Vehicle to Vehicle Communication System for Smart Cities

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Abstract— *A Vehicle-to-Vehicle (V2V) communication system for smart cities is proposed here. The V2V communication system is an advance wireless technology to reduce the number of fatal roadway accidents by providing early warning messages. For development of smart cities V2V and V2R are important to reduce road accidents on highways. It gives ease of access by providing different facilities such as ATM transaction, accidents safety messages to the transport or central unit. Based on a careful analysis of application requirements, an effective protocol can be used, which comprising congestion control policies, service differentiation mechanisms and methods for emergency warning dissemination. The proposed protocol achieves low latency in delivering emergency warnings and use of efficient bandwidth in stressful road scenarios. This system uses WSN for communication between two vehicle modules.*

Keywords— Intelligent transport system, Broadcast scheme, Efficient protocol.

I. INTRODUCTION

Smart city is very much important for developing country. The smart life of today makes us to arrive at our destination as soon as possible. The changing lifestyle is also important with the safety and comfort of vehicle is becoming an important factor. Development of technology has allowed the concept of an intelligent transport system. Now a day's tremendous growth increases in transport system. Every individual has vehicle for their usages. -Traffic congestion is the main problem of every individual.

So the main objective of V2V communication system in smart city is to provide early warning safety massages to drivers, so that driver can take action and accident can be avoided. The research has been takes place for more than a decade [1] for development of V2V communication system. The support and effort in research from leading vehicle developers shows that this concept has industrial support and can be expected to take a place in the future car. The V2V communication system is an extra feature added [2] to the terms smart car and intelligent vehicle are rather broad and can contain anything that has to do with making the car aware of and reacting to the environment. Smart Cities are the Key Innovations for Stakeholder Platform [3]. The Platform supports innovation in advance technology. It aims to use maximum number of smart and new technology

Vehicular Ad-Hoc Network (VANET) is an advance technology in ITS [4]. It is in the form of mobile ad hoc network, used to provide communications among between other nearest vehicles and between vehicles and nearest fixed equipment, such as roadside equipment. VANET is developed for wireless communication between two vehicles and authorities. Each vehicle will be consists of different sensors and communication devices. These communication devices will allow cooperating with each other by sending different safety messages and information exchange messages. An application V2V communication system can exchange information messages according to condition of road side unit [3]. For cooperative communication system there is a need to have some standard protocols for V2V communication system. This helps to design a communication protocol and interfacing of different sensors as well.

II. PROPOSED SYSTEM

Here the design and implementation of V2V communication system for smart cities along with an efficient communication protocol is proposed. Efficient communication protocol helps for providing cooperative collision warning messages with low latency and minimum delay [5]. Expected outcome of the proposed system will be to develop a prototype vehicle models which will communicate with each other using and road side unit through wireless technology. There are many scenarios are considered for this application which are as follows;

2.1 Vehicle Overtake Messaging

For overtaking scenario two keys are placed here, left and right overtake. User has to press the key left or right

overtake. As soon as user from back vehicle has to presses the key the corresponding indicator starts blinking and a wireless request is sent to the vehicle in front. The request and respond protocol is used here for asking the user to overtake. The front vehicle will accept the request and respond to the request using RF communication. If the request is accepted then only overtake can be done.

2.2 Accident avoidance with safety message

For this an ultrasonic sensor is interfaced at the front end of vehicle. The ultrasonic sensor will continuously sense the distance using Doppler Effect. When the distance between the two vehicles decreases the vehicle will automatically apply brakes for accident avoidance. Different safety/emergency messages are used in this system, which are as follows.

2.2.1 Safety Message

In this kind of message communication the later vehicle takes permission to overtake so that accident can be avoided.

2.2.2 Information Exchange Message

In this kind of message communication one vehicle asks different type of information with each other such as ATM query, Bank query, Address query etc.

2.2.3 Accident avoidance Message

In this kind of message communication the vehicles send a distress message on the Wireless network such as FOG warning, Traffic ahead, Landslide ahead ,Diversion ahead, Automatic breaking system.

2.2.4 Road side vehicle to vehicle Message

Here we are using WSN to communicate with each other when a vehicle is in distress such as accident, physical mishap etc. It transmits the info to the passing by the nearest hospital / Police unit.

This system is going to design and implement RF communication network. Two slaves and a Master communication via RF module will take place. For this it is using Request and responds protocol in which the master sends a request over the network with the destination ID. As soon as the destination slave receives the frame it responds with data, also implementing cooperative communication in which the data is transmitted over other slaves. The maximum distance between two vehicle is 100 to 300 meters [3] with is RF modem. Each Vehicle is connected with each other and in the network of wide range. If any one of vehicle is out of range and drop out of the network, other cars vehicle joins the network immediately.

This paper is organized in major five Section .Section I is about introduction. The proposed system is given in Section II. Section III is related work for proposed system. Section IV for development of the proposed system .Section V is given an experimental set up and results. Finally Section VI concludes system and future scope.

III. RELATED WORK

The cooperative driving concept was researched in automated highway systems. The concept of cooperative driving is being recently adapted to broader applications (e.g., cooperative collision warning, congestion control, cooperative intersection safety systems,), as well as to scenarios where information is communicated between vehicles and nearby infrastructure, e.g., intersection or roadside traffic controllers. The proposed work is to assess the safety for application of V2V communication is a system used to design to transmit basic safety information messages between two vehicles. It helps to provide and facilitate warnings to drivers concerning impending crashes. In literature review there are several papers which are as follows:

Chunru Xiong et al. [1] designed an intelligent vehicle which controls the system using voice-driven principle and LCD display. This system makes the car more user friendly and increase machine human interaction. The vehicle control system also uses a ultrasonic obstacle avoidance sensor module with high accuracy for safety by providing information messages. This system is designed by using the LPC2138 ARM embedded microcontroller and real-time operating system. It is used for intelligent car control system. This system can be used in mobile robot, in intelligent toys, and other areas.

Lilli Due and Hoange Dao et al [2] presented analytical formulations to estimate information propagation time delay via a V2V communication network. This system formed on a one-way or two-way road segment with multiple lanes. The road side infrastructure communication is explained to distinguish the previous efforts the proposed system involves several critical communication and traffic flow features in reality, a wireless communication interference, intermittent information transmission, and dynamic traffic flow are also explained. The system can be further extended to characterize information propagation time delay and coverage over local transportation networks.

Ai Lin GAO Et Al. [3] proposed the design of the intelligent vehicle system based on SPCE061A which is a single chip. The hardware design of this system includes SPCE061A as main controller .It uses different transistors to make H-bridge driver control circuit board to control the motion of the car. The graphical result shows that the vehicle can be controlled by the voice commands such as moving left, moving right, moving forward, moving backward and stop.

William J. Fleming et al. [4] , explained an adaptive alert message dissemination protocol for VANET, for Improving Road Safety. This paper shows the different

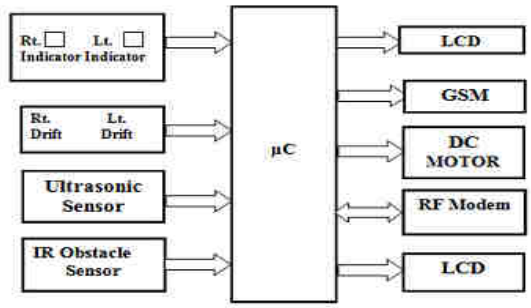
protocols for making a communication between vehicles. It also explained the way to transfer the message. A Secure Cooperative approach is presented here. This paper shows the non-line of site communication in vehicles. They presented a collaborative protocol to verify a broadcast position when direct communication between the replied node and the verifier is not possible. Different security methods were involved here to improve the message reliability and machine. The system gives experimental results for five voice commands that are forward, backward, left, right and stop.

V2V technologies are simple and easy to implement in wireless communication. From literature survey it is understood that there are various ways to implement v2v communication system but having some disadvantages like dissemination delay, accuracy and speed limitation. This survey motivates to present an approach to design a system to overcome these drawbacks and designing a efficient protocol for v2v communication system.

IV. DEVLOPMENT OF PROPOSED SYSTEM

This system is designed for two vehicles as shown in fig.1. Here we are designing a broadcast scheme for V2V communication system for accidents avoidance and co-operative collision warning in road safety system. This system consist of microcontroller, RF modem, GSM modem, DC motor, Ultrasonic sensor, IR obstacle sensor are the main components. The microcontroller based embedded system has many different features such as high performance, architectural simplicity, cost sensitive and ultra low power consumption.

Vehicle1:



Vehicle2:

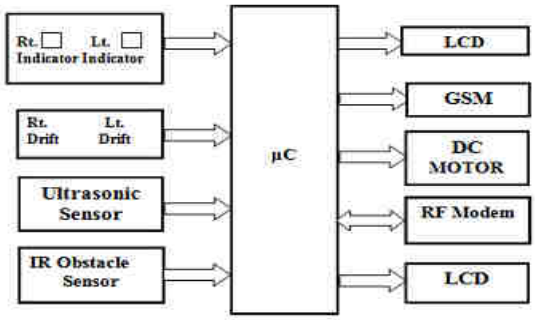


Fig.1: Block Diagram of V2V communication system.

RF communication is for establishing connection between two vehicles [5]. This system is designed for a V2V communication system i.e. for between two vehicles only. Under smart city there is another scenario i.e. Vehicle to Road side infrastructure (V2R or V2I). V2R consists of following parts.

4.1 Vehicle tracking

This unit is placed on the vehicle. GPS onboard the vehicle will receive the latitude and longitude for the position. These co-ordinates are then transmitted to the base station using GSM modem. The µc sends the GPS co-ordinates via GSM module. Upon receiving the SMS, the VB s/w sorts the GPS co-ordinates.the coordinates are shown on Google map using VB software.

Smart city applications

There are different applications we can use under V2R, which are as follows:

- Bank Transaction
- Petrol pump payment
- Traffic information
- Dangerous road condition information
- Accident information to control unit
- Hospital help
- Foggy road condition for highways

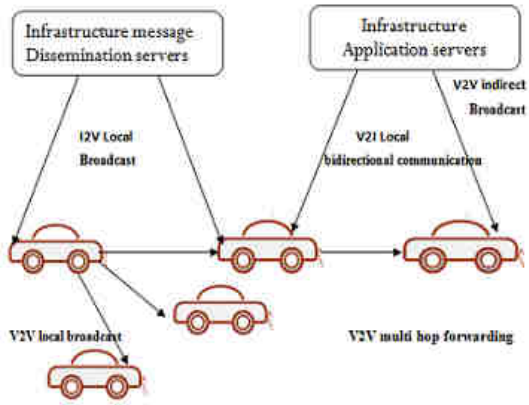


Fig. 2: V2V, V2I and I2V communication system.

V2V local broadcast is as shown above, a vehicle sends messages to all other vehicles within its communication range. This communication mode serves as the foundation for cooperative applications aimed at collision avoidance. For example, vehicles can use V2V local broadcast to inform neighboring vehicles of each other's current position [7], heading, and speed, since the set of neighboring vehicles changes frequently.

V2V Multi-Hop Dissemination consists [8] of V2V multi-hop dissemination; messages from one vehicle are relayed by other cars to reach vehicles that are outside the source vehicle's communication range. When the number of hops is very low, this mode can be used to support hard safety applications such as EEBL V2V multi-hop

message dissemination could also be used for soft safety purposes such as the distribution of hazardous road and traffic information [6].

V2I bidirectional communications mode is as shown above [10]. Examples include navigation, Internet access for browsing or email, electronic transactions for purchasing goods or services, and media download. V2I communications can also be used to "broadcast" messages from a vehicle to other vehicles through infrastructure applications servers. This mode can be supported using long-range or short range radios.

V. EXPERIMENTAL SET UP AND RESULTS

Top view and front view of V2V communication system prototype module is as shown in fig. 2 and 3. Here some results of V2V communication are shown below. The other safety messages like information exchange messages are displayed on LCD as shown below. Overtake request asking message is also displayed on LCD screen .

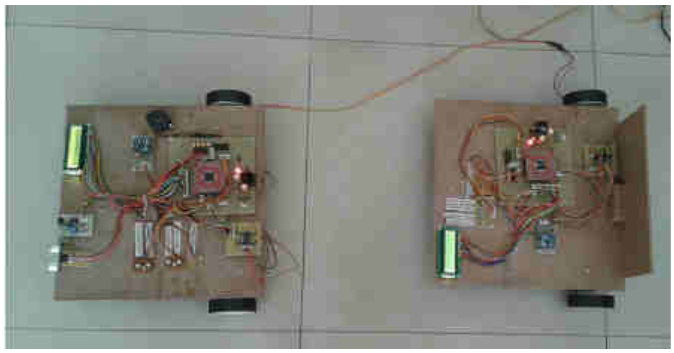


Fig. 3: Top view of experimental set up.

Fig. 4: Front view of experimental set up.

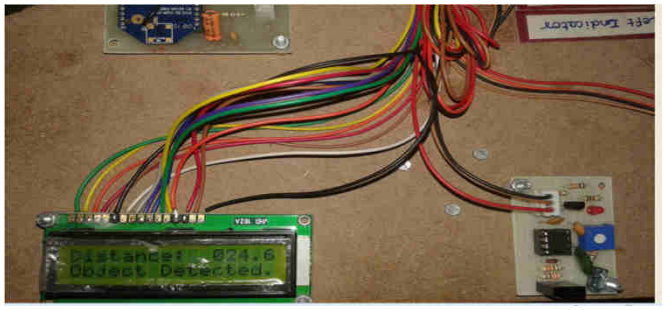


Fig. 5: Object detected message on LCD.

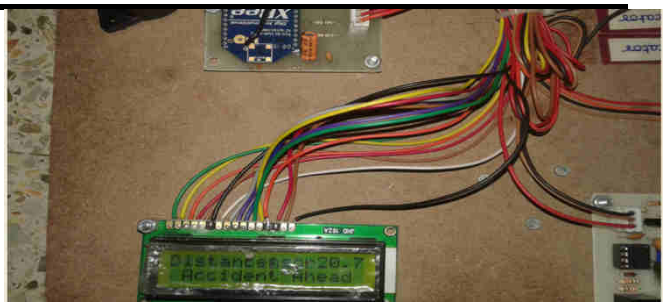


Fig. 6: Accident Ahead message transfer.

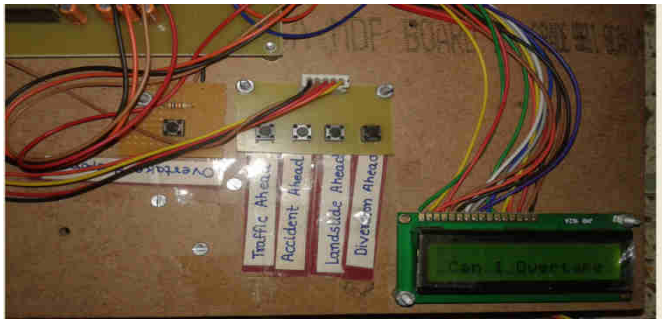


Fig.7: Request message for overtake.

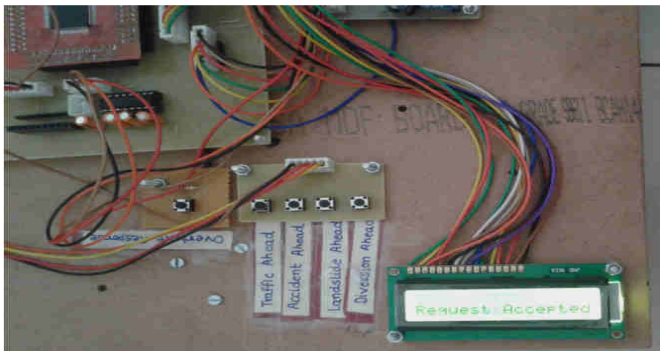


Fig. 8: Request accepted message for overtake.

VI. CONCLUSION & FUTURE SCOPE

Here V2V communication system for smart city is proposed. Panic situations on road can be controlled on Road itself with this technology so that accident can be avoided. Different safety messages results are given here. The future part of this work is to develop communication module with roadside unit also.

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