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Smart Parking Allotment System for Urban Areas in India Using VANET

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ABSTRACT*:* Parking is limited in almost every urban area in India leading to traffic congestion, air pollution, and driver frustration. In large parking lots, a driver may leave the lot without knowing about new spots that have just become vacant. Finding a free parking spot may also lead to driver irritation if another car takes the spot before the driver can reach it. With Vehicular ad hoc network intelligent service- oriented parking allotment can reform parking space utilization and drivers frustration. The dissertation inspiration is to fill the near term parking demand using vehicular ad hoc network. The contribution of the dissertation include to provide the real time parking navigation service to the drivers, friendly parking information dissemination service to the drivers means the drivers can easily and quickly get their favored parking lots close to their destination therefore the parking navigation is convenient and efficient, and increase the space utilization in the parking area.

KEYWORDS: Parking system, information Dissemination, On-Board-Unit (OBU), RSU (Road-Side-Unit), TA (Trusted Authority).

I. INTRODUCTION

Finding an empty parking space in a congested area or a large parking lot, specially, in peak times, is always time consuming and frustrating to drivers. It is common for drivers to keep circling a parking lot and look for a empty parking space. To minimize difficulty to the drivers, many parking guidance systems have been developed over the past decade, where the system provides correct, real-time car park space availability to the drivers looking for parking spaces and then guides them to the available spaces by dynamically updated guide signs. The current smart parking systems obtain the availability of parking spaces using the sensors installed across the whole parking lot. However, deploying sensors in a large parking lot can be very expensive. Furthermore, the sensors can become defective and would stop functioning easily when time passes. Therefore, it is highly desired to have a reliable and cost effective way to find available parking spaces and guide drivers to the available parking spaces. Likewise searching for available parking spaces. If the driver have the up-to-date knowledge about the traffic position like information about the free parking place near the destination area it would be then great profit.

Vehicle Ad Hoc Networks (VANETs), as shown in Figure that is given below, have been received particular attention both in industrial and academic levels. With the advance and wide disposal of wireless communication technologies, many large scale car manufactories and telecommunication industries gear up to furnish each car with the On Board Unit (OBU) communication device, which allows different cars to interact with each other as well as roadside infrastructure, i.e., Roadside Units (RSUs), in order to reform not only road safety but also better driving experience. Therefore, it becomes possible to track the parking space control, guide drivers to the empty parking spaces in large parking lots through vehicular communications.

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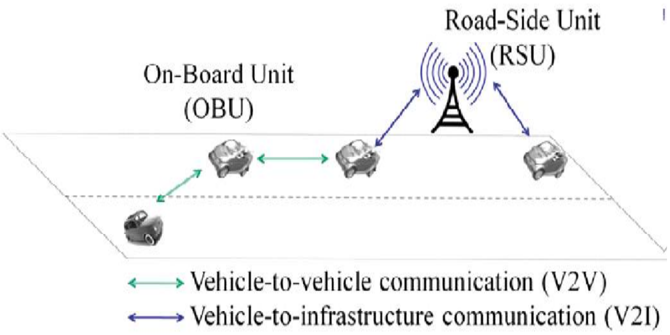

Vehicular Ad-hoc Network

Secondly, the scheme provides VANET-based intelligent anti-theft protection service. With this service, all vehicles parked at the smart parking lot are guarded by the parking lot's RSUs. Once a vehicle is illegally leaving the parking lot, the RSUs can quickly notice the anomaly. Thirdly, the scheme can provide friendly parking information dissemination service to the moving vehicles. With this friendly parking information, the drivers can easily and quickly choose their preferred parking lots close to their destinations.

II. RELATED WORK

Now a day's more vehicle manufacturing companies provide the On Board Unit (OBU) communication devices. The current parking systems obtain the parking space availability using sensors installed in the parking zone. The implementation of the sensors in the parking zone is very expensive; it can be inaccurate and would stop the functioning when time passes. Therefore it is desirable to have a loyal and cost effective way to track the available parking space and guide the drivers. In Wireless ad hoc Discovery of Parking Meters they have proposed a scenario of wireless ad hoc networks for finding free parking lots. They use multi-hop dissemination of information only among interlinked parking meters, and not among vehicles. Requests from vehicles for parking places are received and managed by such a parking meter via single-hop communication. In SVATS: A sensor-network-based Vehicle Anti-Theft System they presented a sensor-network-based vehicle anti-theft system. In this setup, the sensors in the vehicles that are parked at the same parking lot first form a sensor network and then monitor and identify possible vehicle thefts by recognizing unauthorized vehicle movements. In Smart Parking: an Application of optical Wireless Sensor Network , the authors present a smart parking management system based on wireless sensor network technology, which presents remote parking monitoring, automated guidance and parking reservation service. They demonstrate this system architecture can help travelers to find vacant parking spaces [8]. In Towards an Intelligent GPS-based Vehicle navigation system for finding street parking lots has described algorithm to find the most likely available parking slots within a specified distance from the destination. The proposed algorithm utilizes the occupancy history and the present status of a parking lot in order to determine its availability at the time when the vehicle would reach the destination.

III. SYSTEM SETUP

Proposed model consist of the Trusted Authority (TA), On Board Unit (OBU) which is equipped in the Vehicles, stationary RSU (Road Side Unit) which is deployed in the Parking area. Once the vehicles enters into the parking area the identification should be kept secret for an extraordinary event occurs, so the RSU can get the information about the registered vehicle from the TA. Trusted Authority is the registration in charge of the both RSU and OBU. TA first initializes the required parameters. Trusted Authority inspects the parking lot and generates the private key and stores the same private keys into the three RSUs.

OBUs are communicated with each other and with the RSUs to get the current parking information. Each OBU has provided the unique ID i.e. vanet_ID. To protect the privacy of the OBU each vanet_ID (IDv). When OBU with IDv registers to TA, TA converts the IDv into PIDv and generates the private key Sk. When OBU enters into the parking slot it will receive the ticket ID and the ticket key which is known to driver only.

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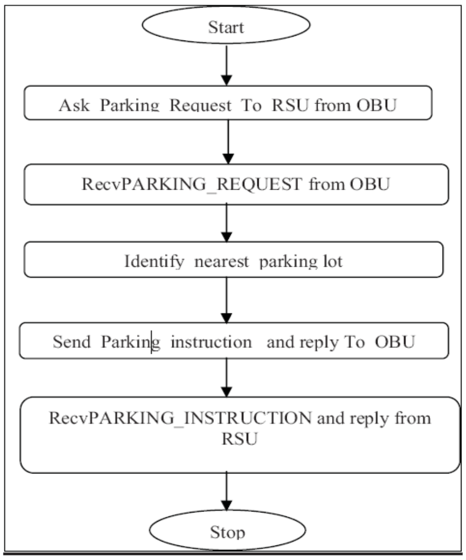
Here we deployed the three RSUs in the parking lot; these all RSUs cover all the parking lot with road side. All these parking lot are inspected by the TA, Trusted Authority will generate the corresponding private key for the identifiers and distribute the private key to these parking lot RSUs. The RSUs communication range used here is recommended by the IEEE 802.11p Wireless Access in Vehicular Environments (WAVE) standard.



Following steps shows the communication between the OBU to OBU, and OBU to RSU and vice versa.

1. Ask Parking Request To RSU from OBU:

The driver, who wants to park his vehicle, will send the parking request to RSU, with vanet_ID, current timestamp, and current position from where the request is sent by the OBU, and then the packet will be scheduled for broadcasting through the down target of linked layer (LL) and querying the mapping of the given destination address.

2. Receiving the parking request from OBU:

Here, RSU will get the parking request message from OBU with the header information rbc_senderID, and then RSU will reply back to the OBU by calling the Send_Parking_Instruction_To_OBU(rbc_senderID), by inquiring the available parking point from the respective parking lot and update the routing information of the parking lot with the current time-stamp.

3. Identify nearest parking lot:

When OBU enters into parking slot the RSU choose the correct vacant parking points (lot_x, lot_y), the three RSUs simultaneously measures the distance from the vehicle to themselves. With the vacant parking points (lot_x, lot_y) and the position of the vehicles (X, Y), the RSU will choose the shortest path for the vehicle and navigate the vehicle to the vacant parking space. To calculate the nearest parking points for the requested OBU the formula is used:

$$\text{Nearest distance} = \sqrt{(x-x1)^2+(y-y1)^2} \quad (1)$$

4. Send Parking Instruction to OBU

After finding the vacant parking position points at parking slot with nearest parking points, the parking points information is sent to the respective OBU from where the parking request is received; with the Parking_lot_ID and parking points(x, y).

5. Receive the Parking instructions from RSU

Requested OBU will receive the parking information from the RSU about the free parking points(x, y) and Parking_lot_ID _id.

6. Send the parking reply to OBU:

With the parking instructions the RSU will sends the parking reply to the OBU with the RSU_ID and the parking points (x, y).

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7. Receive the parking reply from OBU

Finally after receiving the parking points by OBU, the drivers will park the vehicles at the respective parking points.

8. OBU registration at TA

In our considered summary first every OBU will do the registration of himself at TA by sending the registration message to TA with his vanet_ID, and current time-stamp.

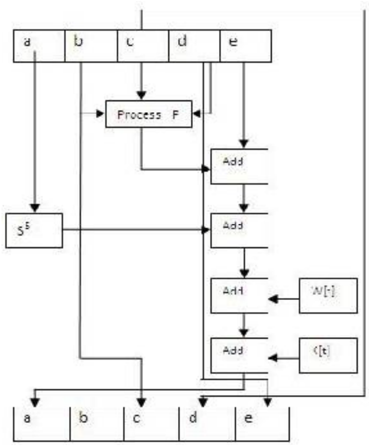
9. Receive registration message by TA:

After receiving the registration message from OBU, the TA will do the registration of OBU and generate the private key for the OBU. Once the vehicles enters into the parking area the recognition should be kept secret for an exceptional event occurs, so the RSU can get the information about the registered vehicle from the TA.

IV. ALGORITHMS USED

A. SECURE HASH ALGORITHM (SHA-1)

Here we used SHA-1 algorithm to generate the Private Key for every vehicles those have registered with TA. Following figure.1 shows the working of SHA-1 to generate the secure private key for the OBUs those are registered with the TA. SHA work with any input message that is less than 264 bit length. The output of SHA is a message digest, which is 160 bits in length. This SHA-1 requires 2160 operations to break in, if any attacker try to find out the original message (here vanet_ID) therefore it is more secure.



Single SHA-1 iteration

OBUs are installed in the vehicles; they can communicate with each other and RSUs to get the parking lot information. Every OBU will have the unique identifier (vanet_ID) to protect the privacy of the OBUs. When OBU with vanet_ID registers itself to Trusted Authority (TA), TA converts the vanet_ID into pseudo-id, and generates the private key corresponding to the pseudo-id of the OBU. When an OBU enters into the parking slot, it will receive the pair of ticket ID and respective ticket key, which is only known to the driver. Figure.6 shows the generation of private key, Ticket ID, Ticket key sends to the OBU in the parking lot area.

B. MOTION VECTOR ROUTING ALGORITHM (MOVE)

The MOVE algorithm is an algorithm for specialized sparse VANET summary. In these scenarios, vehicles act as mobile routers that have intermittent connectivity with other vehicles or stations in their network. The network is so comparatively populated that there is seldom, if ever, a completely connected path from source to the static destination (a fixed data collection point or roadside unit). A carry-and-forward advent is used for vehicles to store data for lengthy periods between connections. Connection opportunities must be scrutinized carefully since they occur infrequently and the global topology is unknown and immediately changing. At each opportunity, the algorithm must predict whether forwarding a message at that instant provides progress toward the intended destination.

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C. GREEDY FORWARDING ALGORITHM

Greedy forwarding tries to bring the message closer to the terminal in each step using only local information. Thus, each node forwards the message to the neighbor that is most convenient from a local point of view. The most suitable acquaintance can be the one who minimizes the distance to the destination in each step (Greedy).Greedy forwarding variants: The source node (S) has different options to find a relay node for further forwarding a message to the destination (D).

A = Nearest with Forwarding Progress (NFP),
B = Most Forwarding progress within Radius (MFR),
C = Compass Routing,
E = Greedy

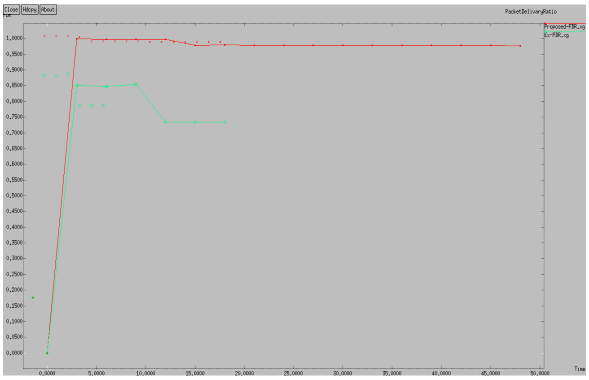
V. RESULT

The network Performance in simulation environment is measured in Packet delivery ratio, Packet loss ratio, Throughput, Average delay

Packet delivery ratio

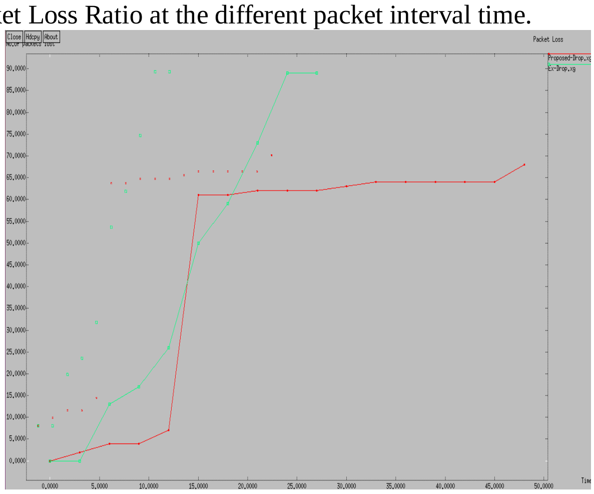
Packet delivery ratio is the ratio to evaluate the performance of the simulation. The ratio of the packets that successfully reach destination.

PDR= Total no. of packets delivered/Total no. of packets transferred*100



Packet Loss Ratio

Following result shows the Packet Loss Ratio at the different packet interval time.



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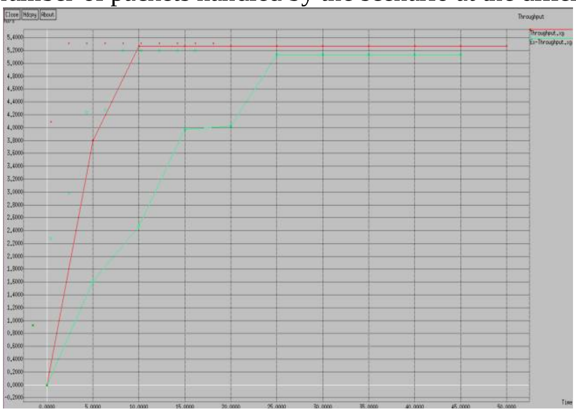
Throughput

Following result shows the total number of packets handled by the scenario at the different packet interval time.



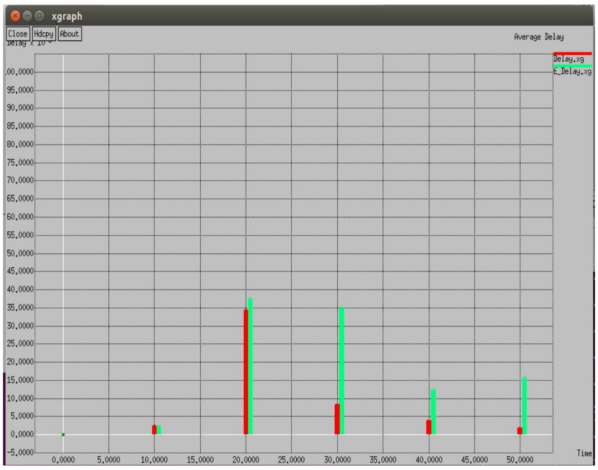
Average delay

This metric gives the overall delay, from packet transmission by the application agent at the source node till packet reception by the application agent at the destination node. The following equation is used to calculate the average delay,

$$\text{Average Delay} = \frac{(T\_DataR - T\_DataR)}{\text{Received packets}}$$

Where, T_DataR = Time data packets received at destination node,

T_DataR = Time data packets sent from source node.



Vehicle Parking

The following is the Parking System Scenario in NS2, where all the process gets completed and the car gets parked into the free lot

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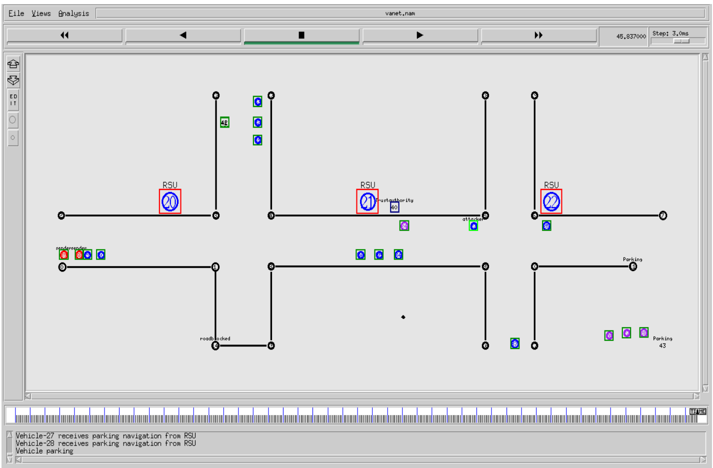

VI. CONCLUSION AND FUTURE ENHANCEMANT

The dissertation proposed a Smart Parking Allotment system for Indian urban Areas by using the vehicular ad-hoc network. It will be an intelligent parking service application.

First, vehicles on the road can view and reserve a parking spot. The parking process can be an efficient and nonstop service. On the other hand, parking service is an intelligent service. New vacant parking spot can be assigned to the cars passing by.

Second, the parking process has been modeled as a stochastic (random) process. Not only maintenance work can be scheduled but also the revenue of the parking site can be predicted. New business promotions can be broadcasted to all vehicles passing by the parking site through wireless networks.

Finally, privacy of the drivers and security of the information are protected by using the sensor framework and encryption/decryption approach. Simulation results prove the proposed system results in high parking space utilization and fast parking spot finding time.

The **future work** includes more extensive simulations on the proposal. The future work can provide an efficient car parking system based on internet of things method. A favorable IoT solution must make the parking facility easy to upload the field data to the Internet. Using an Internet of Things (IoT) gateway to connect with the microcontroller, however, sensors and other edge devices, field data can be retrieved, stored and analyzed to the Internet.

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