

# Vehicular Communication: A Survey

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**Abstract** – The absolute number of vehicles in the world has experienced a remarkable growth, increasing traffic density which results in more accidents. Therefore, the researchers, manufactures and government is shifting focus towards raising the on road safety rather than enhancing the quality of the roads. The good development in the wireless technologies emerged different new type of networks, such as Vehicular Ad Hoc Network (VANET), which provides communication between the vehicles and between vehicles and road side units. Various advanced concepts such as smart cities and living labs [1] are found in the recent years where VANETs plays an essential role. In this paper, a review on various Intelligent Traffic Systems (ITS) and various V2V and V2I communication technologies are proposed. In this framework, we have also proposed a simple, reliable and efficient V2V communication technology to reduce traffic collisions. It's an intelligent robust, cost effective system which is able to reduce road accidents and notify same to the driver so that he can take necessary action prior to accidents.

**Key Words:** VANETs, Vehicle-to-Vehicle (V2V) communication, Intelligent Traffic System, Collision avoidance.

## 1. INTRODUCTION

During the last decades, the world has experienced a remarkable growth in the total number of vehicles. Road traffic has also been getting even more congested, as a higher population and increased business activities result in greater desire for cars and vehicles for transportation. Thus, increasing traffic density and causing more and more traffic accidents. Presently, many vehicular traffic safety systems have been developed and implemented, which may also reduce the accidents. The development of new vehicular technologies has changed companies, researchers and institutions to focus their efforts on enhancing road safety.

The evolution in wireless technologies has enabled researchers to develop communication systems where vehicles directly participate in the network. Thus networks such as VANETs are made to facilitate communication among vehicles themselves and between vehicles and road side unit (RSUs). Vehicular ad hoc network (VANET) is a technology that utilizes moving cars as nodes in a network to develop a mobile network [2]. The ultimate target of vehicle

development is driverless vehicles nevertheless all of which rely on vehicle communication technology development. Vehicle communication is defined as communication between vehicles' communication between vehicle and road side union. Furthermore, vehicle to X (V2X) represents the communication setup between vehicles and any other smart equipments or infrastructures ([3],[4]). New concepts such as smart cities and living labs have emerged in the last years where vehicular network plays an important role.

VANETs are getting attention because of the various important applications associated to traffic controlling and road safety. Smart cities full of traffic would like to decrease their transportation problems due to the increasing population that results in congested roads. VANET assists to solve this problem by improving vehicles' mobility and also helps at having more secured and sophisticated cities. At the beginning of the evolution of vehicular technologies, the more focus VANETs are getting attention because of the various important applications related to traffic controlling and road safety. Smart cities filled of traffic would like to decrease their transportation problems due to the increasing population that results in congested roads. VANET assists to solve this issue by improving vehicles' mobility and also helps at having more secured and sophisticated cities. At the beginning of the development of vehicular technologies, the more focus was on building effective and more safe roads. But nowadays huge development of wireless technologies and their application in vehicles, it becomes feasible to use Intelligent Transportation System (ITS) that will change our way to drive and assist emergency critical services. VANETs present easier communication facility among vehicles and also with fixed infrastructure. This will not only boosts the road safety, but also gives benefits commercially. Accidents preventions, safer roads, pollution and congestion reduction are some of the benefits of VANETs. The development of an efficient system in VANETs has many essential benefits, to the traffic police as well as to the drivers. Proper traffic alerts and modernizes information about traffic incidents will make safe driving improve road safety and reduce the traffic jams in the city. It also assists to identify where the traffic rules contraventions takes place. Furthermore, it also helps us in economic ways; real time traffic alerting will diminish trip time and fuel consumption and therefore decrease pollution as well [5]. So it is definitely beneficial in many ways.

The management of the paper is as follows: Section 2 describes the related work; Section 3 represents conclusion and future work.

## 2. RELATED WORK

The main objective of vehicle communication is to reduce the potential driving risk, improve drivers' safety index and also act as complementary of humanity's response interval in an accident. Hence, it has great effect on passenger safety and for drivers to smoothly driving in urban area. Many countries support this technology research. There are many public funds projects implemented in Europe in the past decades. The projects cover several aspects; one side is the inter-vehicle communication and network systems which assistant driver for safety and detecting of the key components status, when sub-system exist problems then warning system can pre-alert through inter-vehicle communication network.

FleetNet (internet on the road) project funded by Germany government which looked at different base radio systems that could be used to execute vehicle communication, among these UTRATDD (technology designed for the unpaired UMTS bands), data transmission based on IEEE 802.11 Wireless LAN systems and 24 GHz radar [4]. Actually it is communication technology application between vehicles, when the running vehicle meets an emergency situation in front of it, the system can detect conditions meanwhile feedback alert message to the driver through the vehicle to vehicle communication for safety pre-alert. Furthermore, vehicle communication research also steps in to new stage in US, Asia countries such as China, Japan and Korea. These countries established many public fund support projects which continuous focus on vehicle communication and evolution of the technology. There are several ongoing researches related to this area, the representative one is PATH project which is aim to improve the intelligent of transport systems [6]. SafeTrip-21 initiation is another project sponsored by U.S. department of transportation [3], [4]. It is part of the IntelliDrive program in which a consortium of carmaker conducts demonstrations and operational tests to speed up the development of vehicle communication technologies that enhance transportation safety and mobility features. China government established a series of policies which special focus on intelligent transportation system builds; several trial areas has been put in to practice in Shanghai, Tianjin and Chongqing [7].

A survey of several Intelligent Traffic Systems (ITS) and various routing protocols is described in [8]. It also introduces a new scheme composed of a smart city framework that transmits information about traffic conditions that will help the driver to take appropriate decisions. It includes a warning message module composed of Intelligent Traffic Lights (ITLs) which gives information to the driver about current traffic conditions. In [9], an

advanced communication technology is aided by intelligent Artificial Neural Network (ANN) system and fuzzy system in order to mine the specific features of data sets. Hence it assigns accurate notification and severity estimation of the accident for better assistance in traffic accidents. This system decrease the response time to give alert about accident and hence will improve the overall rescue process after an accident happens. It's an intelligent robust, cost effective system which is able to identify road accidents, notify them, and estimate their severity. The work in [10] is a survey about multifunctional data driven intelligent transportation system, which gathers a large amount of data from different resources: Vision-Driven ITS (input data assembled from video sensors and used recognition inclusive of vehicle and pedestrian detection); Multisource-Driven ITS (e.g. laser radar, inductive-loop detectors, GPS etc.); Learning-Driven ITS (efficient prediction of the occurrence of accidents to enhance the safety of pedestrians by decreasing the effect of vehicle accident); and Visualization-Driven ITS (to help decision makers rapidly identify abnormal traffic patterns and accordingly take effective measures). But, it needs large amount of memory to stores the videos [8].

To minimize the negative effect on the health of the occupant, rescue services and medical assistance should provide immediately after accident. Manuel Fogue et.al. [11] designed a e-Notify system for automatic detection, reporting and assistance of road traffic accidents which helps in decreasing the time needed to deploy the emergency services after an accidents takes place. The vehicles in this system involves various sensors, would be used to determine the current status of the vehicle. The on board unit equipped inside the vehicle is responsible for detecting the accident then notify this information to an external control unit which estimates the severity of the accidents hence can allocate necessary resources for its assistances. This e-NOTIFY system combines both V2V and V2I communications. Inter-vehicular communication is presented based on an adaptive traffic signal control system [12]. This system reduces the waiting time of the vehicles at the square also results in diminution in waiting time at the signal. To realize this system, the concept of clustering is used to gather the data of the vehicles coming towards the intersection. System that takes the control decisions relied on the information coming from the vehicles is very well described by the authors [13]. Every vehicle is armed with a short range communication device and controller nodes are placed in the intersection with traffic lights. This controller node at intersection represents as adaptive control signal system.

The author in [14] emphasizes some key points favoring the use of an infrastructural architecture with full Road Side Unit (RSU) coverage, presents an review of the used time-slotted oriented MAC approach relied on the Wireless Access in Vehicular Environment (WAVE) standard, indicates the issue

of RSUs' coordination using beacons, and discusses the vehicle slot option for the initial broadcast of safety-critical messages, to guarantee that they are timely delivered. In [15], author gives a brief overview of ways to enhance the performance of safety message delivery in VANET. It explains about Ve-MAC protocol for good broadcast of safety message and hybrid communication scheme to validate connectivity under scant traffic and dense traffic conditions. The paper also studies the influence of hidden terminal problem in VANET. In [16], authors give an analytical survey of existing issues in video-based surveillance systems for the vehicle and show a general architecture for video inspection systems, i.e., the hierarchical and networked vehicle inspection, to observe the different existing and potential techniques. Authors also reviewed and discussed the different methods with respect to each module. Applications and future progress are discussed to provide future needs of ITS services. In [17], author establishes an optical vehicle-to-vehicle (V2V) communication system depend on an optical wireless communication technology by using an LED transmitter and a camera receiver, which appoints a special CMOS image sensor such as an optical communication image sensor (OCI). Due to the LED detection method using the flag image, the camera receiver precisely detects LEDs, in real time and in challenging outdoor conditions. Between two vehicles, various vehicle internal data (like speed), image data (320\_240, color) are transmitted prosperously, and the 13.0-fps image data reception is attained while driving outside.

Several researchers have addressed the topic of unmanned vehicles, particularly dealing with novel routing techniques. Collision prediction can be achieved via estimating the trajectory of objects, while collision avoidance is achieved through controlling the speed of the vehicle or through re-planning the path of the vehicle [18]. In [19] Xu et al. propose an autonomous real-time driving motion planner with trajectory optimization, based on a set of cost functions. In [20], Krogh and Thorpe present a method for vehicle guidance that is based on path relaxation to compute critical points using a priori information and sensor data along a desirable path. The scope of this method is to provide a collision free path for the vehicle.

### 3. CONCLUSION AND FUTURE WORK

Highway obstacle identification is one of the most challenging tasks in real time for autonomous vehicle navigation system. In this paper, the different vehicular communication techniques are reviewed and on this basis, we are intended to propose a fully equipped, intelligent vehicle system which will not only be useful for collision avoidance but also for the wireless communication between two vehicles for information exchange. This vehicle will be able to communicate with the other vehicles wirelessly by using xbee.

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## BIOGRAPHIES



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