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***Research paper***

# VCIN Vehicular Interconnected Informatics Network "A interconnected network of vehicular information, Data, and Interface"

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**Abstract**

With market moving towards smart city development, the importance of data and its analysis has increased. According to a report by HIS Market, data generated from IOT devices will increase to 125 billion in 2030. Such huge amount of data is going to bring opportunities for all level of industries and markets. Thus, intelligent collection of data along with storage, processing and analysis will be a key to develop smart city. The information generated through data can target both users and market. It will be a result of various machine learning, data mining algorithms and distributed data storage technologies. The users can access information through web/mobile applications. The real time analysis of data and delivering it to user with no time will reduce accidents. This will increase productivity in hardware and software markets .VCIN the system of interconnected network of vehicles and infrastructure model in which, it focuses on four core modules. The interconnecting modules makes the network of data coming in and out of the system and finally getting displayed on one of our dashboard.

***Keywords :*** *IOT(Internet of Things), Cloud Storage, Data analytics , Smart city development*

## 1. Introduction

The, ultimate aim is of intelligent collection of data along with storage, processing and analysis to develop smart city. Using this system will help to create a predication model and make complex real world situations in control and gain more potential coverage ,about what is happening around a smart vehicular network. Making adaptable to most frequent heavy traffic problems and more than that it can offer a quite range of other benefits as well such as avoiding accidents, alerting user to an incoming threat prior to the event happening and making the smart decisions to make the go with an ease.

VCIN is made up of 4 modules:

1. Data from vehicles.
2. Data handling module.
3. Data Analytic module.
4. User Interface module.

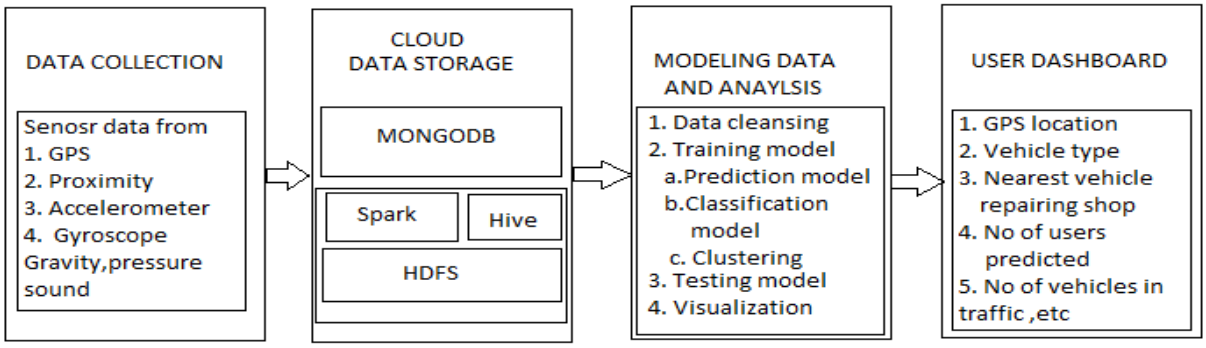


**Fig. 1:** The four modules of VCIN

## 2. Data from Vehicles

Comparing the present use of informatics system of vehicles in across the globe, we can find that, they are not smart and innovative so that it can make the best use of geographical, and time as well as traffic management and resources, therefore using this part of data from vehicles the data bits collected from the vehicles are sent to cloud hosted platform , so that it can stay safe there and can be accessed by different other modular system and modules. So this part is contributed using different Iot enabled devices, and communicating interconnected system.

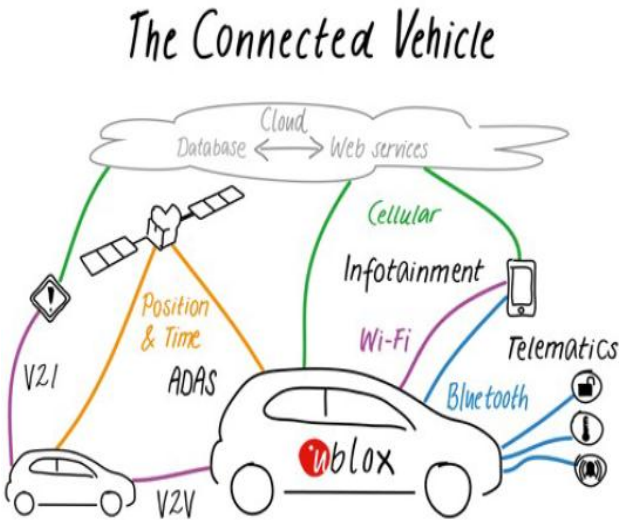


**Fig. 2 :** Abstract view of connected vehicle.

## 3. Data Handling Module

No Sql database (MONGODB) can store different types of data coming from various types of sensors. To handle such huge data. hadoop framework along with add-on tools such as Spark, hive will be best. The hadoop clustering will be able to hold increasing data. Through fault handling feature the lost data can be recovered. The distributed file system and map reduce provided by hadoop will increase efficiency of IOT application. Using this database system , data can be used by user interface module in form of key value pair and can be used as a data model. When the problems comes to managing this application or network to few cities or expanding to cities, the data collection will be large and handling such data can be a huge task for the system to bring to the cloud and process the data, and finally send back to the different providers.

## 4. Data Analytic Module

The data sent over to the cloud using the Iot enabled devices, kept as key value pair, protected onthe cloud hosted platform system, the data need to be analyzed why because of certain other reasons

1. Predicting the next possibility of uncertainty
2. Making the decisions based on analyzed data.
3. Framing form factor.
4. Useful data sets for companies in designing and making certain to present needs and requirements.
5. Making use cases.

The information generated through data can target both users and market. It will be a result of various machine learning, data mining algorithms and distributed data technologies. Using kmeans clustering ,the number of vehicles in a particular area can be shown. Accordingly, user can choose path depending upon number of vehicles in the traffic. The calculation of how much time will be needed for the traffic to get clear will make user more clear of choosing path. SVM (Support vector machine) is efficient algorithm to classify objects. This classification algorithm can be used to classify type of vehicle.

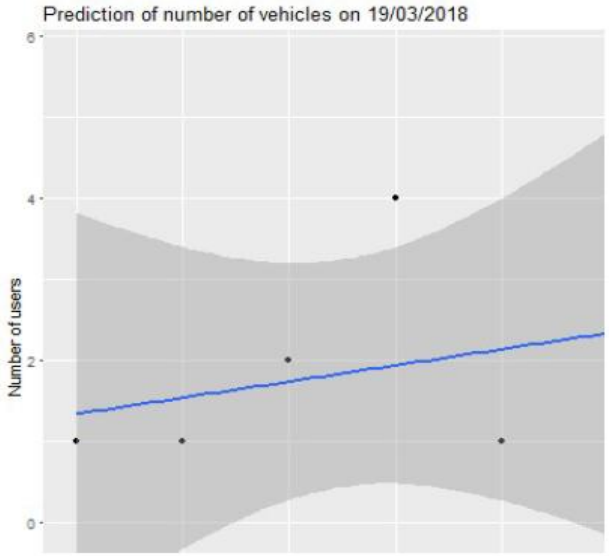


**Fig. 3 :** Graph which shows the no of users per last 6 dates.

## 5. User Interface Module

The best way a user, or the data that can be shown in digital format is through present most widely used digital technology , in the form of web application ,used by infrastructures, industries, car manufactures across the globe, and the control centers on the highway, to track the real time data using web application and take certain actions accordingly.

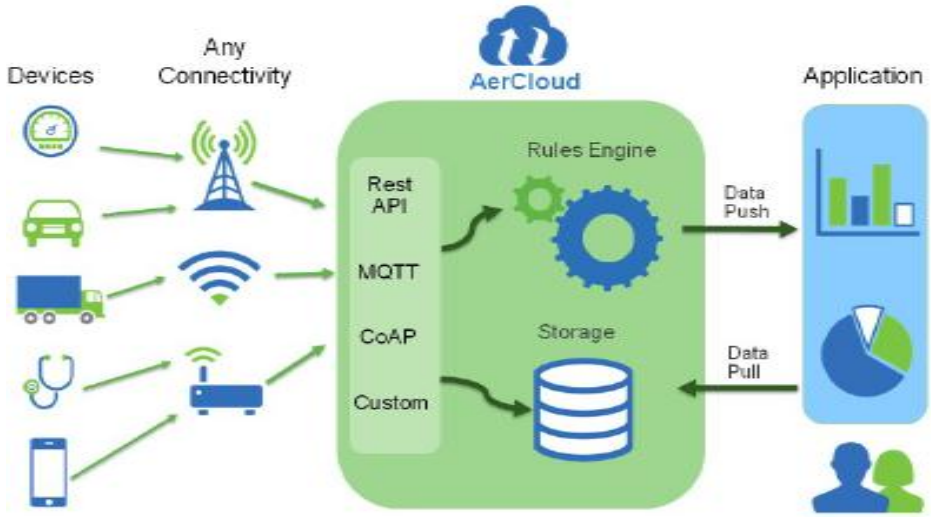


**Fig. 4:** Analytic functions

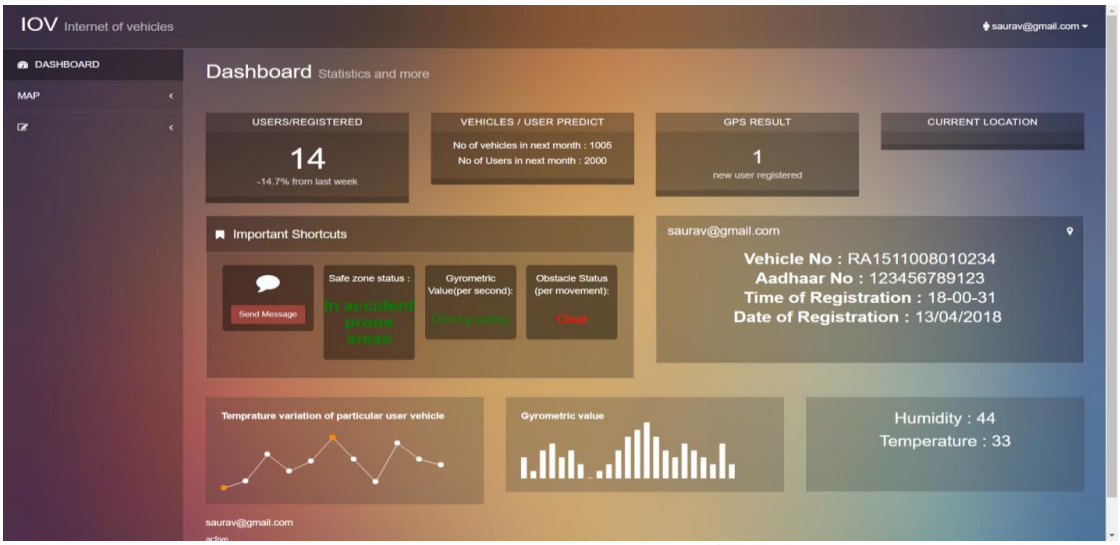


**Fig. 5:** The VCIN Dashboard, which displays the data of particular vehicles.

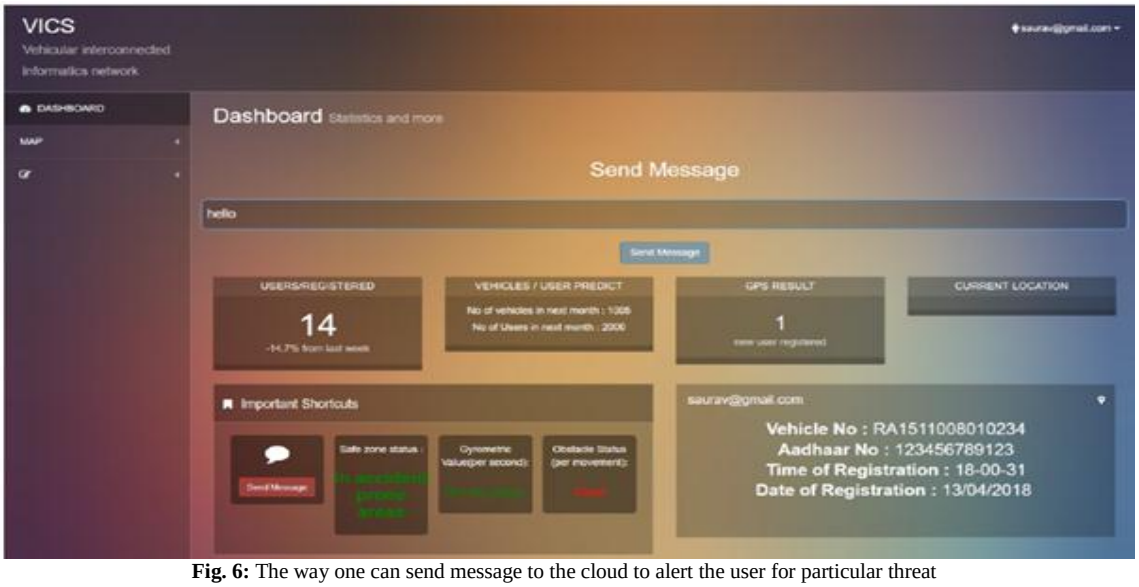


**Fig. 6:** The way one can send message to the cloud to alert the user for particular threat


**Fig. 7:** The geographical view of two places on the map, for tracking the vehicle

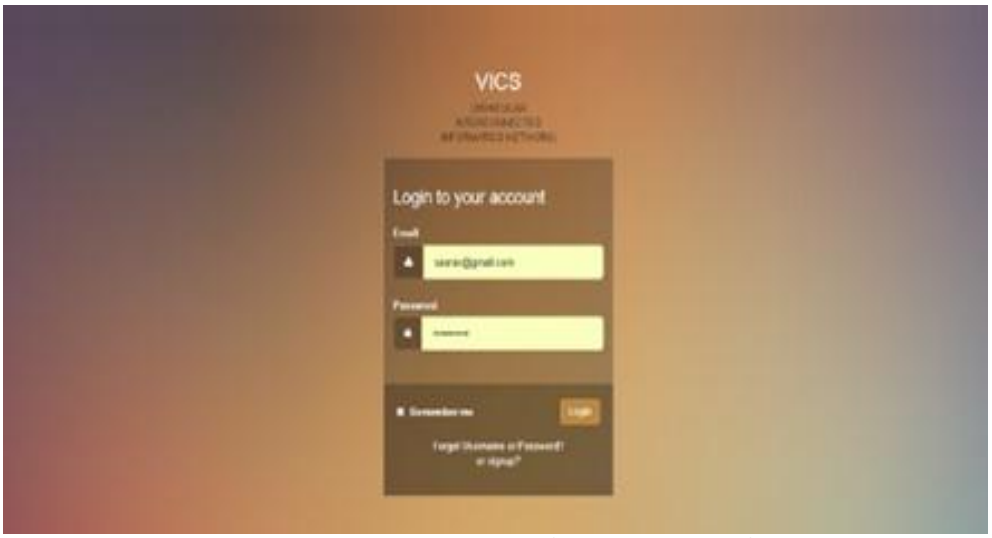


**Fig. 8:** The Authentication module, which will be used for logging in/out user from the application

## 6. Literature Survey

There have been number of protocols which are used for inter-vehicular communication network. These protocols are classifieds as

A) Unicast –It uses traditional routing protocols that can be used to establish unicast communications among vehicles. This protocols requires a intense service discovery mechanism, as a result it increases overheads and introduces latency, thus the network capacity reduces. Hence, this method won't work in safety critical applications.

B) Flooding - To improve the flooding approach i.e. to reduce the number of re-transmissions and side-by-side to increase the bandwidth usage , many protocols have been proposed.

C) Diffusions - Each node is responsible to maintain a view of its surrounding and periodically broadcasts it, the activity and sensor based data to the cloud server where it is used for storage and processed.

Apart from above classification ,the protocols can be further classified on the basis of applications or the urgency of the message, for an example: protocols for alert message (safety applications) dissemination, vehicle to internet communication & vehicle to vehicle communication. Similarly ,the vehicle to vehicle communication protocols have three subcategories:

(a) Bounded-delay safety alerts ,

(b) Persistent traffic warnings and

(c) Streaming media for entertainment applications.

Firstly, we reviewed the protocols designed particularly for safety applications and then have extended our investigation to other application areas. One of the main applications for vehicular network is broadcasting of safety messages, which may include dissemination of traffic ,road side information and accident . These services require intercommunication among all vehicles traveling over a geographical area, with high reliability and low delay. Thus, the broadcast or

multicast approach can considered to be better for the application. In traditional multicast techniques for information sharing, high delay was observed. Hence, new methods are proposed. The variant of traditional multicast is geocast, in which destination is a geographic position. It uses geographical location details to partition the forwarding zone into grids and elects one gateway node within each grid to forward packets from the source to the geocast region. The Geo-casting works on the assumption that nodes will stop forwarding packets when packets leave a predetermined surrounding area traced by GPS sensors.

## 7. Methods and Materials

### 1. Data collection

Data was collected from various sensors .The attributes that were used are namely linear acceleration, gyroscope, gravity, proximity, sound, speed, magnetic field and pressure inside vehicles. Some NA values were replaced with zero and some with average of that column. Visualization was done in order to remove outliers .It is done so that it won't affect the model and result values. Below is one example of finding such outlier. Similarly, for all variables the outliers were removed with proper visualizations techniques.

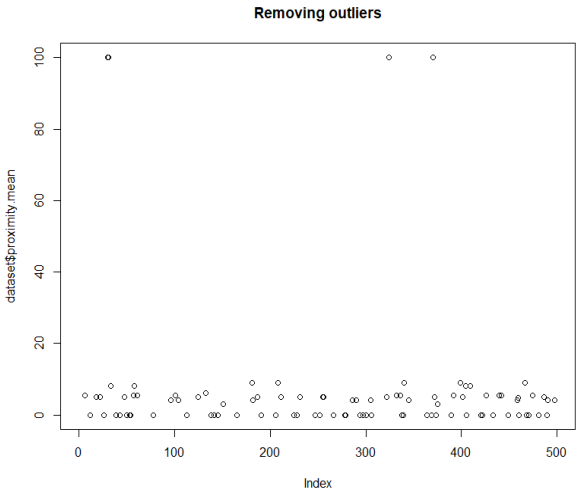


**Fig. 9:** Finding outliers

### 2. Model Planning

The correlation between variables was noted. Accordingly, they were used for

various models.

**Model 1.** Vehicle prediction model: SVM (Support vector machine) was used to classify objects /Types of kernel that we can use are linear, radial, sigmoid and polynomial. TUNING is used as hyper parameter optimization to help to select best model out of available models. As an output linear kernel model has shown higher efficiency with less supporting factors.

**Model 2**. Number of vehicles prediction model: To predict number of vehicles going to be registered on next day from the available historical data.

**Model 3.** Traffic detailing model: k-means is unsupervised learning algorithms which is used to solve clustering problem .In its procedure, a given data set is classified through a fixed number of clusters (assume k clusters) fixed apriority. Nbclust is used to find best number of cluster to group vehicle. k-means model was used to cluster vehicles according to the number of vehicles obtained from Nbclust method. The different clusters are colored for easy visualization by the user. The main idea behind defining k centers is to have one for each cluster. These centers should be placed in a deceitful way because different results are obtained due to different locations. So, placing them as much as possible far away from each other will give better results. This model used K-means clustering to cluster vehicles according to their positions collected from gps. Finally, this algorithm aims at minimizing an objective function know as squared error function given by:

$$J(V) = \sum_{i=1}^{c} \sum_{j=1}^{c_i} \left( \left\| x_i - v_j \right\| \right)^2$$

Where,

'||x i - v j ||' is the Euclidean distance between x i and v j.

'c i ' is the number of data points in i th cluster.

'c' is the number of cluster centers.

### 3. Web Interface

(Frontend & Backend) -

1. Jquery 2.0.3 -Javascript Framework for making the web elements interactive.
2. Modernizr 2.6.2 - Javascript Framework for making animation like feeling.
3. Font Awesome - Font Script for font styling.
4. Bootstrap framework - Web framework on which elements are rendered.
5. PHP - Hypertext pre processor. A backend server side language.
6. Windows server - Operating system, a hosted platform.
7. Open SSL - Web server extension.
8. Firebase - A real time database application, for making transactions on real time.

## 8. Results

1. Accident avoidance : The prediction of occurance of accident by historical data of user can avoid accidents.The user can be alerted of occurance of accident.
2. Emergency guide :Whenever a vehicle face any failure in vehicle ,its gps location is traced. The full path to nearest help place is shown.
3. Market needs : With increase of IOT applications, the need of devices should be meet. This can be done by predicting future needs.

## 9. Discussion

The proposed system that VCIN (vehicular interconnected informatics network) offer is that it allows to come to the conclusions that a vehicle applications ranging from advertising to emergency/traffic/parking information and raw data about a vehicle that can be useful for different vehicle manufacturer company and the control centers across highway, security institution or body to make decisions and predictions and track the activity and the behavior the particular vehicular running. The gps device on the vehicle will be sending the real time position of the vehicle moving on the road and in case if the situation comes where on moving to a particular destination , beforehand some accident had already taken place , so the other vehicle in that area will send the data to the cloud about the vehicle position along with the current state of the area and whether the vehicles following it, can be alerted before it moves into the accident prone area, which can end up rising some of the major problems such as traffic congestion and time wastage, and end up in transportation delay. So, the proposed system figures out these all problem that is currently faced by the heavy traffic roads and highways. VCIN will act as an smart manager assistance which will collect the data accordingly from different vehicles and sent to the cloud storage , where by the help of complex algorithms and scenarios the decisions are made and the artificial intelligence module will predict the key factor by which this real world problem can be solved and finally data in form of json with accurate time stamp saved and sent to the web server platform where it gets refreshed at less quantum of time so that it can manage a
huge big data and data flow and at the same time preventing data congestion and queue. Finally, the data is fetched from the firebase real-time server and put in the web application dashboard which can be seen on the web dashboard.

## 10. Conclusion

In recent years, vehicular network has seen a lot of initiatives, both by the government and industry like, allocation of frequency band for DSRC and research collaboration between industry and universities. There is lot of curiosity and growing interest in developing networking techniques which will enable wireless communication between vehicles, or between vehicles and fixed infrastructures near the road. With the above literature review, on developments in vehicular
inter-communication protocols; we can derive the following conclusions:

(a) Traditional broadcast protocols like flooding won't suitable to be used for vehicular networks because of the broadcast storm problem associated with it.

(b) Traditional position based routing protocols cannot be used because it requires a service discovery mechanism, which in turn increases overheads and introduces latency, thus reducing the network capacity.This approach becomes impractical for large number of vehicles and high mobility

(c) There's a need of protocols that can handle varying vehicle density and mobility and at the same time be robust to sparse network connectivity. The possible solution for this is to reduce the assumptions about the environment and use lightweight protocols (in terms of protocol complexity, parameters, and internal state) which would provide reasonable performance in all traffic scenarios.

(d)There're certain complications associated with multi hop broadcast which needs to be addresses while designing a multi hop protocol like hidden node problem, interference and packet collisions.

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