# A Survey On Road Accident And Vehicle Collision In VANET

**Yashashwani**
YMCA University of Science and Technology, Faridabad, India.
mails2yashu@gmail.com

**Sapna Gambhir**
YMCA University of Science and Technology, Faridabad, India.

**Abstract**

Now a days vehicles are increasing day by day and on road accidents is a major issue of concern. As urban population increasing, road traffic accidents are also increasing. Road accidents occur due to various reasons such as street development, surge hours, human conduct, drunken driving, red light jumping etc. Large number of accidents have occurred at intersections with good visibility in urban areas. To control vehicles automatically collision avoidance is the most important issue. Vehicular Ad Hoc network is an emerging technology to ensure road safety. Various schemes and methods have been introduced to avoid road traffic collisions. This paper presents a review on recent studies on the safety of road accidents. The survey is based on the study of recent techniques and their issues. Discussion is also done on various tools used for simulation and thus provide details of different scenarios and factors involved in VANET.

**Keywords:** VANET, Ad Hoc Network, Accident Prevention, Collision Avoidance, protocol, V2V, V2I.

## 1. Introduction

With the increase in urban population, traffic road accidents are also increasing. Intersections are the most insecure areas because of large number of road accidents and vehicle collisions. According to the Ministry 0f Road Transport and Highways, the number of road crash deaths have increased by 31 percent from 2007 to 2017[1]. The number of fatal accidents has increased constantly since 2005 and saw a sharp rise from 1,31,726 in 2015 to 1,36,071 in 2016 [2]. India faces high rate of accidents in the world because of lack of safety measures. Thus, prime focus is on the improvement in road safety measures to avoid road accidents and vehicle collisions.

Safety measures are the fundamental elements used for improvement in safety and preventing road accidents. There are many places in India having lack of safety measures and improper facilities to prevent accidents and due to this death rates of accidents are increasing. States like Assam, Bihar, Orissa, Uttar Pradesh seen 2-8 percent increase in road accidents fatalities in 2017 [3]. More than 4,80,000 accidents are reported in which 150,000 people are killed in road traffic accidents each year. The number suggests that at least 425 people died everyday in 1,317 road accidents. The World Health Organization [4] estimates that road traffic crashes cost most countries about 3 percent of their gross domestic product. Prevention of road accidents become a challenging issue with road traffic on highways, cities, urban areas. Different safety measures to avoid road accidents include traffic monitoring and channeling which work with technologies like alert systems, message dissemination etc. VANET is a technology which is widely used now a days to prevent road traffic accidents. It is a type of network in which communication takes place between Vehicles and Infrastructures. It is commonly known as Network on Wheels. Warning messages are shared between vehicles for the safety of the passengers. The warning messages can be about road conditions, traffic signal violation, traffic jams etc. VANET communication can takes place in two ways that is, V2V (Vehicle-to-

Vehicle Communication), V2I (Vehicle-to-Infrastructure). In V2V communication, short range communication services like Wi-Fi and Wireless Access in Vehicular Environment (WAVE) are used. In V2I Communication, Wi-Fi hotspot or long range communication services are used to communicate with Road Infrastructure Unit (RSU). VANET technology also uses Inter Vehicular Communication (IVC). Intelligent Transportation System (ITS) are widely used in VANET to make better communication between vehicles with the help of technology called Telematics technology [5]. This technology provides a solution of communication issue in VANET by the exchange of real time traffic information. IVC methods gained importance to avoid vehicle crashing, crash mitigation and warning systems for Intersection collisions [6]. IVC can be controlled by protocol called Dedicated Short Range Communication Protocol and IEEE 802.11p.

This paper focuses on the recent technologies and schemes to avoid collisions and prevent road accidents. Various routing protocols have been discussed in this paper. Different simulation parameters are also studied and detail of different scenarios is also provided. The study is done to provide better safety solutions to prevent accidents and to save people's life. The paper is divided into different sections as follows: The first Section provides the Introduction about this paper. In second section, we briefly describe the related work. Work of various authors have been discussed in this section. In third section, we describe factors that are involved in collision avoidance. In fourth section, we describe the collision avoidance system design. In section five, we finally conclude the paper.

## 2. Literature Survey

Various work have been done by various authors on VANET in order to provide road safety measures to avoid road traffic accidents. Various schemes have been proposed to prevent road accidents.

**Hassan Artail, Kareem khalifeh** [7], in their proposed work provide a solution for car-pedestrian collision. They used a parameterized and reliable design to avoid car-pedestrian collision using VANET. Long Term Evolution (LTE) communication network is used to retrieve information about the pedestrian movement across the area surrounding the car. For positioning they use Global Positioning System (GPS) in cars and mobile phones. A server is designed to retrieve information about the location from both cars and mobile phones. The server has all the information about the position of cars and pedestrians. If the server detects that the pedestrian is going to enter car's area, then it will inform the cars and mobile phones to establish P2P communication using 802.11b so that they can decide the best course of action. A car cluster algorithm is designed which is based on the overlapped breaking distances to reduce the load on the infrastructure. To reduce the load in the LTE network they proposed a adaptable pedestrian position reporting design which is based on the distance from the VANET's road side unit. RSU's are used to report the cars location and speed. The RSU's then send alerts to the cars about the collision.

The results are experimented using the NS2 Network Simulator and Simulation for Urban Mobility (SUMO). A map is selected in the simulator to move the cars on the road. The result describes the effectiveness of the proposed method to detect the pedestrians in the path of the cars.

The system design of the proposed method is built on the LTE network and the Vehicular Ad hoc Network. The architecture of the network defines the two main elements of the design that is, the car and the pedestrian. The LTE Network works on the architecture having Location Service (LCS) for obtaining location and positioning information from mobile phones and base stations. End-to-end element in this system are the cars and the pedestrian phones and RSU's are the third element. They are added at the intersecting roads and the highways. 802.11p protocol is used to communicate with cars and Internet Servers like LCS Server. The location of the pedestrian can be obtained from the LTE and the VANET is used to retrieve the information about the movement of the cars. This information is used to determine the position of the cars accurately and are added in the beacon

messages that are broadcasted by the cars [8] [9]. The RSU will then know the position of the cars on the road in next few seconds or minutes. Hence, their scheme is based on RSU's to obtain vector positions of the cars and pedestrians and to predict future collisions. They then alert the cars to take the required action accordingly.
The drawback in this paper is that the paper describes scheme to avoid car and pedestrian collision using LTE. It is not necessary that all the mobile users are equipped with LTE connection. If the mobile users are on the call then the LTE connection did not work. The author explains the effect on number of cars and their speed on detection performance. There is an effect but it is not noticeable as that of pedestrians and their speed. This is because the cars drive in groups and at close speeds and their mobility is also very limited on roads.

**Estrella Garcia-Lozano, Carolina Tripp Barba** [10], designed a warning service mechanism to prevent accidents by warning drivers about accidents and dangerous road conditions. Their method is divide into three steps:
Step1: Sensed environment data is collected from vehicles on the road.
According to the author, vehicles will assumed to be equipped with sensors which are able to determine weather conditions like humidity, temperature etc. Also, Vehicles are assumed to have GPS positioning and communication capabilities through the use of IEEE 802.11p standard. The author used Participatory Sensing method [11] to reduce the installing cost of expensive and complex sensing units thus provide a better view of the area. Vehicles send the status message to the nearest RSU thus avoiding redundancy in the network. The RSU will then calculate the density of the traffic with the previous RSU. The status message contains a 4-bit field, 2 bits for traffic density and 2 bits for weather information. Vehicles get the weather information from weather on-board sensors. To compute traffic density GPS embedded device and the transmission of hello messages are used. The author also assumes the vehicles having sensors to detect the accident happened.

Step2: Data is processed by RSU's and this data is shared by all the other RSU's in the same road.
Each RSU receives messages containing traffic statistics from vehicles and update their traffic density statistics. The traffic density statistics are updated in the RSU by using Exponential Weighted Moving Average (EWMA). RSU's also update the weather information and store the results. These statistics are then shared with the other RSU'S on the same road.

Step3: The processed information is then distributed to the vehicles.
In this step RSU send the processed information about traffic and weather to the passing vehicles. These vehicles disseminate this information to the vehicles approaching them in the VANET network. If accident happen, then the message is disseminated in both forward and backward direction so that vehicles approaching the accident area will also be warned about the accident to avoid further collisions. Vehicles receiving these messages can reduce their speed accordingly.

The flow of the messages are taken in two directions that is, one from vehicles to RSU and second is from RSU to vehicles. The nature of both type of messages are different and thus these messages receives different treatment. In step 1, all the messages are of low priority. If some messages get lost, it will not affect the system and they do not need to travel faster also. In step3, the priority of the warning messages is higher as these messages are crucial and may affect the lives of the people. Thus these messages need to travel faster as much as possible. The author has also use direction condition and a source RSU from where the transmission has begun and the messages are forwarded to the other end. The limitation of this paper is that the solution is not feasible to highly dense scenarios. The other limitation is that the use of intelligent infrastructure reduces the driver's reaction time.

In [12], Ganesh S. Khekare, Apeksha V. Sakhare provide a solution for road traffic by transmitting information about traffic condition so that the driver can take necessary actions. The solution consist of framework of a smart city having Intelligent Traffic Lights (ITLs) at the intersecting roads of a city. The information about traffic density is gathered by ITLs and update the statistics that is congestion in the city. These statistics are send to the vehicles so that vehicles can select the best possible path which is free from congestion. If in case accident occurs, then these ITLs send the warning message to the vehicles informing about the accident so that no further collision cannot occur. In [13], the author's proposed method that manages the traffic information so as to avoid accidents. The information here is gathered from the vehicles itself, so no infrastructure is needed in the author's proposed work. The vehicles are having a GPS, on board unit and full map of the city including the positions of ITLs. Every vehicle sends hello messages from which the exact location of each vehicle is determined and using this information traffic density of the city can be calculated.
The author studied various different protocols like Greedy Perimeter Stateless Routing (GPSR) [14] and Geographical Opportunistic Source Routing (GOSR) [15] but uses AD hoc On Demand Distance Vector (AODV) [16] routing protocol because of the simplicity of the protocol and its widespread use.
The drawback of AODV Protocol is to forward the packets, it needs end-to-end paths. This is not easy to maintain in VANETs. The reason for this is that due to high speed of vehicles, end-to-end paths cannot exist for long.

In [17], the author Mi-hye Lee, Sun-young Im suggested Red Signal Delay method to prevent vehicle collisions at the intersections. Their proposed method consist of traffic light, camera and a controller. The controller is used to control the camera and traffic lights. Camera is used to capture the image of the vehicles which are arriving at the left turn. Controller is responsible for red signal delay to avoid vehicle collisions turning left at intersection. The author used various methods to determine the speed of the vehicle and entry at the intersection [18] [19].
According to author proposed work if the signal of the left-turn lane turns into red then vehicles move straight. It is because the signal of the waiting lane turns into green from red signal. In this scenario, if vehicles can't able to go completely through intersection and other vehicle approaches the intersection from the waiting lane, then probability of the vehicle collisions increased. So, to avoid this situation, the author increases the red signal timing that is, the timing of the red signal is delayed.
The author implemented this scheme in C language on Visual Studio. The author's scheme has several limitations. The authors fixed the number of lanes that is, four, speed of the vehicles are taken at 60 km/h. The other limitation of this scheme is that the interval time of vehicular traffic is assumed between 8 A.M and 10 A.M. The last limitation of their scheme is that the arriving rate of the vehicles changed from 1 to 5.

In [20], the author mention a scheme to avoid collisions at intersection by using congestion control concept. The author also uses IEEE 802.11p protocols to avoid congestion of vehicles. In their scheme, they used two types of safety messages. These are beacon messages and event-driven messages. Vehicles and RSU s are assumed to be equipped with short range wireless communication devices which is based on IEEE802.11p so that the vehicles can communicate with each other. These message are must be disseminated within an area with certain delay limit. The scheme works by sending the beacon messages which are also known as Hello messages. This message contains information about the vehicle position, speed, location etc. Event-driven messages are generated when any abnormal situation is detected. Beacon messages are send by vehicles to RSUs periodically to inform about vehicle position, direction, speed with the neighboring vehicles and to make them aware

of their environment. These event-driven messages must be delivered to vehicles as fast as possible. To avoid congestion in this scheme author uses 802.11p protocol. The congestion in the traffic is reduced by reducing the transmission time of beacon messages. The author achieved this by using higher data rates. If large number of vehicles transmit beacon messages at high frequency rate then the bandwidth will get exhausted completely. Due to this, packet collision occurs which in turn cost the lives of the people. So, to overcome this problem, author uses congestion detection method by providing dynamic time slot reservation to the vehicles that generates warning messages. If the vehicle does not find any time slot then the author provide unoccupied time slots from the adjacent segments. The author experimented the scheme on the NS2 Network Simulator. The limitation in this scheme is that the event-driven messages may be lost or can be delivered to its recipient with higher delay.

In [21], the author proposed a system for vehicular cloud environment so that the road accident and air pollution get reduced. This system architecture consist of three layers: V2V, V2I, RSU to static cloud and vehicle to dynamic cloud. The author assumed that every vehicle is equipped with on board unit with built-in navigation system. The on board unit transfers data through 3G or 4g communication devices like Wi-Fi, WAVE, Wi-max etc. If the vehicle is detected with abnormal behaviors like sudden lane change, exceeding speed limit, accelerating with reverse direction etc. then an emergency warning message will get generated and is send to the cloud storage and vehicles. The second layer is vehicle to Infrastructure layer. This layer is responsible for transmitting the movement, location of the vehicles and traffic related information. The third layer is RSU to static cloud which is used to store all the information related to the RSU data on static cloud and is also responsible for creating free space for future use. The system is experimented on the SUMO simulator. The proposed system still has various issues like protocols, congestion, architecture and privacy issues.

In [22], the author proposed a system to overcome the road accident issue in by using real time simulation. They uses decision server to collect information about the traffic from RSUs. RSU devices are used as Wi-Fi and also used for connecting link nodes. Authors take vehicles as devices to send and retrieve data from other devices. The author proposed this system mainly to utilize the decision server which are used to retrieve information from the RSUs. The author in his work assess the performance of various routing protocols. They design a rule based technique to detect the congestion and also to prevent it. The author implemented their proposed work in three different scenarios. First they choose the better communication method for V2V communication using Weighted Cluster Algorithm (WCA) to improve the performance of network in different scenarios [23][24].

The author takes four different parameters such as connectivity to check vehicles are in same range, speed to check the moving speed of the vehicle, distance to check the distance between vehicles and mobility. The proposed approach is experimented on the NS2 Network Simulator on various parameters. The proposed work has various issues like the speed of sending messages to vehicles. The author also mention that the above issue can be solved using V2V, V2I, V2R communication. The summary of the literature survey is given in Table 1.

**Table 1. Comparison Table**

| S.no | Name | Issue Discussed | Approach and method | Limitations | Simulation |
|---|---|---|---|---|---|
| 1. | Hassan Artail, Kareem khalifeh[7] | Collision between car and pedestrians | The system is designed on LTE network<br>Car cluster algorithm is designed to reduce load.<br>Server is designed to retrieve information about car and pedestrians. | Users are not necessarily equipped with LTE connection.<br>If the mobile users are on the call then the LTE connection did not work. | NS2 SUMO to generate car movement file |
| 2. | Estrella Garcia-Lozano, Carolina Tripp Barba [10] | Message dissemination system to handle various types of messages | Sensed environment data is collected from vehicles on the road.<br>Data is processed by RSUs and shared with other RSUs.<br>Processed information is send to vehicles. | The solution is not feasible to highly dense scenarios. | NS-2.34 (Network Simulator) |
| 3. | Ganesh S. Khekare, Apeksha V. Sakhare [12] | Information sending about traffic condition to vehicles so that driver can take necessary action. | Designed a smart city framework having Intelligent Traffic Lights.<br>Traffic Density Information is retrieved by ITLs and send to vehicles.<br>AODV protocol is used | AODV Protocol is to forward the packets, it needs end-to-end paths. This is not easy to maintain in VANETs. | NS2 (Network Simulator) |
| 4. | Mi-hye Lee, Sun-young Im [17] | Vehicle Collision at Intersection | Controller is used to control the camera and traffic lights.<br>Camera is used to capture the image of the vehicle.<br>Increases Red signal time at intersection to avoid vehicle collision probability from increasing. | The interval time of vehicular traffic is assumed between 8 A.M and 10 A.M. and the arriving rate of vehicle change from 1 to 5. | C Language on Visual Studio |
| 5. | Vaishali Manwar, Sayali N. Mane [20] | Prevent accidents of vehicles while intersected at crossing. | Use congestion control concept to avoid collisions at intersection.<br>IEEE 802.11p is used to avoid congestion of vehicles.<br>Use two types of safety messages: Beacon | The event-driven messages may be lost or can be delivered to its recipient with higher delay. | NS2 (Network Simulator) |

| | | | | | |
|---|---|---|---|---|---|
| | | | messages containing vehicle location, id , speed and event-driven messages for alerting the driver. | | |
| 6. | Sumit A. Khandelwal, Ashwini B. Abhale, Uma Nagaraj [21] | Reducing road accident and pollution control under cloud environment | On-board unit sends data using 3G communication devices like Wi-Fi, Wi-Max, Wave. Emergency warning message will be generated and send to cloud storage and vehicles in case of any abnormal conditions. | Protocols, Architecture, Congestion and Privacy Issues. | SUMO simulator |
| 7. | Prashant Panse, Tarun Shrimali, Meenu Dave | Traffic load detection on highways and preventing accidents | Uses weighted cluster Algorithm for better communication. Decision server is used to collect the information about the traffic from RSU. Vehicles are used as devices to send and retrieve date from other devices. | Speed of sending messages to vehicles | NS2 (Network Simulator) |

Table 1. Comparison Table

**3. Factors involved in collision avoidance system**

There are numerous factors that are involved in vehicle collision. These are:

1. *Information about the vehicles*

   In this, information about the vehicle speed, velocity, distance, direction, position is involved. The communication between the vehicles can be vehicle to vehicle or it can be vehicle to infrastructure.

2. *Prediction of the trajectory followed by vehicles*

   This factor involved the information about the vehicles about the path followed by the vehicles. This can be achieved by using some formulae or by some algorithms. These formulae can vary according to the methods and scenarios.

3. *Calculating the probability of the collision*

The probability can be predicted by assigning some threshold value and then the probability of the collision can be calculated. The threshold value can be different for different methods, different scenarios and different users.

4. *Warning messages*

This factor is very important in the collision avoidance system. The warning messages are sent to the vehicles to alert adjacent or approaching vehicles about the collision. Then accordingly, the vehicle can take appropriate action. These warning messages must be reached to the intended vehicle within the time limit. If there is any delay occur in the delivery of these warning messages, then it can cost the lives of the people.

## 5. Conclusion

In this paper, we have studied various schemes provided by various authors to solve the road accident or vehicle collision problem in VANET by message dissemination, sending warning messages to the vehicles etc. along with the brief results of their experiment. We have also studied the various factors that are involved in collision avoidance system like information about the vehicles, prediction of the trajectory followed by vehicles, calculating the probability of the vehicles and the warning messages. We have studied the various simulation parameters used in the proposed methods of different authors. There are still some challenges that needs to be overcome. We have found various issues in their proposed work regarding authentication, security, protocols etc. The VANET is used widely now a days. VANET architecture provide reliable and best solutions to prevent road traffic accidents and also for the safety of the people. Preventive measures should be taken and further research should be conducted in order to provide better methods for the road safety.

## References

[1] http://savelifefoundation.org/wp-content/uploads/2017/09/Road-Crash-Factsheet_SLF_2016.pdf

[2] http://indianexpress.com/article/india/road-accidents-in-india-2016-17-deaths-on-roads-every-hour-chennai-and-delhi-most-dangerous-4837832/

[3] http://pib.nic.in/newsite/PrintRelease.aspx?relid=170577

[4] https://economictimes.indiatimes.com/news/politics-and-nation/400-deaths-a-day-are-forcing-india-to-take-car-safety-seriously/articleshow/62439700.cms

[5] Chung-ming, Chung-ming and Yao-chung Chang,"Telematics communication Technologies and Vehicular Networks: Wireless Architectures and Applications," Book ,2009 .

[6] Brian Cronin, "Vehicle-to-Vehicle Communications for Safety,"ITS Joint Program Office Research and Innovative Technology, available at http://www.its.dot.gov/research/v2v.htm#sthash.GCEQCvMo.dpuf, June 2014.

[7] Hassan Artail, Kareem Khalifeh, and Mohamad Yahfoufi,"Avoiding Car-Pedestrian Collision using VANET", Electrical and Computer Engineering Department American University of Beirut, IEEE Conference 2017.

[8] K. Mershad and H, Artail, "Finding a STAR in a Vehicular Cloud", IEEE Intelligent Transportation Systems Magazine, V. 5, N.2, pp. 55 – 68, 2013

[9] K. Mershad and H. Artail, "We can deliver to far vehicles", IEEE Trans. on Intelligent Transportation Systems, 13(3), pp. 1099 – 1115, Sep. 2012

[10] Estrella Garcia-Lozanoy, Carolina Tripp Barba_, M´onica Aguilar Igartua_ and Celeste Campoy," A Distributed ,bandwidth- efficient accident prevention system for interurban VANET", Departament d'Enginyeria Telem`atica, Universitat Polit`ecnica de Catalunya (UPC), Barcelona, Spain Department of Telematic Engineering, University Carlos III of Madrid, Spain, IEEE conference, 2013.

[11] D. Mendez, A. Perez, M. Labrador, J. Marron, "P-Sense: A participatory sensing system for air pollution monitoring and control", in: Pervasive Computing and Communications Workshops (PERCOM Workshops), 2011 IEEE International Conference on, 2011, pp. 344 –347.

[12] Ganesh S. Khekare, Apeksha V. Sakhare,"A smart city framework for intelligent traffic system using VANET", Department of Computer Science and Engineering, IEEE conference 2013.

[13] 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.

[14] Karp, B., Kung, H. T., "GPSR: Greedy Perimeter Stateless Routing for wireless Networks," MobiCom 2000.

[15] Zhongyi l., Tong, Z., Wei, Y., Xiaoming, L., "GOSR: geographical opportunistic source routing for VANETs," ACM SIGMOBILE Mobile Computing and Communications, Vol. 13, Issue 1, 2009.

[16] Perkins, C.E., Belding-Royer, E. M., Das, S.R., "Ad hoc ondemand distance vector (AODV) routing," IEEE Personal Communications, pp.16-28, 2001.

[17] Mi-hye Lee, Sun-young Im, Byeong-uk Lee, Byeong-hee Roh , and Bo-mi Kim,"Red signal delay scheme to prevent vehicle accidents at the intersection", Dept. of Information and Computer Engineering, Ajou University Suwon, Korea, IEEE conference, 2015.

[18] S. Atev, H. Arumugam, O. Masoud, R. Janardan, and N. P. Papanikolopoulos,"A Vision-Based Approach to Collision Prediction at Traffic Intersections," IEEE Tr. Intelligent Transportation Systems, vol. 6, ppAI6-423, Dec. 2005.

[19] N. Buch, S. A. Velastin, 1. Orwell, "A Review of Computer Vision Techniques for the Analysis of Urban Traffic," IEEE Tr. Intelligent Transportation Systems, vol. 12, pp.920-939, Sep. 20 II.

[20] Vaishali Manwar, *Sayali N. Mane, Dr. Manish Sharma,"Intersection collision avoidance at vehicular ad hoc network",* D Y Patil College of Engineering, IEEE International Conference on Computer, Communication and Control (IC4-2015)

[21] Sumit A. Khandelwal, Ashwini B. Abhale, Uma Nagaraj," Accident prevention and air pollution control under VANET using cloud environment", 3rd International Conference on Recent Trends in Engineering & Technology (ICRTET'2014)

[22] Prashant Panse1, Dr. Tarun Shrimali2, Dr. Meenu Dave," An Approach for Preventing Accidents and Traffic Load Detection on Highways using V2V", IJICCT, Vol IV, Issue I (Jan-Jun 2016):ISSN 2347-7202

[23] Anjali Verma and Dr. Sapna Gambhir, "Comparison Study of Various Cluster Based Routing Protocols in VANET," Proceeding of international journal of Advanced Computer Science and Technology, vol. 2, no. 1, pp. 53-61, 2012.

[24] Megha, Sapna Gambhir, "Security Issues and Challenges In Vehicular Ad Hoc Networks (VANETs)" International Journal of Electrical Electronics & Computer Science Engineering Volume 3, Issue 1, pp. 13-18, February, 2016.