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Intelligence Transportation Service Using Vehicular Cloud Network

Ms. Ashwini B. Abhale
Department of Information Technology
D Y Patil College of Engineering,
Akrudi, Pune, India
ashwiniabhale@gmail.com

Sumit A. Khandelwal
Department of Computer Engineering
MIT Academy of Engineering
Alandi(D), Pune, India
sumit3khandelwal@gmail.com

Abstract **Today transportation play important role and have major economic sector of world. In contrast, increase in number of vehicles can increase number of road accidents and human fatalities. In addition, we are facing traffic problem also. Under this condition, it is necessary to provide promising solution to prevent an accident and traffic on road. Vehicular cloud network is help to maintain the communication between vehicles and road side units. Vehicular cloud network is a hybrid solution for maintaining traffic information and providing road safety. In this paper, we focus on vehicular cloud network and provide simulation result explore the working of propose methodology.**

Keywords Intelligent Transportation Systems (ITS), Vehicular Cloud Network, Taxi Services, Traffic simulator.

I. INTRODUCTION

Millions of people around the world die every year in car accidents and many more are injured [1]. Road traffic safety remains a big question in our life. In modern car, numbers of mechanisms are available for providing the information about traffic condition using GPS Navigation system as well as some physical security against during an accident are also present [2, 3] but this approach is active one, it is more affective in limited area as per range of nodes as well as it is applicable after an accident respectively, because physical security such as air bag is functional after accident. In this condition, instead of active approach, we work on proactive approach is better solution to solve the problem up to certain extends. Vehicular Cloud Network is proactive approach to prevent accident. Most of time accident happens due to driver misbehavior during turning, changing in lean and many other conditions. Vehicular Cloud Network provides real time information about state of vehicles and traffic information due to that driver is aware about the condition of road [2, 3, 4]. Vehicular Network consists of two types of units i.e. On Board Unit (OBU) and Road Side Unit (RSU) [2,3,15,16]. The continuous communication between On Board Unit (OBU) which is present inside the vehicles is say as Vehicle to Vehicle Communication (V2V)[5]. Vehicle to Vehicle Communication (V2V) is used to measure the state of vehicles (i.e. Speed, Direction will followed by Vehicles) [2, 3, 4, 7, 11, 12, 13, 14]. While communication is done between Vehicle and Road Side unit say as Vehicle to Road Side unit (V2R) Communication. Vehicle to Road Side unit (V2R) is used to explore the real road traffic condition. But some issue is associated with pure VANET technique[15,16], i.e. first large amount of data are generated during the communication, and it is necessary to hold for further communication is a big issue. Second, sometimes data may be loss due to unavailability of vehicles, because speed of vehicles is too much large, it can be varies from 0 km/hr to 150 km/hr and third each and every vehicles follow the traffic rule and density of vehicles on road are not constant. Under this condition, build a system that can resolve the problem of VANET. In this work we propose the Vehicular Cloud Network help to solve the problem related to pure VANET technique and provide the information related to traffic and state of vehicles.

The remaining paper highlighted as follows. Propose System Framework our scheme described in section II. The implementation and proposed model is given in section III. Simulation and results addressed in section IV, Finally, Section V concludes the paper and provides recommendation about work.

II. ARCHITECTURE OF VEHICULAR CLOUD NETWORK:

Vehicular cloud networking is future cost effective technology for road side communications [2, 5]. Vehicular network support of vehicle-to-vehicle and vehicle-to-infrastructure communications, VANET specific communication solutions are essential. Vehicular Cloud Network hybrid techniques while VANET is subcategories of MANET [2,14] where vehicles are treated as a node with high speed mobility and maintaining the traffic rules.

As certain challenges are associate with VANET [15,17,18,19] such as cost to implement infrastructure as well as high speed mobility pattern, Vehicular cloud environment provide cost effective technique for road side communications

The system model is shown in Fig 1. The elements involved in system model are as follows [5]:

A. Producer Vehicle (P)

P is a service provider in vehicular cloud. Before providing particular services in a network it has to make advertisement of those services. It will do through broadcasting the hello packet continuously. In that hello packet it will send its GPS location, timestamp, traffic data, type of service (NaaS, SaaS) and cost of that service usage(per hr., per day etc.).

B. Consumer Vehicle (C)

C is a vehicle, which wants services. C is not a part of our network. Means C will not send any packets. C will communicate with Cloud it will not communicate with any P.

C. Producer and Consumer (P/C)

Any vehicle can act as a producer as well as consumer. Means it can provide service and it will send request for another service.

D. Road Side Unit (RSU)

It is used in providing SaaS, for storing data (Marketing data and/or Traffic data) for making payment of producer vehicle etc.

E. Dynamic Cloud (NaaS)

Producer (P) vehicles continuously broadcast the traffic information through hello packet and multi hop communication occurs. In this way, all vehicles share their nearest traffic information such as condition of road, info related to traffic on road, and form a dynamic cloud, which provides a network as a service to consumer vehicle. Using that info C can predict the situation of next road and he/she can select the route for next journey.

F. Static Cloud (SaaS)

There are two scenarios we are assuming over here as follows

- Suppose, any p vehicle enters into parking slot (Mall Parking, Airport parking). RSU will receive its hello packet and check the type of services provided by P. during this time RSU will send free space location available in parking. If P provides a SaaS, in that case it will apply pipeline batch concept and find which suitable data (Malls, airports data etc.) we have to store on that vehicle and it will stored on that vehicle. In short, it will form a data center.

- Suppose, any C vehicle enters into parking slot then it will send request to RSU for particular service. RSU will share the data such as marking means in that mall how many shops are available, which brands are available, which discounts, offers are going on etc. on airport it will display timing of planes, shops available on that airport etc.

The elements involved in system model are in which we predict dynamic cloud, the Producer vehicles (P) continuously broadcast the traffic information through hello packet and multi hop communication occurs. In this mode, all vehicles share their nearest traffic information such as condition of road, info related to traffic on the road, and form a dynamic cloud, which supplies a network as a service to consumer vehicle (C).

Using that info Consumer Vehicle (C) can predict the position of next road and it can select the route for the next journey. Consumer Vehicle (C) is a vehicle which wants services. C is not a component of our network and not sends any packets and communicates with Cloud it will not communicate with any Procedure vehicles show in Fig.1.

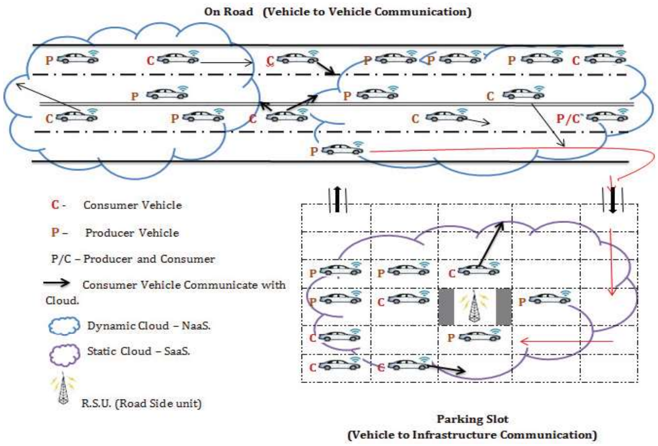


Fig. 1. *Propose model for VANET with cloud*

For performing the experimental task we consider basic elements of our model for transferring message and maintaining communication between them, the $\sum$ is finite set of message elements and those messages are handling by the message buffer. Initially, all nodes are in control state and local node message buffer is empty, while the set of control are in finite, but we are not predict about final possible configuration at each and every times.

The message structure is M = {M, add, del, del*[]), where M is represent the set of elements denoting possible message contents over finite number of message elements $\sum$, if $a \in \sum$ and $m \in M$ then function add (a, m) represent the message obtained by adding an element to message m is application when produce vehicle generate the request for service.

del(a, m) represent the message content a is remove from m then newly generated i.e. updated message is represent by *del(a, m)** and *[ ]* define the empty message when the services is discarded. This functionality can be various for various scenario.

Number of protocol are associated with network and each protocol define by the method/Process P defined by set

$$P = \{Q, \sum, Ro, q0\} \tag{1}$$

Here, Q represents the finite set of control state for each scenario and $\sum$ set of alphabets in message, Ro the transition relation i.e. $R \subseteq Q$, $q0$ initial state.

Γ Show the ability performing the initial operation and *!!a [??a]* show the ability for broadcasting and receiving message respectively when $a \in \sum$. Configurations are undirected Q x M graphs. $Q \times M$ graphs Γ has a tuple $\{V, E, L\}$. Where V is a finite set of nodes and $E \subseteq V \times V$ is a finite set of edges (we not allow the edges how make self-looping) and $L: V \subseteq Q \times M$ is a labeling function.

We use the notation $u \sim \Gamma v$ and say that the vertices u and v are adjacent to one another in Γ and we retrieved Γ and consider $u \sim v$, when it is clear communication between producer and consumer vehicles.

We assume, $L\{\Gamma\}$ to represent the set of labels in Γ. The set of all possible configurations is denoted C and $C0 \subseteq C$ s the set of all initial configurations, in which vehicles always have the same label $\{q0, L\}$.

Producer vehicles providing the message with $\{q0, L\}$ and requesting to consumer vehicles for accessing the services. Multi requests are differentiated with respect to time at every amount of time ∆t and allowing for sharing the space.

$$\frac{\partial space}{\partial tspace} = Totalspace - \frac{\partial allocated}{\partial tspace} \quad (2)$$

Taking integration on both side,

$$\int \frac{\partial space}{\partial tspace} = Totalspace - \int \frac{\partial allocated}{\partial tspace} \quad (3)$$

Here we have converted the share space into the actual space

$$\text{Space} = \text{totalspace} \quad \text{allocatedspace} \quad (4)$$

F is function to allow access for services for n number consumer vehicles and m number of RSU units

$$\text{F} = \left(\sum_1^n \sum_1^m Space\right) \quad (5)$$

The value associated the function is varies and it fully depend upon number of producer and consumer vehicles and all traffic related data are associated with it and it will be hold on online cloud for further operations. Then □F is function representing the number for space is available for accessing the service and that are provided by the Producer vehicle, while this space is randomly varies with respect to number of producer vehicle represent by following equation.

$$\Delta F = \left(\sum_1^n \sum_1^m Space\right) * Space\ Offer\ by\ P\ vehicles \quad (6)$$

Then all data are hold in respective space location for further operation and allow for accessing the different services are represent in our project.

III. Implementation and Results

For implementation of propose idea, we are using traffic simulator i.e. SUMO (Simulation of Urban Mobility)[8,11]. For study purpose we consider the PUNE city from India and design City as per our requirement i.e. adding different detector for maintaining and holding traffic data and transfer towards the cloud for further services [22].

The Fig. 2 shows the flow of programs and files for the simulations run in this scenario. Each simulation is controlled by a Python script called Simulation Controller[5,6,7]. This script calls each of the programs involved, starting with Grid Creator. Grid Creator is in charge of creating the road network used in the simulation. After the road network is defined, Simulation Controller activates NETCONVERT, a tool that comes with SUMO, which converts the road network files into a single file for use with SUMO. The next step is to define vehicles for the roads. Simulation Controllers choose either Journey Maker or Journey Typhoon, depending on the scenario, for defining these vehicles. The vehicle file created by either of the two journey programs is then fed into the SUMOs routing tool, DUAROUTER, which gives the vehicles their initial paths. The last preparation for the vehicles before they are fed into SUMO is to create a single file with links to the files that SUMO will read. This single file is created by Configure. SUMO is started up in server mode by Simulation Controller, and then a loop begins for each second of the simulation with exchanges of gathering information about the vehicles, feeding them into my routing program, RouteMan, making the appropriate changes, and then running the next step of the simulation. Once simulation is completed successfully, then all data are generated are store in cloud database for further operation. All Updated information is exchange between RSU Unit as well as with vehicles.

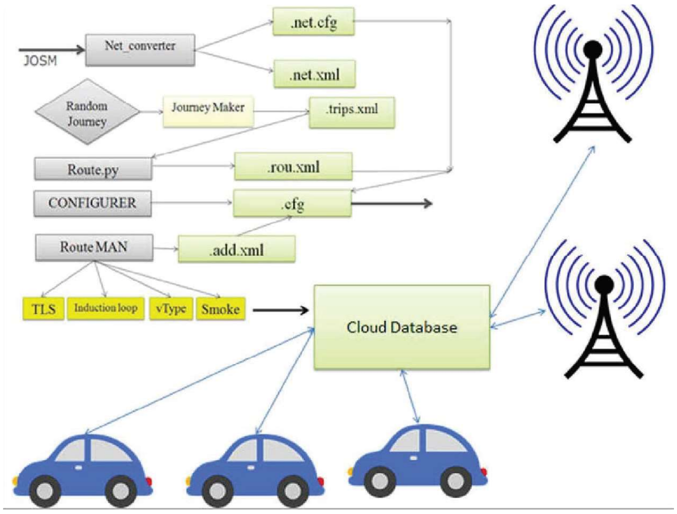


Fig. 2. *Design plan of proposes work*

A. *Experimental results and discussion*

The aim of this paper is to find out monitoring the position and delay on a road during transport under cloud environment and it can use to check the traffic information and check delay as well as traffic density in an intersection, lastly provides information to next vehicles to reroute its own path. The various answers are coming out after simulation and all data can transmit to the cloud, the cloud can hold different information can help to find out location of vehicles and pollution on each lane as per RSU fixed.

We provide a unique id to each vehicle it is equivalent to providing registration identification. For simulation purpose, we consider 10 vehicles from different places to find out the delay in complete journey. Fig. 3 represent the vehicles are running on road and each and every vehicles follow the traffic rules and traffic sign are continuously change after some delay. Fig. 4 represent the Pune city map developed using JOSM [22] and imported in SUMO [21] and number detector are fixed on road.

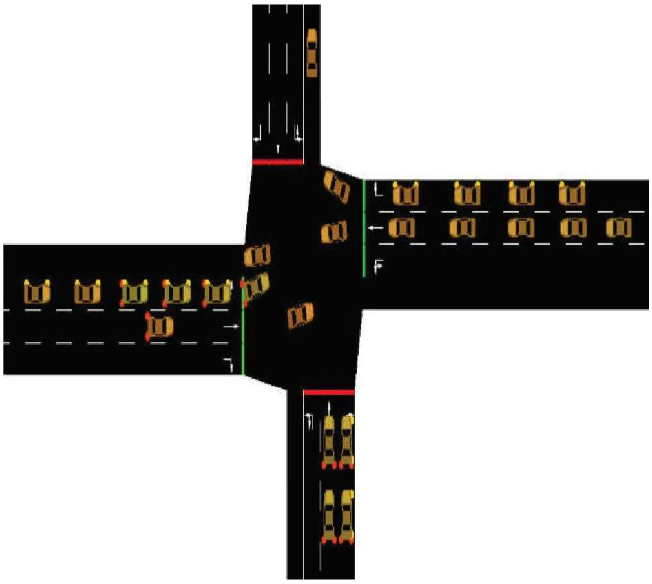


Fig. 3. *VCE is implemented to maintain the track of vehicles*

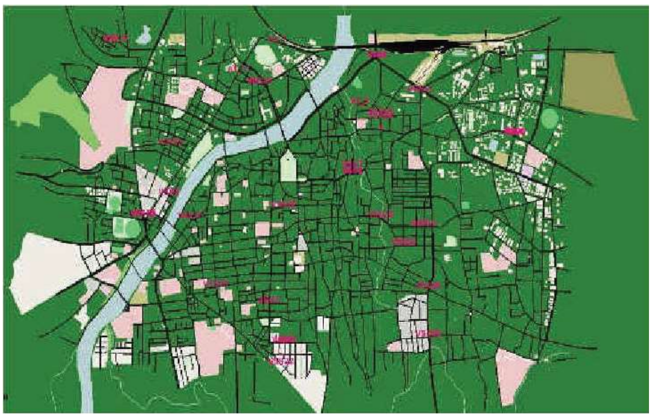


Fig. 4. *VCE is implemented to maintain the track of vehicles*

With the help of detector, we find out traffic information from different location and store into database files. The result are generated are shown in table 1 as follows,

The generated result can store in Google cloud database [26] (Design table using Google Cloud SQL) as a Table 1, shows at specific location vehicles are continuously come (we can say as enter), Due to traffic jam it may halt (we can say as stay) and left the location (we can say as Leave) with regard to time location, it can refer extra time required to complete the journey. As all data can store in the cloud database, which can help to find out the minimum path between two stations. Below result show the total vehicle with variable speed can complete their journal via Western Detector with respect to time duration.

TABLE I. TRAFFIC DENSITY OF 10 VEHICLES AND ITS BEHAVIOR ON TRAFFIC SIGNAL

ID	VEHICLE ID	TIME	STATE
Western	V1	395.18	enter
Western	V1	395.79	leave
Western	V2	644.75	enter
Western	V2	644.95	leave
Western	V3	1058.9	enter
Western	V3	1059	stay
Western	V3	1059.50	leave
Western	V4	1113.61	enter
Western	V4	1113.8	leave
Western	V5	1122.21	enter
Western	V5	1122.39	Leave
Western	V6	1688.44	enter
Western	V6	1688.66	Leave
Western	V7	2537.94	enter
Western	V7	2538	stay
Western	V7	2538.13	leave
Western	V8	2632.92	enter
Western	V8	2633	stay
Western	V8	2633.12	leave
Western	V9	3012.91	enter
Western	V9	3013	stay
Western	V9	3013.11	leave
Western	V10	3202.66	enter
Western	V10	3203	stay
Western	V10	3203.28	leave

TABLE II. STATE OF VEHICLE AT DETECTOR B WITH ID AND TYPES OF VEHICLES.

id	time	state	vehID	speed	length	type
b	28.19	enter	t18	11.11	13	bus
b	29	stay	t18	11.11	13	bus
b	29.32	leave	t18	12.61	13	bus

Table 2 represent the state of vehicle at specific time duration and types of vehicles, it will help to provide for security purpose. Table 3 help to trace out the route of vehicles that are help to trace the vehicles are represented in figure 6 and 7.

TABLE III. *ROUTE FOLLOWED BY VEHICLE*

Time step_time edge_id	lane_id	vehicle_speed	vehicle_id vehicle_pos
0	53761712 53761712_0 0	V1	13.1
1	53761712 53761712_0 1.44	V1	14.54
2	53761712 53761712_0 3.12	V1	17.66
3	53761712 53761712_0 5.08	V1	22.73
4	53761712 53761712_0 6.71	V1	29.44
5	53761712 53761712_0 9.3	V1	38.75
6	53761712 53761712_0 11.56	V1	50.31
7	53761712 53761712_0 13.49	V1	63.8
8	53761712 53761712_0 15.38	V1	79.18
9	53761712 53761712_0 17.09	V1	96.27
10	53761712 53761712_0 19.48	V1	115.75

For accessing the services, we design the webpage using php and call the data from different location and calculate the load on cloud and offer different services that help for traffic monitoring. Fig. 5 represents the services provided by the cloud and authorized user can handle the website and call the data as per requirement.

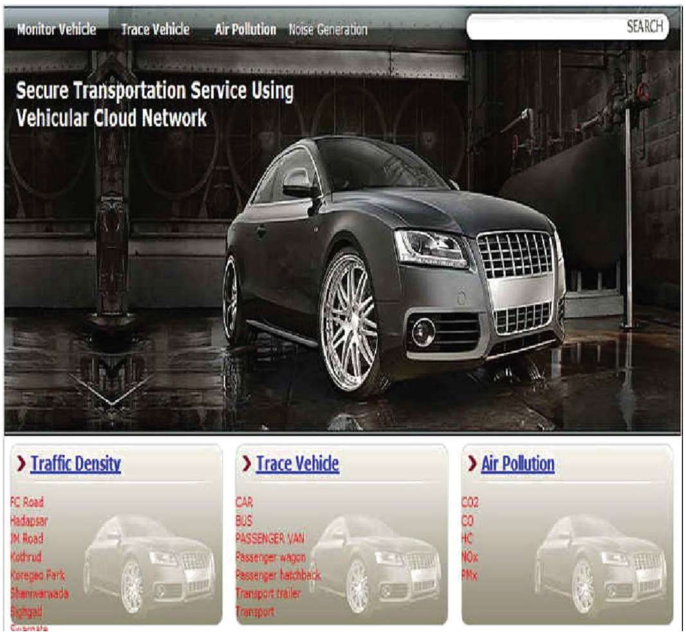
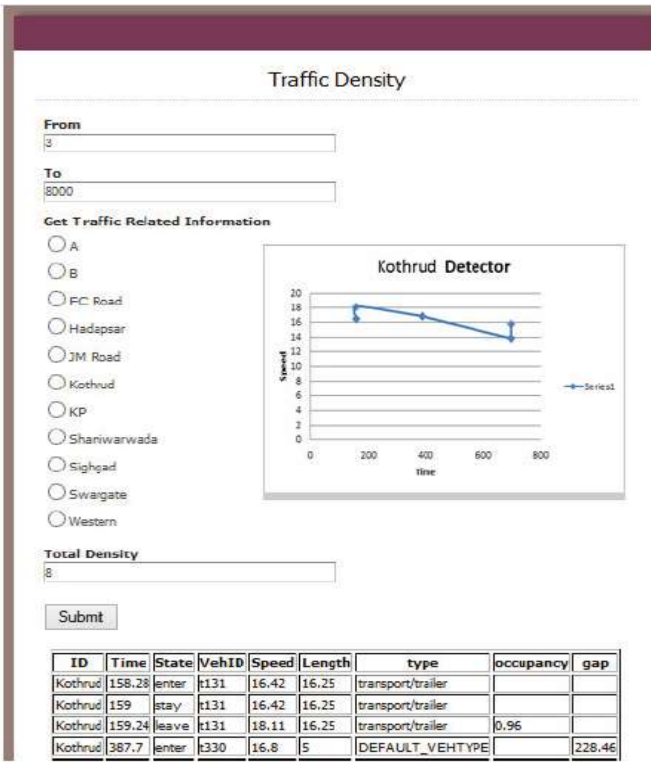


Fig. 5. *Google Cloud pages for accessing the data for traffic management and handing different services provided by vehicular cloud.*



ID	Time	State	VehID	Speed	Length	type	occupancy	gap
Kothrud	158.28	enter	t131	16.42	16.25	transport/trailer		
Kothrud	159	stay	t131	16.42	16.25	transport/trailer		
Kothrud	159.24	leave	t131	18.11	16.25	transport/trailer	0.96	
Kothrud	387.7	enter	t330	16.8	5	DEFAULT_VEHTYPE		228.46

Fig. 6. *Extract the data from cloud and generate statistic as per time stamp basis.*

With help of website we can extract the data of vehicles, trace the vehicles, Air pollution report and state of Vehicles. Consider example of finding the traffic density, we fill some information as per our requirement as shown in fig. 5, for example we consider the time stamp range the display the result and it statistics in form of graph as shown in fig. 6.

Below Fig 7 geographic location of vehicle with respect to time duration of whole city map that help to trace particular vehicles easily.

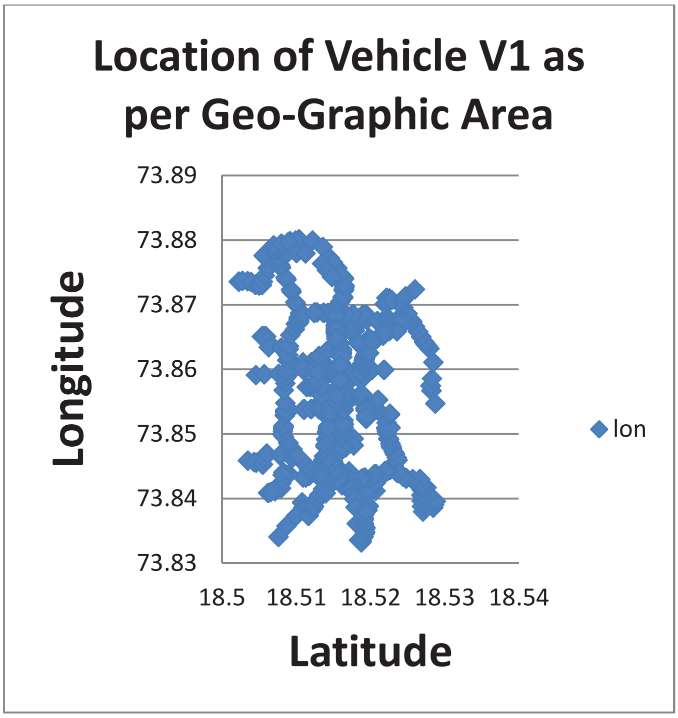


Fig. 7. Location of Vehicles with respect to time.

Fig. 8 represents the amount of CO2 gases emitted by vehicles with respect to time duration as shown.

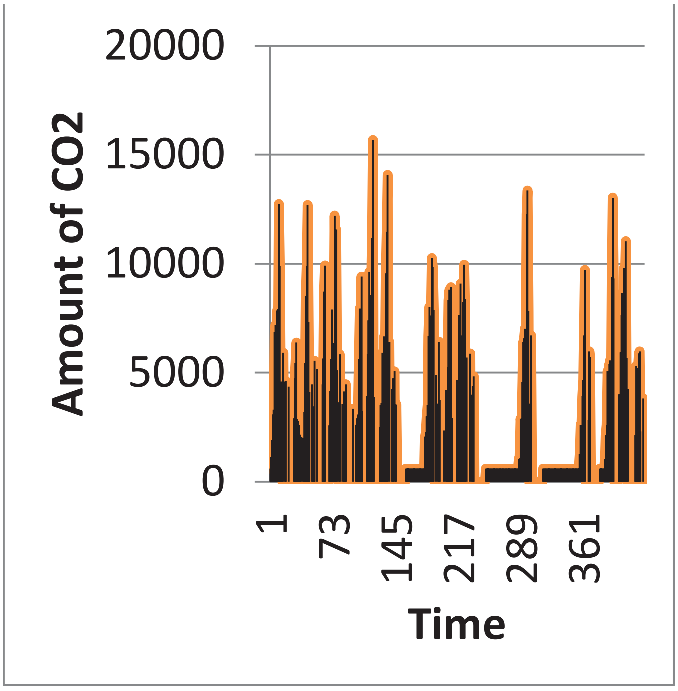


Fig. 8. Amount CO2 emitted by different vehicles

IV. CONCLUSION

In this work, we propose the realistic model of Vehicular Cloud Network for cost effective in high density vehicle structure with traffic parameters. This work try to study of initial stage of vehicular cloud environments by providing various cloud services such as network as a service and storage as a service using traffic simulator simulators. Propose technique can help to society for tracing the traffic conditions and help in road side emergency services and some advantage in near future, but it's necessary to make the system more secure due to number of communication attacks and privacy issues are deal in near future.

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