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Vehicular Cloud Computing Based Intelligent Transportation System for Traffic Management and Road Safety

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Abstract— Vehicular systems has turned into a major research area because of its highlights and applications. An efficient traffic management with proper road safety and its standardization is needed to develop a smart transportation system. To achieve the smart transportation system the vehicles on the road requires are required more correspondence computing features and expanded sensing power about other vehicles travelling in the same road. There are various arrangements were proposed to address the difficulties and issues of vehicular systems. Vehicular Cloud Computing (VCC) is one of the arrangements, that remarkably affects movement administration and road safety by right away utilizing vehicular resources. Consequently, a few advanced Intelligent Transportation Systems (ITS) techniques were utilized by using VCC. In this technique, conveyance resources concerned computing power, storage, and web property which will be shared between drivers. They are connecting with customers through web. VCC based ITS idea is a vital society impact that desires traffic management and road safety.

Keywords—Vehicular Cloud Computing, Transportation Systems, Cloud Computing, Wireless Network

I. Introduction

Recent vehicles are outfitted with different highlights, computing capacities, storage space and sensors. They have the adaptability to impart each different and in addition with Road-side unit with remote handset. In this way by the mix of such assets seriously will make a groundbreaking impact on the space of correspondence. The underutilized vehicular assets can be leased to clients as a regular cloud foundation [1]. The VCC framework organizes the vehicular cloud and the remote cloud appropriately to give in-time administrations to clients. The pervious works had built up the models for asset distribution in the VCC framework.

The development in the quantity of vehicles out and about has put awesome weight on transportation frameworks. This unexpected development of vehicles has made driving dangerous and perilous. Along these lines, existing transportation foundation requires upgrades in rush hour gridlock wellbeing and productivity. To achieve this, Intelligent Transportation Systems (ITS) have been considered to empower such assorted activity to applications as movement wellbeing, agreeable movement checking and control of activity stream. These activity applications would progress toward becoming substances through the rise of VANET in light of the fact that it is considered as a system domain of ITS. The expanding need of this system is a force for vehicle producers; investigate networks and government organizations to build their endeavors toward making an institutionalized stage for vehicular correspondences [2]

Advances in vehicular innovation have given assets such as settled stockpiling gadgets, better figuring power, subjective radios, furthermore and extraordinary sorts of programmable sensor hubs. By utilizing Wireless Sensor Networks (WSNs), applications upgrade. As innovation is drawing nearer and closer to pressing complex assets in vehicles, numerous makers are directing their concentration toward making the vehicles on our streets more fuel and vitality proficient than any time in recent memory [3].

The rest of the paper is organized as follows, Section I contains the introduction of VCC and ITS , Section II contain the related work of VCC, WSN, VANET Section III contain the Methodology, Section IV contain the essential steps of Implementation of VCC, section V concludes research work with future directions.

II. Related Work

Modern Vehicles are progressively equipped with an outsized quantity of sensors, actuators, and communication devices (mobile devices, GPS devices, and embedded computers).In explicit, various vehicles have possessed powerful sensing, networking, communication, and processing capabilities, and can communicate with alternative vehicles or exchange data with the external environments over varied protocols ,including communications protocol, TCP/IP, SMTP, WAP, and Next Generation Telematics Protocol (NGTP) [4]. In general, based on functionality, VCC systems are divided into four parts: Computation-as-a-Service (CaaS), Network as-a-Service (NaaS), Storage-as-a-Service (SaaS), and Sensing-as-a-Service (S2aaS) [5]. The information dispersal inquire about for VANETs is outlined into the two classifications of V2V and V2I/I2V correspondences[6].

The information dispersal inquire about for V2V correspondences centers around how to accomplish dependable and auspicious information conveyance among versatile vehicles on streets over discontinuously associated remote connections [7]. The vehicles at crossing points keep the information sent by the source hub in their cushions also, over and again rebroadcast it to different vehicles passing the crossing point [8]. The course data of vehicles, which is promptly accessible through the GPS empowered route framework in the vehicles, is utilized for lightening divert clog in information spread by choosing fitting directing ways. The relative separation between neighboring versatile vehicles is anticipated and abused for enhancing the unwavering quality of information conveyance [9].

Vehicular cloud computing has great potential to change the contemporary vehicular communication paradigm. Explicitly, the underutilized resources of vehicles can be shared with other vehicles to manage traffic during congestion. The emerging communication technologies enable data and resource sharing among vehicles. Various vehicle resources can be configured and integrated dynamically over the VANET. Vehicular data are processed and the information is shared among vehicles to control traffic flow. At present, vehicles have multiple radio interfaces that enable vehicles to communicate with roadside units (RSUs) and other access networks, such as 3G/long term evolution (LTE) [10]. The availability of different communication technologies in vehicular clouds addresses the problem of intermittent connectivity, but it also simultaneously introduces heterogeneity in communication. The heterogeneity of devices, software, and communication technologies involves challenges in the effective implementation of VCC. To investigate the role of VCC in managing road traffic, the capabilities and challenges of VCC must be explored. Vehicles can access these resources to sense, process, store, and communicate vehicular data in cloud computing form, known as vehicular cloud computing In VANET vehicles are considered as multiple interacting intelligent agents within an environment [11]. Smart Transportation applications by nature are examples of Vehicular Ad-hoc Network (VANETs) applications where mobile vehicles, roadside units and transportation infrastructure interplay with one another to provide value added services. While there are abundant researches that focused on the communication aspect of such Mobile Ad-hoc Networks, there are few research bodies that target the development of VANET applications [12]. Among the popular VANET applications, a dominant direction is to leverage Cloud infrastructure to execute and deliver applications and services. Recent studies showed that Cloud Computing is not sufficient for many VANET applications due to the mobility of vehicles and the latency sensitive requirements they impose[13].
The composition of such agents can be used to solve problems that are difficult for a monolithic system to solve. A general multi-agent scenario is shown in Figure 1.

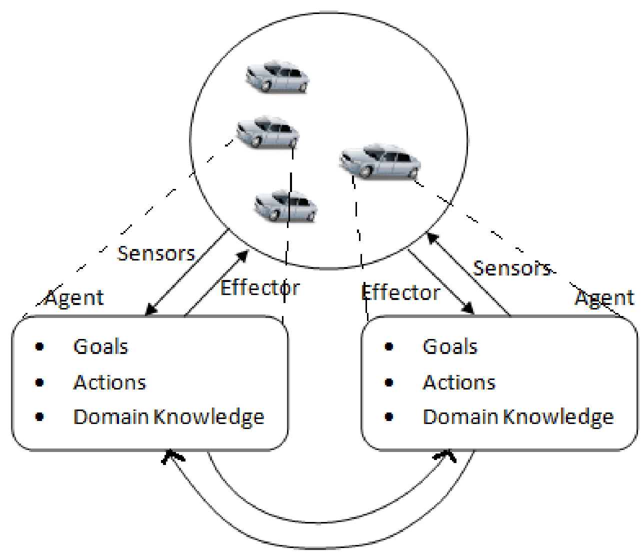

Figure 1 : Multi-Agent System in VANET

In Multi-Agent System (MAS) three kinds of specialists exist in Independent specialist, Cooperative Agent, and Learning operator. Self-ruling specialists are the individual vehicles that are in any event halfway free, mindful, and self-governing. Agreeable Agents are the adjacent vehicles to whom the solicitations are sent for the required data. It might be vehicles or adjacent street side unit (RSU). Learning operators are canny once. They take in or derive from the learning to accomplish their objectives [14].

The information spread for V2I and I2V interchanges centres around how to effectively share the constrained asset of roadside APs to enhance the nature of information dispersal administrations [15]. Model of cooperation utilized as a part of multi-specialist frameworks as a decentralized other option to past coordination incorporated on the unit's pioneer and blueprint its advantages utilizing communitarian driving reproduction situations[16] &[17].

III. METHODOLOGY

The Vehicular Cloud Computing shown in Figure 2 depends on three layers [18]: inside-vehicle, correspondence and cloud. The main layer is within vehicle layer, which is in charge of checking the wellbeing and state of mind of the driver and gathering data inside the auto, for example, weight and temperature by utilizing body sensors, natural sensors, advanced cell sensors, the vehicle's interior sensors, Inertial Route Sensors (INS), and driver conduct acknowledgment

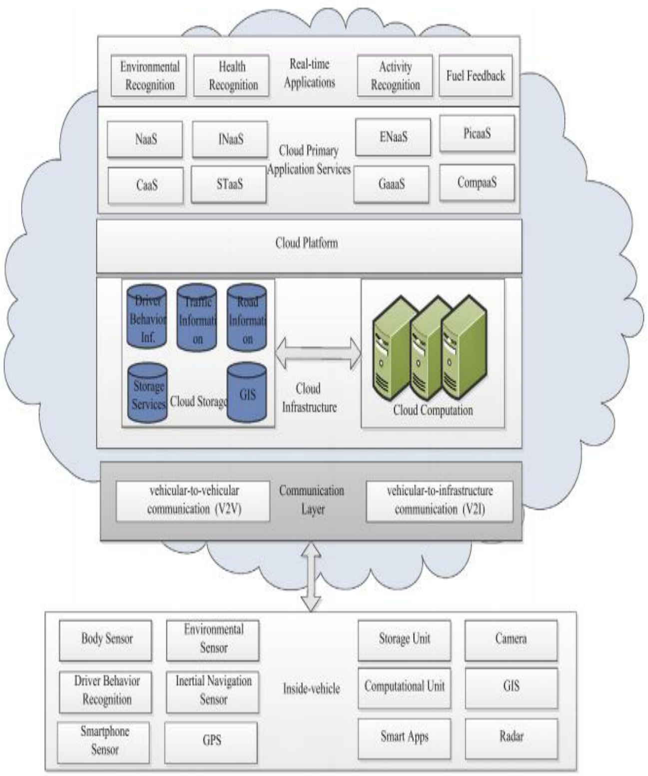

Figure 2 : Architecture of Vehicular Cloud Computing

The following layer of this Architecture is called correspondence, which incorporates two sections: the vehicular-to-vehicular (V2V) systems by means of DSRC. On the off chance that a driver shows the strange conduct out and about, for example, altering course drastically, rolling over as far as possible or the event of a noteworthy mechanical disappointment in the vehicle, an Emergency Warning Messages (EWMs) will be produced and sent to the distributed storage and encompassing vehicles, which contains the geological area, speed, increasing speed and moving heading of the guilty party[19]. The second part of the correspondence layer is vehicle-to-Infrastructure (V2I), which is in charge of trading the operational information among vehicles, frameworks and the cover over remote systems, for example 3G, satellite or web. The V2I segment is utilized to enlarge the well-being level of vehicles on interstates by decreasing the level of accidents; postponements and blockage enhance portability, and give Wireless Roadside Inspection (WRI) to naturally review business vehicles[20].

The cloud architecture in the system is divided into two layers: remote cloud (RC) and vehicular cloud (VC). The RC consists of multiple powerful computing resources so that any service can be handled efficiently through RC computation. Different from previous settings, this work considers heterogeneous vehicles in the VC[21]. The VC is constituted of a number of VEs of heterogeneous vehicles within a certain range and a number of RSUs with computing resources. To quantize the computing resources in the VC, the computing resources provided by vehicles and RSUs are measured in terms of number of resource units (RU)[22]. These RUs from a resource pool, which is controlled and allocated by a centralized VC system. The computing ability of VC depends on the number of RUs in the resource pool [23] & [24].

The Figure 3 shows, suppose that each black vehicle has a weaker computing ability to provide only one RU to the VC; whereas each blue vehicle (which may cost more expensive) has a strong computing ability to provide 2 RUs. Suppose that each RSU provides 2 RUs. Then, 2 RSUs and 5 vehicles (in which 2 in blue and 3 in black) provide 11 RUs in the VC resource pool.

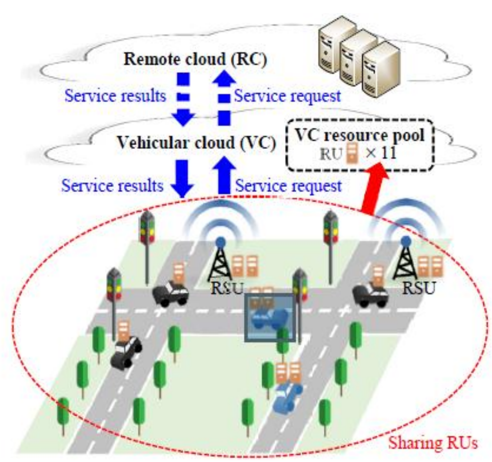

Figure 3 : Framework of remote cloud and vehicular cloud

A. *Traffic Management Scenarios*

Consider for instance, a city square where a movement related occasion (e.g. a mishap) has happened and where, as a result, countless are co-found. Once the activity occasion has been cleared, depending on the current planning of the movement lights won't help disperse the gigantic activity accumulation in an effective way. We imagine an answer for this issue where the vehicles themselves will pool their computational assets together making the impact of a ground-breaking super-PC that will prescribe to a higher specialist a method for rescheduling the activity lights that will fill the need of de-blocking the burdened territory as quick as would be prudent. A regular downtown clogs circumstance in which the Autonomous Vehicular Cloud (AVC) idea can be significant. We take note of that, as a rule, the arrangement can't include a bunch of activity light yet may require rescheduling the moving lights in an extensive geographic region.

As specified previously, the capacity of vehicles to pool their assets, in a dynamic path, in help of the benefit of everyone will have a tremendous societal effect easing, among others repeating clog occasions that torment our urban areas around the morning or evening surge hour. Additionally, and significantly, while blockage is a day by day wonder, proactively taking care of the issue is infeasible in view of the dynamic nature of the issue, and of the colossal computational exertion its determination requires. The issue is best fathomed if and when it happens in an on-request mode devoting the perfect measure of assets instead of moderately pre-distributing of rich assets in light of the most pessimistic scenario, which is ending up progressively infeasible. The key idea that enables the issue to be tackled productively and financially is the commitment of the essential assets from the accessible vehicles taking an interest in the movement occasion and their inclusion in finding an answer self-governing without sitting tight for an expert to respond to the confused circumstance on the ground.

B. On-Road Safety Precautions

The pattern in the auto producing industry is to outfit new vehicles with major detecting capacities keeping in mind the end goal to accomplish proficient and safe task. For instance, Honda is now introducing cameras on their Civic models in Japan. The cameras track the lines out and about and help the driver remains in path. A vehicle would hence be a portable sensor hub and an AVC can be imagined as a gigantic remote sensor organize with exceptionally unique participation. It would be helpful for a vehicle to question the sensors of other vehicle in the region with a specific end goal to build the constancy of its own detected information, get an evaluation of the street conditions and the presence of potential peril ahead. For instance when the tire weight sensor on a vehicle reports the misfortune of air, vehicles that are coming behind on a similar path should speculate the presence of nails out and about and may think about changing the path. The same happen when a vehicle changes path every now and again and essentially surpasses as far as possible; vehicles that come behind, and which can't see this vehicle, can associate the nearness with forceful drivers out and about and consider avoiding the paths as well as keeping a separation from the conceivably perilous driver. The same applies when identifying gaps, plain speed breakers, dark ice, and so on. Contemporary VANET configuration can't pull together the required arrangement and cultivate the level of coordination required for giving these wellbeing measures.

IV. IMPLEMENTATION

We consider a VCS that comprises of cloud servers at a server farm and roadside remote APs with nearby information stockpiling. Portable vehicles have discontinuous system availability to the cloud framework through the remote APs, which are associated to the cloud servers by methods for wired foundation systems. To assist information spread to vehicles, each AP can have little information from the server farm before they are asked for from vehicular supporters. We make the accompanying presumptions for the VCS:

- The data in a cloud system is divided into a number of small chunks that are the basic units for data delivery from the data center to vehicles.
- Each AP is placed at an intersection and has limited Transmission coverage such that a vehicle can download data chunks of interest only when it stays within the coverage area for at least a certain amount of time.
- Each AP has a stochastic characteristic for communicating with the mobile vehicle going through its coverage region due to limited communication capacity and time varying wireless channels.
- For effectively using a data dissemination service, the driving route of vehicles must be available in advance from online navigation and long-term archived traces.

V. CONCLUSION AND FUTURE SCOPE

VCC emerges from the convergence of powerful implanted vehicle resources, advances in network mobility, ubiquitous sensing and cloud computing. The combination of a massive amount of unutilized resources on board vehicles, such as internet connectivity, storage and computing power, can be rented or shared with various customers over the internet, similar to the usual cloud resources. Several of these resources can dynamically provide us support for alleviating traffic incidents. This paper provides efficient traffic management, cloud communication systems and interoperability between the vehicular cloud. However, a number of areas still remain unexplored for researchers including: context based routing, security and privacy aware data sharing, data indexing, high mobility, unstable communication links, physical location of attackers inside the same cloud server, and the synchronization of VC federation.

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