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An Intelligent Vanet Architecture Design for V-I and V-V Application

Sulata Das and J. Selvakumar

ABSTRACT

The scope of the proposed work is to target for vehicle to infrastructure and vehicle to vehicle communication (VANET) for the next generation with wireless signaling devices. The developed devices are autonomous nodes with the capability to accumulate and save time. In the proposed scenario, infrastructures and vehicles can exchange and broadcast messages with respect to (protocol IEEE 802.11b) safety and security measure. Vehicle can get information from road side infrastructure or switch into other vehicles for information to provide safety and security to the travellers. The span of the life time taken in this particular approach (V2V & V2I) is very less, as data will be uploaded to cloud (DAQ database system) by offline mode. No vehicle needs to spend more than one second in any kind of toll plaza as the toll taxes can be paid monthly by credit card or debit card (like:- landline bill, electric bill).

Keywords: VANET (vehicle Ad Hoc Network), V2V (Vehicle to vehicle communication), V2I (Vehicle to Infrastructure), DBU (Dash board Unit), IU (Infrastructure Unit)

I. INTRODUCTION

Vehicle Ad Hoc network (VANET)[1][2] is a sub part of the Mobile ad hoc network where networks can configure itself without any wire. Vehicles utilizing wireless communication networks, are well known as "computers networks on wheels", having data sharing capabilities and also pretty reliable. It aids the sharing data among vehicles and nearby roadside infrastructures like tollgate, school zone, hospital zone, traffic signals etc.

This technology can improve road side traffic safety by interacting among vehicles, so that drivers can take proper decision on proper time. VANET is autonomous and self-organizing wireless communication network, where vehicles also act as nodes of the network. These nodes act as servers or client for exchanging and sharing information and broadcast messages. VANET has two types of approach [3]. They are following:

i) V2I: vehicle to infrastructure

ii) V2V: vehicle to vehicle

In a sentence, we can say that "VANET is an intelligent transportation system".

II. DESCRIPTION

Intelligent Transportation System (ITS) means that a vehicle itself acts as a sender, receiver and router for the broadcasting information [4].ITS provides two types of communications. First one is vehicle to vehicle comm. where multi-hop communication is being used, and second one is vehicle to infrastructure communication where vehicle can always get some broadcast messages from any kind of infrastructure (eg: tollgate, school zone, hospital zone etc) while it is passing through the infrastructures and according to that message, to infrastructures so that it can easily get or send some acknowledgements to them. No harm

* SRM University, Chennai, India, *E-mail: sulata194@gmail.com; selva2802@gmail.com*

will be occurred during the time of sending messages. This process is pretty confidential and flexible to all type of drivers. And also, VANET related communication is shown below:

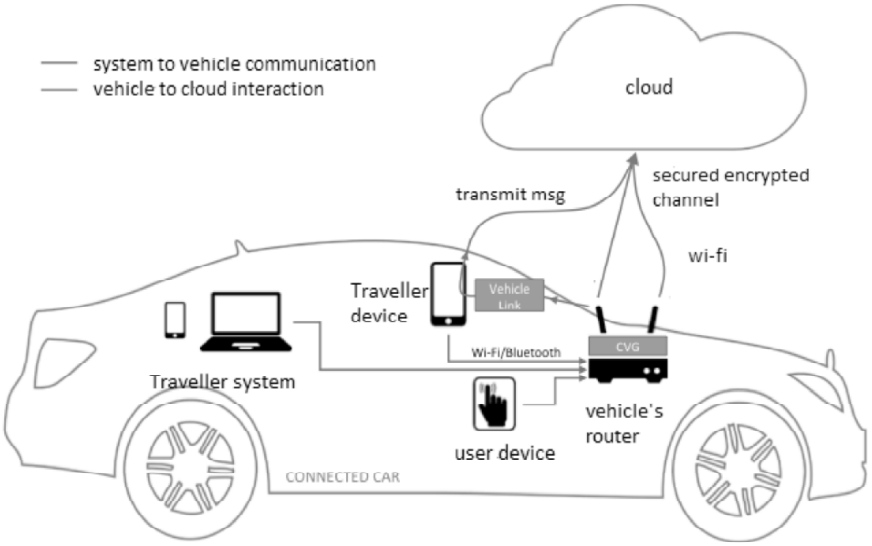

Figure 1: V2I application (using concept of cloud)

Here communication is done by vehicle to cloud. Travellers can communicate with vehicle as well as cloud by using laptop or any kind of devices. As a wireless connection here radio frequency of 433MHz (protocol IEEE 802.11b)[6][7] has been used by RF module of 40 meter range. From the cloud we can access data as per our requirement with payment or without payment also.

III. ARCHITECTURE OF PROPOSED VANET

In vehicles discussed setup should be present so that it can easily communicate with another vehicle or infrastructure. Here LPC2138 is used from ARM family. RF module is for wireless communication to pass the all data from vehicles to cloud and other vehicles. I have used 40 meter range RF module so that all the broadcast messages from any kind of infrastructure and other interacting messages among vehicles with in 40 meter range, node detected a vehicle. Even messages can be passed to another vehicles so that drivers can take proper decision while they are driving. The purpose of this real time system is to save lives, valuable time, protect from any kind of injuries.

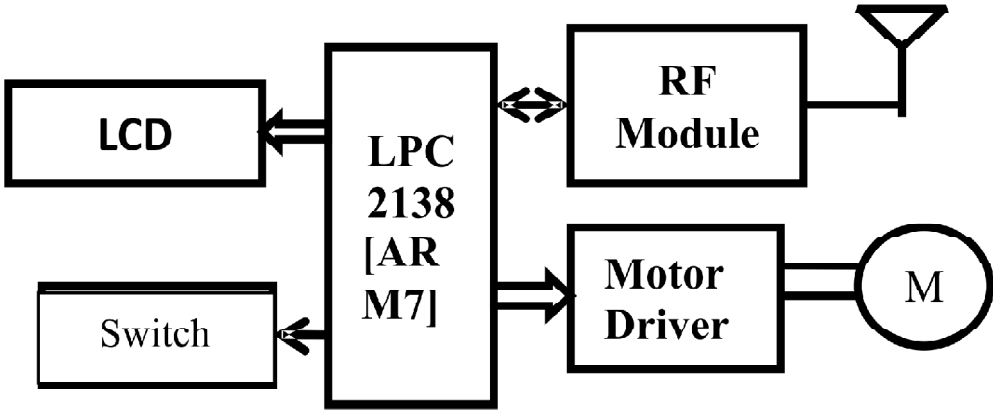

Figure 2: Hardware design inside vehicle

(A) Modeling of vehicle to Vehicle

Vehicles send some message related information. Whenever an ambulance is detected by other normal vehicles, automatically message will be displayed on LCD, so that other vehicles easily give way to the ambulance.

Whenever any vehicle will want to take left or right turn, messages will be displayed on LCD of other vehicles, so that they can give way to take proper turn at the proper place which is very useful to avoid any injuries or accidents.

When one vehicle wants to overtake front vehicle that message will be automatically displayed on front vehicle LCD. So there will be no harm at the time of overtaking.

Upper Switch: Emergency vehicle communication (e.g. Ambulance)

Left & Right Switch: L-Board

Down Switch: Over taking purpose (among vehicles)

Figure 3: V2V communication example

(B) Modeling of Vehicle to infrastructure

Here vehicle can interact with any kind of infrastructure (eg: toll gate, school zone, hospital zone, traffic signal etc) and all data will be uploaded to cloud [8] by off-line method [9].

If a vehicle is passing by school zone then automatically displayed on vehicles LCD is ‘go slow’, speed will be in limit, so that no injuries will occur. If a vehicle is passing by hospital zone then LCD will show

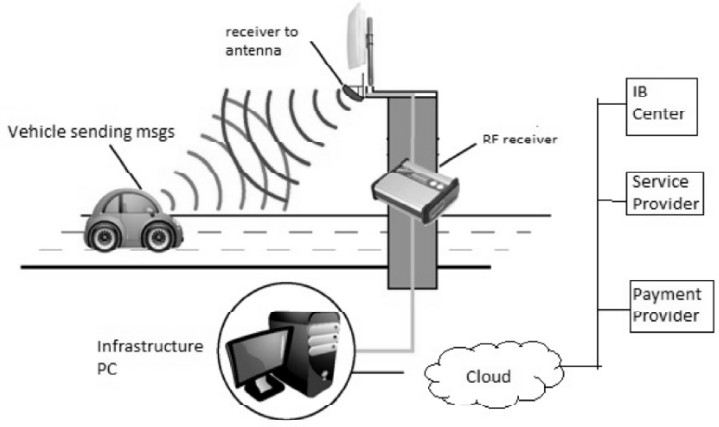

Figure 4: V to I application example

that ‘do not horn’ and ‘speed in limit’. If a vehicle is going through a toll gate then need to follow some instructions by vehicles. In V2I communication whatever message a vehicle is getting, all are broadcast messages by different type of infrastructures.

III. SOFTWARE DESCRIPTION

This application is related to minimize traffic congestions and helping driver to reach to destination in compatible way. It improves traffic congestion, co-ordination and assistance of any kind of infrastructure. This software providing information regarding roads’ present situation, maps and relevant messages (like broadcast messages) needed time by time. V2V and V2I optimization applications and software description can be further discussed below:

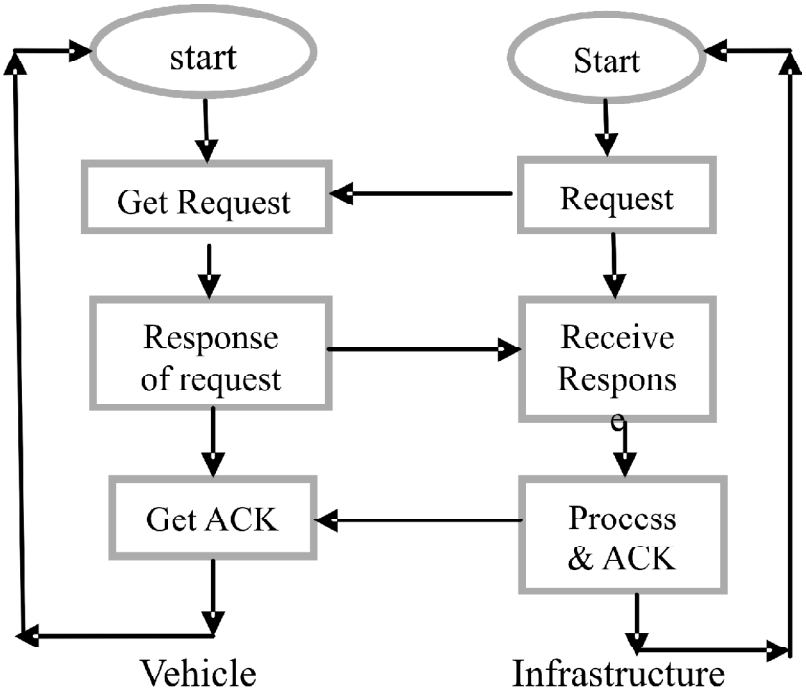

Figure 5: V-I communication flowchart

The vehicles which will come under a particular infrastructure, will receive a request to share their information (like- Vehicle Identification number, license, tax records etc). The vehicles will receive the requests and response back within a few milliseconds (measured by watchdog timer in keil cross compiler). After getting response form a particular vehicle, the infrastructure will process that and will send some acknowledgement to the particular vehicle and will wait for new VIN number. On the other hand, after getting acknowledgement form infrastructure, vehicle can move forward to its destination. This whole developed system will be finished within a second, so easily can save the span of lifetime.

VANET starts from safety, to road traffic optimization and data sharing problem [10]. Road safety messages or broadcast messages are time critical and speed of data transfer is in high importance. That is why we need proper throughput and high data transfer speed for V2V and V2I communication. Infrastructure units (IUs) are the source of any kind of infrastructure situated at road junctions or beside roads. But still we are stating this infrastructure data uploaded as offline method because of high speed of vehicle, saving of energy, avoiding internet congestion and it is available to vehicle within the short duration of time. The connection with IU [11] remains only when vehicle is within the range (40 meter range)of an infrastructure unit and not all the time.

(A) Upload to cloud Module

This process is allowed by the proposed system, the user text files can be uploaded to the server using cloud (DAQ database system). This text file is initially present in cloud upload file and the copy of it is stored in DAQ system database. The file can be uploaded by the user to the cloud by taking file from the DAQ system database.

(B) Download from Module

The smart/authenticated car users can request the access point (IUs) for the data file download from the server or cloud using Data Access Object [DAO]. The access point gets the request from particular vehicle and calculates the range of transmission of the particular vehicle. If the vehicle is within the range, the file can be taken using getTextFile (). If vehicle is not within the range, the data file is fragmented into sub-files and sent to the nearby access point of the vehicle. This nearby access point sends the files to that particular vehicle when it comes into transmission range of this access point.[10]

(C) Vehicle to Vehicle (V2V)

In the V2V domain, it is taken care of communication between vehicles which are equipped with Dash Board Units (DBUs)and RF modules(40 meter) range. An DBU is a device that are fixed in vehicle and helpful in sharing data with infrastructure units (IUs) or with other dash board units (DBUs)[11]. Its equipment includes a user interface, a specialized interface to connect to DBUs and a device for short range wireless communication based on IEEE 802.11b [12]. It has capabilities which are used to send, receive and forward data with wireless connection. Functioning capabilities of DBU includes routing, quality of service, security and IP mobility.

IV. SIMULATION RESULT

Here I have attached my simulated results:

1) Keil- cross compiler snapshot: It shows how vehicle to Infrastructure communication has been developed.
2) Vehicle to Vehicle communication with LCD display: There are four types of communication, we have proposed. One of those four communication snap shoot has been given.

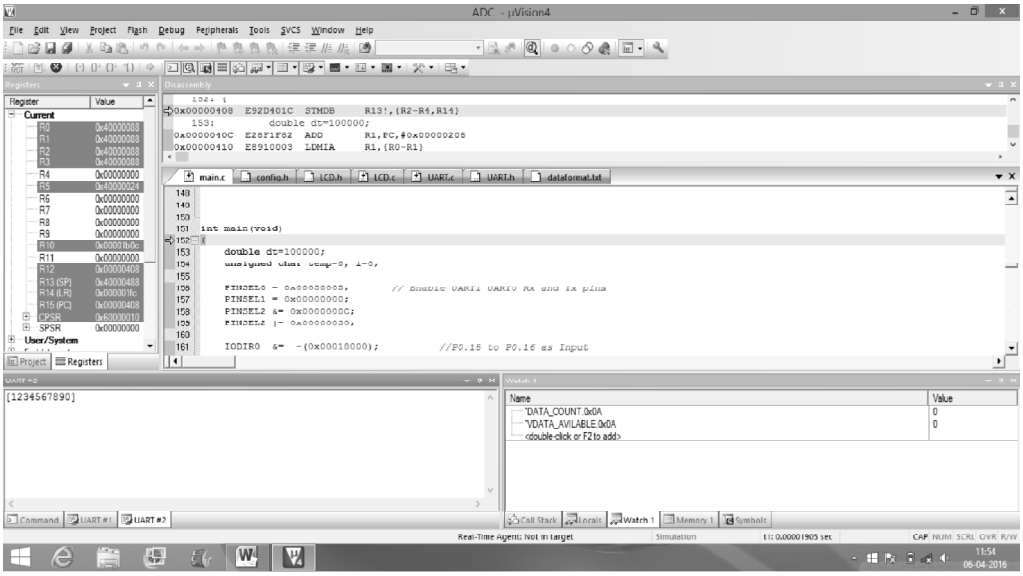

Figure 6: Keil software screen shot

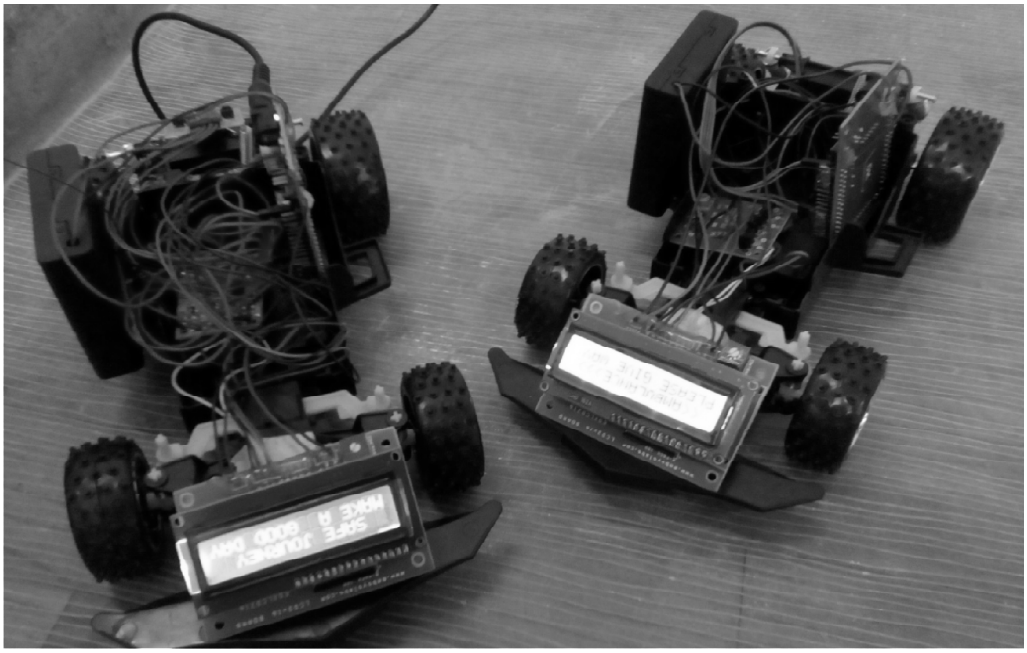

Figure 7: V2V Application kit

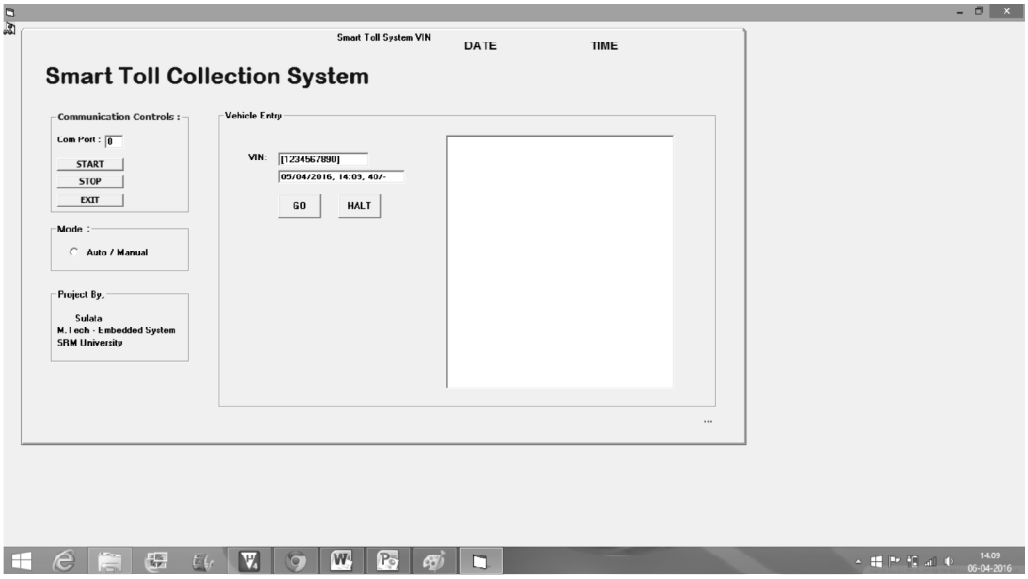

Figure 9: V2I Application: Tollgate Page

3) Vehicle to infrastructure (Toll Gate) communication: How to communicate with toll gate to a vehicle and the proposed communication.

The proposed wok is concentrated on vehicle to vehicle comm and vehicle to infrastructure communication. How data is being uploaded and how those data can be used for further all these shown by those snap shots.

V. DISCUSSION AND CONCLUSION

This paper provides a complete survey on all the issues facing VANET, the design of components of VANETS to focus on V2V and V2I communication areas. Wireless network access VANET technology and characteristics, challenges. Here we deal with in depth to find out to know the factors critical in making VANET a reality reliable and getting to know how to handle all the issues related to VANET discussion on

some Challenges. This paper showed that there are several challenges including routing, security and the effective research efforts are being undertaken to map required to make VANET architecture in our real life.

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