An Approach for Preventing Accidents and Traffic Load Detection on Highways using V2V Communication in VANET

Prashant Panse[1], Dr. Tarun Shrimali[2], Dr. Meenu Dave[3]

ABSTRACT

Street security has turned into a fundamental issue for governments and vehicle producers in the most recent a quarter century. The aggregate number of vehicles on the world has encountered an astounding development, expanding activity thickness and bringing on more mishaps. In this paper we emphasized on the problems with traffic load detection on highways and proposed a system to detect and prevent accidents on highway using vehicular ad hoc network. For this, we are implementing a vehicle 2 vehicle communication scenario with weighted cluster algorithm (WCA) and computing the performance on different parameters of network. Day to day population increase in India, leading to massive increase in road traffic. The improvement of new vehicular advancements has moved organizations, specialists and foundations to center their endeavors on enhancing street security and it is of prime need now a days.

KEYWORDS

VANET, Ad Hoc Network, D2ITS, ITS, DBCV algorithm.

INTRODUCTION

Amid the most recent decades, the advancement in radio advances has permitted specialists to outline correspondence frameworks where vehicles take part in the communication systems. Along these lines systems, for example, Vehicular Ad-hoc Networks are made to encourage communication between vehicles themselves and in the middle of vehicles and infrastructure. Vehicular ad hoc network is a new type of network in which nodes (i.e. vehicles) communicate with each other and possibly with a roadside infrastructure [1]. The aim/goal of VANET includes auto crash prevention, more secure streets and clog decrease etc. The improvement of an effective system in vehicular network has numerous important advantages, from road operators as well as drivers point of view. Efficient Effective movement alarms and overhauled data about traffic incidents will diminish car influxes, expand street wellbeing and enhance the sheltered driving on the Highways. Vehicular ad hoc networks are getting consideration because of the various important applications related to street safety and movement control. Our proposed work includes the concept for detection of congestion and provides information to driver regarding the same and communicating these to other vehicles. We are using a remote server to take a decision for the same. Additionally, to increase the decision performance of the remote server, this is connected in RSU (Road Side Unit) device as intermediate communicating device; these devices are fully functional devices and able to work as sender, receiver and route device. The server is implemented to make rule based decision and broad cast a message as alert to all the car drivers. The proposed work provides the efficient and effective architecture for complete alert process.

RELATED STUDY

The related research in VANET focuses on simulating vehicular traffic [2, 3, 4, 5, 6, 7] and multi-hop routing [8, 9, 10, 11] A few researches have considered the issue of utilizing VANETs to find and disperse traffic congestion data [12, 13, 14]. Using vehicle based GPS systems we can create an ad-hoc wireless network that can find and disseminate traffic congestion information. Collision avoidance systems [15, 16] are designed to detect a traffic incident in real-time and rapidly relay this information to nearby vehicles to prevent a collision. These systems are very different from traffic congestion systems, in the former, information should be transferred quick over short separations and should be to a great degree solid as it has an immediate impact on life-and-demise circumstances, while in the latter data remains current for a more extended time, should be dispersed over long separations and is used for congestion amelioration.

Fukumoto et al. [17] proposed a system that uses vehicle based GPS systems to discover and disseminate traffic congestion information, the system is called COC for VANET. This system maintains and disseminates three types of information: Raw Information (level 1), density information (level 2) and congestion areas information (level 3).

Donrbush et al. [18] from the University of Maryland proposed a novel system for congestion detection in VANET: Street smart that uses grouping as an information total method to consolidate related recordings of abnormally slow speed. Street-smart uses clustering algorithms that work over a distributed network where each node analyzes the collected statistics eliminating the need for a central entity.

Yoon et al. [19] proposed a system for traffic estimation that is based on road segmentation and focuses on complex inner-city traffic scenarios. Some of these systems rely, either explicitly or implicitly, on having the location for all vehicles in the congestion available in order to make the determination that congestion exists and where it is located. When congestion sizes exceed transmission ranges, common in freeway scenarios

[1] *PhD. Scholar, JaganNath University, Jaipur*
Email: [1] prashantpanse@gmail.com
[2] *Principal, Sunrise Group of Institution, Udaipur*
Email: [2] shrimalitarun@gmail.com
[3] *Professor, CS/IT Department, JaganNath University, Jaipur*
Email: [3] meenu.s.dave@gmail.com

the use of multi-hop communications is required in order for all vehicles in the congestion to have knowledge of all other vehicles in the congestion. Existing systems has limitations that, if we want to keep location information anonymous: a vehicle may receive fresh information directly from a vehicle as well as re-broadcasted information (older) from the same vehicle. Because vehicles constantly move, these two information will be undistinguishable referring to two different vehicles. For this reason, these systems rely on unique vehicle IDs as a mechanism to identify the source of each piece of information and maintain a unique location for each vehicle. The broadcasting of unique vehicle ID's at the application level opens the door for location tracking raising major privacy concerns.

Most recently, companies have began to realize the potential of using vehicles as collectors of traffic information, Dash Navigation, Inc. [20] a start-up in Sunny Valley, CA begun offering an administration in 2009 called The Dash Driver Network that permits drivers to telecast their area and speed in return for getting upgraded movement data arranged from different vehicles in the system. This system is centralized and relies on wireless internet connectivity which is not widely available on roads and highways around the globe. Since the gathering substance is a focal, trusted area, security concerns are alleviated.

According to the CAR 2 CAR communication Consortium [21], An non-profit organization initiated by European vehicle manufacturers with the objective of improving road traffic safety and efficiency published in 2007 a pronouncement in which it proposes principles for V2V and V2I interchanges besides everything else. Other organizations [22] initiated by industry, government and universities have started similar efforts in the last few years.

According to European Commission. Cooperative Vehicle-Infrastructure Systems [23] took a major first step towards deployment of system depending on V2I and V2V interchanges by saving a radio frequency over the EU for vehicle applications going for empowering co-agent system between carmakers. The EU expects this action to lead to the eventual roll-9 out of the first production examples early next decade with the first efforts expected to be focused in the area of road safety.

Junping, Z. et al. [24] presented a review about multifunctional information driven intelligent transportation system, which gathers a lot of information from different assets like VDITS, MDITS, LDITS.

Maslekar, N. et al. [25] proposed a versatile activity sign control system focused around V2V communication is introduced. This system lessens the holding up time of the vehicles at the crossing point alongside the diminution in queue length. To understand this framework, the idea of clustering is utilized for the vehicles approaching the convergence. Timing cycle of traffic signals is controlled by vehicles in groups. It uses DBCV algorithm. This algorithm is a blend of cluster and dissemination procedure and is utilized to accumulate the obliged dense data. Clusters are formed around the heading of the vehicles in a given geographic district approaching the convergence.

Gradinescu, V. et al. [26] proposed a framework that takes the control choices focused around the data originating from alternate vehicles. Every vehicle is outfitted with a specialized gadget and trans-receivers are set in the crossing point with traffic signals. This controller host at intersection goes about as versatile control signal framework.

Fogue et al. [27] proposed an e-NOTIFY framework for automated accident detection, which sends the information to the Crises Center and help of street mishaps utilizing the capacities. e-NOTIFY concentrate on enhancing post crash care with the quick and effective supervision of the accessible crisis assets, which builds the shots of recuperation and survival for those harmed in traffic collisions.

Francisco J. Martinez, et al. [28] proposed a Vehicular Ad hoc Networks (VANETs) provide ample elucidation for communication between cars on highways. V2V communications improve route forecasting, reduce traffic congestion and provide greater safety. IEEE 802.11p is new standard which are adopted by WAVE (Wireless Access in Vehicular Environments) whose architecture support ITS. In this work researchers present a driver alerting system in which damaged vehicles sends warning message and other vehicles make the diffusion of these message. The Researchers concentrated on diffusion of warning messages sent by damaged nodes in order to inform the rest of vehicles in the scenario in 802.11p-based VANETs. The target is to send vehicle security messages with high unwavering quality and low delay.

In 2012, S.P. Bhumkar, et al. [29] proposed a new fatigue detection algorithm and technique which uses eye blink, alcohol sensors etc. through which fatigue can be detected without delay and events of drivers can be trapped.

PROBLEM WITH EXISTING SYSTEM

Highway traffic load is formed by numerous factors; some are unsurprising like street development, surge hour or container necks and some are eccentric like mischance, climate and human conduct. Drivers, unaware of traffic load ahead inevitably go along with it and expand the seriousness of it. The more extreme the traffic burden is, the additional time it will take to clear once the reason for it is improved or eliminated. The capacity for a driver to know the road conditions will empower him/her to look for alternate ways to go sparing time and fuel. At the point when numerous drivers have this capacity, traffic load, particularly those identified with confined incidents, for example, mischance's or interim interruptions will be less extreme and just the vehicle in the prompt region of the occurrence, at the season of the occurrence, will be influenced. This would prompt an a great deal more productive utilization of our street foundation. Increase traffic burden result from driver conduct and the absence of wide distance data. Current systems, such as helicopter traffic reports are effective because from the air we can get a good picture of a congestion area, where it starts, where it ends and how slow or fast is moving, however these reports require enormous resources and are therefore limited to major metropolitan areas. In order to make ready drivers with useful information about traffic conditions a system must:

i) Recognize the traffic load, its position, seriousness and boundaries.

ii) Relay this data to drivers inside of the congestion and those heading towards it.

These two requirements must be satisfied by any traffic detection system. To identify the traffic load an observer, like one riding on the helicopter, needs to see vehicles that are a long distance away from each other, and outside of each other's line of sight. A visual picture of the congestion can only be obtained from a vantage point, well above the road surface. For vehicles within the congestion to form their own picture of congestion they need to collaborate using V2V (vehicle-to-vehicle) or V2I (vehicle-to-infrastructure) communication. Once a clear picture of the increase load has formed, this information needs to be relayed to vehicles away from the congestion so that vehicles heading towards it can take evasive actions avoiding further escalation its severity.

PROPOSED METHODOLOGY

A system is proposed which provides the high level conceptual way to resolve the problem identified using real time simulation using various tools and techniques and also provide a comparison between different road safety techniques.

The solution and application involves following steps:

- *Simulation scenario:* To simulate the contribution of the proposed highway mobility model an assumption is made to for a high traffic highway with real time traffic simulation tools.
- *Vehicle to Vehicle Communication (V2V):* V2V is a technology which enables the vehicles to communicate with each other.
- *Vehicle to Infrastructure Communication (V2I):* Vehicle-to-infrastructure communications is the wireless exchange of data between vehicles and highway infrastructure. In this phase vehicle to infrastructure communication is simulated where, the vehicle and decision server communicate with each other for providing the traffic, accidental information over highways.
- *Vehicle to Road Side Unit (V2R):* In V2R communication, Road Side Units (RSUs) keep the data of moving nodes i.e. vehicle like speed, distance from RSU, and route information of vehicles. This is a communication infrastructure used to support the route information during traffic over highway.

Therefore using the hybrid of V2V, V2I & V2R creates an effective accidental prevention system. The major part of the proposed system utilizes the following devices:

1. Decision server: That is additional functional server which collects information from RSU nodes about the traffic (if the nodes are under load condition then power consumption in node is high).
2. RSU: Road side unit (RSU) devices are working as Wi-Fi or access point for vehicle nodes and for similar nodes (other RSU) these devices are working as connected link nodes. These RSUs are connected using a backbone bus and in direct communication with the server.
3. Vehicle: These are MANET fully functional devices which are able to send and receive data from other devices and also behave as router node.
4. Improvements: This is our main goal to achieve the following prospective over the proposed research work.

The major part of the proposed system utilizes the Decision Server which collects information from RSU about the traffic and vehicles. Our main perspective is to achieve high performance, evaluate the performance of different routing protocols. Design and implement rule based system server machine to detect and prevent the congestion. Figure shows the pictorial representation of concept.

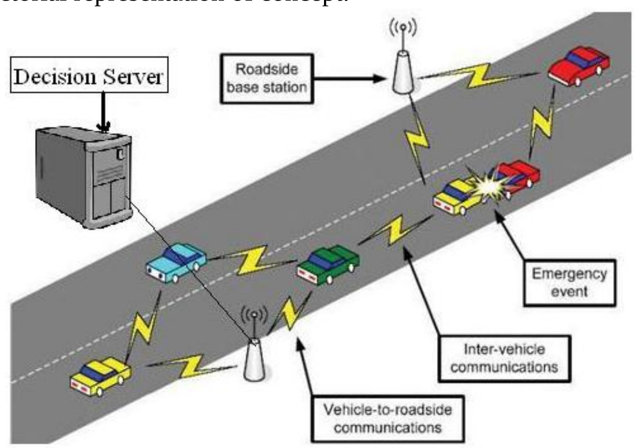

Figure 1. Proposed architecture

In the above diagram RSU is represented and connected using a high speed bus via underground cable, with a server. And the other nodes are represented using objects (e.g. cars) which are running over highway.

IMPLEMENTATION

The entire system implementation of proposed approach is required to accomplish in 3 different scenarios. In first, we are finding the appropriate communication approach for vehicle 2 vehicle communication using Weighted Cluster Algorithm (WCA). The main aim behind using this algorithm in communication is to enhance the performance of network in complicated scenarios. In WCA we need to find the quality of communicating nodes(V) by which the stability of network parameters becomes also stable. Therefore in this WCA, we are going to consider four different factors that are related to direction of speed and vehicles.

The key parameters are connectivity, mobility (distance), and Speed. Connectivity parameters indicate that vehicles are in same range or not. Mobility shows the distance among the vehicles. Speed shows the how fast vehicles are travelling on highway.

The performance of vehicular network is calculated on parameters like throughput, Packet Delivery Ratio, Routing Overhead and End-to-End Delay for different number of vehicles (nodes).

SIMULATION

VANET is simulated considering various network parameters which tabulated in Table1.

Table1. Simulation Parameters

Parameter Name	**Value**
Number of Nodes	10, 20, 30, 40, 50
Traffic Type	UDP
Connection Type	CBR
Routing Protocol	AODV
Queue Type	DropTail

Simulation Scenario: Network is simulated with different number of vehicles (nodes) i.e. 10, 20, 30, 40, 50. VANET Scenario with 20 nodes is shown in figure 2.

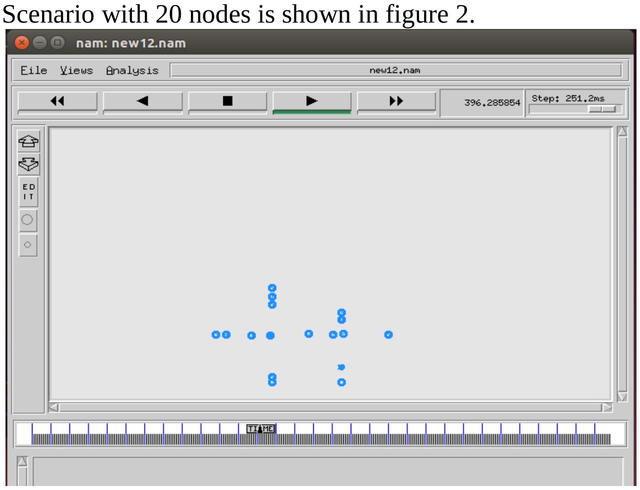

Figure 2. Simulation Scenario of 20 nodes in NAM

RESULT ANALYSIS

The performance of vehicular ad-hoc network is evaluated considering different parameters, for example throughput, routing overhead, end-to-end delay, and packet delivery ratio which are computed on the basis of simulation.

Throughput is defined as average number of bits, bytes or packets per unit time.

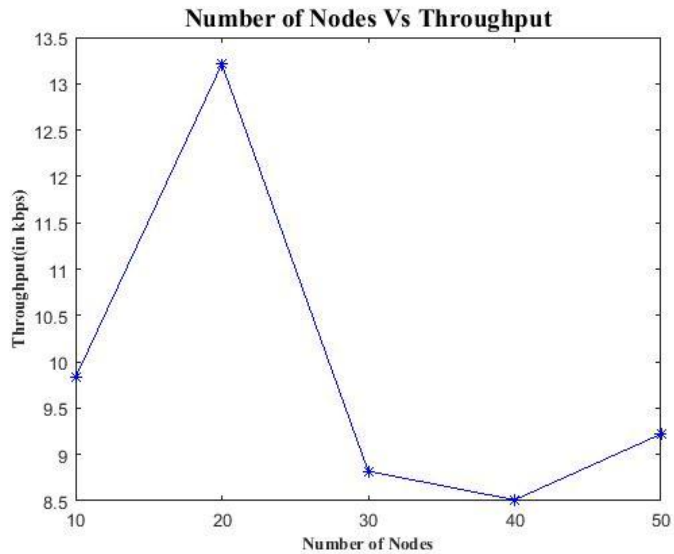

Figure 3. Throughput Vs Number of Nodes

Data Delivery Rate is the ratio of received packet and sum of dropped and received packets in a network.

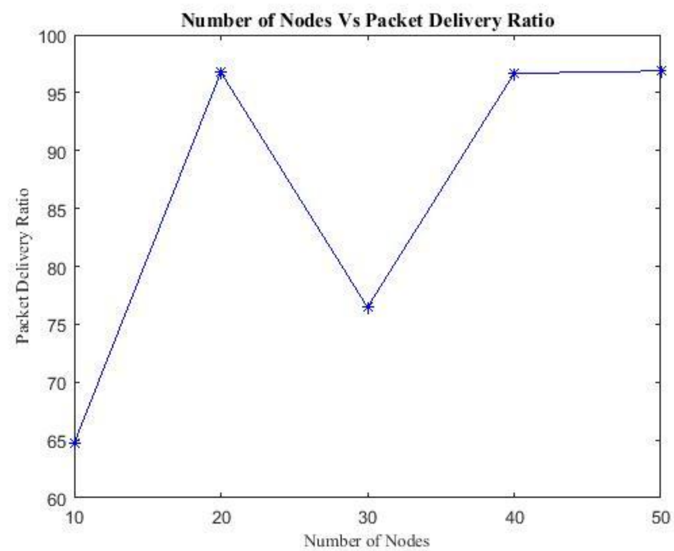

Figure 4. PDR Vs Number of Nodes

End-to-End Delay is time required by a packet to reach its destination.

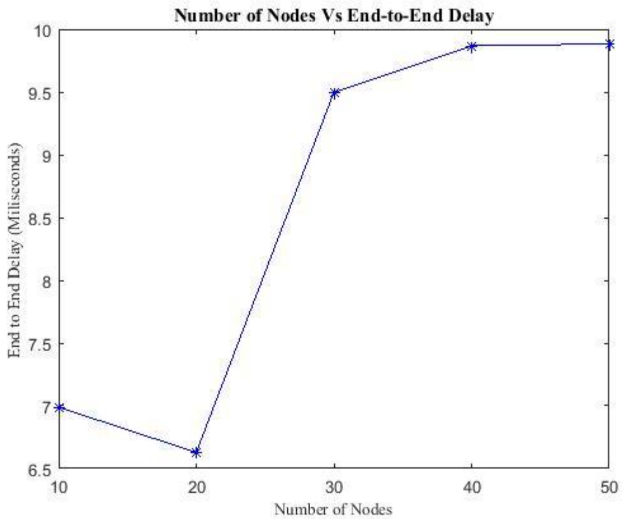

Figure 5. End to End Delay Vs Number of Nodes

Routing Overhead is the total number of routing packets traversed in network over simulation time.

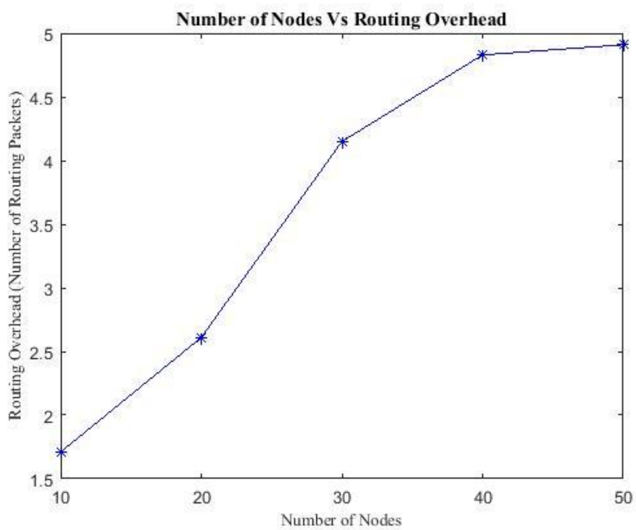

Figure 5. Routing Overhead Vs Number of Nodes

CONCLUSION

VANET is a network of vehicles where nodes are capable to communicate with each other. This work evaluated the performance of VANET with parameters i.e. routing overhead, packet delivery ratio, end-to-end delay and throughput. The main issue with the networks is spreading messages to vehicles on high speed. Integrating I2V, V2R and V2V approach can provide solution to this.

REFERENCES

[1]. Azzedine Boukerche, Horacio A.B.F. Oliveira, Eduardo F. Nakamura, Antonio A.F. Loureiro – Vehicular Ad Hoc Networks: A New Challenge for Localization-Based Systems. A. Boukerche et al. / Computer Communications xxx (2008) xxx-xxx. Available online at www.sciencedirect.com

[2]. Choffnes, David and Fabin, Bustamante E. STRAW - An integrated mobility and traffic model for VANETs. International Command and Control Research Technology Symposium (CCRTS). June 2005.

[3]. Harri, J., et al. VanetMobiSim: Generating Realistic Mobility Patterns for VANETs. VANET'06 ACM 1-59593-540-1/06/0009. September 2006.

[4]. Karnadi, Feliz, Mo, Zhi Hai and Lan, Kun-chan. Rapid Generation of RealisticMobility Models for VANET. Wireless Communications and NetworkingConference, IEEE. 2007.

[5]. Potnis, Niranjan and Mahajan, Atulya. Mobility Models for Vehicular Ad Hoc Network Simulations. ACM SE'06. March 2006.

[6]. Sommer, Christoph, Dietrich, Isabel and Dressler, Falko. Realistic Simulationof Network Protocols in VANET Scenarios. Mobile Networking for VehicularEnvironments. May 2007, 11-11, pp. 139 - 143.

[7]. Zhang, H.M. and Kim, T. Understanding and Modeling Traffic Behavior in Dense Traffic Flow. University of California Transportation Center. www.uctc.net.

[8]. Dikaiakos, M., et al. Vipt: And information Transfer Protocol for Vehicular Computing. 2nd ACM International Workshop on Vehicular Ad-Hoc Networks (VANET). September 2005.

[9]. Eichler, Stephan, et al. Strategies for Context-Adaptive Message Dissemination in Vehicular Ad Hoc Networks. 3rd Annual International Conference on Mobile and Ubiquitous Systems. 2006.

[10]. Tonguz, Ozan, et al. Broadcasting in VANET. Mobile Networking for Vehicular Environments. May 2007, pp. 7-12.

[11]. Wischhof, Lars and Rohling, Hermann. Congestion Control in Vehicular Ad Hoc Networks. IEEE International Conference on Vehicular Electronics and Safety. October 2005, pp. 58- 63.

[12]. Filip, Perichm, et al. On data Management in Pervasive Computing Environments. IEEE Transactions on Knowledge and Data Engeneering. May 2004.

[13]. Parkany, Emily and Xie, Chi. A Complete Review of Incident Detection Algorithms & Their Deployment: What Works and What Doesn't. s.l. : The New England Transportation Consortium, 2005.

[14]. Wedde, H.F., et al. Distributed Embedded Real-Time Systems and Beyond: A Vision of Future Road Vehicle Management. Software Engineering and Advanced Applications. September 2008.

[15]. Rawashdeh, Z.Y. and Mahmud, S.M. Intersection Collision Avoidance System Architecture. 5th IEEE Consumer Communications and Networking Conference. 2008, pp. 493 - 494.

[16]. Mak, T.K., K. P. Laberteaux and R. Sengupta. A Multi-Channel VANET Providing Concurrent Safety and Commercial Service. Proceedings of the 2nd ACM international workshop on Vehicular adhoc networks. January 2005.

[17]. Fukumoto, Junya, et al. Analytic Method for Real-Time Traffic Problems by Using Content Oriented Communications in VANET. 7th International Conference on ITS. 2007, pp. 1-6.
[18]. Dornbush, S. and Joshi, A. StreetSmart Traffic: Discovering and Diseminationg Automobile Congestion using VANET. Vehicular Technology Conference. 2007, pp. 11-15.
[19]. Yoon, Jungkeun, Noble, Brian and Liu, Migyan. Electrical Engineering and Computer Science. University of Michigan.
[20]. Dash Express. The first two-way, Internet-connected GPS navigation system. [Online] www.dash.net.
[21]. Car 2 Car Communication Consortium. www.car-2-car.org. [Online]
[22]. European Commission. Cooperative Vehicle-Infrastructure Systems. www.cvisproject.org. [Online]
[23]. European Union Intelligent Car Initiative. [Online] ec.europa.eu/information_society/activities/intelligentcar/.
[24]. Junping, Z., Fei-Yue, W., Kunfeng, W., Wei-Hua, L., Xin, X., Cheng, C., Data-Driven Intelligent Transportation Systems: Survey ‖, IEEE Transactions on Intelligent Transportation Systems, Vol. 12, Issue 4, pp. 1624- 1639, 2011.
[25]. Maslekar, N., Boussedjra, M., Mouzna, J., Labiod, H., VANET based Adaptive Traffic Signal Control‖, IEEE 73rd Vehicular Technology Conference (VTC Spring), pp. 1-5, 2011.
[26]. Gradinescu, V., Gorgorin, C., Diaconescu, R., Cristea, V., Iftode, L., Adaptive Traffic Light Using Car-to-Car communications‖, IEEE 65th Vehicular Technology Conference (VTC Spring), pp. 21-25, 2007.
[27]. Fogue, M., Garrido, P., Martinez, F. J., Cano, J. C., Calafate, C. T., M anzoni, P., Sanchez, M ., Prototy p ing an Automatic Notification Scheme for Traffic Accidents in Vehicular Networks‖, Wireless Day s (WD) IFIP, p p . 1-5, 2011.
[28] Francisco J. Martinez, Juan-Carlos Cano, Carlos T. Calafate, and Pietro Manzoni, A VANET Solution to Prevent Car Accidents, partially supported by the *Minis- terio de Education y Ciencia*, Spain, under Grant TIN2005-07705-C02-01, and by the *Fundaci on Antonio Gargallo*, under Grant 2008/B010.

[29] S.P. Bhumkar, V.V. Deotare, R.V.Babar, ACCIDENT AVOIDANCE AND DETECTION ON HIGHWAYS, International Journal of Engineering Trends and Technology-Volume 3 Issue 2- 2012.