A Survey on Approaches to Collision Avoidance in Vehicular Networks

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Abstract— Ever since its conception, Vehicular Ad hoc Network (VANET) assured to escalate ones driving experience through its unparalleled features which include robustness, safety and enhanced security. However, due to the shortcomings in privacy and security, it was soon disregarded. Although there has been a considerable amount of research in the field of conventional VANET, its detriments such as wastage of bandwidth have provoked a paradigm shift in the community and the focus has been shifted from conventional VANET to cloud-based vehicle routing. Cloud computing driven by its tempting features such as scaling, storage virtualization, and cost-effective solution is espoused with the vehicular information that a VANET shares. An agreement is said to be defined between cloud and vehicular networks. While vehicles periodically share a gamut of their information which includes its position, speed and the direction it is traversing in the cloud it in turn, caters the vehicles with the information on the traffic dynamics. In recent years vehicle to vehicle communication in vehicular networks becomes very challenging has it leads to many road accidents. Challenges arise in avoiding road accidents by providing efficient collision avoidance system. Survey on various techniques of collision avoidance in vehicles on-road is discussed in this article.

Keywords— ***VANET [Vehicular Adhoc Network]; CWS [Collision Warning System]; IOV [Internet of Vehicles]; IOT[Internet of Things];Rear end collisions.***

I. INTRODUCTION

Vehicular Ad-hoc Networks or VANETs are defined as a set of moving conveyances in a Wi-Fi network that implement the ITS (Intelligent Transportation System) to hand over inventive facilities of traffic administration and transportation. These technologies assist to overcome several undesirable situations like vehicle collisions, traffic jams, lengthy transit period, air deterioration and fuel utilization. The end users are served in terms of their requirements such as geological traffic data, Internet and software services, computational and storage resources etc.

A. Vehicular Cloud Computing

VANET Cloud Computing is a set of large self-governing conveyances which corporate in computing, sensing, communication and physical resources also coordinate and dynamically allocate to authorize users. The large transit of conveyances on the streets, highways and parking garage are considered as productive and not utilized computing resource capable of giving public benefits. Most of the time conveyances waste a long time in the parking lots, driveway. the parked conveyances are huge resources is not utilized. These make the conveyances the excellent applicant for modules in the cloud computation network. Many owners of the conveyances will be mutually agreeing to lease out the surplus on board resources, equivalent to the owners of the enormous storage computing facility who lease out surplus resources and gain profit. Applying self-governing resources, conveyances will provide on demand in real time to resolve high, thoughtful issues of sudden incidences. The advanced vehicular clouds assist in resolving technical demand and afford to complicated transit systems. This technology leads to the IOV [Internet of vehicles] which is a developing technology from Intelligent Transportation System.

The VANET Cloud computing architecture is as shown in figure 1. The first layer is important for controlling the Vehicular condition and collecting information about the vehicles. The next layer is conversation which comprise two parts, the Vehicular-to-Vehicular (V2V), which is important for Vehicle to Vehicle Communication and the other element of the Communicating Layer is V2I (Vehicle to Infrastructure), intended to transmission of the operative information between conveyances, Infrastructure and the Cloud over wi-fi networks such as 3G, Satellite or Internet. The last layer which is cloud consists of three internal layers: Application, Infrastructure, and Platform for the Cloud.

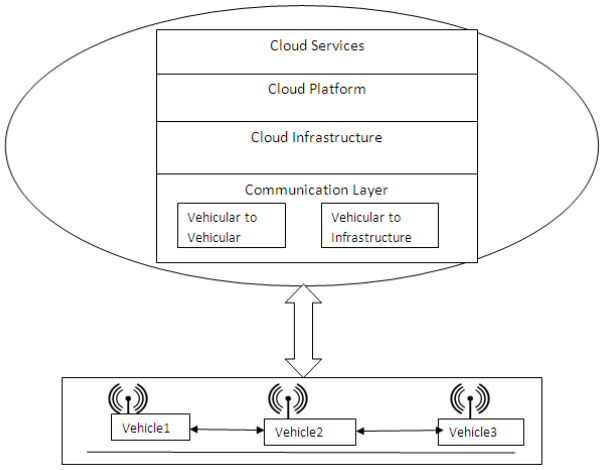

Figure.1 Overview of VANET Cloud Architecture

B. Internet of Things

Internet of things has been a buzzword for quite some time. It has a wide scope and is gaining popularity at an exponential level. With recent innovations in technology, there is a shift towards an invariably connected model" Future Internet". Internet of Things aims to be the consolidated element of the imminent Internet wherein every object in our environment will be provided [1]. The key conception of Internet of Things is the interconnection of all real hardware equipment's or things with the capability to transmission of information by the network to serve a common purpose with minimal human interference. There two main aspects to consider with Internet-of-things that is Internet and Things. Internet a global computer network which gives various data and transmission services using the standardized protocol suite. 'Thing' refers to entities which can provide association that precisely interfaces the physical world like embedded equipment, sensors actuators and Radio-Frequency Identification (RFID) tags [2-3]. Devices or objects are continuously being attached to the above mentioned 'Things' making 'Smart Devices'. The coalescing of the above two aspects gives rise to smart objects or devices being connected to the cyberspace (internet) forming as Internet of things. With the ever increase in IoT there is an abundance of different kinds of data being generated from these smart devices which should be stored and processed in an interpretable, effective manner so that intelligent decisions can be made. With the ever increase in wireless telecommunications capabilities, sensor networks, high-speed internet connectivity makes the evolution of ubiquitous computing and pervasive computing significant [4].

C. Internet of Vehicles

Internet of Vehicles indicates to lively mobile communication systems which connect among conveyances and public networks with the help of Vehicle-to-Vehicle, Vehicle-to-Road, and Conveyance to driver (Human) and Conveyance to Sensor communications. it empowers data allocation with the association of data between the conveyances, roadways and neighborhood. Furthermore, it features the processing, computation, allocation and protected release of data over the information platforms. With this information, the system can efficiently mentor and administer conveyances and provide at large multimedia and mobile Internet application services.

II. TRAFFIC COLLISION AVOIDANCE SYSTEM

India is growing with the largest number of motorists growing everyday with an accelerated improvement in the road-way network. There are severe safety issues on the road as the usage is increasing. The growth rate of the number of collisions is getting more than 2.5% in the year 2015. The count on the number of people killed due to collisions is more than 1.4% in 2015. The severity of collisions which is measured at a rate of the number of person's kills for 100 collisions has been increased from 28.1 in 2014 to 29.1 in 2015. The investigation of high-way collisions information 2015 revealed of around 1400 collisions and 400 people ending lives happen each day on the roads, equivalent to 57 collisions and 17 deaths every hour in India. Around 54% of all deaths in collisions are in the age of 15 to 34 years in 2015 [5]. Table-1 details about the statistics of road accidents occurred in India during the period 2005 to 2015.

Year	Number of Accidents		Number of Persons		Accident Severity*
	Total	Fatal	Killed	Injured	
2005	4,39,255	83,491 (19.0)	94,968	465,282	21.6
2006	4,60,920	93,917 (20.4)	105,749	496,481	22.9
2007	4,79,216	1,01,161 (21.1)	114,444	513,340	23.9
2008	4,84,704	1,06,591 (22.0)	119,860	523,193	24.7
2009	4,86,384	1,10,993 (22.8)	125,660	515,458	25.8
2010	4,99,628	1,19,558 (23.9)	134,513	527,512	26.9
2011	4,97,686	1,21,618 (24.4)	1,42,485	5,11,394	28.6
2012	4,90,383	1,23,093 (25.1)	1,38,258	5,09,667	28.2
2013	4,86,476	1,22,589(25.2)	1,37,572	4,94,893	28.3
2014	4,89,400	1,25,828(25.7)	1,39,671	4,93,474	28.5
2015	5,01,423	1,31,726(26.3)	1,46,133	5,00,279	29.1

Source: Information supplied by States/UTs (Police Departments).
Figures within parentheses indicate share of fatal accidents to total accidents.
* Accident Severity : Number of persons killed per 100 accidents

Table 1: Statistics of Road Accidents and Number of Persons affected in India: 2005-2015[5]

The system of collision controls main aim is in reducing the hardness of the crash or accident. This system is also called by pre-crash, forward-looking collision signaling system. this will use the RADAR (Radio Detection and Ranging), LIDAR (Light Detection and Ranging) and the image recognition camera to identify a forward collision. The roadway signals like stoppage signals are detected using the GPS sensors via the database location. If there is an identification of stoppage signal then the system gives an alert to the vehicle user of the possible crash or independently proceeds to act without any user instructions with the brake or steering.

Automobile safety control systems work with the guarantee that, if the probable accident is not controllable but the suitable directions of warning will decrease the

severity of the collision. With this, the harm caused to the property or people are severely decreased. to implement this system varied number of sensors are utilized to identify the obstacles. Public bodies such as NHTSA (National Highway Traffic Safety Administration), European Commission and other third-party institutions execute routine inspection on modern security techniques. In these studies, fascinating information has been turned up which directs for the capability in developing new technologies to protecting the life and determined that certain avoidable safety systems will have a large bounce in decreasing the backward or rearmost accidents. Certain measures have been taken in some parts of Europe that the novice vehicles should be incorporated with automatic braking technology. Collision avoid system works on the current technology, as these techniques need front view sensors which utilizes the information from sensors which are given to the adaptive cruise controlling systems. As the information is received from fore-view sensors, the systems do the computations to identify for any probable interruptions occurring. If the distance is large between the conveyance and the obstacle then the system might be able to perform many tasks such as signaling the driver to warn him of possible obstructions in the front side ahead. The collision control system might also apply the braking in addition to the driver applying the brakes at the time he applies the brakes. Few newer systems such as ABS (Anti-Lock Brake System) also kick in to avoid the conveyance from gliding to assist in driver controlling the conveyance [6].

III. SURVEY ON COLLISION AVOIDANCE

Mazias et.al [7] have discussed about rear-view collisions occurring constantly many times on the road. Investigation about how conveyances local configurations in a unit of vehicles affect the global property of the traffic systems in terms of rear-view accident control and gives details about how V2V (vehicle-to-vehicle) wireless transmission are utilized to prevent rear-view accidents.

Eric Dallal et.al [8] describes the issue of accident control on the road-way crossings in vehicular networks for uncontrolled and immature measurements. Provided a conveyances group interchanging a crossover, would like to acquire a highly permissible supervision that guarantees every conveyance crossing over an interchange take a highly permissible guidance to ensure that every conveyance reach the crossover with safety though the conveyance distances are computed accurately.

An intersection-collision-warning [ICW] is developed mainly based on infra communication. ICW uses WIFI sensor networks in identifying and communicating warning data to the vehicles to avoiding the accidents. The ICW system is installed at crossover signals and enables real time avoidance by measuring upcoming traffic and alerting the warning to the drivers if there is high accident probability [9].

Vivek Singhal et.al [10] gives an overview of many techniques available in collision avoidance. There are many case studies and techniques discussed in the article where one of the prominent technique discussed is sensor based accident control methods utilizing geospatial information.

M.A.Berling et.al [11] proposes a distance warning system which alerts the driver when a minimum distance to another device is reached. This would enable the driver to take emergency measures, like braking to avoid vehicle collision.

Gurpreet Singh et.al [12] have proposed a new model to develop smart and intelligence transit networks with accident identification and controlling with risk routing for healthy route scheduling over the provided area. The information guidance of the intelligence conveyance communication need incorporation of the conveyance information priority to effectively transmission and interchange the information over the conveyance points in the provided clustering. The approach as well yields hazard control utilizing conveyance motion tracking method in identifying and controlling the accidents.

S. Azmi et.al [13] discusses the use of vehicle to vehicle communication to empower the direction of vehicle intersection, to avoid the accident hazards and to increase intersection turnout remarkably. This paper describes conveyance network protocol that combines with mobile Wi-Fi radio transmission standardization like DSRC (Dedicated Short-range Communication) and WAVE. It also mainly depends on the usage of vehicle to vehicle transmission, global positioning system and sensors to securely navigate intersections and to empower auto conveyance controlling capability.

Burgett et.al [14] have developed an experimental rear-end accidents signaling algorithm to the scenarios where two motorists are travelling in the same route at the same acceleration and the leading motorists applies braking. Also develops a method for issuing warnings to drivers when a rear-end crash with a lead vehicle which is initially moving.

Milanes et.al [15] has described a fuzzy rear end collision avoidance scheme. They provided needed replacement to avoid the accidents. It also finds the location of every vehicle and computes the best sideward to apply the aid procedure before disappearing on the road-way. this approach controlling the accidents it will also manage the conveyances on the road-way. Fuzzy control was designed based on the time difference and the time for accidents to signal the aid avoidance system. the presented system experimented with the help of conveyance to infra transmission system with a local system for interchanging data between the leading and the trailing vehicles.

Lee et.al [16] have proposed two experiments which were performed utilizing a high-fidelity movement based driving simulator tool examined driver outputs to estimate the capability of REACAS [Rear-End Collision Avoidance Systems]. This warning system reduced the number of collisions.

Araki et.al [17] have proposed Rear-end collision avoidance system (RCAS) as a system of Advanced safety vehicle (ASV). This is a driver guidance approach to control the rear end accidents by signaling the leading head-way. This also has independent braking facility in case of crisis and distant signaling facility to the trailing conveyance. This article proposes the outline of Rear end collision avoidance system, approaches to the preceding conveyance identification and accidents probability valuation.

Lee et.al [18] Collision-warning or collision-avoidance systems (CW/CA) aim at major collision types and their progress is the main push in the intelligence conveyance plan. The vehicles are already equipped with the adaptive cruise control systems. There are many collision-warning and collision-avoidance algorithms and this article focus on the development of those. The prime outcome of this article is the usage of natural driver information for the valuation of collision-warning and collision-avoidance algorithms. The man-driven data is collected from the ICCFOT project and the driving behavior of fifteen man-driven vehicles. With those observations of the driver's attitude, two grouping are created, one for safe and other threatening driving environments. The production of these algorithms was calculated with a performance metric which is mainly used in signal identification and data querying.

Kusano et.al [19] this article investigates the probable efficiencies of below pre-collision algorithms (PCS) designs. 1) forward collision warning only; 2) forward collision warning and pre-crash brake assist; and 3) forward collision warning, pre-crash brake assist, and autonomous pre-crash brake. Real-life rearward collisions are retrieved from nationally representative fragment of accidents in the USA.

A sampling of around 1400 collisions, approximate to 1.1 million collisions, were imitated using simulators on vehicles with pre-collision incorporated on them. A possibility-based scheme is implemented for different driver actions to the signaling system. this article has been proved an impressive decrease in severe injuries when pre-collision systems were deployed in the vehicles having road-way safety.

Chang et.al [20] focuses on developing rear-view accident signaling systems for advanced safety conveyances with the help of rear-view cameras. the article undertaken to evaluate the vehicle drive environment information and developed a rear-view accident signaling design. The prime objective of the signaling system is to avoid the collisions due to inactive drivers. Nowadays parking guidance systems with sensors and rear-view cameras are the minimal facilities in the conveyances. But the parking guidance system will be used only during the parking of vehicle. This investigation proceeds to utilize the rear-view guiding camera data as rear-view accident surveillance for forthcoming driving. With this the camera's usage will be properly used without keeping idle. An experiment is carried out using commercial PC, an LCD screen and camera. Using the image processing techniques, the proportionate distance and speed with the following conveyance is computed. The test results were rewarding on the offline video testing. This article concludes to mention that the rear-view signaling system will help in warning the drivers if the follower vehicles are not in appropriate distance.

Cabrera et.al [21] Collision Warning Systems (CWS) are safe systems developed to signal the vehicle user on any immediate accidents. a collision warning system supervise the changing vehicle movements in real time from retrieving data from different sensors. It evaluates the probable danger and determines if the warning to be provided for vehicle user via voice or visual method. Various initiatives are described for hazard estimation and different collision warning system are described in this paper. And concentrates on couple of time basis measurements which determine the frontal and rearward accidents. In precise, the time to last second acceleration for leading conveyances in rearward collisions is described and correlated with the opposite, the time to last second braking. The time to last second acceleration is a novice approach which aims on the leading conveyance as compared to the succession conveyance.

Ye et.al [22] greater than 23 percent of yearly conveyance collisions are rear-view accidents, marking a crucial scenario for increased accident controlling methods on vehicle to vehicle communications. This paper presents the studying of 802.11 basis multi hop MAC (Medium Access Control) protocol that transmits an alert EWM (Emergency-Warning-Message) down a platoon of vehicles on the road-way. The development aim is to guarantee the receipt of the message with rigorous (least) delay such that the vehicle users are provided with sufficient time to control the rear end accidents. The authors have studied using a real simulator tool using ns-2 setup for different topologies (one and three lanes) with various protocol input configurations.

Nekovee have derived analytical bounds for the maximum acceptable information transfer delay and the reduced retransmission frequency of 802.11 based conveyance V2V transmission protocols for rear-view accident controlling applications. With the use of micro-scope car following models of high-way traffic along with probable two ray base expansion models of the vehicle to vehicle wi-fi mode, investigation is done on the differences for those bounds with average vehicular velocity, road-way grip co-efficient, vehicle to vehicle packet drop count and wi-fi medium fluctuations. The investigation gives quantifiable instructions and analytic input to develop adaptive vehicle to vehicle protocols, with the capability of having high reliability and effectiveness in situations of high variations in vehicle traffic and vehicle to vehicle network situations [23].

IV.CONCLUSION

In this paper, the various approaches to avoid rear-end collisions has been discussed. Identifying the distraction of driver and guiding the driver with the rear-end vehicle

information retrieved from different devices is a major factor in vehicular networks. Suitable measures need be taken to get the status of the driver and vehicle monitoring. Current vehicles already have on-board sensors in identifying the vehicle driving environment. Different safety measuring techniques are needed in improving collision avoidance systems to control vehicle accidents.

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