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VANET Based Remote Diagnostic Safety System Using Cloud

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Abstract:

Today, vehicles are emerged with new technologies and deployed with numbers of software applications. Checking reliability of these software applications is very challenging. The applications can be updated, diagnosed and tested remotely on road which makes the job of vehicle user easy and convenient. For vehicle communication, Vehicular Ah-hoc Networks (VANET) is used which is application of Ad-hoc Network. This paper gives brief overview about VANETS and cloud computing and also discusses the wide research work going on this domain.

Keywords — VANET, ad-hoc, cloud computing, ITS.

I. INTRODUCTION

Vehicular ad-hoc network (VANET) is a technology which uses mobility of vehicles as nodes and create mobile network and creates wide network range. VANET is an application of ad-hoc network as an open wireless network and also important part of Intelligent Transportation System (ITS). Intelligent Transportation System (ITS) means the vehicle itself acts as a sender and receiver as well router for broadcasting information which can be useful for other vehicles or accessing cloud for real time information. VANET mainly consists of two components: Road Side Unit (RSUs) and the vehicles with On Board Unit (OBDs). Consider the Fig. 1, where two types of communication takes place in VANET while vehicles moving on road or on fly. One is Vehicle to Vehicle (V2V) communication and the other is Vehicle to Roadside (V2R) communication. Vehicle to Vehicle (V2V) communication mainly concentrate on driver safety which includes sharing information among vehicles regarding the traffic jam, vehicle accidents, road under construction, some file downloading etc. By using Vehicle to Roadside (V2Rs) communication which acts as wireless access points, people can connect to Roadside unit to access internet for downloading and updating files or to get neighbourhood location information which helps driver when the vehicle on fly. This communication facilitates consumers to enjoy services without subscription. Vehicles use VANET for real time information through vehicle to vehicle or vehicle to infrastructure communication, it provides real time safety and other applications.

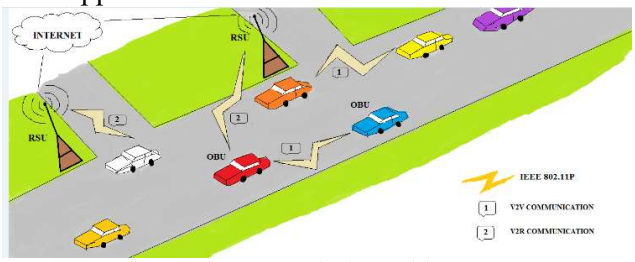

Fig.1 Communication Model

Vehicular Ad-hoc Networks (VANETs) have gained much interest in automobile industry in recent years because of lot of emerging software applications in vehicles to take care of passengers and drivers safety and comfort such as emergency breaking, traffic jam detection, entertainments for passengers and applications aiming for passenger and driver safety and comfort. The research has proved that increased number of software's in vehicles has not only affected vehicle warranty and also maintenance cost which all made car harder to repair.

Therefore, we propose a remote diagnosis system to eliminate bugs in software applications running in vehicles using cloud and which also improves reliability of softwares. To do this, OBU, RSU and cloud are major important components which act as bridge to one another to communicate each other to update and remove errors in softwares. Vehicles can upload and download data present in RSU by accessing it where RSU acts as a router or access point. RSU manages the OBD which takes log details from the vehicle and also from cloud server,

downloads execution file and compares log details of vehicle with cloud server. If result analysed gives error then next RSU is updated with correct results to eliminate errors and to reconfigure correct software applications in vehicles.

When vehicle is moving or its mobility is constrained by road layout, speed limit, and traffic and vehicle destination to keep vehicle in track. To reconfigure correct software application in vehicles by RSU, vehicle has to travel within its speed limit otherwise driver will get warning message if he/she exceeding speed limit and provides next nearest RSU where vehicle can reconfigure correct software application. Location based services to treat applications in effective way and central RSU sends details of vehicle which includes vehicle ID, version number, OBD name, OBD model name to the next RSU to create awareness of vehicle mobility, so that other RSUs can be aware to vehicle direction of moving to be ready for providing services such as resuming updation of software application left by previous RSU.

With explosively emerging softwares in vehicles made harder to maintain and develop OBU softwares and which this is also major issue in automobile industry. Tracing out and documenting OBU software bugs have become one of the major issues from testing and validation perspective. when vehicle is facing some operational problems or needed information to know the status of running vehicle or health of the vehicle, the vehicle need to be present at ”vehicle diagnosis centre”. These centres incorporate advanced computer technology which allows vehicles to test and interact on board sensors of vehicles with centre’s advanced diagnosis programs. This practice is done to point out vehicle problems which facilitates to overcome the problems or to provide necessary information regarding status of vehicle. This process needs vehicle manually be present at diagnosis centres, has a slow correction rate and degradation in terms of satisfaction.

The main reason for choosing this topic is to remotely diagnose the vehicle and upgrade new version softwares quickly and fluently when vehicle on fly via RSU as well no need of driver manually take vehicle to diagnostic service centre.

II. PROBLEM DEFINITION

To develop a remote diagnosis system to fix, test and upgrade the software applications which are used in vehicles using V-2-I communication model of vehicular ad-hoc networks on cloud. The on-board unit (OBU) software which is used in the vehicles can be diagnosed, reconfigured and updated remotely without any bug over the wireless network and make many other vehicles to diagnose at the same time through RSU, and make use of reliable and updated version of software, which increases the driver safety and provides comfortable to driver as well as passengers. Location awareness is another concentrated proposed system work.

III. SCOPE OF THE PROJECT

The main aim of this project is to remotely diagnose, reconfigure and update new version of software applications in vehicles automatically and fluently via RSU which in turn access cloud for real time data or information.

IV. OBJECTIVES

The main objective of the project is to diagnose the software applications in vehicles remotely using remote diagnosis system.

Main objectives concentrated are:

- Improving customer safety and location awareness.
- Diagnosing software applications in vehicles.
- Reconfiguring and automatic updating correct software applications.
- Improving reliability of updated software application.

V. EXISTING SYSTEM

Many research works has been carried out in recent years by researchers in Adhoc Network field. Vehicular Adoc Network (VANETS) and Mobile Adhoc Network (MANETS) are two main domains of research carried out. Today, vehicles are emerged with new technologies and deployed with numbers of software applications right from braking systems to engine coolant temperature. Checking reliability of these software applications is very important and challenging factor. Existing system only

concentrates on downloading the the software applications but no work has been carried out for diagnosing, reconfiguring, updating and maintaining reliability of software applications when vehicle on fly. In existing system vehicle user or driver has to manually take vehicle to diagnostic centre for testing applications and get bugs fixed which is inconvenient and waste of time. In proposed system, the applications can be diagnosed, tested, updated remotely in vehicle which helps the vehicle user, without manually be present at diagnostic system.

VI. PROPOSED SYSTEM

As there is need for automotive testing and validation due to emerging software applications in modern vehicles. This new era is all dependent on software technology hence vehicles are also dependent on software to handle their applications. By introducing wireless communication technology in vehicles, the proposed system remotely diagnose, update and fix bugs, this system is called remote diagnosis system which greatly enhance vehicle maintenance and also various innovative applications can be introduced to vehicles. The following are the benefits of the system:

- To provide a latest and improved vehicles wireless diagnosis system to update software with quick response time and high accuracy.
- To support remote software download which help customers to download new version softwares without taking car to repair shop.
- Support for wide range of services being provided by automobile industry targeting to improve the qsuality of ITS infrastructure.
- To help automobile industry to identify problems in vehicles fluently and take appropriate decision to overcome such problems and improve their business.

VII. RELATEDWORK

This section describes the literature survey that gives researchers and authors point of view and also gives accomplishment in the field of Vehicular ahoc network and also discusses various limitations.

According to authors, S. Shanker, and S. M. Mahmud and I. Hossain [2] software download in vehicles via RSU is performed by means of protocol using Intelligent Transportation System (ITS) infrastructure. During software transmission between software provider and vehicle, symmetric keys are provided by provider to encrypt software. From predicting the message order, the message should be sent twice or in random order to avoid attackers and to improve security in transmission of software. A set of keys are assigned to vehicles to authenticate vehicles during authentication.

S. M. Mahmud and I. Hossain[3] describes special device called Network Device Monitor (NDM) which authenticate vehicles and installed in the AP within an ITS infrastructure.NDM uses keys which cn be transmitted to authenticate vehicle.

Munir Sayyad, Sanjay Nalbalwar, Shomik Dasgupta, Jagdish Bakal, [4] propose vehicular dianostic information is send to central server where database is created to store this information which accounts Advanced Intelligent Vehicular analytics. The database created is used by automotive industry for business purpose where they can create interactive graphical interface for mobile phones so that vehicle owner gets real time live update of vehicle's health

VII. REQUIREMENT ANALYSIS

This section gives the details of functional and non functional requirements and also hardware and software requirements of the proposed system.

A. Functional Requirements

- Establishment of Adhoc wireless network to enable different RSU's and vehicles to communicate.
- Hello packet and version number of vehicle need to be exchanged with nearest RSUs.
- Software applications needs to run all the time installed on the vehicle and also display appropriate values based on the

condition of the vehicle to know the health of the vehicle to the user.

- Application log details from vehicles must be able to send to the RSU for checking and testing.(Ex: Intake Air Temperature check)
- RSU must be capable of performing version check by fetching the log details from cloud server.
- This system requires updating of software applications which are installed on vehicles and detect bugs and fix them and also capable of improving the reliability of the software applications.

B. Non Functional Requirements

- Reliability: High probability of the system to deliver improved and required functionalities in the system.
- Availability: The system should be highly available to satisfy the dedicated and desired operation of application testing.
- Scalability: The system should be scalable to handle more than one application for checking reliability.
- Flexibility: This is possible because the system functions are modular and hence also flexible to withstand future changes.
- Performance: As the vehicle is constrained with speed and distance, the time taken to produce list of results during its execution when the vehicle is stationary should be low.

C. Software Requirements

1. JAVA Socket Programming.
2. JDK 1.4 or Higher.
3. Eclipse.
4. Windows 7& or Higher.
5. Cloud Server.
6. Mysql Database.

1. Adhoc Network.
2. Minimum 2 PC with Dual Core Processor.
3. Minimum 4GB RAM.
4. Minimum up gradation 20GB Hard Disk.
5. Two vehicles for realistic testing.

VIII. SYSTEM INFRASTRUCTURE

Case-I: System works as below if currently installed application is Up to date.

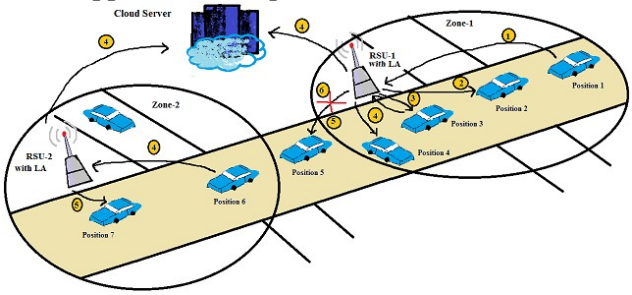

Fig. 2 System infrastructure

1. Moving vehicle inquires RSU-1 by sending hello packet, version number and vehicle ID.RSU-1 in Zone-1 which is waiting for the hello packet, receives packet and performs version check by accessing its own database.
2. RSU-1 in Zone-1 will reply back to incoming vehicle(position-2) with OBU shown in fig. 2 with status(version up to date or updation required) after performing version check. Suppose if the version number of vehicle matches with version stored on RSU, the RSU reply to vehicle saying version is up to date.
3. After version check,RSU-1 requests for log details from the vehicle(position-3).
4. vehicle(position-3) will reply by sending log details to RSU-1.At the same RSU-1 by sending vehicle ID fetches the log information from the cloud server.RSU-1 then performs test for log details collected from vehicle and cloud server.
5. RSU-1 will replay back to vehicle(position-4) saying application is working appropriately or if it fails RSU-1 will fix error and sends updated patch to vehicle.
6. High speed of vehicle may make it to move out of coverage Zone-1 link breaks and reliability check is rejected.
7. Until all the applications are tested, step 4 is repeated.
8. OBU in vehicle(position 7) replies to RSU-2 of Zone-2 by sending positive Acknowledgement(ACK) if it receives the file successfully.

Case-II: System works as below if currently installed application is not Up to date.

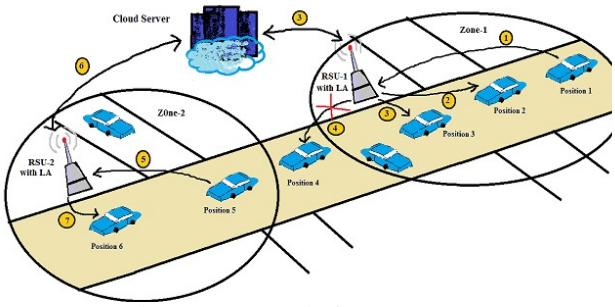

Fig. 3: System infrastructure

1. Moving vehicle inquires RSU-1 by sending hello packet, version number and vehicle ID.RSU-1 in Zone-1 which is waiting for the hello packet, receives packet and performs version check by accessing its own database.
2. RSU-1 in Zone-1 will reply back to incoming vehicle(position-2) with OBU shown in fig. 3 with status(version up to date or updation required) after performing version check. Suppose if the version number of vehicle does not match with version stored on RSU, the RSU reply to vehicle by giving warning: version updation required.
3. After successful updation of application a flag is set in vehicle(position-3) when RSU-1 starts updating the application.
4. As vehicle moves out of coverage zone-1 link breaks due to high speed and therefore updation of application is rejected or suspended.
5. Vehicle does not send application log details if its updation is completed and flag is set, if not then log details are sent to along with Hello packet nearest RSU. And RSU-2 will resume updation process after receiving protraction hello packet.

IX. APPLICATION MODULE

Automobile industry has developed a wide variety of applications to look after the temperature variable in vehicles and if not working in their threshold values then displays a warning message to driver. Standard threshold values of each temperature variables are given below:

A. Engine Coolent Temperature (ECT)

To measure the temperature of engine coolant in a internal combustion engine, coolant temperature sensor is used.ECT has threshold value for efficient operation between range 200 deg F -225 deg F and for inefficient operation range is 225 deg F and above. Database is created to store the temperature values for each vehicle.

B. Intake Air Temperatue (IAT)

IAT sensors are used to handles the temperature of incoming air or air entering into the engine.IAT has threshold values for efficient operation between range + 40 deg F/-40 deg F ambient temperature, displays “All is Well” message to driver and for inefficient operation range is + 40 deg F/-40 deg F and above ambient temperature, in such case displays “Engine Overheated” message. Database is created to store the temperature values for each vehicle.

C. Catalyst Temperature (CT)

CT helps in removing pollutants released from combustion reducing Hydrocarbons(HC) and Carbon monoxide(CO) emission to extremely low level. CT has threshold value for efficient operation between range 400 deg F - 1600 deg F and for inefficient operation range is 1600 deg F and above. Database is created to store the temperature values for each vehicle.

X. OUTPUT ANALYSIS

This section gives overall output of our work with snapshots. There are 2 interfaces, one is vehicle interface and other is RSU interface. Vehicle interface contains vehicle section and vehicle details, in which vehicle details have vehicle ID, OBD name, model name and version number.RSU interface has stop unit and location awareness buttons, also displays pop up message when vehicle probes RSU to send hello packet and version no.

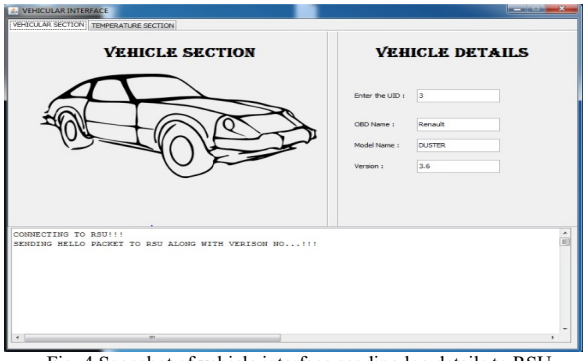

Fig. 4 Snapshot of vehicle interface sending log details to RSU.

Fig. 5 Snapshot of the request establishment at RSU.

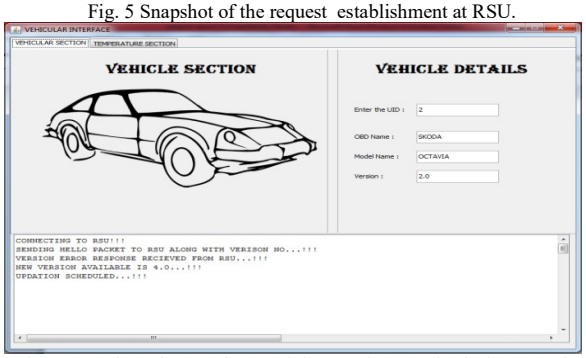

Fig. 6 Snapshot of RSU after receiving version no. checks it comparing with cloud database and starts updating.

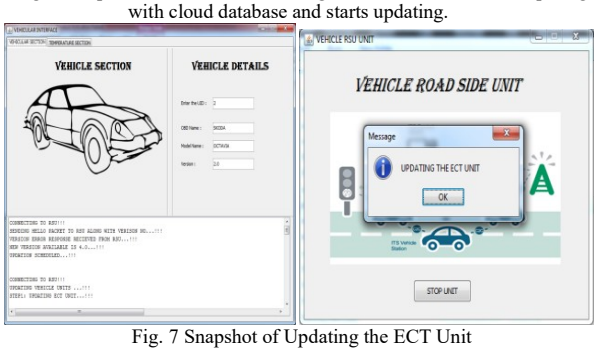

Fig. 7 Snapshot of Updating the ECT Unit

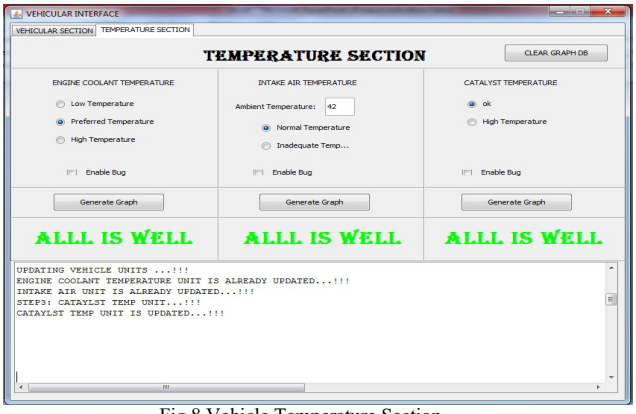

Fig 8 Vehicle Temperature Section

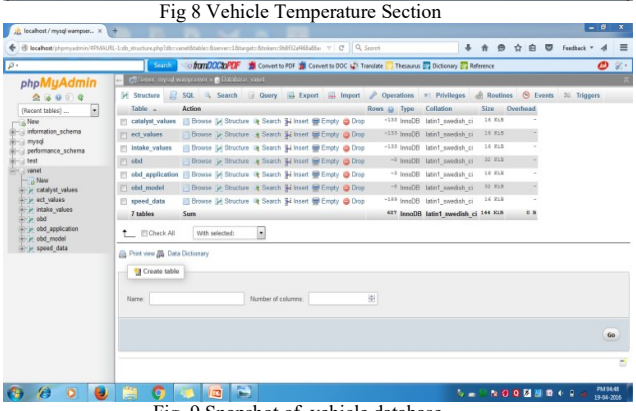

Fig. 9 Snapshot of vehicle database.

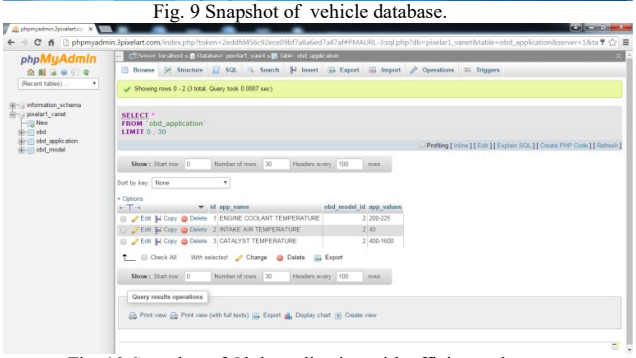

Fig. 10 Snapshot of Obd_application with efficient values

Location Awareness:

The VANET implementation also involves an additional implementation of the Location awareness. Location awareness allows the First RSU to transfer the details of the vehicle to the remaining the RSU's on the lane where the vehicle is oriented. This helps the other RSUs on the same lane or the direction in which the vehicle is moving to determine the status of the vehicle thereby updating the application version if required.

RSU1

Fig. 11 Press the Location Awareness button to check out the details of the vehicles detected and being forwarded to the other RSU's.

RSU2

Fig. 12 Press the Location Awareness button to check out the details of the vehicles detected and being forwarded to the other RSU's.

RSU3

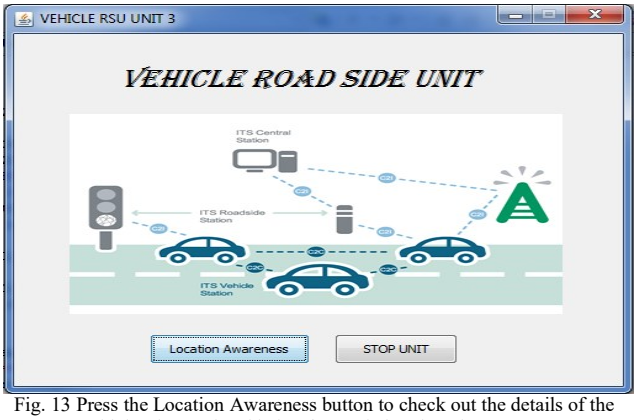

Fig. 13 Press the Location Awareness button to check out the details of the vehicles detected and being forwarded to the other RSU's.

RSU 1 sending the information to other RSUs

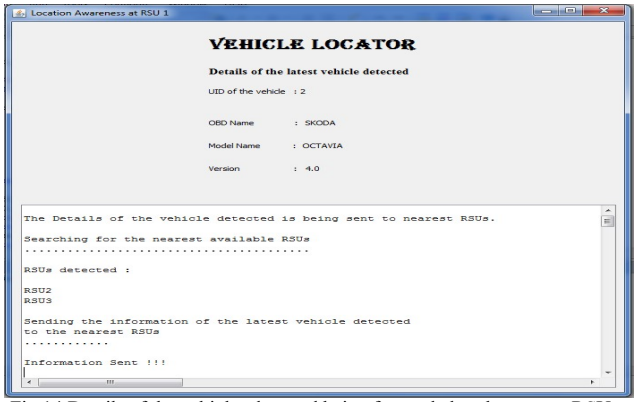

Fig.14 Details of the vehicles detected being forwarded to the nearest RSUs

Vehicle details detected by RSU2 from RSU1

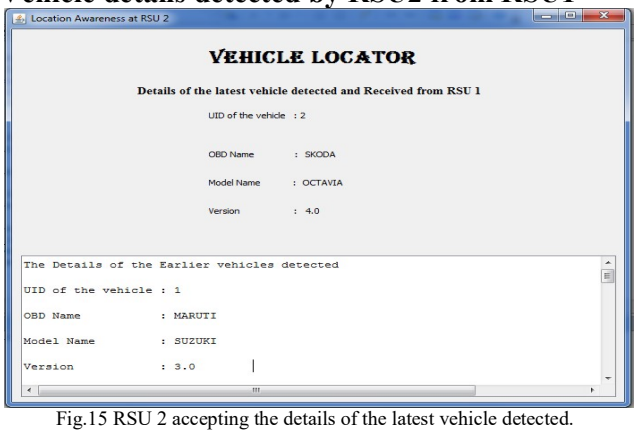

Fig.15 RSU 2 accepting the details of the latest vehicle detected.

Vehicle details detected by RSU3 from RSU1

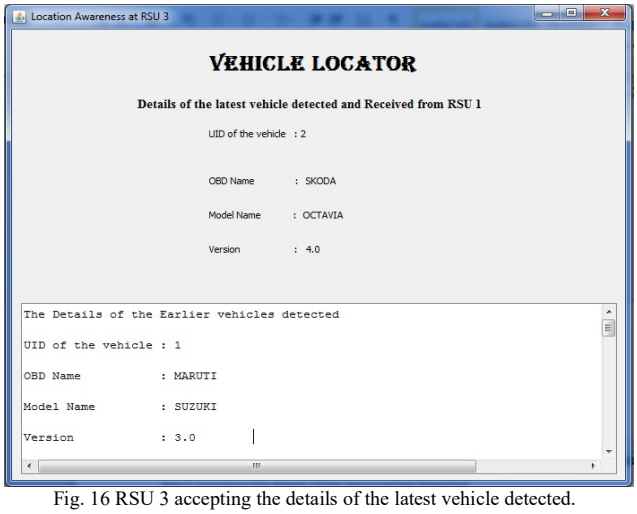

Fig. 16 RSU 3 accepting the details of the latest vehicle detected.

XI. CONCLUSIONS AND FUTURE REMARKS

In this paper, we propose remote diagnosis system to improve customer safety and concentrated on Location Awareness (LA) which helps for resuming the updation of software application suspended by another RSU. Concentrated on driver safety, comfort and use of reliable updated software application. This technology may take innovative dimension in future to contribute its use with even more improved way.

REFERENCES

1. *M. Raya and J. P. Hubaux, "Securing vehicular ad hoc networks," Journal of Computer Security,vol. 15, no. 1, pp. 39–68, 2007.*

2. *S. M. Mahmud, S. Shanker, and I. Hossain. "Secure Software Upload in an Intelligent Vehicle via Wireless Communication Links". Proceedings of the IEEE Intelligent Vehicles Symposium. 2005, pp. 588–593.*

3. *I. Hossain and S. M. Mahmud. "Secure Multicast Protocol for Remote Software Upload in Intelligent Vehicles". Proc. of the 5th Ann. Intel. Vehicle Systems Symp. of National Defense Industries Association (NDIA). Traverse City, Michigan, June 2005, pp. 145–155*

4. *Munir Sayyad1*, Sanjay Nalbalwar2, Jagdish Bakal3, Shomik Dasgupta "Advanced Intelligent Vehicular Analytics (AIVA) using IMS Architecture", International Journal of Smart Home Vol. 5, No. 2, April, 2011.*

5. *L. Zhang, Q. Wu, B. Qin, and J. Domingo-Ferrer, "APPA: Aggregate privacy-preserving authentica- ion in vehicular ad hoc networks," in The 14th Information Security Conference (ISC 2011), LNCS 7001,pp. 293–308, Springer-Verlag, 2011.*

6. *Java programming Basics Tutorial http://staf.cs.ui.ac.id/WebKuliah/IKI40972/Java/ get Started/intro/definition.html*