International Journal of Engineering &Technology, 7 (3.12) (2018) 545-549

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

Internet of Vehicles: Commencing Intellectual Hoarse Towards Self-Regulating Cars and Vehicular Clouds for Smart Transportation Structure [Vehicular Ad-Hoc Network: A Review and Application in the Internet of Vehicles]

Risabh Mishra[1*], M.Safa[2], Aditya Anand[3]

[1, 2, 3] Department of information technology, SRM University
**Corresponding Author Email: [1]risabhmishra_ma@srmuniv.edu.in, [2]safa.m@ktr.srmuniv.ac.in, [3]anand1996aditya@gmail.com*

Abstract

Recent advances in wireless communication technologies and automobile industry have triggered a significant research interest in the field of Internet of Vehicles over the past few years.The advanced period of the Internet of Things is guiding the development of conventional Vehicular Networks to the Internet of Vehicles.In the days of Internet connectivity there is need to be in safe and problem-free environment.The Internet of Vehicles (IoV) is normally a mixing of three networks: an inter-vehicleNetwork, an intra-vehicle network, and a vehicle to vehicle network.Based on idea of three networks combining into one, we define Internet of Vehicles as a large-scale distributed system to wireless communication and information exchange between vehicle2X (X: vehicle, road, human and internet).It is a combined network for supporting intelligent traffic management, intelligent dynamic information service, and intelligent vehicle control, representation of an application of the Internet of Things (IoT) technology for intelligent transportation system (ITS).

Keywords: *Internet of Vehicles (IoV), Internet of Things(IoT), Intelligent Transport System(ITS), Cloud Server.*

1. Introduction

Regarding the development of next generation intelligent transportation systems Internet of Vehicles is intended to play essential role. For IoV to see its full potential there are many challenges that are need to be addressed including collecting real-time vehicle information, enhancing on-time delivery rate, optimizing dispatch and fleet management to improve the operating performance and reducing manpower and fuel costs, the ultimate goal is to achieve a more efficient, safe and green world of transportation

Internet of Vehicles (IoV) is of basically made up of three modules:

1. Vehicle to Infrastructure (V2I) communication
2. Vehicle to Vehicle (V2V) communication
3. Infrastructure to Vehicle (I2V) communication

2. Vehicle to Infrastructure (V2I) Communication

In this type of communication, the communication is established between the inter-vehicular network and the cloud. In this communication, the data is collected from various sensors fitted in the body of the vehicle to the central unit the data center of the vehicle which basically consists of the microcontroller body ESP8266 Node MCU. This data Centre is connected to the cloud database (Firebase) at all times which is a real-time database and the sensor data are stored and monitored from the cloud through the Infrastructure end.

It also sends real-time GPS location from the vehicle to the Infrastructure at all times which can be duly tracked with google maps integration at the Infrastructure end.

It has become very common nowadays for vehicles to have sensors inbuilt. However, with such a large amount of data to be analyzed, sensors have to be of same standards to have effective results.

The cadent of the vehicle that needs to be monitored are:

- Gps Location
- Accelerometer Gyro-meter values
- Temperature and Humidity values
- Proximity Sensors
- Ultrasonic Sensors
- Tire pressure
- Fuel level
- Exhaust gases' contents

These are fixed at their respective positions to continuously monitor the data being generated. All these localized sensors are set with some threshold values. When breached, all the data regarding the breach are to be sent to a processing and communications device onboard.

The processor will basically be a mini computer on board, powerful enough to handle the processing of the incoming data and the communication modules implemented on board.
Few Attributes like speed of the vehicle and level of fuel in the vehicle are already been directly reported to the user by the vehicle but there are other important things which need to be reported to the user through the cloud even when the user is not physically present in the vehicle.

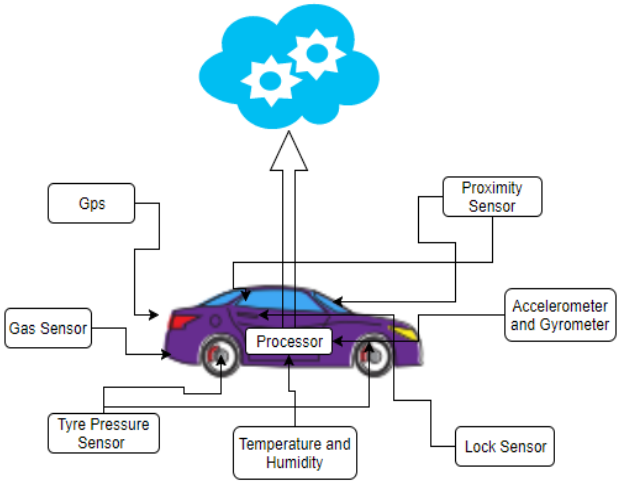


Fig. 1: Connected Vehicles

The sensors used in the Vehicle are:
1. Gps Module (GY-NEO6MV2): this will track the location of a vehicle at all times and send the real-time data to the cloud server.
2. Lock Sensor: this will detect the door lock status of the vehicle and inform the owner accordingly.
3. Tire Pressure Sensor: this will detect the tire pressure of the vehicle and inform the owner about tire burst related information.
4. Proximity Sensors: these sensors are used to detect any human or any other object presence in and around the vehicle and it informs the owner about it especially useful during night time.
5. Accelerometer and Gyro-meter (GY-521): These sensors are used to detect the actual speed of the vehicle and angle of the vehicle and these data are analyzed accordingly in the cloud further actions are taken in case of sudden change of the accelerometer and Gyro-meter values.
6. (DHT11) Temperature and Humidity Sensor: These sensors are used to record the temperature and humidity levels inside the vehicle.
7. MQ2 Gas Sensor: It is used to monitor the exhaust and pollution level of the vehicle and corresponding gases and their content found in the smoke are analyzed in the cloud.
8. Ultrasonic Sensors: Two Ultrasonic Sensors One at the back and One at the front of the vehicle are mounted so as to detect the actual distance between the owner's vehicle and the vehicle's behind and in front of the owner's vehicle. This data is basically used during V2V communication.
9. Emergency Button: There is also an emergency button fixed in the vehicle so that in case of any kind of emergency situation on pressing this button an alert is sent to the Infrastructure End with the exact location of the vehicle so that nearest police station in that area is informedand further action is taken by them.

Along with all these sensors the onboard processor (ESP8266 Node MCU) will be attached to the vehicle which acts as the data unit of the vehicle. The processor collects data from all the sensors attached to the vehicle and this data is then sent to cloud Infrastructure end for further storing and analysis of data all in real time with no delays involved.

3. Vehicle to Vehicle (V2V) Communication

V2V brings us near to a future where vehicles will be able to interact with each other. The whole idea is to use the vehicle to vehicle communication to provide drivers with the utmost important information whenever they need it and provide them warnings every time the sensors sense a potential crash. The notification os the crash is reported to drivers with the display of the alert on their windscreen, an alarm tone or even vibration in the seat. The vehicle to vehicle communication provides the drivers with an all-around awareness by providing them with the real-time 360-degree feedback, equipped with an ability to detect other vehicles in 300m or 984 feet radius.
Security of the vehicles and the information being radiated by the sensors are also kept in check as the personal information are kept anonymous and the vehicle is not tracked under the name of the owner of the vehicle.
Th driver has control of the car at all the time, this is one of the biggest concerns that needed to be addressed. The sensors will only warn the drivers at no time will it take control of the car. There are various applications that are present in the car to provide assistance to the driver in different situations The Intersection Movement Assist application warns the driver whenever it is unsafe to enter an intersection. The Blind Spot Warning allows the driver to virtually see what's happening in the blind spot of the driver, where the driver is unable to view properly. The Do Not Pass app gives a heads up to the driver when it is not safe to overtake a slower moving vehicle. They have emergency electronic brake light application which notifies the driver when an out of sight vehicle, which might be present several cars ahead applies a sudden break. There are several other applications which are available to assist the driver and prevent car crashes.

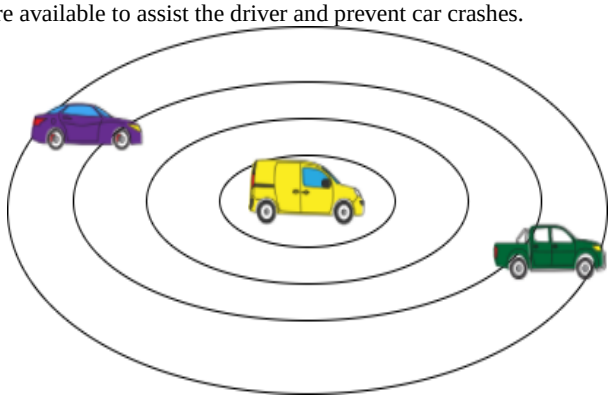


Fig. 2: Vehicle to Vehicle Communication

So how does the V2V work?In V2V Zigbeeis used to carry out the communication part between the cars. We chose Zigbee because it is extremely less power consuming and keeping the distance in mind we need to communicate it is a perfect choice. The plus point with using Zigbee is that the communication between any two cars will be encrypted as Zigbee uses 128-bit of encryption by default, so there will be no chance of someone being able to decipher/decrypt the message.
Special focus has been given to the security and making the communication secure between cars. The idea we are proposing here is to set-up a certificate-based authentication joined with blockchain. Each of the cars will be provided with a unique number and certificate by the car manufacturer, so before any communication between two cars will start the two cars will exchange their certificates and if the certificates are valid only when the communication will be initiated between them. We are using blockchain here to add an extra level of security and have reliable logs for each communication between any of the cars. So any car or module that have been used for transmitting a malicious message with wrong parameters can be traced back immediately.
Transmitted messages common to all vehicles include current GPS position, vehicle speed acceleration and heading, vehicle

control information such as transmission state, brake status, and steering wheel angle, as well as the vehicle's path history and path prediction.

4. Infrastructure to Vehicles (I2V)

Infrastructure to vehicle is the communication that takes place between the infrastructure and the vehicles on the road that are equipped with the sensors. The data that are being obtained by the other nearby vehicles are identified on the basis of the RFID sensors that are attached to the vehicle. The data is obtained from the cloud database and the required analysis is carried out on the data present to get the desired outcome. The outcome of the analysis of the data is then transferred to the infrastructure end, which is a web application where the concerned person can view the data analytics. The infrastructure keeps a track of the real time location of the vehicle and displays it on the maps that is integrated with the web application. Using the data that has been collected over time, the system can detect the areas which are more accident prone depending on the number of accidents that takes place in a certain area.

Whenever a vehicle is crossing a speed limited area the infrastructure could alert the vehicle driver by the speed limits and control the vehicle speed accordingly. At the Infrastructure end of the web application there are also functionalities such as an alert is displayed whenever an emergency button placed in the vehicle is pressed by the driver indicating an emergency situation and notifying about proper actions to take and also whenever there is a sudden change in the gyro meter values of the vehicle the infrastructure is notified about it and further actions are taken.

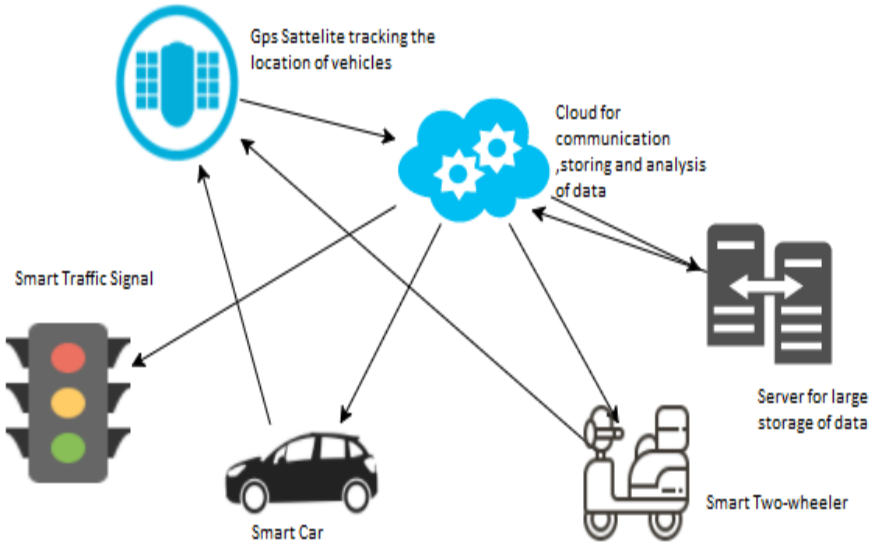


Fig. 3: Vehicle to Infrastructure Communication

Smart Toll Gate: The whole idea of creating the smart toll gates is to make payment easier for the drivers at the toll gates. In smart toll gates whenever a vehicle is identified which consists a RFID tag the driver needs not stop his car and pay the toll, the payment is done depending on the size and type of the vehicle and the amount of money is deducted from the owner of the vehicle and the bill is then emailed to the driver.

Smart Traffic Signal: In these smart traffic signals an IR sensor is placed at the front of the signal. The IR sensors get activated whenever the signal is red and if any vehicle crosses or breaks the signal during that time the vehicle is identified using the same rfid technology and corresponding fine amount is deducted from the vehicle owner's account and challan is generated and mailed to the owner.

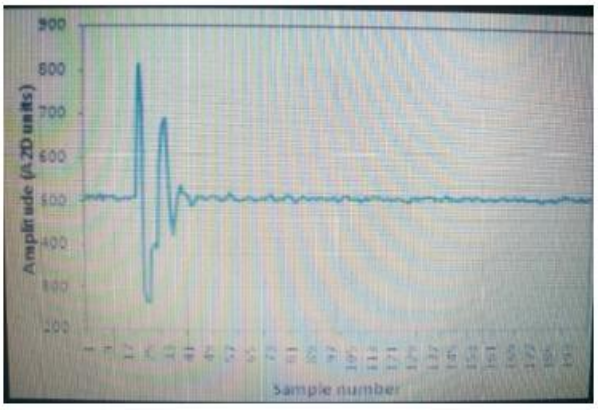


Fig. 4: Accelerometer

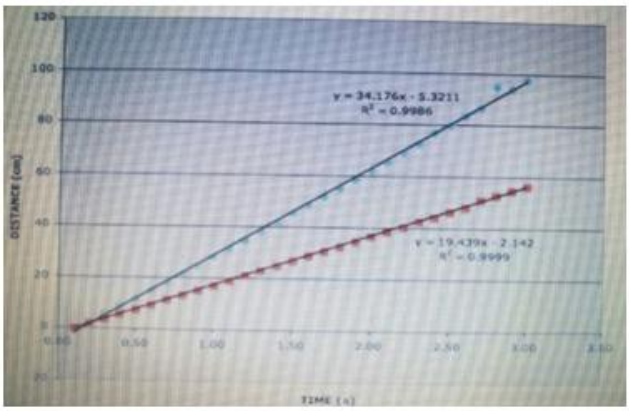


Fig. 5: Gyrometer

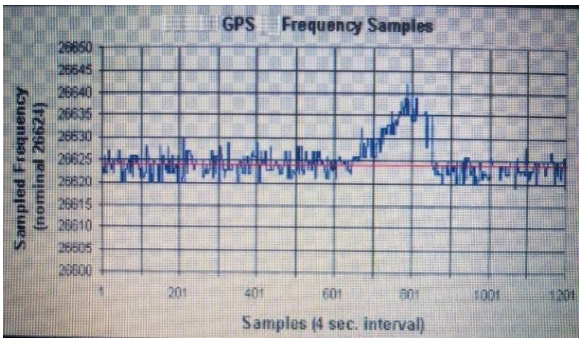


Fig. 6: GPS Sensor

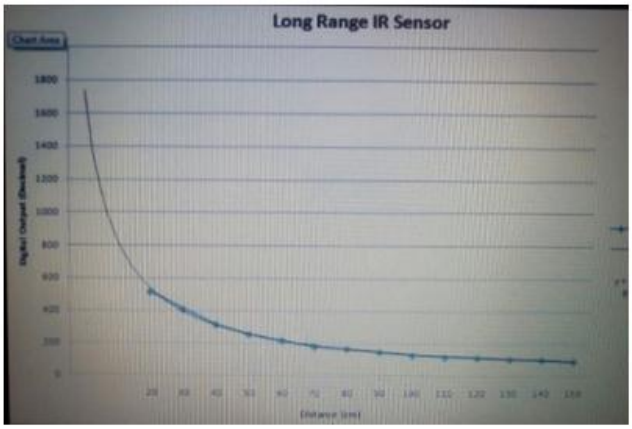


Fig. 7: IR Sensor

5. Advantages of IoV

There are few advantages of using IoV in traffic management. They are:

1. Traffic control
The IoV enabled car can send the data directly to the infrastructure so that traffic signals can decide which lane to clean faster and the time limit of allocation of signal to each lane. Also the lane could be made free if emergency vehicles are approaching.

2. Human proximity detection
The proximity sensors installed in the smart vehicles detect the humans or wandering animals nearby the vehicle on the road which is very useful during night time or times with lower visibility and the Vehicle is programmed as in to reduce the speed or automatically emergency brakes are applied in any such situation.

3. Accident avoidance
The V2V model discussed earlier can help to detect vehicles avoid any kind of collision and read the attributes like speed, tire pressure and lane deviation data close by vehicles on the road.

4. Emergency response
Whenever a vehicle if undergoes collision or detects a collision to a nearby vehicle or if the emergency button is pressed emergency responses such as ambulance, police vehicles are immediately sent to the exact GPS location of that vehicle

5. Vehicles
The smart vehicles on the Internet of Vehicles and their basic parameters such as GPS location, tire pressure, fuel level, etc. are always monitored through the cloud and a warning is issued to the user in case the mentioned attributes exceed or drop below preset threshold values.

6. Services
These Internet-connected smart vehicles will also provide different types of services relieving human burden to an extent. These services include smart parking system, remote diagnosis of garages, the advanced recommendation of hotels and restaurants along the route of the vehicle and also if the fuel is low or low power in case of electric vehicles, it will indicate the route to the nearest petrol pump or charging station. The list remains endless.

7. Infotainment
Integrating the mobile phones with smart vehicles give them the true mobility concept. The journeys will be enriched with all kinds of trending music, radio, news, information from friends or surroundings etc. Various apps in the market are making vehicles their companions that make various preferences and recommendations for us making every mile traveled valuable and useful.

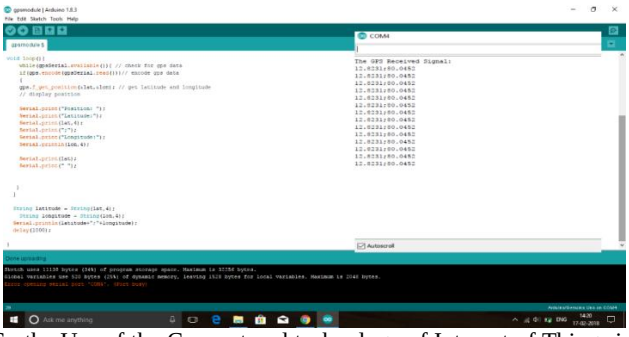
6. Drawbacks of IoV

There are few drawbacks identified when using IoV for traffic management.
They are:

1. Security
Security is a major concern in the concept of the Internet of Vehicles (IoV). All the smart vehicles on the road form an ad hoc network all linked to the central server i.e. infrastructure. As these vehicles are becoming more and more connected the risk of being hacked also increases and leading to a paradise for hackers. Security isn't restricted to the stealing or theft of vehicles but it can lead to situations such as hackers driving the occupant's car into sea or river, or a rich person's family is kidnapped and held to ransom. A single loophole in the entire system of IoV can lead to the exploitation and destruction or crashing of the entire system.

2. Failure of networks
The very concept of IoV or to be precise IoT needs internet network as it's driving force and if it is only not available everywhere or absence of strong network can lead to crashing of the entire IoT based system.
While the concept of IoV looks very appealing, the idea is still very hard to achieve. With such a number of smart vehicles on the roads to make sure all the vehicles and owners comply with this system need some kind of jurisdiction and legal support. Organizing the system mainly the Infrastructure end and making the data center in every smart vehicle internet friendly and always working in unison poses a significant amount of challenge.

7. Conclusion



So the Use of the Concept and technology of Internet of Things in the field of transportation and implementing it in vehicles leads to the evolution of the Internet of Vehicles. The Internet of Vehicle can most effectively reduce the no. of vehicular accidents to a great extent and save a huge amount of human lives as Road accidents account to one of the top five reasons of human death in the world. Enabling internet in each and every smart vehicle on the road forming the Internet of Vehicles can lead to complete automation of vehicles and traffic. The basic concept of IoV can be extended to various modes of transportation making a significant difference in the modern day communication between different transport media leading to a complete development of Intelligent Transporting System (ITS).

References

[1] Nima Bari, Ganapathy Mani, Simon Berkovich, "Internet of Things as a Methodological Concept", Fourth International Conference on Computing for Geospatial Research and Application, 2013.
[2] Juhi R Srivastava, Sudarshan, T.S.B, "Intelligent Traffic Management with Wireless Sensor Networks", IEEE, 2013.

[3] Marta Pla-Castells, Member, IEEE, Juan Jose Martinez Duran, J. Javier Samper-Zapater and Ram6n V. Cirilo-Gimeno, "Use of ICT in Smart Cities. A practical case applied to traffic management in the city of Valencia", Smart Cities Symposium Prague, 2015.
[4] Syed Misbahuddin, Junaid Ahmed Zubairi, Abdulrahman Saggaf, Jihad Basuni, Sulaiman A-Wadley, Ahmed al-sofi, "loT Based Dynamic Road Traffic Management for Smart Cities" 12th International Conference on HONET, 2015.
[5] H.Ho, K.Wako; T.Murase; K.Sasajima,"Crash warning for intersection and head-on collision in vehicle-vehicle communication", International Conference
[6] R. Kumar and M. Dave, 'A Comparative Study of Various Routing Protocols in VANET', International Journal of Computer Science Issues (IJCSI), Vol. 8, Issue 4, 2011.
[7] Paul, Bijan, and M. J. Islam, 'Survey over VANET Routing Protocols for Vehicle to Vehicle Communication', IOSR Journal of Computer Engineering (IOSRJCE) , pp. 01-09, 2012.
[8] B. Paul, Md. Ibrahim and Md. Abu NaserBikas, 'VANET Routing Protocols: Pros and Cons', International Journal of Computer Applications (0975 - 8887), Vol. 20, 2011.
[9] S.S. Manvi, M.S. Kakkasageri, J. Pitt, A. Rathmell, 'Multi Agent Systems as a Platform for VANETs', Proc. Autonomous Agents and Multi Agent Systems (AAMAS), pp. 35-42, 2006.
[10] Zeadally, Sherali, 'Vehicular Ad -Hoc Networks (VANETS): Status, Results, and Challenges', Telecommunication Systems , pp. 217-241, 2012.
[11] Balmahoon and R. Peplow, 'Vehicular Ad-Hoc Networks: An Introduction to Privacy' , Southern African Telecommunication Networks and Applications Conference (SATNAC), Vol. 2, 2012.