Traffic Management Through VANET

Farza Baber, Muhammad Rizwan
Department of ComputerScience
Kinnaird College for Women
Lahore, Pakistan
farza0111@gmail.com

DOI: 10.29322/IJSRP.9.02.2019.p8647
http://dx.doi.org/10.29322/IJSRP.9.02.2019.p8647

Abstract—**Vehicular ad-hoc network (VANET) is one of the biggest components of intelligent transportation system (ITS). VANET requires routing protocols but it's a challenging task as we have to check city environment, vehicle speed and network partitioning. VANET have many routing protocols but the most promising protocol is Position based protocol as it avoids overhead, heavy storage, delays, disruption of nodes, wasting bandwidth. Position based routing protocol are on geographical position of vehicles to select best path to exchange data. This paper discus GPSR and A-STAR routing protocol. We deal with many GPSR improved versions to get the best path by lowering the delay and tackling low delivery rate. This paper aims to improve A-STAR so that it not only facilitate urban area by predicting the motions of vehicles to improve efficiency but also by getting distance to get accuracy for data to be routed. A-STAR uses Dijktra's algorithm, but this paper uses curvemetric algorithm to find best path.**

Keywords— VANET, Best path, A-STAR, Curvemetric distance, Routing protocols

INTRODUCTION

Intelligent transport system is one of the biggest applications for road safety by protecting us from road collision or distributing road information. Vehicle communication has made life easier as we can share road information at any time and at any place. There are two types of vehicle communication vehicle to vehicle and vehicle to infrastructure and this vehicle communication is through VANET as shown in Figure 1. VANET is a major component of ITS. VANET allow vehicles to communicate to avoid accident, to inform about road blocks, ensures about blocked areas. VANET characteristics involves mobility, furiously changing network topology, No bound on network size, frequent change of information last but not the least multi hop data circulation due to which it can spread warning messages, exchanges information. Through these characteristics, VANET can analyze large amount of data on routes which are predefined.
As said above. Routing protocol is divided into five categories topology based, geographical, cluster based, broadcast and geocast.

The purpose of this paper is to compare these routing protocols by viewing their pros and cons. The best routing

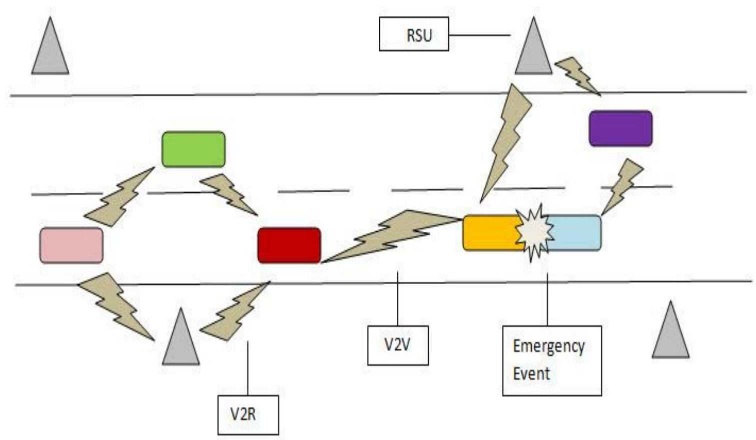

Figure1. VANET showing types of vehicular communication

Protocol is geographic protocol as it avoids overhead, heavy storage, delays; disruption of nodes, wasting bandwidth. Geographical protocol depends on position where each node knows the position of its destination, surrounding neighbors and its own position and for this it uses resources like global positioning system (GPS).
This study is concerned with GPSR, A-STAR, Vector based improved geographical routing protocol, Greedy curvemetric geographical, IDTAR and URAS. GPSR makes sure that packet is send from source. The rest of the paper is organized as follows: Section II explains the problem statement; Section III discusses a number of approaches and protocols which are related to our research. Section IV describes proposed algorithm which is a hybrid of A-STAR and curvemetric greedy algorithm. Section IV a) proposes a new module. Section V provides conclusion. The main purpose of this paper is to get a view of challenges faced by routing protocols and how to overcome through A-STAR new

version. It is not easy to build a protocol due to number of vehicles moving around especially in urban areas.

In urban areas speed of vehicles is different from highway as there are so many obstacles while driving like traffic lights, zebra crossing, and vehicle density is more which weakens signal strength.

PROBLEM STATEMENT

One of the major challenges geographic routing protocol faces is local maximum. Local maximum is when current node does not find any closer node to destination to hop in. There is no neighboring node to destination so it gives a dead end. Many methods have been proposed for local maximum issue like GPSR, A-STAR, IDTAR, URAS and vector based routing protocol. Through these routing protocols, it gives us shortest as best path. Major issue is that these protocol uses dijktra's distance which is a straight line distance. Our environment is full of obstacles. While moving around we get hindrances so shortest distance is not always the best path. Sometimes we need full path to get shortest distance.

LITERATURE REVIEW

VANET provides vehicle to vehicle communication through routing protocols. Figure 2 shows few routing protocols with reference to V2I and V2V. GPSR and A-STAR are the most efficient routing algorithms to forward packet in a best manner, but still faces a lot of challenges like delivery rate, throughput, and delays. In this section we will be discussing Vector based geographic routing protocol, Connectivity oriented routing protocol, Beamforming technique, Greedy curvemetric based routing algorithm and Intersection based algorithm. All these algorithms mentioned above will give us the best path to forward packet.

- GPSR is a combination of greedy forwarding. In GPSR packet contain information of location of destination. Through this information source and intermediate node passes data to those nodes which are closer to destination only. Each node uses greedy forwarding, using Dijktra's algorithm to get the shortest path to next node. Perimeter forwarding algorithm is only used when local minimum occurs. GPSR has a disadvantage that it requires geographic location information of neighboring nodes. In GPSR the more distant is the node; more will be the movement of speed causing packet loss and bad quality of service.

- The basic purpose of Anchor based street and traffic aware routing (A-STAR) is to support city environment. That's a protocol that can even work for low traffic density. The purpose of this algorithm is to deliver maximum packets to destination by using city bus routes information to find anchor path. This protocol has a very effective recovery mode. In a case when there is no node near to destination to forward packet, it computes new anchor path from local maximum.

- Vector Based algorithm chooses next hop through calculation of vector and partition model. It is an

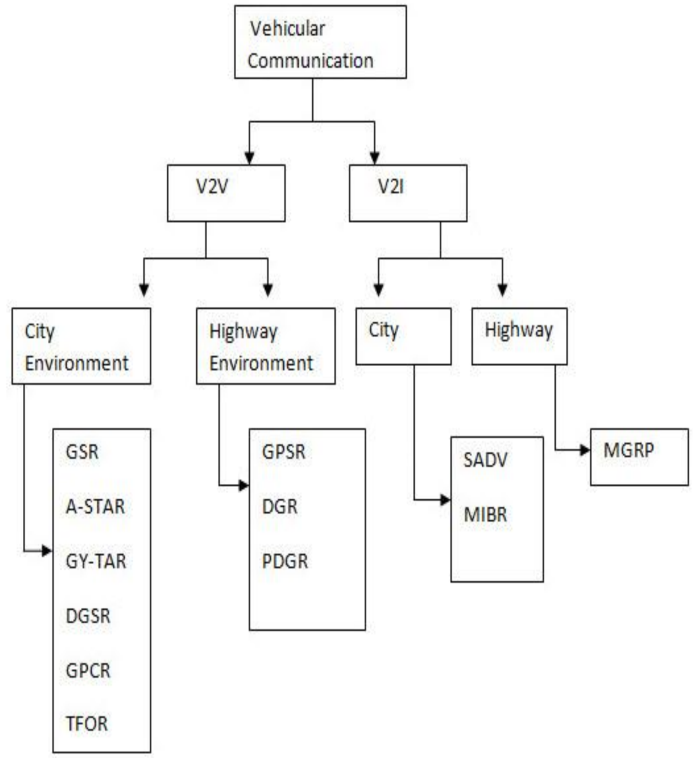

Figure2. Categories of position based routing protocol

improved version of GPSR algorithm [4]. Through this protocol local optimal is avoided by fixing nodes at intersection by which it selects more authenticated nodes. It focuses on forwarding strategy and divide it in two parts (I) To get routing direction decision, node which are intersecting uses partition model algorithm and then to get to next node it will be using intersection greedy forwarding strategy. (II) Forwarding routing strategy will be used so that nodes can forward the data packets. One of the major problem faced using vector based algorithm is that, it cannot tackle obstacle in environment.

- The other routing protocol that is discussed in this paper is Greedy Curvemetric-Based Protocol [2]. Using VANET with greedy routing protocol in city environment faces a lot of obstacles like trees, buildings that could minimize packet reception and decrease signal quality. To avoid these kinds of challenges a new routing protocol was established that used curvemetric distance instead of Euclidian distance to find shortest path. This strategy uses geographic information of neighbors, digital map of a city; destination coordinates to deliver a packet and selects the closest node to the destination through curvemetric distance. Its recovery strategy is not that reliable. It needs to be improved. Packet delivery failure causes local maximum problem causing high cost, end to end delay.

- Better technique than Greedy Curvemetric based protocol is Intersection based distance and traffic aware routing (IDTAR) [6]. Routing is the biggest factor that takes a part in communication between vehicle to vehicle and vehicle to infrastructure. IDTAR provides effective performance within city. It takes distance and real time density of traffic into account to get best path. It is one of the most adaptable routing protocols. IDTAR gives highest packet delivery ratio and lowest end to end delay than any other position based protocol as it determines the path dynamically.
- Another routing protocol that is adaptable to environment is unicast routing protocol based on attractor selecting (URAS) [5]. Through routing feedback of packets, it provides flexible environment. It Works on new algorithm called technique for order preference by similarity to an ideal solution (TOPSIS), It reduces number of nodes to select to hop. URAS improves performance by using method TOPSIS. It self-evaluates to find best path by maintaining current path and evaluating next path through current one. This routing protocol uses cellular attractor selecting model to give robustness and adaptability to take decision through feedback data.

Table 1 gives a brief comparison of VANET routing protocols as discussed in this paper. It shows how each routing protocol is better than other.

Table1. Comparison of different publications

Publications	Year	Strength	Weakness
TawfiqNebbou and Mohamed Lehsaini “Greedy Curvemetric-based Routing Protocol for VANETs”	2018	This strategy uses destination coordinates to deliver a packet and selects the closest node to the destination through curvemetric distance to avoid obstacles like building, trees and etc	Its recovery strategy is not that reliable. It needs to be improved. Packet delivery failure causes local maximum problem causing high cost, end to end delay.
Liu Zhang and JinxuGuo “A Vector based-Improved Geographic Information Routing Protocol”	2017	This strategy chooses next hop through calculation of vector and partition model. Through this protocol local optimal is avoided by fixing nodes at intersection by which it selects more authenticated nodes.	One of the major problem faced using vector based algorithm is that, it cannot tackle obstacle in environment.
DaxinTian, KunxianZheng, Jianshan Zhou, XutingDuan, Yunpeng Wang, Zhengguo Sheng, and Qiang Ni “A Microbial Inspired Routing Protocol for VANET ”	2017	It self-evaluates to find best path by maintaining current path and evaluating next path through current one. This routing protocol uses cellular attractor selecting model to give robustness and adaptability to take decision through feedback data.	Position services may fail in tunnel or obstacles (missing satellite signal) Unnecessary flooding
Abdelmuttlib Ibrahim AbdallaAhmed,AbdullahGani, SitiHafizahAb Hamid, Suleman Khan, NadraGuizani, Kwangman KO “Intersection-based Distance and Traffic-Aware Routing (IDTAR) Protocol for Smart Vehicular Communication”	2017	This strategy takes distance and real time density of traffic into account to get best path. It gives highest packet delivery ratio and lowest end to end delay as it determines the path dynamically.	It has security issues such as authentication and trust Position services may fail in tunnel or obstacles (missing satellite signal)

PROPOSED SOLUTION

In our solution we would be redefining A-STAR routing protocol. A-STAR uses anchor path to forward a packet. Anchor path is a list of middle nodes to reach to destination. This path is calculated through dijkstra's algorithm. But for our new version we would be using curvemetric distance to get best path. Shortest path is not always the best path. Sometimes longest path is the most suitable one. Through this curvemetric distance a node would be selected that is not surrounded by any obstacle. A-STAR is the best approach when local maximum occurs. Local maximum occurs when node has no node nearer to destination other than itself. This issue can be resolved if packet is only forwarded to traffic area. It has two layers. Lower layer exchanges information about network and higher layer computes most eligible path. In this new version we will be using curvemetric distance, by taking weight of multiple edges of each node and will prove that shortest path is not always the best path.

This section explains how node selects hop through curvemetric distance [2]. We assume that each node knows its own position; each node has a GPS receiver to get velocity and direction and digital map city to calculate curvemetric distance. Curvemetric distance is calculated between two nodes through formula:

Curvemetricdist(ni, nj) = Shortest Pathlength(ni, nj) [2]

As we know that we have geometric shape of roads and each road is different from other road so calculating Euclidean distance would give us wrong information as it would be calculating more hops.

Actually this is the real world scenario. Vehicle will never get a path that is obstacle free. Our environment is full of hindrances like buildings, roads and so on. Curvemetric distance shows that it covered full distance from A to D and that longest path is the shortest distance to get to destination this is because shortest distance is composed of multiple shortest sub paths due to which all next hops will belong to the shortest path as shown in Figure 3[2].

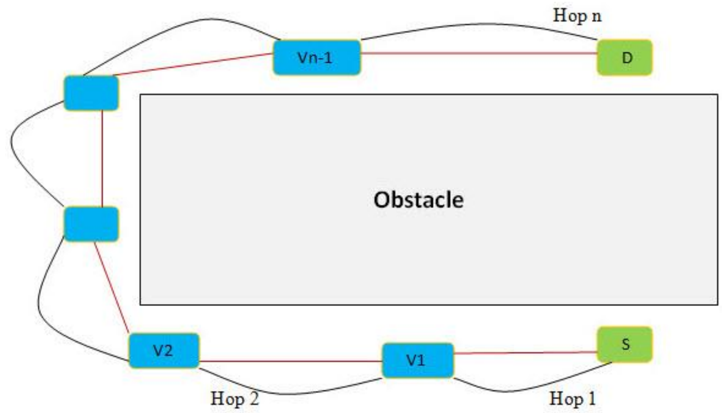

Figure3. Shortest Path

A. MODULE

There are two net layers high net layer and low net layer. In low net layer traffic monitoring is done as shown in Figure 4 [1]. Beacons are used to hold observation of nodes which are in neighbors. Traffic monitoring module manages these observation which are maintained in data structure. Neighbor table maintains position of its neighbors through beacons. Presence vector (PRV) has four counters. It tells about number of neighbors. Each counter is incremented when neighbor is in that direction and decremented when neighbor information is not updated within particular time.

PRV has two parameters high PR and low PR. If PRV counter exceeds high PR that means there is a lot of traffic within that direction and if PRV counter is less that low PR than there is less or no traffic within that direction. If any of these situations occur than the element in PEV is changed. PEV has four elements as seen in Figure 5. Element can be in any three states reset state, growing state and shrinking state. If an event exceeds high PR, then PEV is set to reset or to growing state, gets incremented. If an event is less than low PR, then PEV is set to reset or to shrinking state, gets decremented. When PEV value of element is out of range, then the value of element is stored into traffic table. Traffic table has five fields position: it indicates coordinates of nodes if any different traffic situation occurs, direction: it is the direction where deviation occurs in traffic, traffic bit (Tbit): identify type of traffic (high or low), already sent bit (ASbit): is this entry traffic already used to neighbors and Time to live (TTL): number of hops. Each entry has a traffic timer, when it expires entry is deleted from the table.

Each node has a traffic table. Each node sends a beacon message to other node, which is stored in neighbors table. If elements PEV is higher or lower than new entry is added in traffic table. Information about neighbors is set in traffic table like TTL is maximum, ASbit is zero, Tbit value chosen according to traffic being high or low. Each beacon is copied in traffic table. If traffic table gets information that is same and also have same direction and position then entry having greater TTL will exist. If deviation for traffic occurs for short time but twice then traffic table entry is refreshed by setting ASbit to zero. When beacon timer expires, new beacon is created. If ASbit is 0 then traffic table is copied to beacon else deletes information.

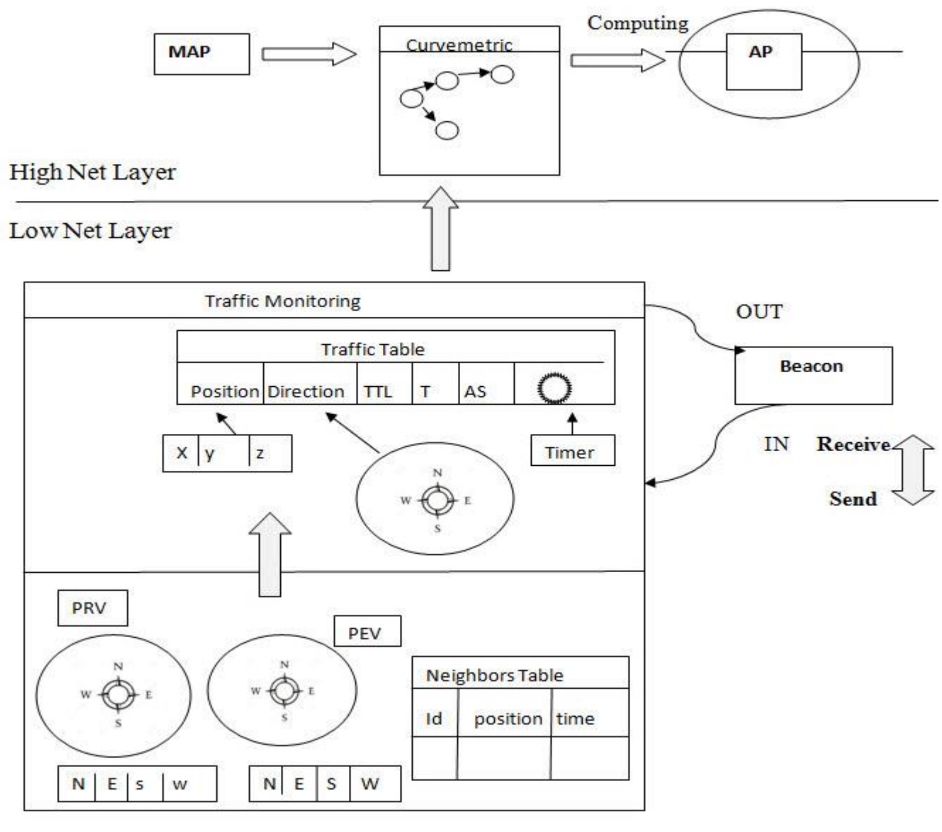

Figure 4.Architecture for A-STAR algorithm using curvemetric distance

At higher layer When S need to send packet to destination, S creates a weighed graph through the help of street map and traffic information. Edges have more weight, if there is no traffic. If there is more traffic then weight is decreased. Initial edge weight makes sure that weight is never negative or null. Curvemetric algorithm is applied to get full path which is actually the shortest path. Let me explain it through an example shown in Figure 5 [3]. Let's say source node S wants to forward a packet to destination node D. It has two intermediate nodes A and B.d1 is the Euclidean distance between AD, d2 is the Euclidean distance between BD, c1 is the curvemetric.If we see figure 5 [3], it is obvious that if we use Euclidean distance closest node to destination is node B. but if we use curvemetric distance, closest node would be A as there is an obstacle shown in figure 5 [3]. APs are simulated along streets. Each packet header contains destination id, destination position and few APs. Packet is forwarded through geographic routing protocol from one AP to another AP. In case of any failure, recovery mode is on through which new route is explored updating traffic information.

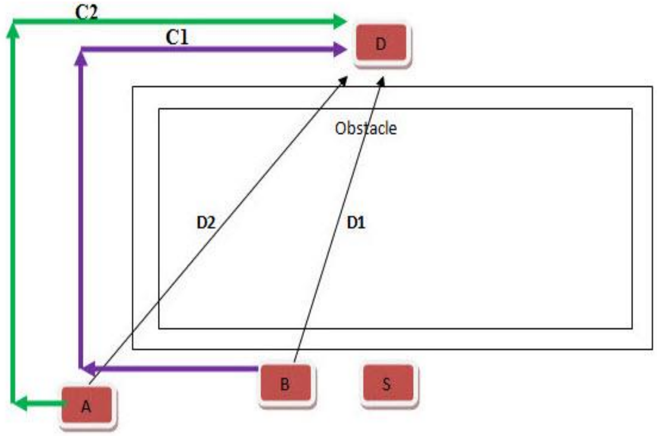

Figure 5. Curvemetric v/s Euclidean Distance

Algorithm1: A-STAR algorithm using curvemetric distance

1. Each node sends beacon message to other node.
2. Message has sender identifier, sender coordinates and the vehicular traffic conditions it has in its traffic-table.
3. Node receiving beacon stores position of sender in its neighbor table.
4. Update PRV and PEV
5. Loop
    a) IF PRV counter exceeds a parameter high PR
    a high concentration of vehicles exists in that direction.
    b) Else
    Low PR Indicates scarce vehicular traffic along a street in the direction of the node.
    c) PEV is triggered if any of the situations occurs.
    d) Loop
    e) IF In case of exceeding high PR, if the corresponding PEV element is in either reset or growing state
    Then it is incremented;
    ELSE
    PEV element is set to reset state.
    f) IF In case of event of a PRV element below low PR, if the PEV element is in either reset or shrinking state
    Then it is decremented
    ELSE
    PEV element is set to reset state.
    g) End Loop
    h) IF the value of an element of PEV goes out of a range [lowPE, highPE]
    The information about vehicular traffic stored in the element is recorded in the traffic-table and the value of the PEV element is reset.
    i) End IF
    j) End Loop
6. IF one of the elements of PEV becomes either lower than low PE || higher than high PE
New entry is added in the traffic-table.
7. End IF
8. Update information of neighbors.
    a) ASbit set to zero
    b) TTL set to a value maxTTL
    c) Tbit is set to the appropriate value 'H' or 'L' according to the vehicular traffic condition detected.
9. IF TTLs are equal
The traffic-timer (determining entry expiration time) of the traffic-table entry is set to the initial value and the ASbit is set to 0.
10. End IF
11. While a node's beacon-timer does not expire
12. A new beacon carrying node's identifier and position is created.
13. For Each
14. IF TTL>0 && ASbit=0
15. The traffic-table is copied into the beacon and ASbit is set to 1 to prevent diffusing multiple times certain information.
16. The beacon is sent.
17. Loop
18. At higher layer
19. While S need to send packet to destination
20. S creates a weighed graph through the help of street map and traffic information.
21. Curvemetric algorithm is applied to get full path this is actually the shortest path.
22. End Loop
23. Gives Best path

CONCLUSION

In this present paper we proposed A-star routing protocol with new strategy. Main purpose was to choose best path from one to node to another node. A-STAR is being used with curvemetric distance instead of Euclidean distance. Curvemetric distance doesn't provide shortest distance but it gives the best path. Euclidean is the distance for straight line but curvemetric distance will help in tackling obstacles like buildings, trees and so on. As future work, we plan to work on recovery strategy in order to reduce end to end delay.

REFERNCES

[1] F. Guidici and E. Pagani, "Spatial and traffic-aware routing for vehicular system," Italy.

[2] T. NEBBOU and M. LEHSAINI, "Greedy Curvemetric-based routing protocol for VANET," Algeria, 2018.

[3] L. Zhang and J. Guo, "A Vector based Improved geographic information routing protocol," Wuhan,Hubei Province,China, 2017.

[4] D. Tian, K. Zheng, J. Zhou, X. Duan, Y. Wang, Z. Sheng and Q. Ni, "A Microbial Inspired Routing Protocol for VANET," no. Finding best path, p. 10, 2017.

[5] A. Ibrahim, A. Gani, S. Hafizah AB Hamid, S. Khan and N. Guizani, "Intersection-based Distance and Traffic-Aware routing(IDTAR) protocol for smart vehicular communication," Kuala Lumpur,Malaysia, 2017.

[6] G. D. H, "Improvement of GPSR Algorithm for Vehicle Network," 2017.

[7] L. Y. B, W. Y. H. and C. G. H. , "Security model and key technology for VANET," China, 2016.

[8] Z. Gao, K. J. and Y. , "Crossroads Optimal Geographic routing for vehicular ad hoc network in city," 2014.

[9] L. Hu, Z. D. and H. , "Imp[roved GPSR routing strategy in VANET," 2012.

[10] B.Karp and H. , "Greedy Perimeter stateless routing for wireless network".

[11] D. Jiang and L. , "International Standard for Wireless Acess in Vehicular Enviornment," Singapore.

[12] J.Gong, C. and J. , "Predictive Directional Greedy Routing in Vehicular ad hoc network," Toronto.

[13] C.Lochert, H. J. T. H. D. and M. , "A routing strategy for vehicular ad hoc networks in city environment".

[14] M.Young, "Scalability Problem of Vehicular Ad Hoc Network and how to solve it," 2014.

[15] K. Ganesh and A. V.Sakhare, "A Smart City framework for intelligent traffic system using VANET," 2014.

[16] Karp.B and K. , "GPSR for wireless network," 2015.

[17] Perkins, C. B.-R. and E. , "Ad-Hoc On-Demand Distance Vector," Toronoto, 2015.

[18] L.J.Chen, H. W.-P. and P. Y. , "Research on transmission control on VANET," *Jopurnel of Software*, pp. 117-126, 2014.

[19] L.Bieker, D. F. and A. , "Traffic Simulation: A real world traffic scenario from city of Bologna," Springer International, Bologna, 2015.

[20] G.Motoyoshi, K. and M. , "Proposal and evaluation of a future VANET," vol. 24, p. 259, 2014.