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A Proposed Model for Simulation Based Vehicle to Vehicle Communication

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***Abstract*—** Intelligent Transport System (ITS) is playing one of the important role in Vehicle to Vehicle communications specially in Vehicular Ad hoc Networks (VANET), in which many of the vehicles are equipped with IOT devices. The current generation of mobile networks, requires some major amendments and up gradation, that is; network needs to be improved in various properties for the implementation of new technology. Moreover, the infrastructure and other characteristics should be improved majorly. Therefore, there is a need to implement or introduce the new and advanced technology Vehicle to Vehicle communication with the help of latest technology. The vehicle to vehicle and vehicle to tower communication have many important factors such as speed, location of base station or tower, monitoring of vehicles, range of transmission and others. The current model examines only two road styles to enforce the vehicle to vehicle communication which have been tested such as straight and diamond that may suit in reality and simulation purposes. The simulation has been done on MATLAB 2017.

Keywords—Intelligent transportation system (ITS), V2V Communication, V2I communication, 5G Network

I. INTRODUCTION

With the advancements in technology and devices, there is a trend of building more bandwidth-hungry applications and services which have been already supported by existing networks. Future network is a broad concept and covers many of the aspects of the wireless networks and the services to be expanded and created to cater the challenges of the increasing demands of the customers. Many of the research groups, nations and government agencies are engaged to prepare for the development of open access and the converged new networks.

The CHARISMA project initiated by European Union as a Horizon 2020 program and China's accelerated program to deploy latest networks and services are the examples of transformation from legacy to future generation mobile networks. Pakistan is also a potential region for the deployment of next generation services. The state of the art services and existing networks are easily upgradable, and there is an excellent opportunity to transform the existing networks to the future network smoothly.
Various operators are already providing services such as 3G, 4G, and 4G LTE and there is a commercialization potential in the market like Pakistan. This model will analyze the V2V communication as a smooth transformation process from existing networks to the future networks. A new generation of wireless mobile system using small dense cells to provide expanded bandwidth along with high Quality of Service (QoS)[1].

The high bandwidth will be improved and guaranteed quality of service will provide many opportunities to IOT, cloud computing, 3D streaming in high quality and many other applications to mobile subscribers. The size of the cells in networks will be of multiple dimensions such as Microcells, Microcells, Femtocells and Pico cells. The coverage of these cells is from 2 m to 35 kilometers [2].
The central theme of proposed model is to present an architecture using networks advantages with a blend of sensors, cameras and radars fixed or installed in vehicles for continuous monitoring of vehicles communication in Pakistan and all around the globe [3]. The architecture of vehicles contains the sensors, cameras and radars where these show the different scenarios of the road structure which will be simulated by MATLAB 2017 or latest. The vehicles which communicate to each other for data sharing which will send through latest technology to the local servers or cloud servers where artificial intelligence and data mining approaches will identify the situations and essential factors will analyzed, the current status of vehicles position, location and speed.

The emergency situation can be triggered automatically by detecting dangerous condition from the vehicle sensors data cameras and other equipment along the road, and transmits it back to the monitoring operation center for analysis and regulation [4].

There is an essential use case Device to Device (D2D) transmission are vehicle to vehicle communication, and Vehicle to infrastructure (V2I) communications that will be Generally called the V2X transmissions. With each other the vehicles transmit information, that assist the improvement of numerous technologies like the driverless cars, monitoring of automated traffic violation and so on. The vehicle to everything correspondence have a few particular difficulties because of particular sent situations. For instance, the

vehicles speed may be some many kilometers for every hour and these ought to have the capacity to correspond with the cars taking place the other way amid the brief timeframe when these meet on any point [5]. The vehicle hub density is formed by ultra-high density. The prerequisite of QoS with the V2X are explained in [6]. These days V2X advancements have been made specifically, IEEE 802.11p which was called previously as LTE-A [7]. Its bandwidth and execution interrupt at high client density; Figure 1 illustrates the scenario of vehicles controlled by tower.

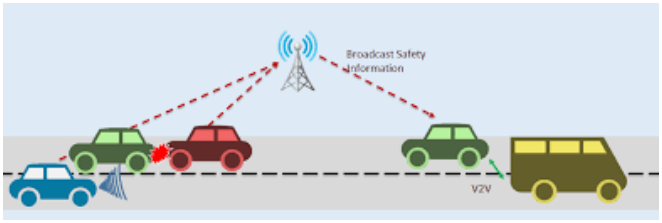

Figure 1: Vehicles controlled by tower

The paper is organized as stated here. Section II discusses the literature review where as Section III is providing a brief discussion on Methods of Transmission section IV is reserved for proposed methodology, and based on the proposed model, results and discussion is done in Section V, finally the conclssion is given in section VI

II. LITRATURE REVIEW

The next generation 5G mobile communication and 3rd Generation Partnership Project (3GPP) architecture and functions are presented in [8]. Smart homes and smart cities and connected cars will be mainly conceptualized on 5G as depicted in figure 2. Many of the research groups and centers are currently working on defining of new rules, standardization and other definitions of 5G communications. SA2 has defined some of the successful standards such as UMTS and LTE which are near to get ready in 2020 commercialization. 3GPP is responsible for the many of the features and main functions of the network identification as well services. The architecture and functionalities are already finalized completed and normative standardization is one of the topics for current research. For the improvement of core NextGen network, the 4G network must be improved for the equal running of requirements and efficient working [8].

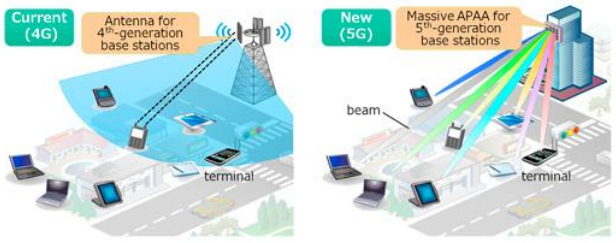

Figure 2: 4G vs. 5G beam forming architecture (Source: https://www.inverse.com/article/48250-5g-beamforming)

Khairnar and Kotecha (2013) presents a technique in which data traffic among vehicles are the main focus of the study where STDMA (Self-organized time-division multiple access) has been proposed for the communication among the vehicles. The various properties have been tested and investigated for the STDMA by employing the scenario of a highway road simulation. The results of this simulation have been declared and promising. The paper contains Mumbai to Pune highway road as a simulation scenario and the scenario selection has been selected because the speed level is 120 kilometers and above normally and it would be challenge for the MAC Layer. The crossing of the vehicles is less than 3 seconds average. The vehicles on the roads are formulated and their speed has been defined as the random variable of Gaussian. For the sake of simplicity, the vehicles have been configured to run on the same line and no any overtaking is possible. The model for the channel has been configured simple in which vehicles transmit and receive packets perfectly. The ranges have been selected are 500 m and 1000m. CSMA (Carrier Sense Multiple Access) and STDMA (Self-organized time-division multiple access) were evaluated for the access delay. A total of ten scenarios have been modeled and tested [9].

The study about continuous monitoring of chronic patients has been presented. The architecture and protocol have been proposed. The model and architecture contain wearable devices, mobile phones and other devices. The wearable devices are for the collecting sensing data and Smartphone's to send the sensed data to the servers. A database is necessary for the record of already available settings and generating alarms when some sort of situations occurred. The big data is stored in database received from patients and hospitals. The data is analyzed and generated alarms when needed. For the experiments, many of the patients were tested by sending the data from patients to server and alarms were generated. The algorithms were also tested by training intelligent approaches [10].

The architecture has been tested to simulate data traffic from patients to database server so that the suitability of architecture in fifth generation networks can be evaluated. The 200 users do not create a difference in the 4G or 5G traffic but when the number of users increased up to 1000 then the 5G is 4 times faster than 4G. The experiments show that for the continuous monitoring of more users or high number of users 5G should be used preferably as it provides the guarantees of bandwidth of high number of users along with low delays [10].

Vikas Hassija et al (2020) proposed a framework for vehicle to vehicle Communication author stated that a peer-to-peer connection among automobiles in a disbursed manner is a Promising solution for immediate communication amongst vehicle [14].
In this study author proposed a Directed Acyclic Graph enabled IoV (DAGIoV) framework. The author made use of a tangle data structure where every node acts as a mineworker and eventually the network achieves agreement among the nodes. To perform the interaction between the automobiles consuming and providing release of services used a game-theoretic approach. For the sake of micro transactions or immediate

transfer of data in vehicular network among the nodes it has been proved that this model is scalable and well suited [14].

WEI YANG et al (2020) formulated a new FCW (forward collision warning) system which is enable to figure out the intention of driving for a vehicle on front to provide alert earlier rather then used systems previously. this system is consisting of few steps which are number one the driving intention recognition module is used to determine the intention of driving of vehicle at the front, second is driving parameters and intention of driving are transmitted to the vehicle following by using vehicle to vehicle (v2v) communication and at the last previously given information and the parameters of driving for next vehicle determines the collision risk by FCW module present in the following vehicle. for the evaluation purpose simulation test has been conducted based on PreScan. The test results of simulation demonstrated that the rate of alerts of the system was 97.67%, the real vehicle test results elaborates that the proposed system was able to alerts earlier then the TTC-(time-to-collision)based system[15].

III. Methods of Transmission

Because of less response time, it produces the merit of rule P2P mobile transmission. The DSRC (Dedicated short-range communication) procedures would be allowed to use various applications [11].

A. Collision Warning Cooperative Forward

The information which is expected to receive from the directed vehicle alongside presents the data of the present vehicle as to its specific location, and furthermore, the highway data support to guess the hazard of crash. It overcomes the risk of crash, information transmitted such as speed, direction track record, and vehicle location [12].

B. Electronic Brake Light Emergency

Communicating with various vehicles, if the detectors are not ready for assistance because of unpleasant climate environments and furthermore if the view of drivers is restricted, when an advancing vehicle control hardly. The below mentioned information is transmitted, direction, Speed, vehicle location [12].

C. Road Condition Alert

Finding of minimal situation is by utilizing OBU (On-Board Unit) framework and detector, and finding the path alert is transmitted to nearby vehicles utilizing transmission information correspondence such as speed, route situation, factors and vehicle location [12].

IV. Proposed Methodology

The proposed methodology contains the steps which will be followed for the creation of simulated vehicle to vehicle communication. The steps start from the analysis of the problem and leads towards the development of the GUI based development. The steps are given in following Figure 3.

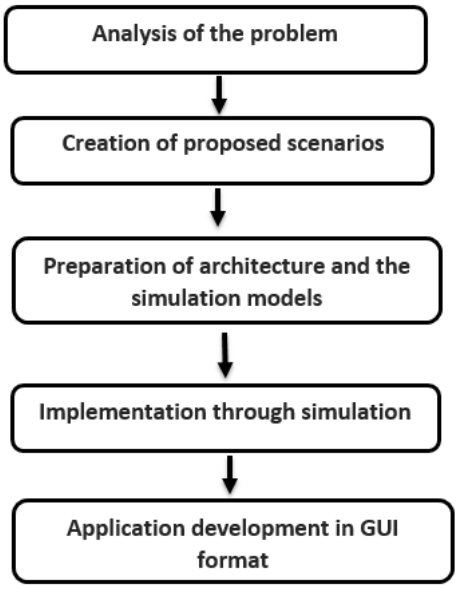

Figure 3: Phases for Simulation based V2V communication

1) *Phase 1: Analysis of the problem*

The problem is analyzed in deep and system provides the communication based on vehicle communication system for the vehicles monitoring coming under the coverage of tower and further information sending and receiving by the vehicles and tower respectively. Various rules, standards, mechanism devices applied and other characteristic for the monitoring system will be available in this step.

2) *Phase 2: Creation of proposed scenarios*

At this stage we have analyzed only two roads, and requirements are decided roads and calculation is made on the bases of obtained data so that the problem can be formed for solution and the best possible solution can be provided. For the monitoring vehicle so monitoring cars and transfer of data made easy process. These scenarios are based on the real situations made on the roads such as straight single road situation, diamond shape road situations.

3) *Phase 3: Preparation of architecture and the simulation models*

This phase identifies the distances, the possible routes, start timing and duration and other factors are analyzed and calculated. The rules that avoid the repetition and monitoring mechanism are defined in this step. The current study creates the custom-built scenario which suitably fits to the requirements [13].

4) *Phase 4: Implementation through simulation*

During this crucial phase two shapes for roads, that is: straight and diamond has been simulated to calculate the accuracy of monitoring and transfer of data and other communication links in order to achieve an optimal solution. In this step, the monitoring is physically done by the simulated model where the cars are shown in a manner and running in a manner that they are synchronized to communication with tower.

5) *Phase 5: Application development in GUI format*

The final stage is the development of a GUI application from the phases defined so that the graphical presentation can be made. The path of the vehicles and monitoring distances are given in representation so that the problem solution can be visualized graphically. MATLAB 2017 has been used for the development and practical implementation.

V. Results and Discussion

For the purpose of experimentation following scenarios have been created and the vehicles under the coverage of tower are shown in experiments.

1) *Straight Line (Straight Road)*

The first formation of the experimentation is the straight line which reflects the situation of a single line straight road is generated in figure 4. In this condition the tower is connecting the vehicles coming on the road. Units of numbers on x and y axis are distance in meters and x-position of vehicles and y- position of vehicles respectively.

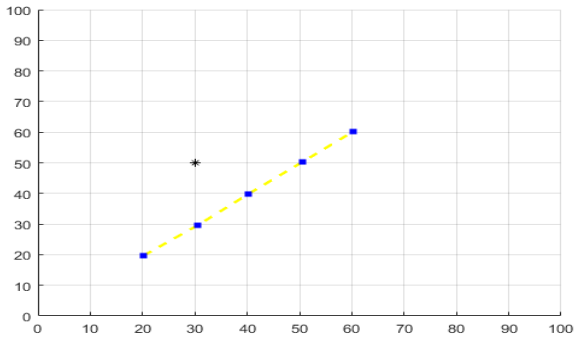

Figure 4: Straight Line Formation

1) *Diamond Shape*

Another formation for the experimentation is the diamond shape where the tower can handle the vehicle communication from center to a diamond shape area or the formation of the road as shown in figure 5. The single tower can handle the communication of various vehicles and at the same time with the application of this tower communication, traffic signaling can also be performed by the tower.

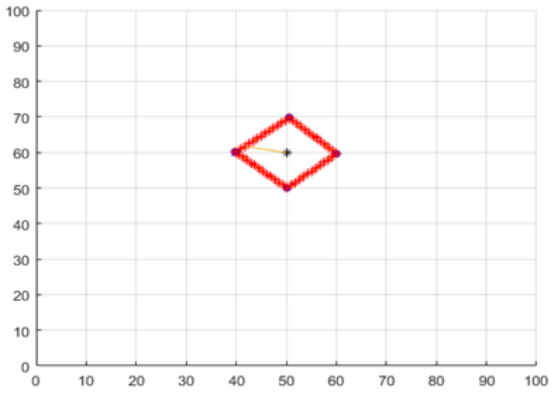

Figure 5: Diamond Shape Formation

The testing results based on simulation present two road scenarios or road formats at this stage, single straight road and diamond shape road have been given. The vehicles are automatically connected to other vehicles and each other on the time when they come into the coverage of a tower or base station. Figure 6 represents the position of vehicle on X-axis and Y-axis.

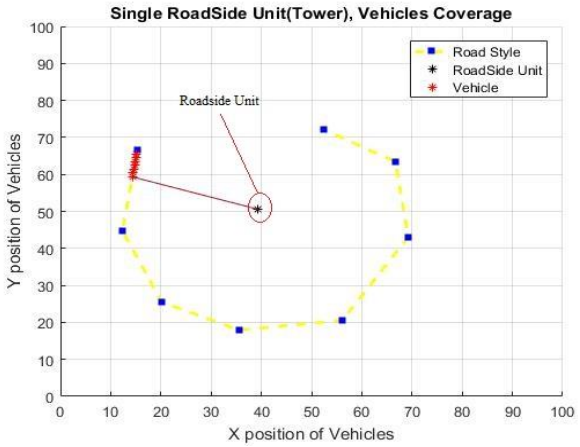

Figure 6: RSU MATLAB simulation for VANET

The outcome of the work is an optimal path to monitor vehicles during their trip and coverage area is generated.

The contribution of this can be understood as the animated working mechanism of v2v where scenarios and shapes of the road including straight and diamond shapes has been simulated and tested.

VI. Conclussion

The study presented a vehicle controlling system based on GSM tower which will use new upcoming technology. Latest technology and all of its features will provide a smarter role for wireless network by decreasing response time, road safety, and traffic data increased efficiency, high level of data rate, mobility services and automated driving. The simulated model has been proposed with architecture in which information about car is provided to the car owner or it will be enabling an owner to get each and every aspect of the movement and other properties.

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