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Design and Implementation of Intelligent Vehicular Ad-hoc Network

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***Abstract*—**Vehicular network is a real time valuable implementation. It takes the advantage of infrastructure based network by Road side unit and fixed access point. Merits of infrastructure less network such as Ad-hoc network adds more features for achieving communication between fast moving vehicles. In fast moving environment, vehicles move faster so providing uninterrupted and continuous service to user being a difficult task to attain. We propose interlinked RSU based vehicular network in which every node could get the access from nearest two road side units. We propose RSU as primary control device and hence avoid the delay between BS and RSU and hence provide fast and earlier service to fast moving user.

Keywords—*VANET, On-Board unit, Roadside unit and DSDV.*

I. INTRODUCTION

A Wireless communication have wide variety of applications and provide limitless future developments. Vehicular ad-hoc networks is a form of mobile ad-hoc networks which comprises communication among nearby vehicles and between vehicles and nearby fixed infrastructure and also comprises vehicle to vehicle and vehicle to roadside communication. Vehicular network is to enable the driver of a vehicle to receive information about their surrounding environment. Vehicular ad-hoc networks help the drivers of vehicles and to create safer roads by reducing accidents [4].

VANET nodes are moving at a fast speed with dynamic nature. VANET gives more processing power, speed and energy than other. The sensors are GPS, Speed, proximity, engine sensor, etc. The architecture of VANET is commonly vehicle to vehicle, vehicle to infrastructure, vehicle to roadside unit and on board unit. The motivation of vehicular ad-hoc network is to improve effective experience of drivers, safety of roads and infotainment. There are many applications such as infotainment, traffic control and safety.

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The requirements are highly critical messages, video entertainment, short range less than 300 ft, mobility and security. VANET turns every participating car into a wireless router or node allowing cars approximately 100 to 300 meters of each other to connect and create a network with a wide range. Intelligent vehicular ad hoc network is another term for promoting vehicular networking. Intelligent VANET integrate multiple network technology. Vehicular ad hoc network are expected to implement wireless technologies such as dedicated short range communication. Vehicular ad hoc network can be viewed as component of the Intelligent Transportation system. Intelligent VANET for easy and effective communication between vehicle with dynamic mobility.

Effective measures such as media communication between vehicles can be enabled as well methods to track automotive vehicles. Intelligent VANET can also be used as a city guide to locate and identify landmarks in a new city. VANET helps the drivers of vehicles to communicate the information in form of voice, data, image etc. Also it ensures safe journey by minimizing road accidents, diverting or instructing the vehicles direction in less populated roads avoiding traffic jams. VANET are expected to improve the driving experience, traffic safety and multimedia infotainment dissemination for drivers and passengers [2].

Inter-vehicular communication services such as intersection collision warning, local danger warning, and the de-central dissemination of traffic flow information.In Base Station (BS) based communication, every VANET node used to get data's from BS only. i.e., every node needs to be authorised by BS and communication established only by BS. If BS fails it leads to entire associated RSU will be idle and vehicle associated individual at RSU will be affected. VANET is a form of MANET, to provide communication among nearby vehicles and between vehicles and nearby fixed equipment, usually described as roadside equipment.

The remainder of this paper is organized as follows. Section II presents the system model of intelligent Vehicular Ad-hoc Networks. We describe vehicular routing system in general and then we describe our protocol in section III. Section IV describes the simulation results using Network Simulator. Section V provides the performance graph and simulation parameter in table. Section VI describes the hardware design using Proteus software and Complier C. Finally, Section VII concludes this paper.

I. SYSTEM MODEL

A. System model

The system model of VANETs in this paper consists of a fixed RSUs at the road side and mobile OBUs equipped in vehicles as shown in Fig. 1.

- RSU is being an primary component which manage and communicate with vehicles in their communication range and high connectivity. They are connected with OBUs by a wireless channel. Delay is less since the vehicles communicate with each other and direct communication from one RSU vehicles to other RSUs. If the system uses base station it would be a secondary storage.
- OBU (on-board unit) which periodically broadcast traffic related status information containing its position, movement and direction to improve the road environment as more safe, traffic safety, and multi-infotainment dissemination for comfort of drivers and passengers. Each vehicle has a source and distributors.

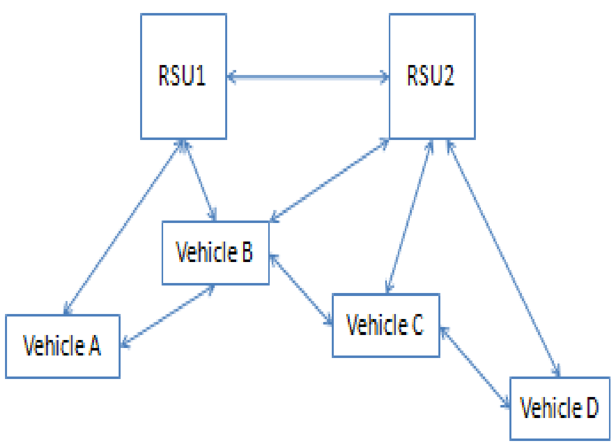

Fig. 1 System model of Intelligent VANET.

II. VEHICULAR ROUTING SYSTEM

Vehicular routing system is classified into three types. They are vehicle to vehicle (V2V), Vehicle to infrastructure (V2I) and vehicle to roadside unit (V2R).

A. *Vehicle to vehicle(V2V):*

In this type of vehicular routing system, used to avoid crashing. If small distance between two vehicles means, the host vehicle speed gets automatically reduced. Vehicle to vehicle communication comprises a wireless network where automobiles send messages to each other [3]. This data would include speed, location, direction of travel, braking, and loss of stability. Vehicle-to-vehicle technology uses dedicated short-range communications (DSRC), a standard set forth by bodies like FCC and ISO.

B. *vehicle to infrastructure(V2I):*

In traffic condition the ambulance path first will be cleared. Next the congested path is cleared and Indication of Road hazards.

C. *vehicle to infrastructure(V2I):*

In school zone, the vehicle speed is automatically reduced. In Accident case, if can send the message to the upcoming vehicles with Doctor he/she can help the people. These are the three vehicular routing system used in intelligent vehicular ad hoc networks.

Routing protocols are classified into proactive routing, reactive routing, and hybrid routing. Proactive routing: Destination Sequenced Distance Vector Routing (DSDV), Reactive routing: Dynamic Source Routing (DSR), Ad hoc On-demand Distance Vector Routing (AODV), Hybrid routing: Zone Based Routing (ZRP).

B. Proactive routing

The routing information like next forwarding hope is maintained in the background irrespective of communication requests. This is also called as table driven. The advantage of this routing is there is no route discovery is required since the destination route is stored in the background [1]. The disadvantage of this routing provides low latency for real time application it also leads to the maintainance of unused data paths, which causes the reduction in the available bandwidth.

A. *DSDV:* This protocol guarantee loop-free paths to each destination. It providing convenient connectivity for mobile computers in ad hoc networks is a challenge that is only now being met. This models the mobile computers as routers cooperating to forward packets to each other aas neede. We believe that this approach makes good use of the properties of wireless broadcast medium.

C. Reactive routing

The routing information is acquired only when it is actually needed. It may often use far less bandwidth for maintaining the route tables at each node, but the latency for many applications will drastically increase. Most applications are likely to suffer a long delay when they start because a route to the destination will have to be acquired before the communication can begin.

A. *DSR:* This is another innovative approach to ad hoc networking, whereby nodes communicate along paths stored in source routes carried along with the data packets. It explores the many advantages of source routing and enjoys the benefits of some of the most extensive testing and deployment of any of the protocols.

B. *AODV:* It offers a pure distance-vector approach to the problem of ad hoc networking, which means reduced memory and processing requirements. Because it acquires and maintains routes only on demand, the control traffic is reduced compared to most table-driven protocols.

D. Hybrid routing

A. *ZRP:* The protocol takes a fresh yet time-tested approach to protocol improvement by constructing a way to hybridize table-driven protocols (such as DSDV) with on-demand protocols. It uses zones that are similar to clusters, but instead of hierarchial routing between clusters being used, special border nodes are dynamically selected that connect adjacent zones. A proactive scheme is used inside the zone, and outside the zone routes are discovered only reactively.

In our project proactive protocol is used. In proactive protocol, before establishing the transmission, each node maintains the tables about the current position of all other nodes. For any changes made by single node, immediately initiated to all other nodes by packet flooding. Path finding time as reduced than reactive protocols. Time delay will be considerably reduced than reactive protocol. All nodes can have knowledge (or) vehicle details about their adjacent nodes.

III. SIMULATION RESULTS

NS2 simulator is used to simulate the results. Especially ns-2.35 is used. NS components NS, the simulator itself contains library etc. NAM, the network animator we develop the network it practically for visualization purpose only. NS is working for user programs works in otcl (object oriented tool command language).
Steps for creating a nodes which as follows as:

- Creating three RSU with high coverage than normal vehicle node.
- Creating vehicle node its position and movements.
- Connecting vehicles with associated RSU.
- to predict from unauthorized node.

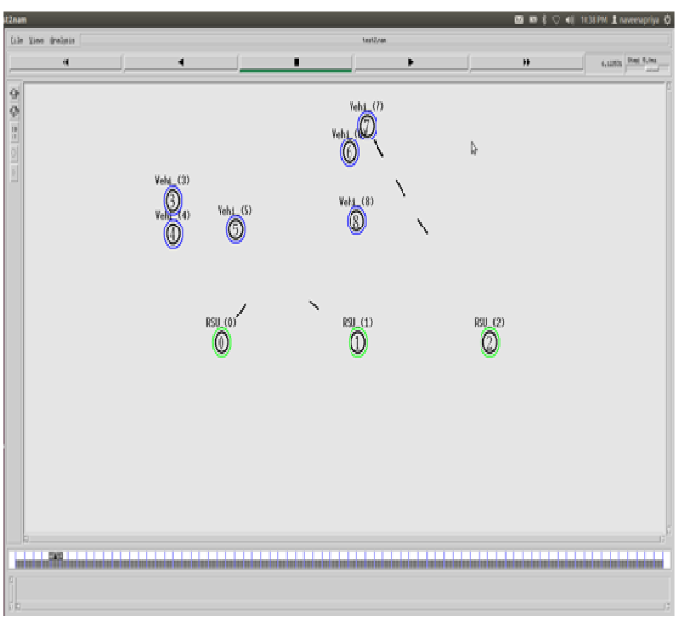

Fig. 2 Simulation result

Figure 2 shows the simulation result which green colour nodes denoting the RSUs with high communication range and blue colour denotes the vehicle node with normal communication range. In Figure 3, the simulation result with unauthorised node which tells about the security. Red colour node denotes unauthorised node which communicates with associated RSU not with the vehicle to vehicle.

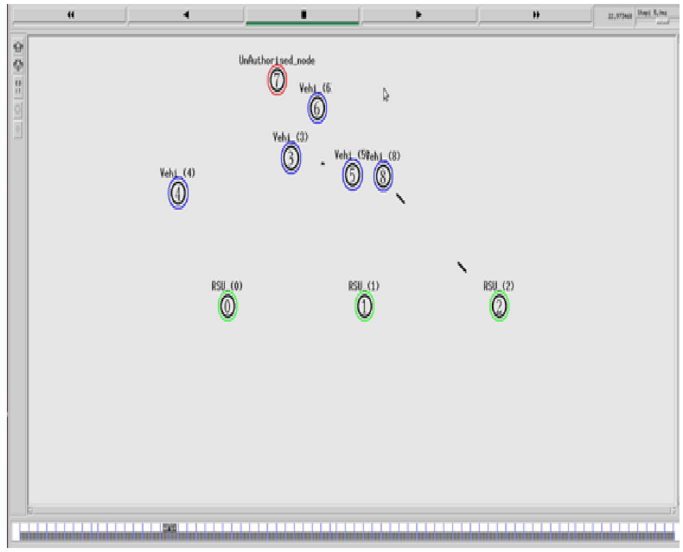

Fig. 3 Simulation result with unauthorised node

IV. PERFORMANCE PARAMETER

The performance graph between the parameters are number of vehicle nodes and communication delay.

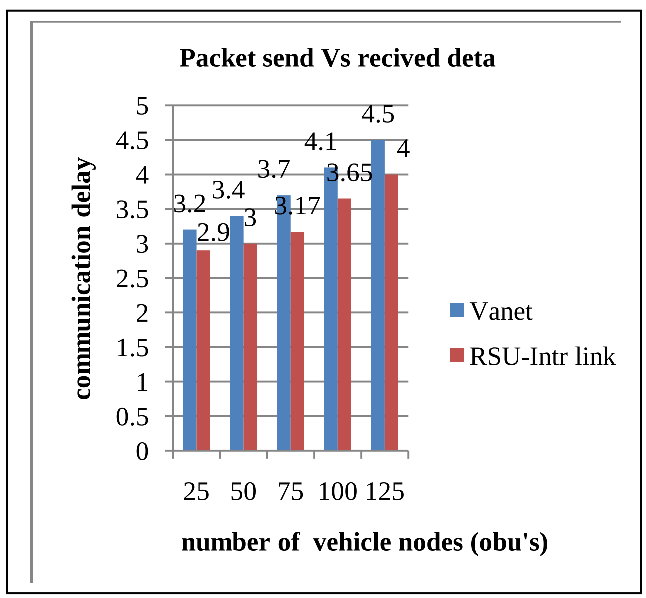

Fig. 4 Packet send Vs received data

Figure 4 shows the performance of packet send and received data. Number of vehicle nodes in x-axis and Time delay in ms (milliseconds) in y-axis. When number of nodes attached to single RSU increases the time delay to communicate with vehicle nodes also increases. This delay indicates the time required to establish communication between RSU and associated vehicles (not vehicle to vehicle). In older base station based system, this delay is high since the vehicle node to communicate with BS through RSU. i.e., signal has to travel from base station to RSU and then end vehicle.

Therefore it is not the case in proposed. Since in existing RSU being intermediate it act as secondary device only, the BS acts primary. But in proposed RSU being primary component. If the system uses base station it would be a Secondary.

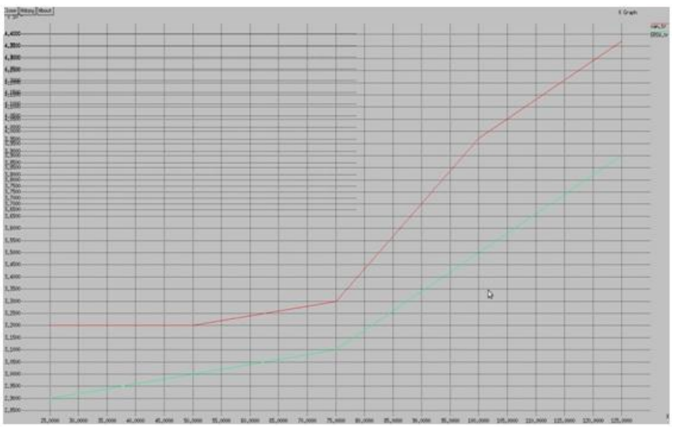

Figure 5 Graph between VANET node Vs ERSU.

Figure 5 shows the X graph between VANET node Vs ERSU. X-axis denotes the number of vehicle nodes and Y-axis denotes the time delay between RSU and vehicle nodes (number of vehicle node increases, RSU reply will get delay).

Table 1 Simulation parameter

Number of nodes	12
Area Size	1000 x 1000
Mobility model	Random Way Point
Traffic's type	CBR
Channel capacity	2 Mbps
Transmit Power	0.3 J
Receive power	0.1 J
Coverage area (RSU)	1500
Coverage area (Vehicle unit)	500m
Idle power	0.01 J
Initial energy	11 J
Communication system	MAC IEEE 802.11
Routing protocol	DSDV

Table 1 shows the simulation parameter which as number of nodes, Area Size, Mobility model, Traffic's type, Channel capacity, Transmit Power, Receive power, Coverage area (RSU), Coverage area (Vehicle unit), Idle power, Initial energy, Communication system and Routing protocol.

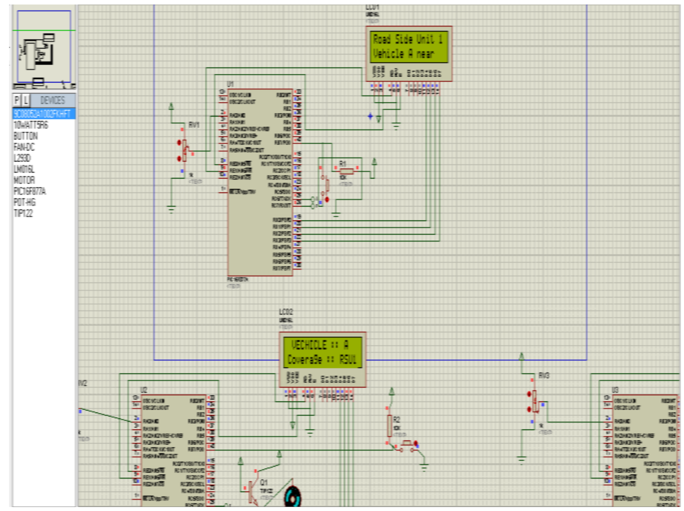

Fig. 6 Design diagram for vehicle and roadside unit.

V. HARDWARE IMPLEMENTATION

Hardware implementation is to be done using Real Time Operating System (RTOS) with the requirements of PIC Controller, Tarang wireless modules and Max 232. Each node consists of pic16f877a where the controller has been loaded with required program. Tarang p20 is a wireless transceiver module communicating at 2.4GHZ in wireless. Each controller connected to tarang P-20 and both communicate by using rs232 communication (UART). MAX232 act as level converter between controller and tarang p20. L293D motor driver used to control the speed of vehicle based on IR.

Figure 6 shows the design diagram for vehicle and roadside unit. Figure 7 shows the design diagram for two roadside unit.

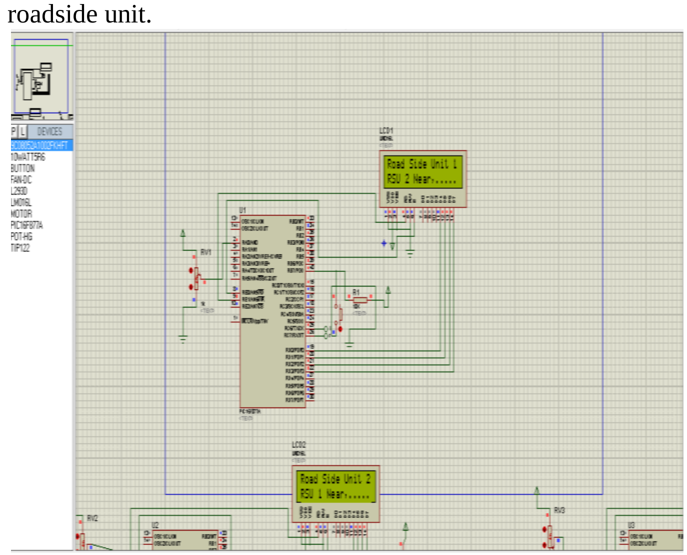

Fig. 7 Design diagram for two roadside unit.

IR transmitter emits signal and it gets reflected signal back at receiver on finding any interrupts. The major application of IR sensor are Emergency application and Arrival of ambulance. For security systems, on any new node arrival at RSU it has to be authenticated to continue its service. Using Proteus software and complier C design an nodes to implement in hardware. The Proteus design are designed between two nodes, between two roadside coverage area and between roadside unit and vehicle.

VI. CONCLUSION

In Intelligent VANET, vehicles can communicate with the roadside communication infrastructure and also among each other. A vehicle is not only information source, but also information distributor. The communication services enable a wide range of applications, ranging from road safety and traffic efficiency and driving comfort.

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