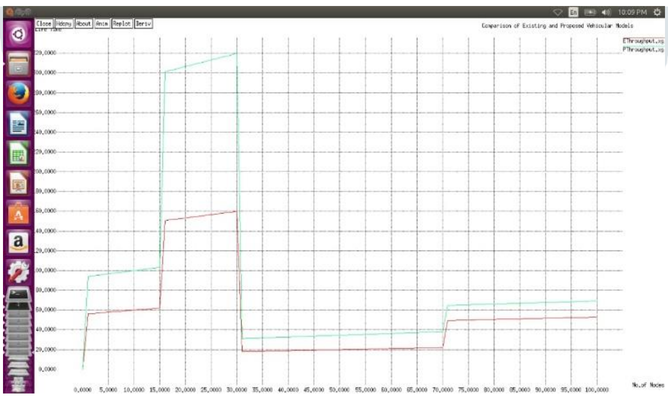

Fig. 4.4. Throughput Analysis

It's evident from the scenario that the STS functions better and the number of vehicles subjected to smooth driving is increased.

V. CONCLUSION AND FUTURE WORK

Recent advances in wireless technologies have given rise to emergence of Vehicular Ad-hoc Networks (VANETs) which is used to provide traffic management route planning, and identifying roadside amenities using short-range wireless communication. The proposed technique discuss about the efficient and effectiveness in managing the traffic by incorporating both VANET and cellular communication. A real time path planning algorithm is used which provide several alternative paths instead of a single alternative path like the existing methods. The shortest path among these alternate paths is determined which reduces the delay of vehicles to a great extent. RSU speed sensors and cumulative sensor are used for detecting the speed of the vehicles and analyzing the road condition. The usage of dynamic source routing improves the bandwidth by avoiding the periodic table update like table driven approach. This system also creates an immediate path during any collisions. The time taken to find an alternate route is minimized comparatively. Because of this, it can also be claimed that the carbon emission is reduced to a greater extent which results in saving of non-renewable energy source such as diesel or petrol.

In our future work focusing on the algorithms improvement, realize the load balance and global optimization in traffic road network. By estimating the performance of the routing model for city scenario and finding the suitable routing protocol among the DSR, AODV and DSDV of a high density traffic area in the city

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