Real Time Path Planning Based On Hybrid VANET Using In Transportation System

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***Abstract*— Real-time path planning can efficiently relieve traffic congestion in urban scenarios. However, how to design an efficient path-planning algorithm to achieve a globally optimal vehicle traffic control still remains a challenging problem, particularly when we take drivers' individual preferences into consideration. In this paper, we first establish a hybrid intelligent transportation system (ITS), i.e., a hybrid-VANET-enhanced ITS, which utilizes both vehicular ad hoc networks (VANETs) and cellular systems of the public transportation system to enable real-time communications among vehicles, roadside units (RSUs), and a vehicle-traffic server in an efficient way. Then, we propose a real-time path-planning algorithm, which not only improves the overall spatial utilization of a road network but reduces average vehicle travel cost for avoiding vehicles from getting stuck in congestion as well. A stochastic Lyapunov optimization technique is exploited to address the globally optimal path-planning problem. Finally, the transmission delay of the hybrid-VANET-enhanced ITS is evaluated in VISSIM to show the timeliness of the proposed communication framework. Moreover, system-level simulations conducted in Java demonstrate that the proposed path-planning algorithm outperforms the traditional distributed path planning in terms of balancing the spatial utilization and drivers' travel cost.**

***Keywords*— Road-side units, Vehicular ad-hoc network, Vehicle – to - Vehicle, and Vehicle – road - side units communications**

I.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-toroadside-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. 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.

I. Related Works

Algorithm that exploits VANET communication capabilities to avoid vehicles from congestion in an urban environment. Both the network spatial utilization and vehicle travel cost are considered to optimally balance the overall network smoothness and the drivers' preferences. Specifically, the contributions of this paper are threefold.

- First, to facilitate the application of real-time path planning, we propose a hybrid-VANET-enhanced ITS framework, exploiting both the VANETs and the public transportation system. Based on the proposed hybrid ITS framework, a multihop message forwarding mechanism is designed to collect the real-time traffic information or the emergent warning messages, which usually have strict delay bounds. A theoretical analysis on the end-to-end transmission delay performance of the mechanism is presented as well.
- Second, we design a real-time global path-planning algorithm to not only improve network spatial utilization but also reduce average vehicle travel cost per trip. A low complexity algorithm is developed based on Lyapunov optimization to make real-time path planning decisions. With the proposed path-planning algorithm, the tradeoff between the overall network spatial utilization and drivers' preferences can be well balanced.To collect time-varying traffic-condition information, most existing works in conventional ITS usually rely on cellular systems or loop detectors. Cellphones or mobile sensors with cellular access have been investigated to collect real-time traffic information for traffic forecast or reconstruction in experimental research. A traffic management system with loop detectors for continuous traffic measurement and monitoring along arterials is introduced. However, inevitable drawbacks cast a shadow on the application of cellular systems and loop detectors. For cellular systems, as they are not dedicated for traffic data collection, 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 deployment expense can also be very high. Moreover, the inaccuracy of position measurement becomes a problem for short-distance transmissions particularly in dense networks,which will degrade the performance of path planning. Due to VANETs, V2V and V2R communications can make real-time message delivery much quicker, cheaper, and more efficient than the existing systems, even for short-distance transmissions in dense networks. More importantly, RSUs in VANETs can greatly enhance the timeliness of data collection and

dissemination , which makes it possible to perform coordinated path planning for a group of vehicles. To improve the quality of experience (QoE), a point-to-point-based vehicular network can be utilized to support the application of multimedia delivery, which however may still experience large transmission delay. Hence, in this paper, 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. On the other hand, media service applications, introducing heavy load to the involved cellular networks, are studied; however, in this paper, the delivered information composes limited small-size packets, leading to a different transmission scenario with smaller data traffic load. Many works have studied real-time vehicle path planning with the assist of VANETs. A distributed path planning method to avoid congestion is put forward, using real-time traffic data collected from VANETs, with the increased traffic flow. Aiming to save gasoline for individual vehicle, a navigation system is designed to avoid congestion. However, the individual-user-optimal schemes may introduce additional traffic congestion due to human uncoordinated selfish behaviors. Thus, the paths of different vehicles should be jointly planned to balance the network traffic. The works consider multivehicle path planning, but the average travel cost or the drivers' preference is not considered. Moreover, how communications in VANETs can impact on the path-planning algorithm is still not clear.

Therefore, in this paper, a globally optimal path-planning algorithm is proposed for vehicles to avoid traffic congestion With the real-time traffic information collection and decision delivery enabled by a hybrid-VANET-enhanced network, the road network resources are fully utilized, and the average travel cost of vehicles is significantly reduced. In addition, the impacts of VANETs on the path-planning algorithm are further discussed.

Existing System

In Real-time monitoring and control on signalized arterials, a traffic management system with loop detectors for continuous traffic measurement and monitoring along arterials is introduced. However, inevitable drawbacks cast a shadow on the application of cellular systems and loop detectors. For cellular systems, as they are not dedicated for traffic data collection, 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 deployment expense can also be very high. Moreover, the inaccuracy of position measurement becomes a problem for short-distance transmissions particularly in dense networks, which will degrade the performance of path planning.

Disadvantages of existing system:

- Cannot make quick response to an emergency or congestion due to a sudden accident
- Not dedicated for traffic data collection
- The collection services can be highly costly

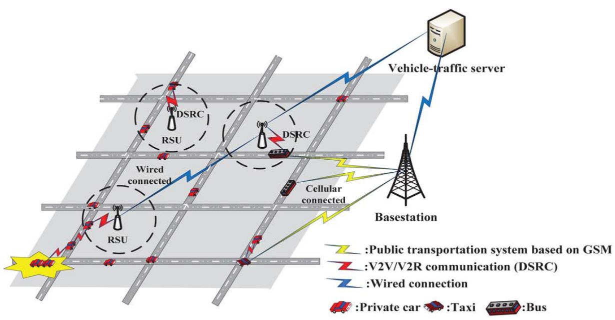
Proposed System

In this project, a globally optimal path-planning algorithm is proposed for vehicles to avoid traffic congestion (including those caused by accidents) in a suburban scenario. With the real-time traffic information collection and decision delivery enabled by a hybrid-VANET-enhanced network, the road network resources are fully utilized, and the average travel cost of vehicles is significantly reduced. In addition, the impacts of VANETs on the path-planning algorithm are further discussed. First, to facilitate the application of real-time path planning, we propose a hybrid-VANET-enhanced ITS framework, exploiting both the VANETs and the public transportation system. Second, we design a real-time global path-planning algorithm to not only improve network spatial utilization but also reduce average vehicle travel cost per trip. A low complexity algorithm is developed based on Lyapunov optimization to make real-time path planning decisions.

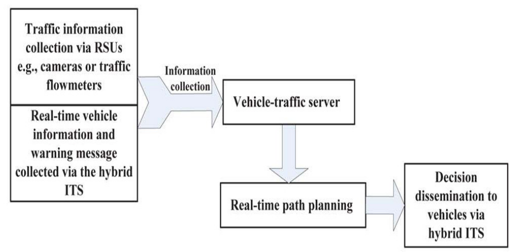
Advantages of proposed system:

- Average vehicle travel cost
- Reduce the delay
- Make a quick response

III .SYSTEM ARCHITECTURE



The architecture of the considered hybrid-VANET-enhanced transportation system, consisting of vehicles, RSUs, cellular base stations (BSs), and a vehicle-traffic server.Vehicles are equipped with the onboard units that enable multihop V2V communication used in delivering the periodic vehicle information (e.g., vehicle velocity, density, and location). When vehicles sense accident-related congestion,the warning message can be generated to alert the emergent accident information and then be shared not only among vehicles but with the nearest RSU via V2R communications as well. Moreover, pure VANETs, cellular communications, e.g.,a GSM system which is set up for the functions such as mobile telemonitoring and management systems for intercity public transportation, are also involved. Hence, the taxis or buses can directly upload the received warning message to the nearest cellular BS, and the BS will deliver the message to the vehicle traffic server. RSUs deployed along the roads are assumed able to obtain vehicle-traffic statistical information (e.g., the vehicle arrival/ departure rate on each road). We consider that taxis and buses are perfectly connected to the cellular system, and RSUs are well connected with each other through wireline. If RSUs are deployed at intersections, the traffic information can be detected by the equipped cameras or traffic flowmeters connected to RSUs directly. Otherwise, the traffic flow can be predicted by the nearest RSUs based on the obtained vehicle information (e.g., periodically obtained vehicle density and velocity) from the VANETs.An RSU can share its own collected information with other RSUs and the vehicle-traffic server.When an accident happens, based on all the collected information, the vehicle-traffic server is capable of performing real-time path planning to provide globally optimized travel paths for vehicles of interest.



To understand a vehicle-traffic flow more clearly, we model vehicle traffic as an “inflow/outflow” system. Each vehicle is expected to follow a planned path from its starting point toward its destination. Here, the planned path can be referred to as a path preset in a GPS, according to the driver’s preferences and based on the locations of the starting and ending points. The driver will keep following the preset path until the vehicle receives any information on congestion or accident. When an accident or congestion occurs, by running the path-planning algorithm, the vehicle-traffic server will be in charge of finding an optimal alternative path or routing for the vehicles of interest. Specifically, in this paper, we refer to the road segments in which one vehicle’s starting point and destination are located as s ($\in \Gamma$) and d ($\in \Gamma$), respectively.Let Ji denote the set of neighboring crossings of intersection$i$. Define the inflow rate of road segment (i, j), $\lambda ij(t)$, as the upstream-vehicle arrival rate from neighboring road segments in time slot t, where $j \in Ji$,

IV. TYPES OF COMMUNICATIONS

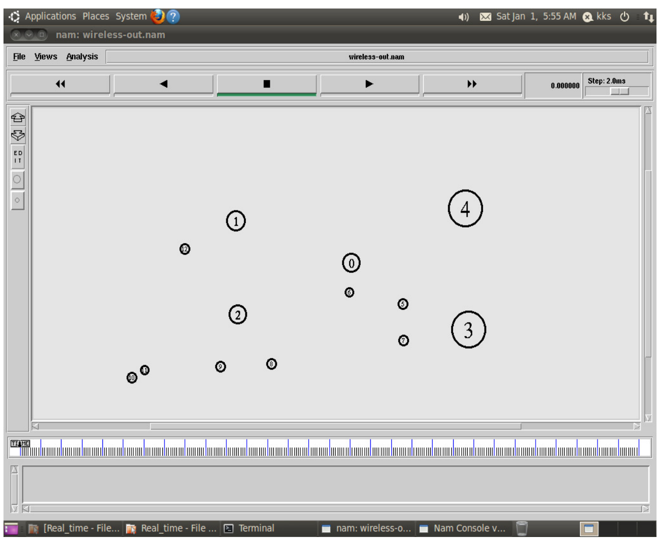
Vehicles are equipped with on-board units (OBUs) that enable multi-hop V2V communications. That will helps to delivering periodic vehicle information (like location, density etc.). When vehicles generate alert about accident related congestion, this information will pass not only among vehicles but also 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.

Road Side Units(RSU)

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.

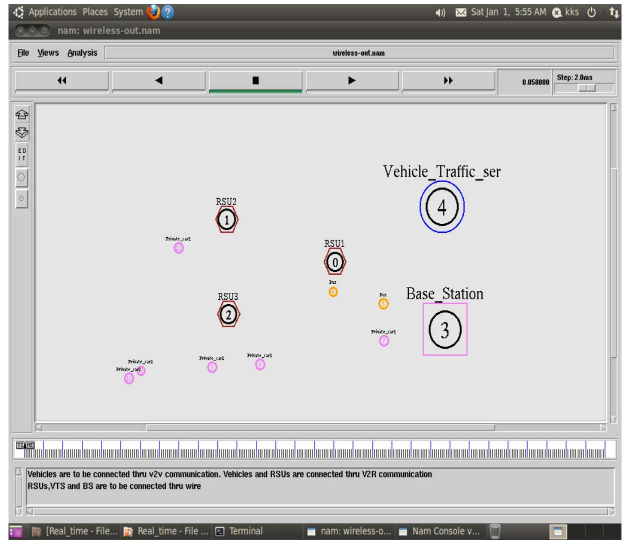
V. PERFORNACE EVALUATION

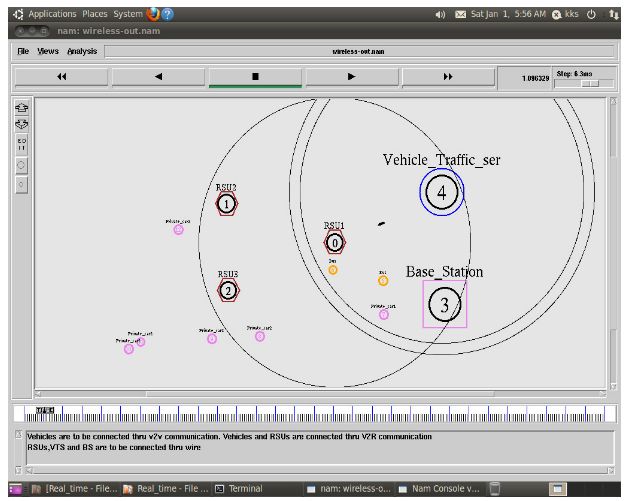
- Node Creation

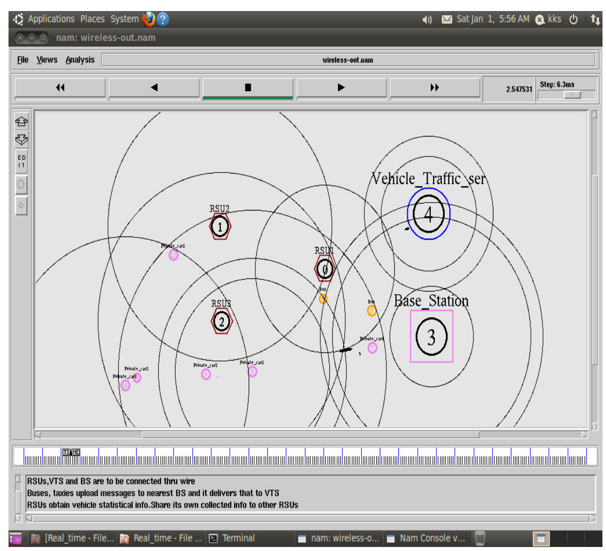


BS, RSUs, VTS, Vehicles such as bus, taxi, car nodes are to be created Structure consists vehicles, RSUs, cellular base stations (BSs), and a vehicle-traffic server.Vehicles are equipped with the onboard units that enable multihop V2V communication used in delivering the periodic vehicle information (e.g., vehicle velocity, density, and location).RSUs deployed along the roads are assumed able to obtain vehicle-traffic statistical information (e.g., the vehicle arrival/departure rate on each road).

- Data communication

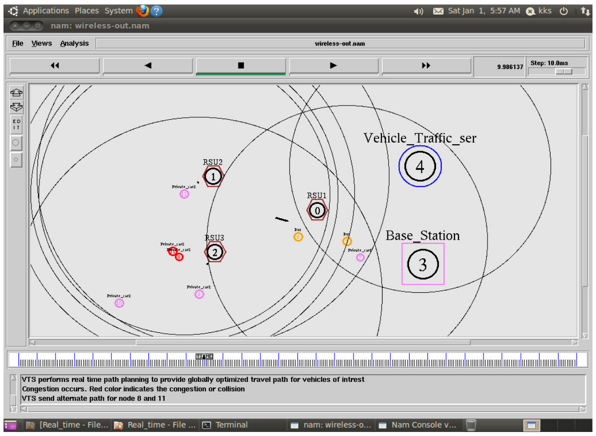


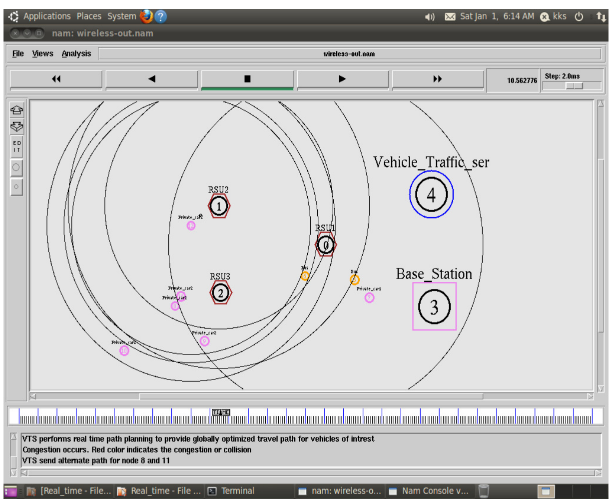




Taxis and buses are perfectly connected to the cellular system, and RSUs are well connected with each other through wireline.The taxis or buses can directly upload the received warning message to the nearest cellular BS, and the BS will deliver the message to the vehicle traffic server.

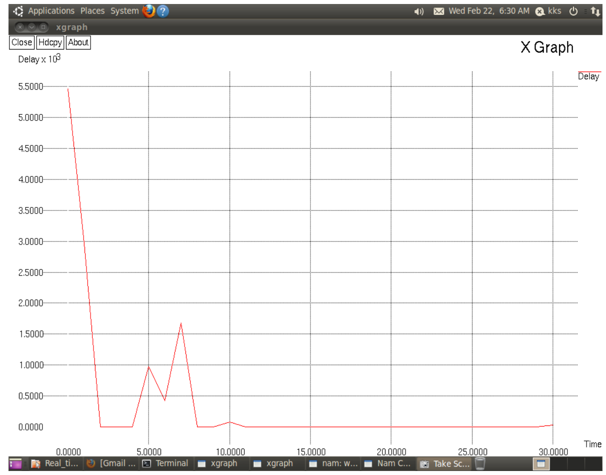
- Congestion Avoidance





Vehicles sense accident-related congestion, the warning message can be generated to alert the emergent accident information and then be shared to all vehicles, the nearest RSU via V2R communications.An RSU can share its own collected information with other RSUs and the vehicle-traffic server. If an accident happens, based on all the collected information, the vehicle-traffic server is capable of performing real-time path planning to provide globally optimized travel paths for vehicles of interest.An accident or congestion occurs, by running the path-planning algorithm, the vehicle-traffic server will be in charge of finding an optimal alternative path or routing for the vehicles of interest.

- Performance Evaluation



PDF and Delay are to be analysed

VI. CONCLUSION

Study about hybrid-VANET-enhanced real-time path planning for vehicles to avoid congestion in an ITS. The existing system contain a hybridVANETenhanced 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)

VII.REFERENCE

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