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Efficient Routing Strategy for VANETs for Smart City Environments

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ABSTRACT: Vehicular Ad-Hoc Networks (VANETs) enable vehicles to create a self-organized network while not the necessity for a permanent infrastructure and routing in VANETs may be a difficult task attributable to the high quality and high density of mobile nodes. Position-based routing protocols, that are principally supported greedy routing, are additional suited to extremely dynamic and mobile network.Attention of the scientific community is to style network familiarized position-based routing protocols, and this has resulted in an exceedingly very high range of algorithms, totally different in approach and performance and every suited solely to explicit applications. However, various, only a few positions primarily based algorithms have truly been adopted for business functions. The aim of this work is to develop a VANET-Simulation situation for supporting varied Considering the large number of nodes that participate in these networks and their high mobility, The problem still exist about the feasibility of applications that use end-to-end multi-hop communication in Intersection Routing on City Roads when they are executed in Real-Time Vehicular Traffic. Simulation was done using urban city maps settings and they will evaluate performance best in terms of average delivery rate.

KEYWORDS: VANET, Ad-hoc Network, Vehicular Routing, Simulation Model.

I. INTRODUCTION

Wireless communication technologies [1] have now greatly impact our daily lives. From indoor wireless LANs to outdoor cellular mobile networks, wireless technologies have benefited billions of user's around the globe. A vehicular ad hoc network (VANET) uses moving vehicles for example cars as mobile nodes in a MANET to create a mobile network.[2] A VANET turns every participating car into a wireless router or node, allowing vehicles approximately 100 to 300 meters of each other to connect and, in turn, create a network with a wide range. As vehicles fall out of the signal range and drop out of the network, other vehicles can join in the network, connecting vehicles to one another so that a mobile Internet is created as shown in Figure 1. It is estimated that the first systems that will integrate this technology are police and fire vehicles to communicate with each other for safety purposes. Automotive companies like General Motors, Toyota, Nissan, DaimlerChrysler, BMW and Ford promotes the Development of VANET.

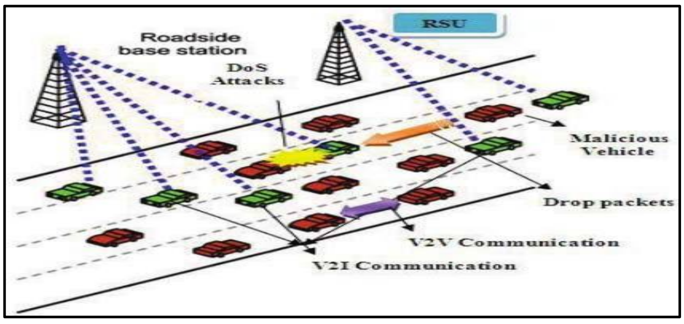

Figure 1: Architecture of a Vehicular Ad-hoc Network

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The era of vehicular ad hoc networks (VANETs) is now evolving, gaining attention and momentum. Researchers and developers have built various VANET algorithms to allow the study and evaluation of various media access, routing, and emergency warning protocols. VANET is fundamentally different from MANETs (mobile ad hoc networks) simulation because in VANETs, vehicular environment imposes new issues and requirements, such as constrained road topology,multi-path fading and roadside obstacles, traffic flow models, trip models, varying vehicular speed and mobility, traffic lights, traffic congestion, drivers behavior, and many more[4].

A. *Categories of VANETS*

Vehicular ad hoc networks (VANETs) represent a rapidly emerging research field and are considered essential forcooperative driving among vehicles on the road. VANETs are characterized by:

i. Trajectory-based movements with prediction locations and time-varying topology
ii. Varying number of vehicles with independent or correlated speeds,
iii. Fast time-varying channel (e.g., signal transmissions can be blocked by buildings),
iv. Lane-constrained mobility patterns (e.g., frequent topology partitioning due to high mobility), and finally,
v. Reduced power consumption requirements.

So far, the development of VANETs is backed by strong economical interests since vehicle- to-vehicle (V2V) communication allows the sharing of wireless channels for collision avoidance (improving traffic safety), improved route planning, and better control of traffic congestion Deploying and testing VANETs involves high cost and intensive labor. Hence, simulation is a useful alternative prior to actual implementation. Simulation of VANET considers large and heterogeneous scenarios. Compared to MANETs, when we simulate VANETs, we must account for some specific characteristics found in a vehicular environment. Based on previous studies of mobility behavior of mobile users [5], existing models try to closely represent the movement patterns of users. Moreover, it is well known that mobility models can significantly affect simulation results. For results to be useful, it is important that the simulated model is as close to reality as possible. For MANETs, the random way point model (RWP) is by far the most popular mobility model [6], but in a vehicular network, nodes (vehicles) can only move along streets, prompting the need for a road model. Another important aspect in VANETs is that nodes do not move independently of each other; they move according to well- established vehicular traffic models, so the results for MANETs may not be directly applicable. Moreover, the speed of these nodes are different (in MANETs, nodes' speed ranges from 0 to 5m/s, while in VANETs speed ranges from 0 to 40m/s)[6].

II. ROUTING IN VEHICULAR AD HOC NETWORKS

Vehicular ad hoc networks exhibit different characteristics from classical ad hoc networks. First, the mobility of vehicles is restricted by the road layout, other vehicles' movements and traffic rules. It is also affected by external factors like weather conditions or the timeframe under consideration. In addition, there are different scenarios such as cities or highways lead to distinct distributions of vehicles. The most salient feature derived from vehicular mobility patterns, is the fact that vehicles tend to move in groups forming clusters. Thus, the network becomes highly partitioned and an end-to-end path between source and destination might not exist at the time of sending a data message [7]. All these factors make traditional ad hoc routing not to be a very appropriate solution for vehicular settings. Thus, specific protocols have has been proposed accordingly. VANET specific applications mobile distributed applications starting from traffic alert dissemination and dynamic route reaching to context-aware advert and file sharing. The most concern is whether or not the performance of VANET routing protocols will satisfy the output and delay necessities of such applications. The aim of this work is to develop a VANET-Simulation scenario for supporting various VANET specific applications mobile distributed applications ranging from traffic alert dissemination and dynamic route planning to context-aware advertisement and file sharing. The main concern is whether the performance of VANET routing protocols can satisfy the throughput and delay requirements of such applications. Because of the great number of vehicles which may participate on a VANET, routing protocols need to be localized to ensure their scalability. That is vehicles make routing decisions solely based on information locally available in their close vicinity. Therefore, exchanging information with neighboring vehicles via beacon messages is a fundamental part of routing protocols in the

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literature. Generally, Vehicles can obtain position information from systems like GPS and Galileo. Hence, protocol designer's have focused on geographic routing as a basis for VANET-specific solutions. By using greedy heuristics, the protocols choose as next hop the neighbor which provides greater advance towards the destination's position (i.e., the one which is closer to the destination). Also, there are various problems comes into existence in geographic routing protocol in VANET scenarios. Several authors have approached traditional geographic routing in VANET scenarios for example GPCR and CAR algorithm.

Other protocols try to improve the performance obtained with geographic routing by means of using digital maps. Throgh the digital map, we gather the information about topology of streets. This is employed by the source node to compute a list of junctions which the data message must traverse to get to the destination. In order to traverse each junction, the protocols apply geographic routing along Each Street. GSR and A-STAR algorithm are examples of geographic-based VANET routing protocols that attach map information [8].

III. VANET ROUTING PROTOCOLS

VANET routing protocols can be categorized in to two major categories [9]:

i. Topology based routing protocols
ii. Geographic (position-based) routing protocols.

In topology based routing protocols each node is expected to know the entire network topology. In Geographic or position based routing protocols the decision on routing is based on the position of the sender, position of the destination and position of the sender's one hop neighbors using GPS. It is assumed that each node knows its position and the position of the destination. The position of its one hop neighbors is obtained from periodically exchanged beacons. In geographic routing the messages can be forwarded to destination without knowing the topology and without prior route discovery.In this section briefly describe some prominent geographic routing protocols.

IV. REQUIREMENTS OF VANET APPLICATIONS

Future VANET applications will have four fundamental demands: scalability, availability, context-awareness and Security and privacy.

A. **Scalability:** Because of the number of vehicles that could be incorporated into vehicular networks, VANET may become the largest ad hoc network in history. Undoubtedly, scalability will be a critical factor. The advantages of hybrid architecture, together within network aggregation techniques and P2P technologies, make information exchange more scalable.

B. **Availability:** Due to the real-time interaction between vehicular networks and the physical world, availability is an important factor in system design. This may have a major impact on the safety and efficiency of future highway systems. The architecture should be robust enough to withstand unexpected system failures or deliberate attacks.

C. **Context-Awareness:** As a cyber-physical system, VANET collects information from the physical world and may conversely impact the physical world. On the one hand, protocols should be adaptable to real-time environmental changes, including vehicle density and movement, and traffic flow and road topology changes. On the other hand, protocol designer should also consider the possible consequences the protocol may have on the physical world.

D. **Security and Privacy:** There are recent trends of making vehicular on-board computer systems inter-connectable to other systems. The Ford Sync, for example, connects the vehicle's entertainment system to the driver's cell phone via blue-tooth technology. In the future, vehicular on-board computers could even be open to software developers. These are trends may have serious implications for security and privacy due to the cyber physical nature of VANET. Governments and consumers will have very high expectations of VANET.

V. PRESENT WORK

Vehicular ad hoc networks (VANETs) are expected to support a large spectrum of mobile distributed applications that range from traffic alert dissemination and dynamic route planning to context-aware advertisement and file sharing.

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Considering the large number of nodes that participate in these networks and their high mobility, The problem still exist about the feasibility of applications that use end-to-end multi-hop communication in Intersection Routing on City Roads when they are executed in Real-Time Vehicular Traffic[10].

The main concern is whether the performance of VANET routing protocols can satisfy the throughput and delay requirements of such applications. Our recent research on VANET routing in city roads based scenarios. On analyses of traditional routing protocols for mobile ad hoc networks (MANETs), we calculated about performance in VANETs [11]. The main problem with these protocols, e.g., ad hoc on- demand distance vector (AODV) and dynamic source routing (DSR), in VANET environments is their route instability.

The traditional node-centric view of the routes (i.e., an established route is a fixed succession of nodes between the source and the destination) leads to frequent broken routes in the presence of VANETs' high mobility, Consequently, many packets are dropped, and the overhead due to route repairs or failure notifications significantly increases, leading to low delivery ratios and high transmission delays. We will design and implement an improved model for Intersection Based VANET Routing on City Roads Using Real-Time Vehicular Traffic and compared them with protocols representative of mobile ad hoc networks and VANETs. Simulation will be done using urban city maps settings and we will evaluate performance best in terms of average delivery rate.

A. *VANET Routing Algorithm*

Dijkstra's algorithm works by visiting vertices in the graph starting at object's as source point. It then repeatedly examines the closest not-yet-examined vertex, adding its vertices to the set of vertices to be examined. It starts outwards from the starting point until it reaches the goal. Dijkstra's algorithm is guaranteed to find a shortest path from the starting point to the goal, as long as none of the edges have a negative cost. The Greedy Best-First-Search algorithm works in a similar way, except that it has some estimate (called a heuristic) of how far from the goal any vertex is. It selects the vertex which is more closest to the goal rather than starting point. Greedy Best-First-Search is not guaranteed to find a shortest path. However, it runs much quicker than Dijkstra's algorithm because it uses the heuristic function to guide its way towards the goal very quickly. Wouldn't it be nice to combine the best of both? Dijkstra's and Greedy-Best-First algorithms are combined to give A* algorithm. A* is admissible and considers fewer nodes than any other admissible search algorithm with the same heuristic. This is because A* uses an "optimistic" estimate of the cost of a path through every node that it considers optimistic in that the true cost of a path through that node to the goal will be at least as great as the estimate. But, critically, as far as A* "knows", that optimistic estimate might be achievable. Here is the main idea of the proof:

When A* terminates its search, it has found a path whose actual cost is lower than the estimated cost of any path through any open node. As above mentioned estimates are optimistic, A-STAR can safely ignore those nodes. In other words, A* will never overlook the possibility of a lower-cost path and so is admissible. Below is the classic representation of the A* algorithm.

$$f'(n) = g(n) + h'(n) \quad \text{...eq (i)}$$

g(n) is the total distance it has taken to get from the starting position to the current location. h'(n) is the estimated distance from the current position to the goal destination/state. A heuristic function is used to create this estimate on how far away it will take to reach the goal state. f(n) is the sum of g(n) and h'(n). This is the current estimated shortest path. f(n) is the true shortest path which is not discovered until the A* algorithm is finished.

B. *Pseudo Code*

Step 1: Select Source and Destination.
Step 2: Find Euclidean distance between Source and Destination as g(n).
$$g(n)=Sqrt((x1-x2)^2 + (y1-y2)^2)$$
Step 3: Find out all the intermediate paths to the destination using city block distance.
Step 4: Calculate the city bock distance h'(n) of each path.
Step 5: Sort according to minimum distance after executing eq (i).
Step 6: while node has not reached to destination

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Check if the next intermediate city block has how much traffic
If it is congested, re-route according to next smallest h'(n).

Step 7: go to step 3.
Step 8: End.

VI. RESULTS ANDANALYSIS

VANET simulators can be classified as microscopic or macroscopic. Microscopic traffic simulators focuses on local behaviour of individual vehicles by assigning the velocity and position of each vehicle at a given moment. This type of simulation is especially helpful for studying localized traffic interactions.Most authors agree that a macroscopic mobility model is not sufficient to allow the study of a vehicular network, therefore microscopic simulation, although more complex, is required. The evaluation of vehicular applications for online traffic control (that produce real time feedback to the driver), such as safety applications, also requires a model of driver behavior. Simulation result shows execution of proposed work (A-STAR) algorithm in Figure 2.As we have imported OSM map for simulation purpose. Now it is time to generate vehicular traffic. Generation of Real time Vehicular Traffic that can be used to test the VANET, the system will use the Micro-simulation of each vehicle in the scenario. Each vehicle will be simulated individually. To enable random choices by the vehicle in the Micro-simulation of each vehicle hence vehicle can take decisions on its own making road traffic is as realistic as possible. In our project we have assigned unique ids to each vehicle that is acting as a node and the micro-simulation identity of VANET nodes is shown in Figure 3.

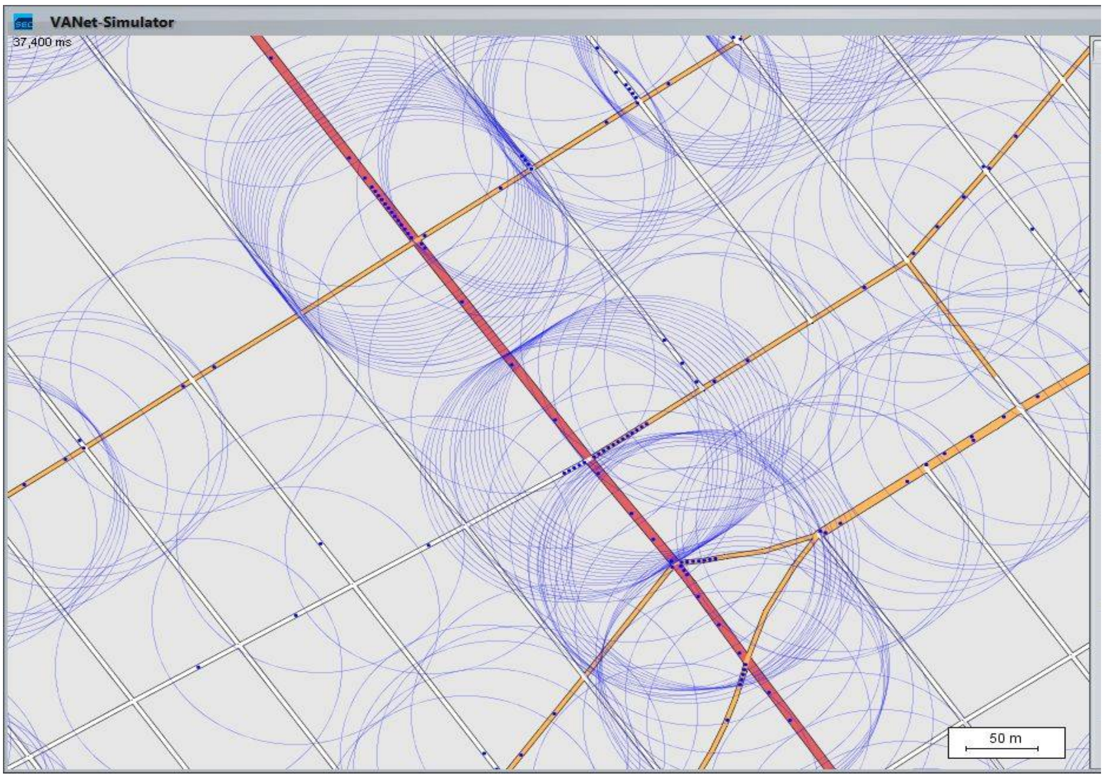

Figure 2: Executions of Proposed Algorithm and Communication Distance between Nodes

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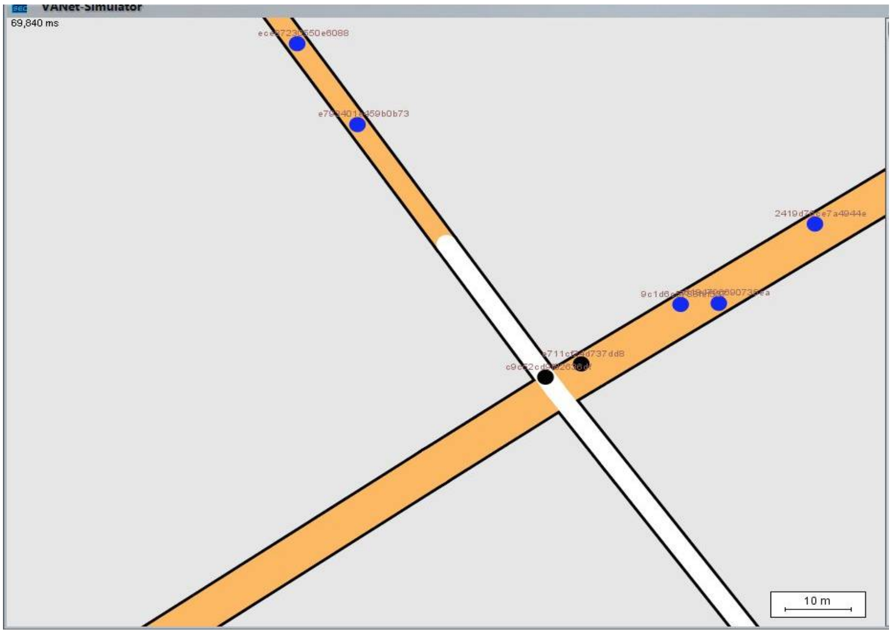

Figure 3: VANET Nodes with Micro simulation Identity.

Simulation results on Average Waiting Time in Silent Period in Figure 4, Average time taken for each node to reach its destination in scenario time in Figure 5 and Average Path time comparison in Figure 6. All are between our scheme (A-STAR) and existing (FS-GPSR) scheme by altering the no. of nodes vehicle. In this table, we can see that the time difference in proposed scheme is nearly half the existing scheme over increasing number of nodes which proves our A-STAR algorithm (Proposed Scheme) is better than FS-GPSR algorithm (Existing Scheme).

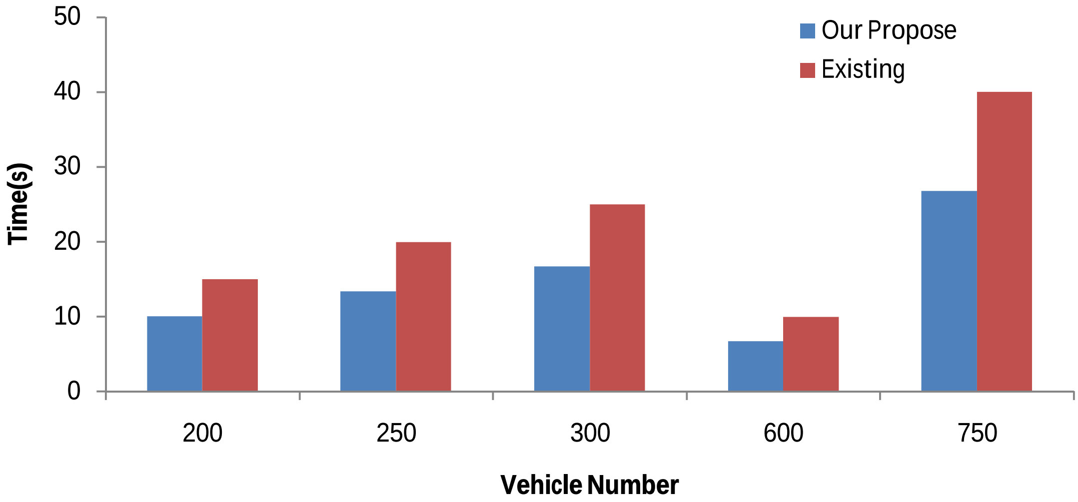

Figure 4: Average Waiting Time in Silent Period between Our Scheme and Existing Scheme

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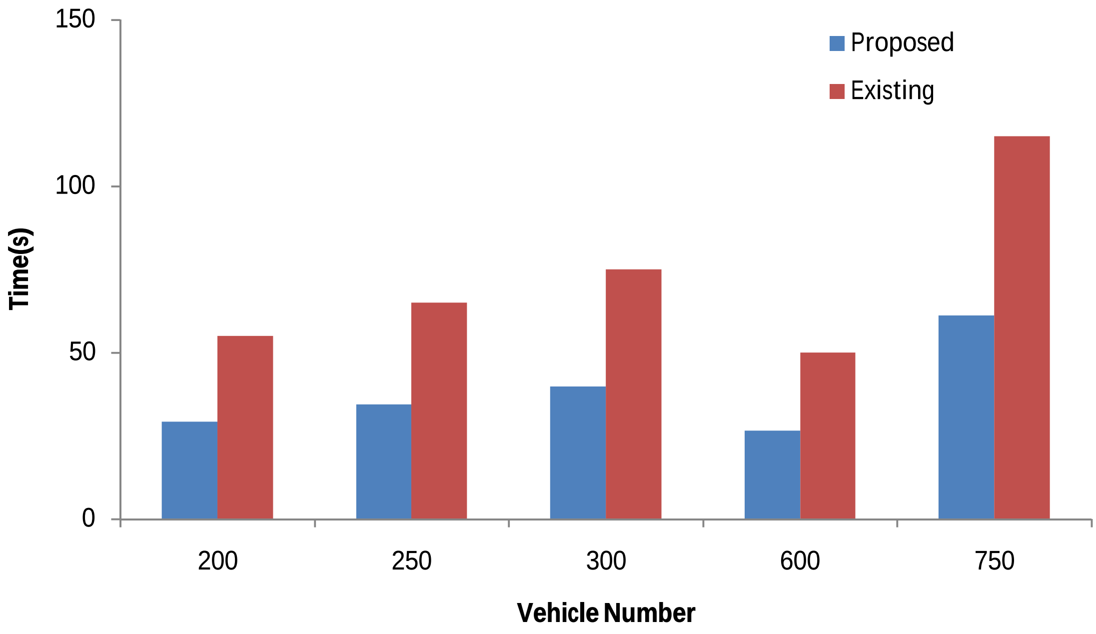

Figure 5 Average Time Taken for Each Node to reach its Destination in Scenario time between Our Scheme and Existing Scheme

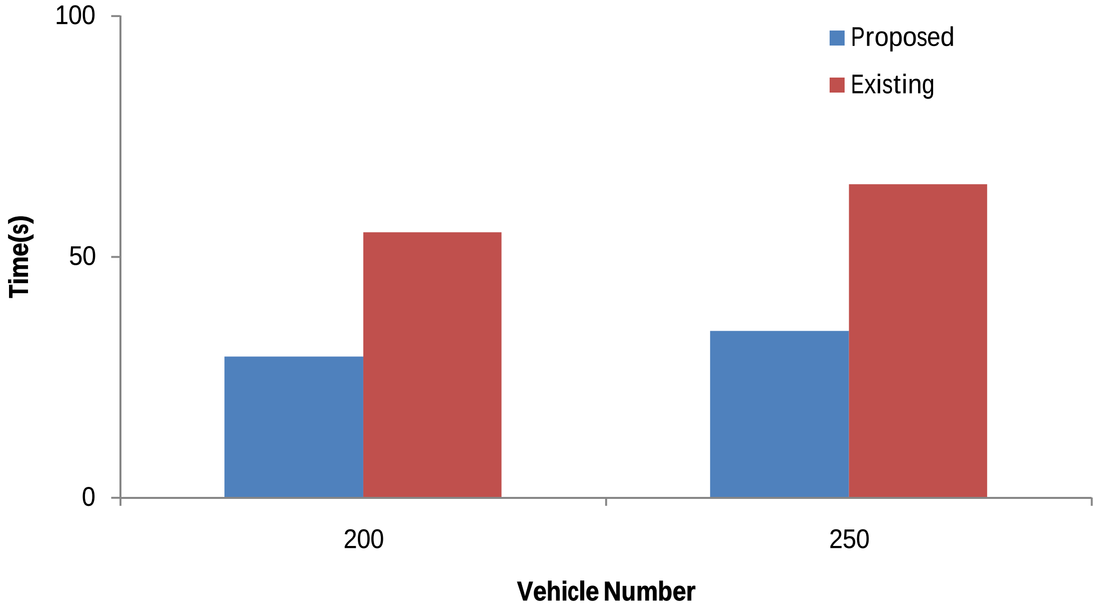

Figure 6: Average Path Time taken for Proposed and Exiting Schemes

Hence, the Proposed work improves this traffic management and reduces ccollision with achieving shortest distance

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between Source and destination point by minimizing average waiting time,time taken to reach destination and average average path time than previous works.

VII. CONCLUSION

We have been successful in achieving the following objectives that were set for this research work we have developed a VANET-Simulation scenario for supporting various VANET specific applications. The large spectrum of mobile distributed applications range from traffic alert dissemination and dynamic route planning to context-aware advertisement and file sharing. Made a simulation setup to allow large number of mobile nodes (vehicles), Considering the large number of nodes that participate in these networks and their high mobility. Designed and implemented an improved model for Intersection Based VANET Routing on actual City Roads (maps) from real world cities. City Maps was imported from XML files. The Algorithm developed is stable in nature and can provide consistent message delivery across the network. We have been successful in achieving the following objectives that were set for this research work we have developed a VANET-Simulation scenario for supporting various VANET specific applications. The large spectrum of mobile distributed applications range from traffic alert dissemination and dynamic route planning to context-aware advertisement and file sharing. Made a simulation setup to allow large number of mobile nodes (vehicles), Considering the large number of nodes that participate in these networks and their high mobility. Designed and implemented an improved model for Intersection Based VANET Routing on actual City Roads (maps) from real world cities. City Maps was imported from XML files. The Algorithm developed is stable in nature and can provide consistent message delivery across the network.

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