CONGESTION CONTROL REAL-TIME PATH PLANNING IN HYBRID VANET FOR URBAN AREA

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Abstract – Real time path planning algorithm is an effective way to avoid traffic congestion in urban areas. It is challenging to develop an algorithm for path planning as each driver has their own preferences while driving. There is existing Hybrid Intelligent Transportation System (ITS) for path planning and it is hybrid VANET enhanced ITS. This system utilizes vehicular ad-hoc network and cellular systems of public transportation systems. With the help of this system, it is possible to have a real time communication between vehicles, road-side units (RSUs) and vehicle-traffic server. This system improves overall spatial utilization of a road network and reduces average vehicle travel cost by avoiding it from getting stuck in traffic congestion. This is achieved by using real time path planning algorithm. Proposed system improvises the path planning algorithm by selecting the right path by considering the criticality of the vehicle (for e.g., ambulance) and the type of the vehicle (a two wheeler can use a narrow path when compared to the path that can be used for a car). By this approach, travel cost should come down and also the spatial utilization should be even better than existing system.

Key Terms – Road-side units, Vehicular ad-hoc network, Vehicle – to - Vehicle, and Vehicle – road - side units communications

1. INTRODUCTION

A significant problem faced when we travel by road is traffic congestion. We waste lot of our precious time 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 detailed research and studies revealed that traffic congestion causes billions of extra travel and also 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 are costly and more than that it is inefficient as it usually fails to give a quick response to an emergency created by an accident or disaster. Even though these traditional systems are capable of providing alternate paths, they can only respond slowly because they do not have a real-time traffic information.

The major challenge to overcome the inefficiency of the traditional intelligent transportation systems is in collecting the real-time traffic information. One solution to this problem is the usage of vehicular ad hoc networks (VANETs) which can be provide an ITS system with better communication techniques in a cost effective way. It enables Vehicle-to-Vehicle (V2V) and vehicle-to-roadside-unit (V2R) communications [3] which enables the exchange of real-time traffic information between vehicles and between a vehicle and road side units (RSUs) [4]. This information can be used to identify real-time traffic congestion and thus it is possible to decide and alternate path for the vehicle. Figure 1 shows V2V and V2I communication.

Many algorithms are available to identify an optimal path in response to the real-time traffic information provided by VANETs [5] [6]. But these algorithms can itself create congestions if not performed uncoordinatedly. One more inefficiency of these path planning algorithms is that most of them does not take driver's preference into consideration. In most cases the algorithms set its main objective as avoiding the congestion rather than finding an optimal paths for individuals. Because of this, there might come an additional cost to those who are travelling because the path suggested might not be an optimal path.

Therefore, algorithms should be designed to jointly consider the balance of the network traffic and the reduction of average vehicle travel cost. To this end, propose a real-time global path planning algorithm which exploits VANET communication capabilities to avoid vehicles from congestion in an urban environment .Both the network spatial utilization and vehicle traffic cost are considered to optimally balance the overall network

smoothness and the drivers preferences .Specifically, the contributions of this paper are:

First, we propose a hybrid-VANET-enhanced ITS framework to facilitate the application of real-time path planning .Second, we design a real-time path planning algorithm to improve network spatial utilization and also to reduce average travel cost. Finally simulations validate the effectiveness and efficiency of the proposed path planning algorithm.

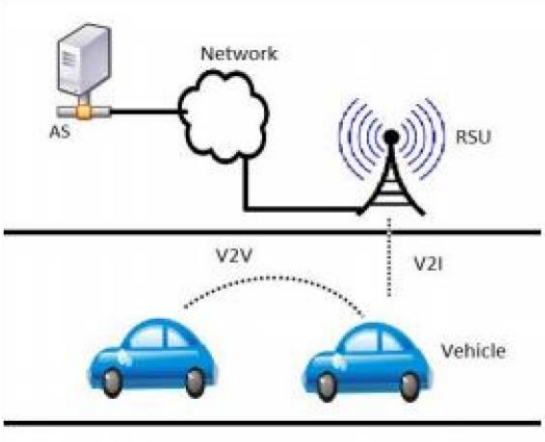

Figure 1: V2V and V2I communication

2. RELATED WORKS

An accident or unexpected incident at the road and cause traffic congestion which often creates too much of problems for those who travel by road. People may fail to reach their destination on time, direct cost incurred by them (e.g. fuel wastage), indirect cost incurred by the driver (cost of not reaching the destination on time – is almost uncountable). This problem can be dealt or at least the cost can be reduced by route planning or path planning with congestion avoidance. The traditional methods which uses GPS, wireless internet or cellular networks are often inadequate to resolve this problem completely because of their incapability to notify a real time accident in a quick time. Delays in transmitting this information is as inefficient as not transmitting this information at all.

One better technique to overcome most of the drawbacks of the traditional systems is by using a traffic management system with loop detectors for a continuous traffic measurement monitoring along arterials. There are certain drawbacks for cellular systems and loop detectors as well [7]-[10]. Cellular networks are highly expensive and as the amount of traffic data increases, other cellular networks my face congestion. For loop detectors also, deployment cost is usually very high. Another drawback is that in dense networks, performance of path planning is always less as the position measurement for short-distance transmissions becomes inaccurate.

VENETs are much more efficient than the traditional methods described above. VANETs enable real time communication when a sudden accident or incident occurs. V2V and V2R communications helps VANETs to achieve this with high accuracy. The advantages of this communication when compared to the traditional techniques is that it is cheaper, quicker and more efficient. RSUs in VANETs is an important entity which improves the timeliness of data collection and distribution. This helps in performing a coordinated path planning for bunch of vehicles. In this method, to reduce the end-to-end transmission delays or buses are considered as super relays.

A lot of studies are still being conducted based on VANETs. Although VANETs consider multi-vehicle path planning, few of its disadvantages are that it does not consider average total cost or the driver's preference. To overcome these challenges, we propose a global path planning algorithm to avoid traffic congestion in urban area. The new system ensures full utilization of network resources and the average total cost of the vehicles are considerably reduced.

3 SYSTEM MODEL

Our aim is to provide a real-time path planning for vehicles from a global perspective.

A. Architecture of Hybrid-VANET Enhanced Transportation System

The architecture of the considered hybrid-VANETenhanced transportation system, consisting of vehicles, RSUs, cellular base stations (BSs) and a vehicle-traffic server [1]. Figure 2shows the architecture of the VANET system.

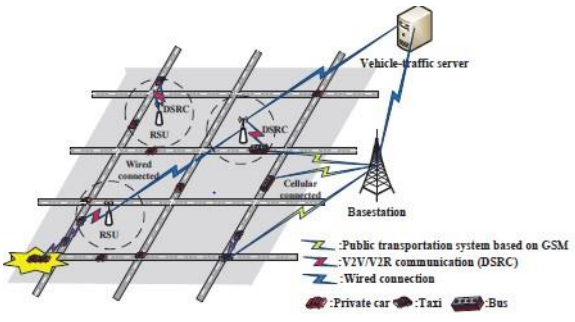

Figure 2: Hybrid VANET-enhanced network architecture

B. Types of communications

Vehicles are equipped with on-board units (OBUs) that enable multi-hop V2V communications. That will helps to delivering periodic vehicle information (like location, density etc.). When vehicles generate alert about accident related congestion, this information will pass not only among vehicles but also with the nearest RSU through V2R communication. The taxis and buses will give priority for directly upload the warning message to nearest cellular BS and the BS will pass this information to vehicle-traffic server.

C. Road side units (RSUs)

RSUs are deployed along the roads for obtaining vehicle traffic statistical information. One RSU can communicate with nearby RSU through wireline communication. If RSUs are placed at intersections then traffic information are detected by cameras or flow meter connected to RSUs directly. Else traffic flow can be detected by nearest RSUs based on the collected information from the VANETs. An RSU can share its own collected information with other RSUs and vehicle-traffic server. When an accident occurs, the vehicle-traffic server using all the collected information for finding global optimal path. Figure 3 shows the path planning structure of enhanced ITS.

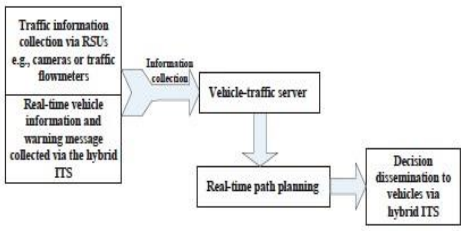

Figure 3: Path planning in a VNET-enhanced ITS

D. Traffic Flow Model

Each vehicle is expected to follow a planned path from its starting point towards its destination. In the proposed system the driver can select his preferred path from a list of paths that connect source and destination. The driver will follow the same path until he receives any accident/congestion notification. When an accident/congestion occurs the vehicle-traffic server will take the responsibility for finding an alternate path by running path planning algorithm.

E. Path Planning algorithm Design

For designing path planning algorithm comprises of main functions such GET ROUTE and SEND ALERT. GET ROUTE function find out all path from source to destination once the driver sets the source and destination. From this list driver can select a route for his journey. So it will keep driver's preferences. When any of the vehicles in the road come across with an accident/ incident/congestion, an alert will be sent to RSUs by using SEND ALERT.

4. PERFORNACE EVALUATION

A. Simulation of the Proposed Path Planning in Java

Figure 4: Simulation of enhanced VANET ITS

Figure 4 shows the simulation done in Java for the proposed enhanced VANET network. Once the source and the destination is chosen list of available paths would be shown. Desired path can be chosen from this list for each vehicle. While moving along the road, system simulates the alert sent by a vehicle to RSU when it come across any accident/congestion. System also simulates RSUs redirecting the other vehicle through alternate paths thus avoiding congestion.

Figure 5 shows the comparison between performance of existing system and proposed system. Proposed System outer performs than existing in terms of number of vehicles per average speed.

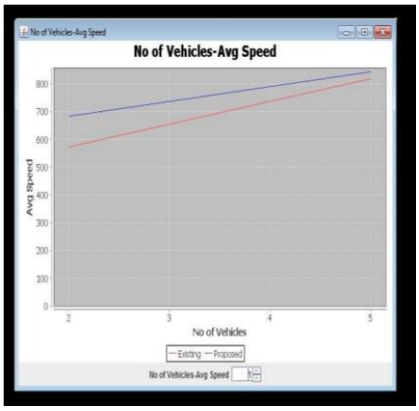

Figure 5: Performance evaluation of the proposed transmission mechanism

5. CONCLUSION

Study about hybrid-VANET-enhanced real-time path planning for vehicles to avoid congestion in an ITS. The existing system contain a hybrid-VANETenhanced ITS framework with functionalities of realtime traffic information collection, involving both V2V and V2R communications in VANETs and cellular communications in public transportation system. Then, a globally optimal real-time path planning algorithm is designed to improve overall spatial utilization and reduce average vehicle travel cost. In the existing system provide the new path when there is any congestion in their route .The new route assigning vehicles according to emergency of vehicle(like Ambulance) .In addition the proposed system provide route based on vehicle type(i.e. four wheeler, two wheeler and so on) .

REFERENCES

[1] Miao Wang, Hangguan Shan, Rongxing Lu, Ran Zhang, Xuemin (Sherman) Shen, Fan Bai Department of Electrical and Computer Engineering, University of Waterloo, Waterloo, Ontario, Canada Department of ISEE, Zhejiang University, Hangzhou, China Communication Engineering School of Electrical and Electronics Engineering, Nanyang Technological University, Singapore ECI Lab, General Motors Global RD, Warren, MI, USA, «Real-Time Path Planning Based on Hybrid-VANET-Enhanced Transportation System" IEEE Transactions on Vehicular Technology,2014.

[2] M. Papageorgiou, C. Diakaki, V. Dinopoulou, A. Kotsialos, and Y.Wang, "Review of road traffic control strategies," Proc. The IEEE, vol. 91, no. 12, pp. 2043-2067, 2003.

[3] R. Lu, X. Lin, and X. Shen, "SPRING: A socialbased privacy preserving packet forwarding protocol for vehicular delay tolerant networks," Proc. IEEE INFOCOM, San Diego, USA, Mar. 2010.

[4] M. Wang, H. Liang, R. Zhang, R. Deng, X. Shen, "Mobility-aware coordinated charging for electric vehicles in VANET-enhanced smart grid," IEEE Journal Selected Areas of Communications, to appear.

[5] A. Khosroshahi, P. Keshavarzi, Z. KoozehKanani, and J. Sobhi,"Acquiring real time traffic information using VANET and dynamic route guidance," Proc. IEEE Computing, Control and Industrial *Engineering*, Wuhan, China, Aug. 2011. [6] P.Chen, Y. Guo, and W. Chen, "Fuel-saving navigation system in VANETs," Proc. IEEE Vehicular Technology Conference, Ottawa, Canada, Sept. 2010.

[7] J. Herrera, D. Work, R. Herring, X. Ban, and A. Bayen, "Evaluation of traffic data obtained via GPS-enabled mobile phones: The mobility century field experiment," WORKING PAPER UCB-ITS-VWP-2009-8, Aug. 2009.

[8] R. Herring, A. Hofleitner, and S. Amin, "Using mobile phones to forecast arterial traffic through statistical learning," Proc. 89th Annual Meeting of Transportation Research Board, Washington D.C., US,Jan. 2010.

[9] J. Jariyasunant, D. Work, B. Kerkez, R. Sengupta, S. Glaser, and A. Bayen, "Mobile transit trip planning with real-time data," Proc.Transportation Research Board 89th Annual Meeting, WashingtonDC, US, Jan. 2010.

[10] J. Chen and A. M. Bayen, "Traffic flow reconstruction using mobile sensors and loop detector data," Proc. Transportation Research Board87th Annual Meeting, Washington DC, US, Jan. 2008.