V2V Communication using Edge Computing for Safe Commute

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***Abstract*—With the emergence of an advanced vehicular applications, it prominent to meet the demand from both communication and computation. The current solutions, like roadside units (RSUs), cellular networks and also mobile cloud computing, are away from perfection because they are very much dependent on the cost of additional infrastructure deployment. We take into account an idea of using the vehicles as the infrastructures for computation and communication, named vehicular fog computing (VFC), that which serves as an architecture which will make use of a near-user edge or end-user client devices to carry out the communication and computation, that is based on better utilization of individual communication and computational resources of each vehicle. The relationship among the connectivity, communication capability and mobility of vehicles are revealed and we also find out the characteristics of the pattern of parking behavior, that is benefitted from the understanding of utilizing the vehicular resources.**

***Keywords*—VANET, IOT, NodeMCU, MQTT.**

I. INTRODUCTION

The Fog computing is one of the paradigm that extends Cloud computing as well as services to the edge of the network. Similar to Cloud, Fog also provides data, storage, compute, and also application services to end users. Here the Fog computing is a decentralized computing infrastructure in which compute, data, application, and storage has been located somewhere between the cloud and the data source. Same as edge computing, fog computing brings power of the cloud and the advantages closer to where data is created and acted upon.

It is considered as an architecture that which uses edge devices that will perform an amount of computation, communicating locally, storage and is routed over the internet backbone. Here the term Fog computing was given by the Cisco in 2014. Cloud and Fog computing are interconnected to each other. Considering the nature, fog is closer to earth than the clouds, in this technological world this will be the same, fog is also close to end users, in bringing cloud capabilities down to ground. Extension of cloud computing itself is fog computing which consist of multiple edge nodes directly connected to physical device.

In Figure 1, the fog nodes are physically closer to devices if compared to with centralized data centres, that is the reason why they were able to give instant connections for considerable processing power of edge nodes that which allows them to perform computation of a great amount of data on their own, by not sending them to distant servers.

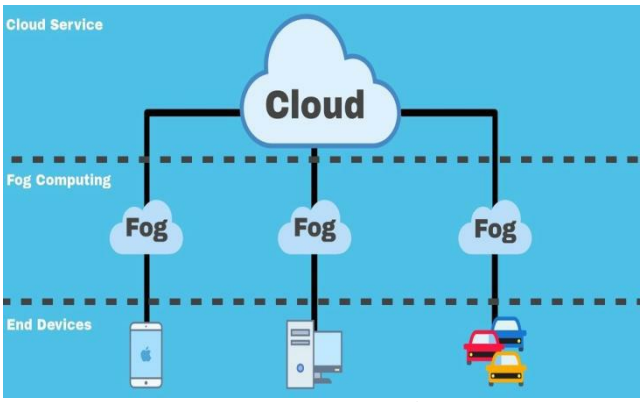

Fig 1. Schematic representation of Fog Computing

The Fog computing acts as the mediator between remote servers and hardware. They regulate information that should be sent to server and also that could be processed in a local way. Like this, fog is considered as an intelligent gateway which offloads clouds enabling more efficient processing, data storage and analysis.

II. MOTIVATION OF THE PROJECT

The motivation for the design and development of IOT is the huge market opportunity ahead for IOT is assessed. Vehicular congestion is expected to severely worsen in magnitude due to rapid increase in the number of vehicles. Commercialization related issues of the VANETs are pointed out. Their clear need for a better communication and also interconnectivity between vehicles. It allows vehicles to exchange information, efficiency and most importantly safety with others as well as.

III. PROBLEM STATEMENT

Vehicular congestion is a global phenomenon. It is impacting the efficiency of the transport sector. In order to enhance the efficiency of the transportation sector and also to reduce the associated environment and an economic consequences, an accurate real-time vehicular congestion identification system is required.

IV. PROBLEM SOLUTION

Monitoring the driver to detect the potholes, humps and low maintenance of roads by using the sensors.Alerting the driver with the help of NodeMCU, by displaying the message on LCD display.

Fig 2. Monitoring using Vehicular Fog Computing

V. EXISTING SYSTEM VS PROPOSED SYSTEM

The existing system of this project involves alerting the doctors through SMS. If any vital parameters of patient's deviates from the normal value. The patient is sent reminder to take the medicine through SMS according to his/her prescription. Existing system is integrated into a large compact unit. It acts as a personal server so that it cannot be access the data from anywere. It does not have any permanent data storage capacity to recollect and access the previous data from the cloud. It is not wearable s that it is not easy to carry the device from one place to another. It cannot be detects the body condition and location of the patients inemergency. The data stores in the raspberry PI which acts as a personal server. Fall detection is also a major concern.

It will keep as a reference for researchers and developers in this scientific areas and to provide directions for future research and their improvements. It is a multi sensor device to collect all the biometric and medical health monitoring data from its wearer. It can be used by everyone and make our health management easier than available systems in our daily life. It will reduce the risk in individual in their overall harmful situations. It consists of permanent data storage capacity to recollect and access all the previous data stored in the cloud. The embedded color changing LED provides the wearer with an additional intuitive visual feedback of the current health state of the patient's, and the wearer can report an emergency condition by using the push button. It is wearable and it can easily carry a device from one place to another. It will detect the body condition and location of the patients in emergency situations. Micro electro mechanical system (MEMS), this system measures and recognizes movements of the person and it is used for fall detection.

VI. OBJECTIVES

- To create edge computing for IOT system to assist vehicles about emergency, women safety, speed limit.
- To detect the potholes and humps on the road and notify the drivers.
- To notify the drivers about the idle state of the vehicle.

VII. LITERATURE SURVEY

A literature survey in a project report is that section which shows the various analyses and research made in the field of your interest and the results already published, taking into account the various parameters of the project and the extent of the project.

The purpose of a literature survey is to gain an understanding of the existing research and debates relevant to a particular topic or area of study, and to present that knowledge in the form of a written report.. Another great benefit of literature reviews is that as we read, we will get a better understanding of how research findings are presented and discussed in our particular discipline.

According to **Shanhe Yi [1]** gives an overall description, goals and challenges in fog computing platform, and presented platform design with several exemplar applications. Computing: Fog computing is generally considered as a non-trivial extension of cloud computing from the core network to the edge network offers a comprehensive definition of fog computing, that would be from the technologies and the challenges which shall shape the fog, also with the emphasis on some of the properties, like geographical distribution, sand-boxed environment and large scale of nodes, heterogeneity and predominance of wireless access, and flexible interoperability.

The Author Ivan Stojmenovic [2] in his paper has saidmotivation and advantages of Fog computing and \networks and software defined networks. Security and privacy issues with study of man-in-the-middle attack.Examining the CPU and memory consumption of these attacks on Fog device. Thus the survey made by this article will expand this concept to recognize cloudlets as special case of fog computing and it relates to the software defined networks(SDN) scenarios.

Miguel Sepulcre and Javier Gozalvez [3] In their proposed paper where the first distributed context-aware heterogeneous V2V communications algorithm which is application and technology agnostic, and that which permits each and every vehicle to dynamically select its communications technology considering its application requirements and the condition of communication context [10]. This study will demonstrate the potential of heterogeneous V2V communications, and the capability of the proposed algorithm to satisfy the vehicles' application requirements while approaching the estimated upper bound network capacity. The study has also shown that CARHet is capable to adequately distribute the load among RATs, and ensure high and homogenous QoS levels across the network with a low computational and communication cost.

According to **Albert Demba(1) and Dietmar P. F. Möller(2) [4]** The main feature of V2V is that it does not rely on third party networks like cellular networks to communicate. It focuses on countering the challenges of control systems with more emphasis on security. In this

context, the technology poses security issues with interference. Thus an enhanced architectural solution is suggested that could help to guarantee system operation without interference and more physical security. The technology works both in V2I and V2V environments providing many mobile safety applications.

According to **Hyun-Yong Hwang, Sung-Min Oh, Jaesheung Shin [5]** In-vehicle networks are composed of numerous electronic control units (ECUs) according to the type of service in various domains (e.g. powertrain domain, body domain, and chassis domain). Vehicle to vehicle (V2V) messages related to vehicle safety should meet lowlatency requirements. This paper will propose ancontroller area network (CAN) gateway method which is effective. Here the method will use CAN gateway that which search for a network table based on the frame of CAN for V2V message. It can be considered that the proposed method is suitable for V2V communications which are applied for delay-sensitive services.

The Author **TiborPetrov∗, Milan Dado∗, Karl Ernst Ambrosch†, Peter Holeˇcko‡ [6]** In their paper have said to allow reliable, low latency Vehicle-to-Vehicle communication new network technologies are needed. Here the paper proposes a hybrid network topology for the communication of V2V to prevent a network overload when it is transmitting a safety oriented information. Properties of the proposed topology are evaluated by network simulation. To check theoretical expectations, a simulation model was built using Riverbed Modeler. In addition to the channel load parameter, an extensive medium access delay simulation was performed to show the impact of the vehicle count on the delay at MAC layer.

EftekharHossain, NursadulMamun and Md. Fahim Faisal [7] In their paper gave an overall description of the V2V Communication that has been accomplished using both Infrared and radio frequency communication without using horn. The IR transmitter that is used to transmit signals to the front side vehicles and a RF transmitter is used to transmit the signal to both left as well as right side where vehicles are placed in front of the driver. Also IR and RF receivers are inserted behind the car inorder to receive the transmitted signal from the other vehicles. Here we they have used a speaker to alert the driver and also a LCD is being used to show from where have the transmitted signal come and the driver will have to decide where the car must be moved. The main aim of this work is to mitigate the vehicle noise to acertain extent and also to lower the unnecessary vehicle horn. This entire system may be used to substitute a horn system in the populated, emergency and busy places.

According to **Maudhoo Jahnavi1, Neha Yadav2, Krishanu Griyagya3, Mahendra Singh Meena4, Ved Prakash5 [8]** The paper first gives an introduction to the Automotive Wireless Communication. It will brief the technology used in the Automotive Wireless Communication along with the various automotive applications that depends on wireless communication. The V2V communication is the wireless transmission of data between the motor vehicles. The goal of V2V communication is to avoid accidents by letting the vehicles in transit to send position and speed data to the other one. The driver of the vehicle may simply receive a warning should there be a risk of an accident or the vehicle itself may take preemptive actions as braking to slow down.

VIII. METHODOLOGY

In this project we have vibration sensor, ultrasonic sensors and buzzer are connected to Node MCU.

Node MCU together creates a hotspot to transfer the data sensed from sensors to other vehicles. The other vehicles must be connected to the same hotspot. Node MCU is connected on the other side of the vehicles and connected to hotspot to access data, so that the data sensed from these sensors are displayed in all the vehicles connected through LCD Display and requires action is taken.

- The data flow of vehicles are taken as sensor readings which are validated and forwarded into Node MCU.
- The processing takes place if the data readings are valid by performing vehicle to vehicle module functionalities.
- The sensor data is stored in the cloud which can be retrieved for further processing.

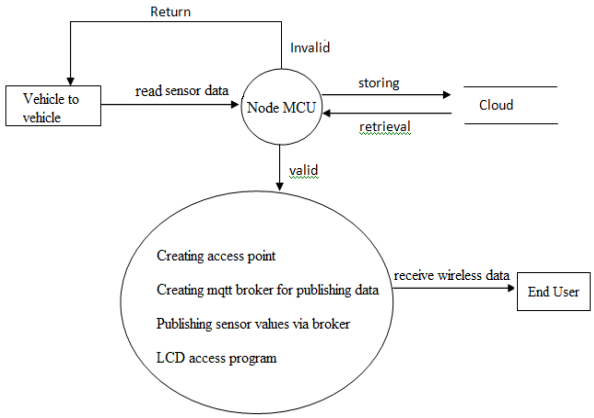

Fig 3. Signal flow diagram of V2V communication.

- The wireless data flows out towards the end user after carrying out the functionality successfully.
- In the vehicle to vehicle scenario, initially, the processing starts from collecting sensor values and storing it in the database (cloud).
- The protocol given to the NodeMCUis to create access point and MQTT broker.
- The data (sensor values) is published and wireless data is received by the end user.
- The result is displayed on the LCD screen of the application.

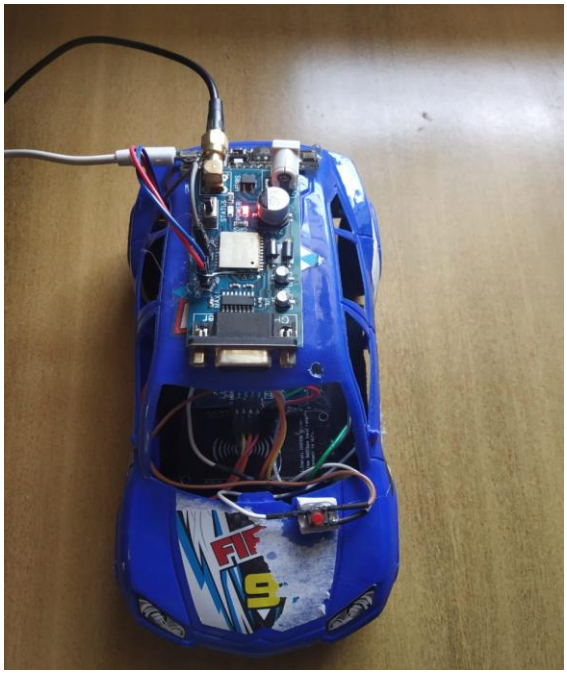

Fig 4. Prototype of V2V communication.

Fig 5. Ultrasonic sensor attached to the bottom of the car chassis to detect the potholes and humps.

Figure 4 and 5 shows the working model of V2V communication. A toy car is used to implement theprototype, to which all the sensors are attached as shown in the figure 4 and 5.

IX. RESULT

In this project both software and hardware components were used. The Vehicular Fog Computing, communication and storage services are provided at near user edge devices.The sensors in the vehicles gather data and this data is stored and processed in intermediate fog servers. NodeMCU creates a hotspot to transfer the data sensed from sensors to other vehicles.The data sensed from these sensors are displayed in all the vehicles connected through LCD Display and requires action is taken.

An example of one such result is shown in the figure 6.

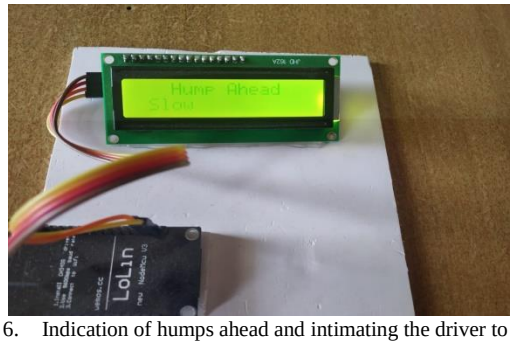

Fig 6. Indication of humps ahead and intimating the driver to go slow.

X. ADVANTAGES

- The Fog computing reduces the bandwidth needed and reduces the back-and-forth communication between sensors and the cloud.
- It reduces Collision avoidance of vehicle in a greater extent.
- Detection of vehicles is made easier by adapting sensor technology.
- It reduces traffic congestion and improves traffic management.

XI. DISADVANTAGES

- Hackers can access and control the vehicle.
- There can access to the owners vehicle location, daily routines and frequently used apps.
- Malfunctioning of cars or sensors or networks can lead to faulty communication.

XII. APPLICATION

- It is used in Automotive industry.
- It will give Intersection and collision warnings.
- It will give Speed advisory for cautious driving.
- It will give real time Pedestrian alerts.

XIII. CONCLUSION

By adapting fog computing in the proposed system, vehicle to vehicle collision can be minimized. The vehicles are provided with more security. The sensor data signals are collected from the vehicles and stored in cloud. Real time processing of data takes place on the edge, much closer to the vehicle. This provides faster results which can be send as messages to other vehicles and roadside units.

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