Advanced Vehicle Management with Cyber-Physical System and Vehicular Cloud Computing

G. Mervin George, B. Dhanalakshmi, N.R.P. Nivetha, M. Sundarrajan, J. Akshya

***Abstract*: *Vehicular cloud computing is a perpetual developing paradigm where the automobiles communicate with each other by retrieving the data, processing it, and sharing it among them even in remote locations through the cloud computing network. This is a developing research platform with innumerable applications both direct and indirect. In other words, it's the way in which not indifferent automobile vehicles interact with one other. There are a lot of applications for vehicular cloud computing in the automobile industry in assisting with people's day-to-day life it includes both direct and indirect applications. This platform has proved its way to aid in multiple fields with innovation and update. Cyber-physical vehicle systems are a fraction of vehicular cloud computing network with budding applications. These computer-based algorithms will eventfully aggregate with the automobiles and facilitate them to correlate and communicate with one other. The existing schemes include vehicular cloud computing in conjunction with Ad Hoc Networks where it has improved its efficiency and faced many technical challenges. There also was the implication of sensor technology where sensor incorporated automobiles interact with the network to assist automation. The proposed system involves controlling vehicles efficiently using VCC in cyber-physical systems. It is an advanced vehicle management system with individual connected and an automated vehicle that communicates with one another via cloud computing. The simulated results showed much higher efficiency, management accuracy, communication speed, and information sharing levels between the vehicles.*

Index Terms*: *Cloud Computing, Vehicular Cloud Computing, Vehicle Automation, Cyber-physical System

I. INTRODUCTION

Vehicle management, in general, is a management platform to perform all sorts of performances in relation to vehicle maintenance, service, and inspection. This can also be extended to controlling the vehicle without the need of manpower aiding in better applications to help those in need.

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This is completely software oriented where one must interact with the module to complete an action requested by the user. The software used in the vehicle management module is a conjoint set of different sub software together forming the complete interacting operation. The vehicle management employed in the system is an advanced vehicle management system which has two different types of communication link in the architecture. One is the V2I communication and the other is the V2V communication. Because of this feature, it makes our proposed scheme more advanced and superior to other vehicle management systems available. In a vehicle management system using cyber-physical system along with vehicular cloud computing, the vehicular data are all collected and stored in the cloud for processing and it is private o specific user hence data integrity is maintained. The data after the storage is then analyzed and the required information is extracted for feeding. This process is a singular segment relating to one particular user. But on the whole, different vehicular information is processed in parallel throughout the operation. Sharing is one of the operations included in the module, where different vehicles share information during processing to support one another. But sharing information has its own limitations like visibility, data range, data speed, and data control. Not all of the information about a particular vehicle shared during the process because there is certain information that is sensitive and requires privacy like the path taken by the vehicle previously, the present location of the vehicle, and the path decided by the user to proceed with the vehicle. Hence restrictions to certain information make it much more reliable and efficient to the user operation.

II. RELATED WORKS

We have researched our concept with many underlying existing approaches and finally brought out our own technological approach to the existing problem. The related works are listed here. In [1], they have proposed an innovative disseminated CPS for automated automobiles and they have illustrated all the obtainable methodologies in the proposed scheme. They have proved their result by using information graphs and they provided design guidelines for future study.

In [2], the authors provided an illustrative survey on vehicular cloud computing along with a taxonomical categorization. A new architecture is been designed for vehicular cloud computing and they have compared all possible research challenges faced in it and the possible solutions to face them. In [3], they presented the recent and upcoming advancements in VCC with a primary focus to two main areas that include framework and research challenges. They have also included certain research paths to prolong along with the same domain. In [4], they have projected numerous techniques to triumph over certain challenges in Vehicular Ad Hoc Networks like collision avoidance, speed baseline changing, and time of arrival in the network. They have introduced the mobile app as an interface for efficient remote traffic monitoring. In [5], they have proposed an automobile power system based on a structural design which aids in sharing internal states between the cloud servers. Their system can also change control between the cloud and edge server without degrading its stability according to its capability. The stability obtained from the full control edge server is almost achieved with this edge server suppressed system.

In [6], they have done a research study to provide a qualitative analysis to prove that there are some applications available in cloud services in AGVoperations like Microsoft Azure, Amazon AWS, Google cloud, and IBM cloud. Based on the principal and inferior computing needs, the proposed comprehensive AGV structural design can uphold the cloud service. In [7], they have projected an exclusive cloud computing model for Vehicular Ad Hoc networks in the purpose to endow with computational services to vehicular nodes. The planned model can also afford additional functions including information aggregation, privacy, security, and resource administration. In [8], they have exploited software-defined network technologies to develop an innovative security approach which will protect the vehicle from threatening nodes. By developing authentication, integrity, confidentiality, and availability through the usage of pseudonyms, revocation and key management list they provided a new advance to authorize protection. In [9], they have addressed certain major challenges faced in the vehicular cloud computing along with some newer approaches developed to overcome these challenges. For this study, they have chosen already an existing scheme in the market known as Elliptic Curve Cryptography. In [10], they have covered almost the entire vehicular cloud computing area with its security, reliability, threats, and application's efficiency. They have also discussed some emerging technologies like Intelligent Transport System and its impact on VCC. In [11], they have demonstrated a high-level trust management model in cloud computing along with is deployment design and scheme. They have proposed a management mechanism that efficiently uses physical resources like computing, communication, etc. These models help to analyze the performance of trust models.

III. PROPOSED SYSTEM

The proposed system is an advanced vehicular management system enabled using a cyber-physical system in a vehicular cloud computing network. This particular model has two different types of communication schemes embedded in the architecture which includes V2I and V2V communication. This two work together in improving the efficiency of vehicular management. This is and will be one of the supplementary attributes in our plot enabled with CPS with cloud computing. This advanced vehicle management system can also facilitate other technologies to be embedded within them in the architecture. This will have a profitable application to be extended in the future. Fig.1 depicts the intact structural design of sophisticated vehicle management system that we propose. It has three major processing compartments which are cloud storage module, cooperation

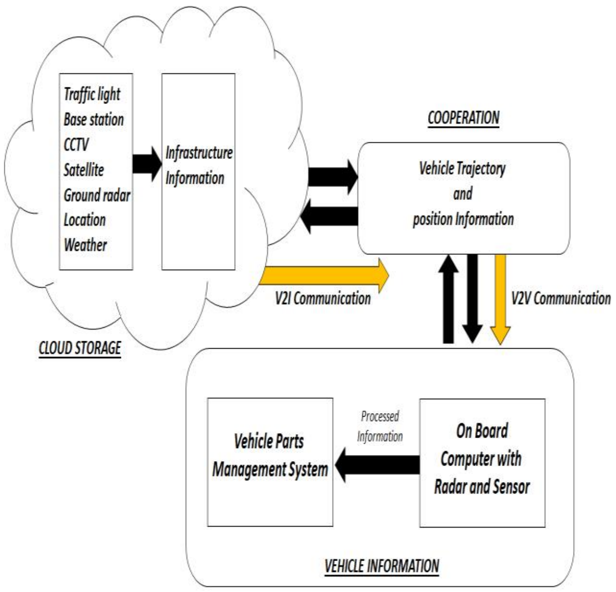

Fig.1—Advanced Vehicle Management Cyber-physical system on vehicular technologies

module, and vehicle information module. In the cloud storage module, contains all possible information that a vehicle might need during locomotion like traffic light data, ground radar data, weather, CCTV information, etc. The data are sent to the infrastructure information sector for storage. Then the information is shared to the next module called cooperation module through vehicle-to-infrastructure communication. The data sharing is a two-way pathway between these two modules. This module specifically contains the vehicle trajectory information and position information which is then transferred to the next module called vehicle information module through vehicle-to-vehicle communication.

The information can be shared in both ways between them. Here the onboard computer process the shared information and send that information to the vehicle management system. CPS is a fusion of three imperative processes like network integration, computation, and physical processes. This cyber-physical system has been deployed and researched in vehicular technology because of the automation of automobiles. This has its own field of applications to it to be developed in the future.

Connected and Automated Vehicles (CAV)

As the name states, these vehicles are advanced than the ordinary manned automobiles where these vehicles communicate with each other and it is autonomous in its own function. This will make the automobile absolutely automatic and does not require individual control. These vehicles have a lot of applications in all possible fields that exist in the industrial world. These automobiles are the stepping stone to the upcoming automation in the automobile industry where locomotion becomes imperative.

Information between V2V and V2I

In V2I communication that is vehicle-to-infrastructure type communication, the vehicle and the infrastructure share information among them to facilitate vehicular management. In V2V communication or vehicle-to-vehicle communication, the vehicles will distribute data among them which are only perceptible to the sharing automobile thereby maintaining the privacy of shared information.

Communication between CAV's

These vehicles are completely automated and do not require any human instructions to operate. These modules are designed in such a way that the only interaction takes place is between the CAVs which makes it a transformative technology. The inputs are all automated like steering, gear, acceleration, etc.

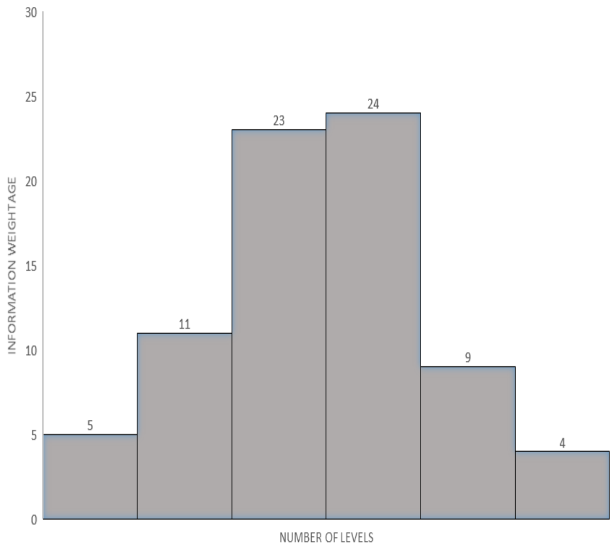

Fig.2—Cloud Information Level

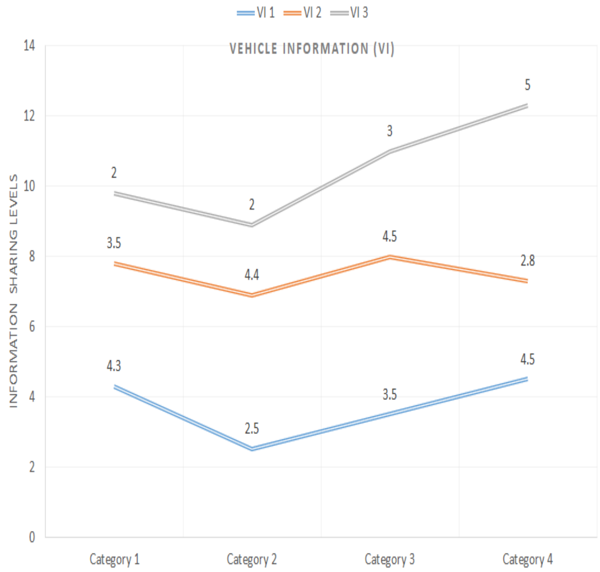

Fig.3—Vehicle Information Sharing

Vehicular Cloud Computing

It is a hybrid technology that has a humongous impact on traffic management and road safety which solely depends on vehicle resources. It is a budding technology in vehicular management where vehicles are integrated data oriented. It closely resembles unendorsed learning where the inputs and outputs are already fed into the system which then takes care of the rest.

IV. RESULT EVALUATION

The result of advanced vehicular management using a cyber-physical system and vehicular cloud computing is simulated and discussed below. The results are charted out in comparison to the currently existing system. Fig.2 describes the relationship between the cloud information levels in correspondence to its information weight. As the chart is drawn between the two factors it is seen that as the level of information is increased the weight to information rises along with it. The postulated here is charted out as information weight along the vertical axis and the number of levels along the horizontal axis. Fig. 3 describes the vehicle information sharing between different levels of information. Here three different vehicle information is compared to four different categories taken in hand and the information sharing level corresponds to different categories and types of shared information. The levels information sharing is taken along the upright axis and the categories are taken along the level axis. The graph is built up two units per sector. Fig.4 demonstrates the management accuracy of the vehicular management system. It is also a comparative chart that compares the level of accuracy to three different categories taken in hand for comparison with three factors in consideration which are infrastructure information, cooperation, and vehicle information.

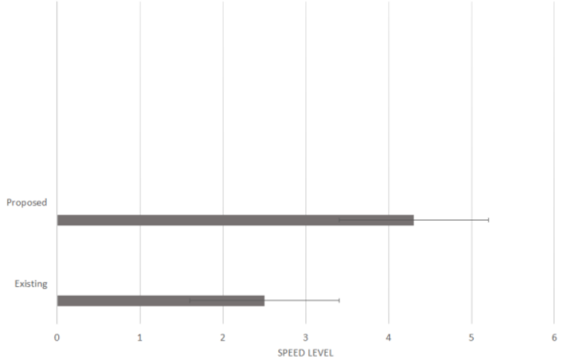

Fig.4—Management Accuracy

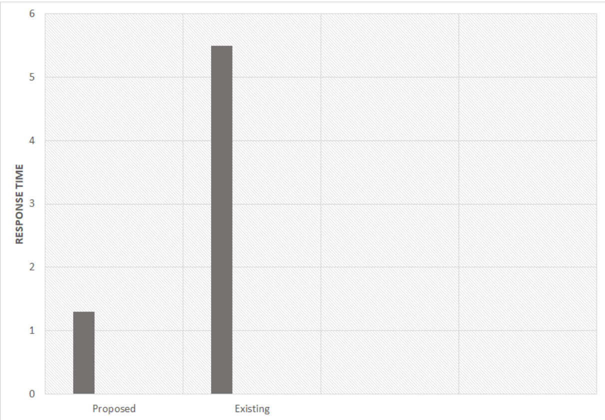

Fig.5—Communication Speed

The level of accuracy is different to each category and the factors in consideration also vary in accordance with the category considered. From the chart, it is inferred that category one and two have much higher accuracy than category three. The scaling unit taken for the chat is in 50 units each. Fig. 5 charts out the communication speed between the proposed scheme and the currently existing architecture. The scheme is taken along the upright axis and the speed is taken along the level axis. From the chart, it is seen that the communication speed of the proposed scheme is almost twice that of the existing scheme. The speed level is taken one unit each. Fig.6 describes the response time required by both the systems in comparison. From the graph assessment, it is seen that the response time required by the projected scheme is one fourth less than that required by the on-hand system. This makes our structure much more proficient and unswerving. The horizontal axis represents the systems being compared and the vertical axis denotes the time parameter. The units are taken singly for each sector.

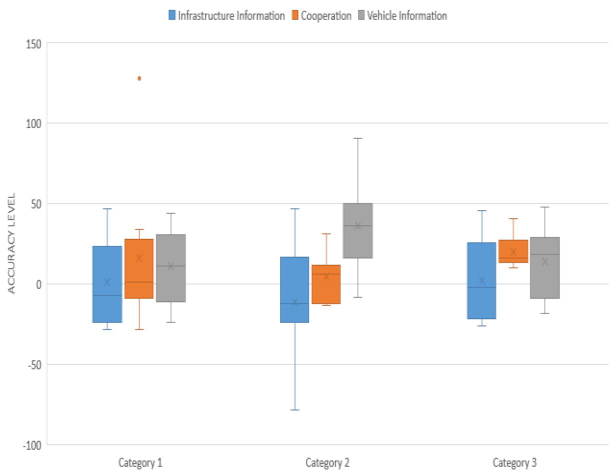

Fig.6—Response Time

V. CONCLUSION

Thus with the proposed approach, we have successfully managed advanced vehicle management in the cyber-physical system and vehicular cloud computing. The simulation outcome showed noteworthy enhancement in the projected system than the currently existing system. It is also highly proficient in terms of functionalities and can be enhanced based on the user necessity for the time being and later it can also be developed into a coexisting technology in conjunction to other technologies that are utterly automated. This technology can also be implemented in a shorter period of time and does not require many resources into implementation. This system is also user-friendly and one can completely rely on its functionalities. In the near prospect, countless supplementary features can be incorporated to assist more functionality with or without little encumbrance.

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