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Implementation of Vehicle-To-Vehicle, Vehicle-To-Infrastructure Communication Using Internet of Vehicles

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ABSTRACT

Transportation safety is an important factor in the Intelligent Transportation System (ITS) applications. Vehicle accidents, road conditions and traffic conditions are the major issues in the transportation system. Around 1200 road crashes occur daily in India and around 350 people die daily due to road accidents. In this paper we are going to implement a solution to avoid the cited issues through a concept of Internet of Vehicles (IoV). The cited issues can be solved by exchanging the internal and external datas of a vehicle connected to a network. The vehicles connected in that network can transmit and receive its datas such as speed, position, direction and traffic between them. The Sharing of datas is done by using a cloud network, in which all the datas will be stored and transferred to vehicles. This allows us to make a safety transportation system.

Keywords: Intelligent Transportation System, Internet of Vehicles and Cloud Network.

1. INTRODUCTION

The Internet of Vehicles is actually a new concept derived from Internet of Things (IoT). The IoV is developed particularly for vehicular Communication. In this the vehicles will be connected in a network. Since vehicles are dynamic, they follow Vehicular ad-hoc network (VANET). The IoV is a distributed system for wireless communication such as Vehicle to Vehicle (V2V), Vehicle to Infrastructure (V2I) and Vehicle to Network (V2N).

Before the introduction of IoV, vehicles used CAN Network Bus to collect internal datas of vehicles by using the various sensors connected in it. By the use of CAN, only the internal datas of vehicle are collected. By using IoV, now the vehicles can collect its datas and share it with the other vehicles connected in the network. With this system we can easily reduce the road accidents occurring, improve road safety, and traffic congestion.

Vehicle to Vehicle communication is actually the communication which takes place between two or more vehicles and they share datas between them. Vehicle to Infrastructure Communication is the sharing of datas between vehicles and road side units like traffic signals, buildings etc.. and vice versa. Vehicle to Network communication is the sharing of datas between the vehicle and the network or cloud and vice versa. The IoV uses wireless communication mode to transfer datas in the network. The Dedicated Short Range Communication (DSRC) standard supports the low latency wireless communication among vehicles and infrastructures. It is known as IEEE 802.11p standard.

The idea of the system is to interface sensors with the vehicles and the sensor readings will be sent to a controller and it will share the datas to other vehicles, infrastructure. Amazon Cloud Service is used as a

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cloud network. The Cloud network is a dynamic network and stores all the information. The prototype of this system is made by using the related sensors, cloud network with sensors are interfaced with Raspberry-pi Board.

2. RELATED WORK

Kazi Masudul Alam et al. [1] offers a SIoV, a unique Social IoV concept which is based on the structure of IoV is joined with the social entities and also provides a message structure.

Stephan Olariu et al. [2] provides a brief details of forming a Vehicular Cloud Network and also the challenges to form a cloud. By using this cloud network is formed.

M.Gerla [3] provides brief details of various types of cloud networks formed and tools for forming a VANET cloud.

Swarun Kumar et al. [4] provides a communication system for making an autonomous driving vehicle and it uses content-centric approach and the system is called CarSpeak.

Xue Yang et al. [5] provides a protocol for the purpose of V2V communication and also to achieve low latency during emergency message warnings.

Ning Lu et al. [6] gives a survey on challenges and solutions for the connected vehicles and provide solutions to the connected vehicles.

Joshua R. Henderson et al. [7] provides a concept of using CAN Bus for controlling a vehicle. It also shows on how to use CAN bus in a vehicle.

3. PROPOSED SOLUTION

This section describes about the both the hardware and software requirements and it is described briefly in this section. In this there are four parts. First part is the sensors connected in a vehicle and gathering datas. Second part is cloud network where the datas are stored and transferred. Third part is another vehicle where sensors are connected. Fourth part is the infrastructure where the message warning will be sent from vehicles.

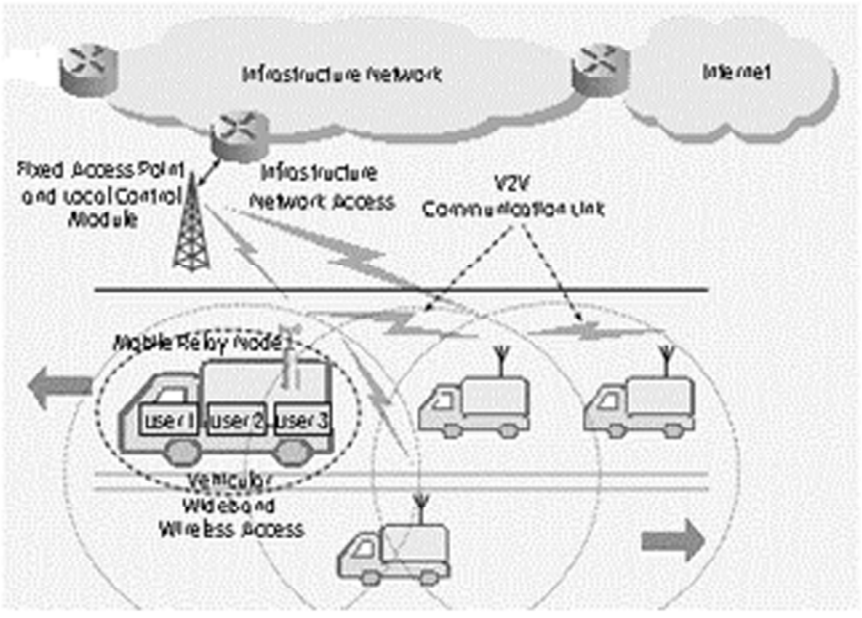

Figure 1: Proposed system Architecture

3.1. Architecture Of V2v

As shown in the figure. All the sensors are connected in the raspberry pi board. Raspberry pi is responsible for collecting the datas from the sensors connected in a vehicle and transfer the sensor datas to the cloud. The sensors are attached in the vehicles and it gathers the datas from the environment. The gathered sensor datas are collected by the board and it transfers the datas to the dynamic cloud network. The datas are transferred using LAN or USB tethering.

3.2. Cloud Network

The main part of the proposed system is integrating the cloud network with the vehicle communication. Cloud network in the vehicle communication is a dynamic network. Dynamic network is a network in which vehicles are grouped together to form a network for certain time.

Cloud network will have a server, in which the datas from sensors are stored and the datas are transferred to other vehicles in the network. The cloud is having a real time decision making, by using it the cloud will send the emergency message warning to other vehicles in the network. It will be able to automatically retrieve the message warning to the vehicles.

3.3. Other Vehicles in Network

The vehicular communication is a multi-way wireless communication. The network is formed by joining a group of vehicles travelling in a same route or same direction. The other vehicles in the network will also have sensors connected to it by using raspberry pi board. These vehicles are also used to collect datas by using the sensors and transfer it to the cloud.

3.4. Vehicle–Infrastructure Communication

The infrastructure is nothing but a building or toll gate or a hospital. The datas from vehicles will also be transferred to the nearby infrastructure with sensors attached to it. This helps when no vehicle is present in the network and the emergency message warning to be notified to other vehicles coming through that route

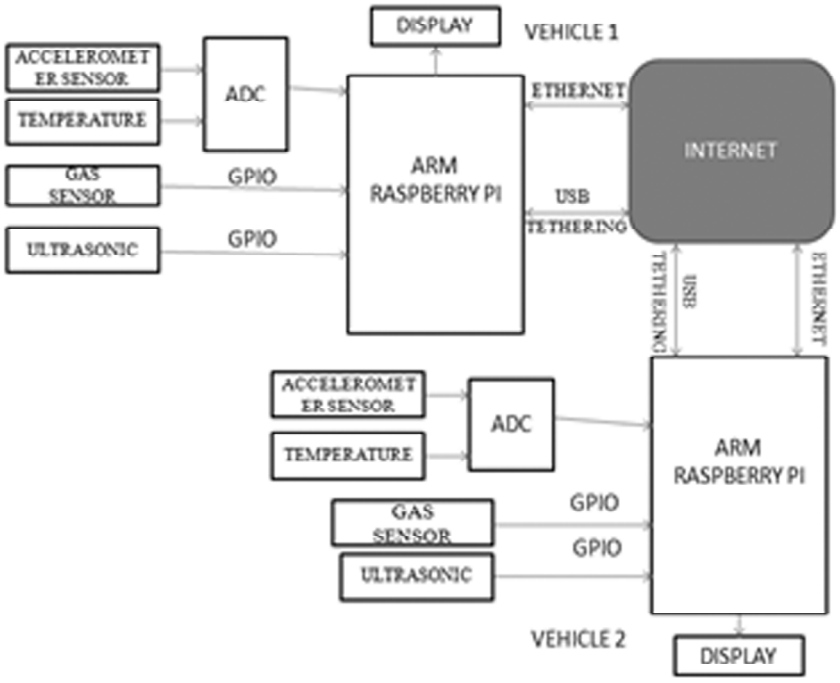

Figure 2: Proposed system Block Diagram

or direction. The building connected in the network will be able to automatically transfer the message to the vehicles in the network.

4. PROTOTYPE

4.1. Simulation Result

The Simulation part of this system is carried out using NS2 simulator. Here the system consists of more than 10 nodes or vehicles connected in a network. Yellow colour nodes are the nodes following the base node BS at the top. The Simulation result shows all the nodes connected in the network are receiving information from the BS node and it also transfers the datas to BS node.

4.2. Hardware Prototype

Raspberry pi2 board is the main feature of the project. Raspberry pi is an linux based microcomputer. It consists of 4 USB ports, 40 General purpose Input Output pins, HDMI Port, Ethernet LAN cable and 32gb memory card. It also acts as mini CPU. It has processing speed of 900 MHZ, 1GB RAM, ARM V7 Quadcore processor. JSON (java script object notation) is used for transferring data to cloud.The Sensors used in the hardware prototype are listed below with its functions.

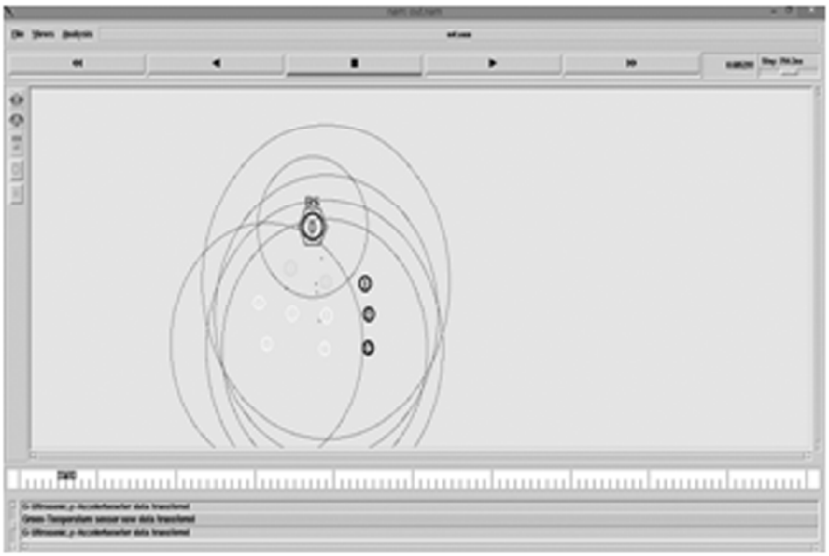

Figure 3: NS2 Simulation result

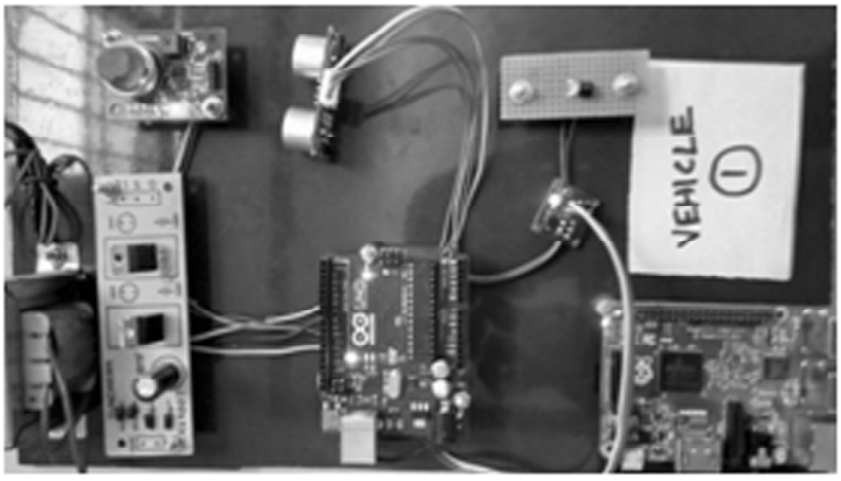

Figure 4: Raspberry pi2 model for Vehicle 1

Ultrasonic sensor HC-SR04 is used for determining the distance between the objects. Accelerometer sensor ADXL335 is used for if the vehicle is tilted or not. Temperature sensor LM35 is used to detect the temperature of the vehicle. MQ6 Gas sensor is used to detect, whether the person driving the car has consumed alcohol and also petrol/diesel leakage. Software requirement for the project is described below. Python language is used in raspberry pi for sensor data acquisition.

Amazon web server is used as the web server. This web server is used to store all the sensor datas and retrieve the datas to other vehicles.

5. IMPLEMENTATION

The implementation of the prototype has been done with four sensors ultrasonic sensor, accelerometer sensor, gas sensor and temperature sensor. The results shown in the terminal window of the raspberry pi2 model for two vehicles.

The datas collected from the vehicles will be transferred to the cloud network. The datas of the vehicle1 is able to view on the display of the vehicle2 and also the vehicle2 datas is able to view on the display of

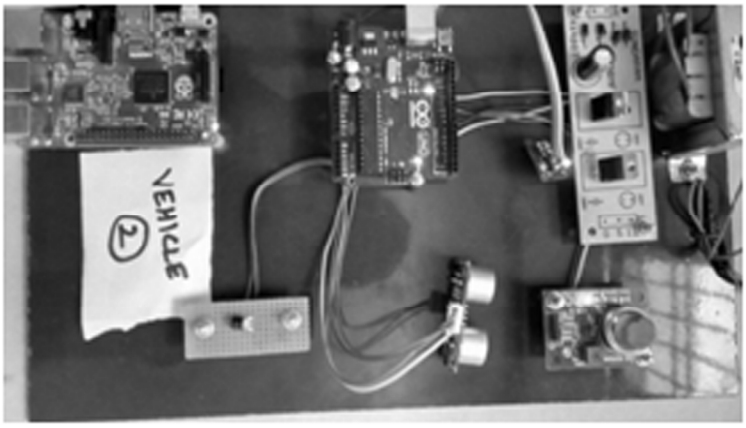

Figure 5: Raspberry pi2 model for Vehicle 2.

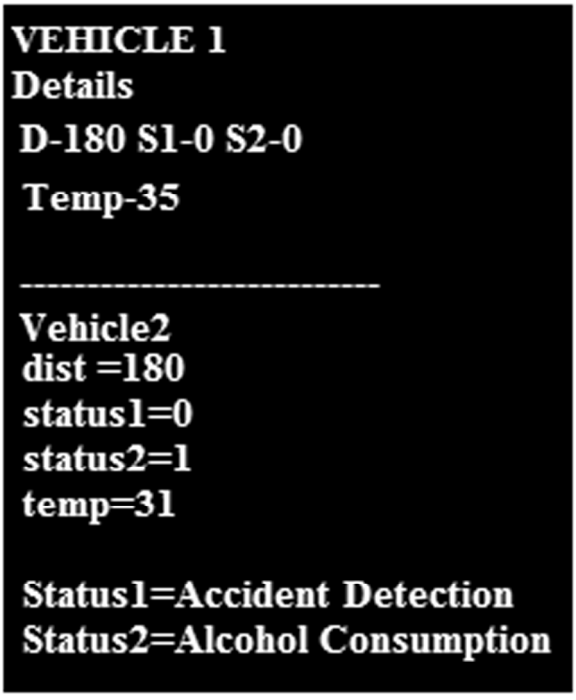

Figure 6: Vehicle 1 Display

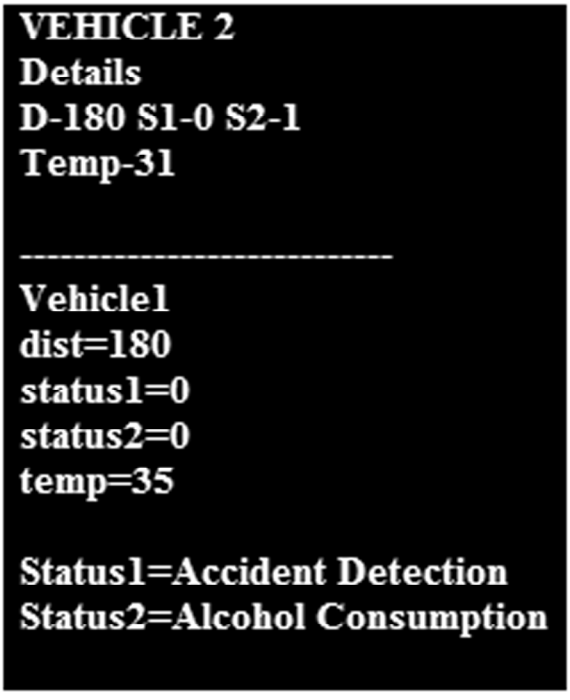

Figure 7: Vehicle 2 Display

Figure 8: Data displayed on Cloud Server

vehicle1. These allow the vehicles to get the datas of other vehicles around it. The cloud part of the proposed system can be viewed using the web page link that is created for monitoring the datas of the vehicles. The cloud part of the system is a back end process and the details are displayed on the web page.

6. CONCLUSION AND FUTURE WORK

Internet Of Vehicles concept is applied in the vehicular communication to make the transportation system more accurate and accident can be avoided by sharing the data of between vehicles. In future this system can be implemented in real time, with more number of vehicles connected in the network and the datas can be shared between them. And also this system can be applied in vehicles to make them as an autonomous vehicles.

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