Heuristic Search based Real Time Nearby Parking Suggestion System through IoT

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ABSTRACT
Vehicles are essential in our life as well as all over the world. A lot of work in recent era depends on different types of vehicles, such as trucks, cars, taxis, etc. Today's number of vehicles has increased dramatically, and in-market, vehicle parking is a burning issue in the city areas. The government provides a parking facility and parking space in a suitable location but the problem is how to identify a convenient nearby parking place and reduce time to park the vehicle in a parking slot. A monitoring system is necessary to store all the vehicle information, provide real-time data regarding parking space in a particular area, and send this information to the vehicle driver.

In this article, author proposes an parking Slot system (PSS) for parking the vehicle in minimum time along with reduced fuel cost. In addition to, it also provides automated parking slips and save time during entering and exiting from parking station. This system provides the GPS location of empty parking slots with minimum time to fill vacant spaces available in that parking station. Here for achieving this, author used heuristic search based A* algorithm for time analysis system (TAS) then calculating minimum distance to reach that concerned parking station and slot appropriately. Heuristic search work on the principle of previous information for calculating the heuristics function value and this value is used in calculating the minimum distance. This distance and time is stored on cloud where it is analyzed and take appropriate action for sending the information to the vehicle driver.

Keywords
Parking, Vehicle, GPS, Heuristic

1. INTRODUCTION
In recent years, there has been a dramatic increase in the number of automobiles in all megacities throughout the world. Many persons waste more and more time finding an empty parking slot nearby [1]. Many techniques and technologies are used to solve the parking problem. These methods provide a solution for parking a vehicle in a particular parking space or a parking building. But the problem is that many vehicles come and out from a specific parking building every minute [3]. The Complete evaluation of different strategies of vehicle coordination based on large-scale datasets of parking sessions in distinct scenarios and under varying demand patterns [2].

The different parking-sensitive module is introduced to enhance a parking slot detection method [4]. Based on GPS location, data collection and analysis efficiency are very good compared to similar processes.

The parking-oriented is developed to detect parking routes precisely and smoothly simultaneously. Access data from different parking stations store this information on the cloud and simulate and give a proper GPS location. The simulation results demonstrate the capacity to deal with diverse parking conditions and check the consequences of each technological aspect [5].

All information stores on the cloud with vehicle arrival time and approximate leave time from the parking station. Based on this information, decide for other upcoming vehicles near that parking station and send data to the vehicle driver to stay in a given time interval and given location. All parking stations coordinate simultaneously with a single monitoring unit that decides parking location and time interval for the particular vehicle immediately because vehicle driver time is significant and fuel is very important. In this proposed system, the shortest route finds based on hubristic search, which gives a nearby suitable location. This article work on two advanced principle:

1) Minimum parking entry and exit time and

2) Balance parking demand nearby any vehicle [7].

Author drive a combined PSS to solve parking problems with located an empty slot parking station and zero time-consuming entry and exit for every vehicle.

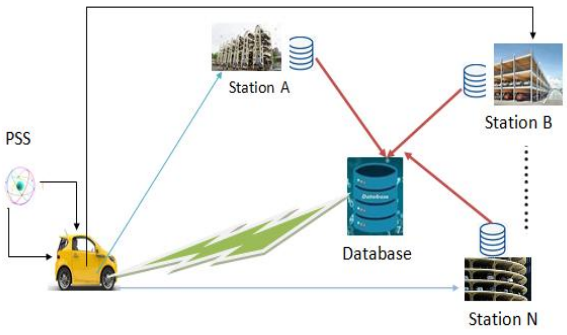

Figure 1

2. RELETED WORK
Many researchers work on the vehicle parking problem and find some solutions regarding this problem. Liangliang Lou et al. propose a system in which a technique for detecting IoT-driven vehicles was presented that combined the data feature with that of UWB radio channels. Finally, the proposed strategy was tested and assessed on a real parking lot [1]. Honghui Dong et al. work On the basis of a single magnetic sensor, work on a unique vehicle detection method is offered. The sensor's raw signal is changed into a signi cant form that

is better appropriate for the double window detection technique. A gradient boosting approach is also provided for increased implementation speed and accuracy [2]. Jose Azevedo et al. Introduce a ground-breaking cooperative parking concept that makes use of automobiles' present low-level driving automation and electrification in terms of propulsion, as well as a thorough examination of different design strategies for automated, high-density parking lots [3][19]. Xumin Huang et al. Fed Parking was created to investigate federated learning-based parking space prediction in conjunction with PVEC management. PLoS were given instructions to train a shared LSTM model for parking space estimates without having to exchange raw data [4]. Jyun-Hao Jhang and Feng-Lilian To address the autonomous parking challenges, the author proposed sampling-based motion planner technique and a parking-oriented vehicle controller make up an autonomous parking system. The suggested vehicle controller, on the other hand, can track correctly and easily control autonomous parking [5][19]. Chintaman Bari et al. present the logic that will used to calculate the capacity of different toll lanes, which is an essential parameter for designers to design the number of toll lanes required at toll plazas [6][20]. Oanh Tran Thi Kim et al. A sampling-based motion planner and a parking-oriented vehicle controller make up an autonomous parking system. The two major goals of the parking assignment problem are to reduce individual parking fees and balance parking demand [7][18]. Chunmei Ma et al. presented the concept of parking edge computing and developed a framework for organizing outside parked automobiles into parking clusters that operate as virtual edge servers, supporting edge servers in job offloading [8]. Mohamed A. Ahmed et al. investigate the design, simulation, and evaluation of remote monitoring of EVCSs in a smart parking lot, also develop the communication network model for the EV system in OPNET modeler based on logical node concept of IEC61850 standard [9]. Chao Zhang et al. A unique vehicle identification technique based on a single magnetic sensor has been proposed. The substantially altered form of the original signal, as well as the parking-sensitive improvement module, is responsible for the efficacy of our efforts [10]. Fabian Bock et al. used two available datasets to accomplish this evaluation: GPS races of 536 taxis and on-street parking data from 5,314 fixed sensors. Empirical findings reveal that, despite a varied distribution in time and geography, [11]. A.el Mrini et al. suggested a WSN-based traffic monitoring and management system. The surveillance system is based on a network of wireless sensor nodes that have been put at all of the traffic network's intersections [12,21]—vehicle identification on the basis of car number plate with the help of image processing technique. Different types of number plates past on deterrent vehicles, License plate recognition, applies image processing and character recognition technology to identify vehicles by automatically reading the license plates and storing information in database [13]. In this arrangement, the vehicle is identified on the basis of a number plate. Wireless sensor networks (WSNs) and low-cost wireless sensors are placed in a parking lot field, with one sensor node for each parking lot. It identifies and monitors the parking lot's occupancy. The installed wireless sensor network and its gateway send the state of the parking field identified by sensor nodes to a database on a regular basis [15]. This system provides an empty slot in a particular parking station.

These all methods and technology are very good for vehicle parking management systems, but some problems are sit present in parking management. The proposed system provides a parking slot suggestion system (PSSS) to suggest a model to vehicle drivers for finding a suitable and nearby parking station location on the basis of previous data collection and data analysis.

3. METHPDOLOGY

In this Propose system author provide the parking station location with an empty slot based on route-finding with the least distance. For achieving this goal, Author have used the shortest spanning tree with the A* algorithm in which we have to calculate the distance and store it in f (k), and h (k) is used for calculating heuristic value. Here is the mathematical notation, and the algorithm is as follow-

n'= g(n) + movement cost(n, n′)+h(n)

Here is the algorithm for calculating the shortest path

A loop repeatedly evaluates the best station n in OPEN in the algorithm. We're finished if n is the last location. Aside from that, node n is switched from OPEN to CLOSED. The following parking station site, n′, is then investigated. Author doesn't need to discover a CLOSED parking station because it has already been observed. We don't need to look at a parking station location that is OPEN right now since it is scheduled to be looked at. Otherwise, we will add it to OPEN, with n as its parent, g(n′) + movement cost(n, n′) will be the route cost to n′, g(n′). Again heuristic value is calculated based on the previous history, such as traffic situation route congestion. Afterward, the value of the closed list is prepared by adding the h(n) value, and the most negligible value is stored and updated at the cloud in the CLOSED list field.

Algorithm for hubristic search:

Algorithm: finding shortest route

Input: user gps location

Input: start location

Output: target location

For location

Do

Score:= distance

Location.heuiristicscore:= tabulated values

Location visited:= false

End

startlocation.score:= 0

startlocation.heuiristicscore:=0

While (true)

Do

Currentlocation: = locationwith lovest graph

Currenlocationvisited: =true

For

Do

Nextlocation in current location.neghbour

Do

If nextlocation.visited==false then

Newlocation.score:=calculatelocation.score (currentlocation.nextlocation)

If then

Newlocation<next location.score then

Nextlocation.score:= newlocation.score

Nextlocation.heuiristicscore:= newlocationscore

Nextlocation.routelocation:= currentlocation

End

End

End

If

Currentlocation ==targetlocation then

Return buildpath (targetlocation);

End

Iflocationwithlocationscore (userGPSlocation). score==targeted.score then

Then nopathfound

End

End

4. PROPOSED WORK

The proposed system provides the real-time empty slot available in all parking stations over the city. It gives the location and route to find the particular parking station to park the vehicle.

This system works on three faces that send their information to the centralized server, and that server sends data to the use or vehicle drivers.

First face:

In this face vehicle, the driver enters the Parking suggesting system (PSS) and uses the web application to find an empty slot. That shows the parking station name, location, and distance and provides the route to reach that particular location. Follow the Google link for the site, get the parking station, and park the vehicle here. Figure 1 explains the above activity.

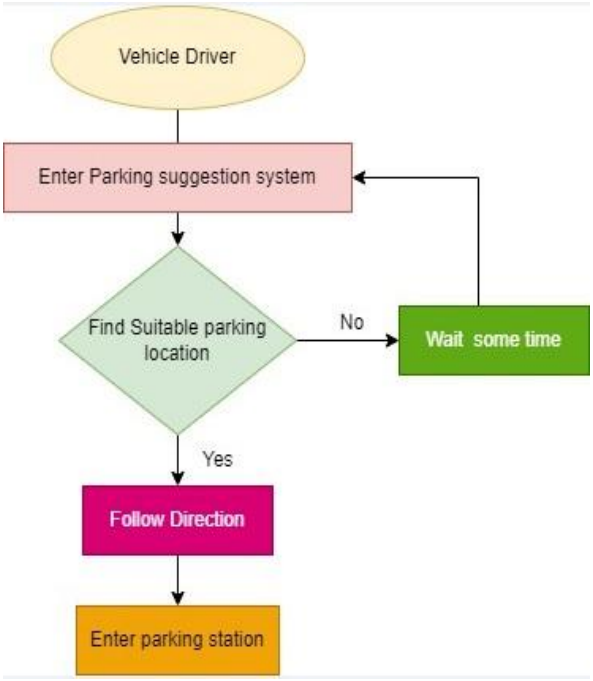

Figure 2(a)

Second face:

In the second face, when the vehicle comes to the parking station entrance camera detects the number plate through Image processing and stores all information about the vehicle like the owner's name, mobile number, address, etc.

In database which connected to the central database. The number of vehicles parked at the station is updated. And find out the empty slot from the allotted place.

Figure 2(a) Show the parking station activity and store some information about the vehicle. And Figure 2(b) shows the data flow when the vehicle enters the station.

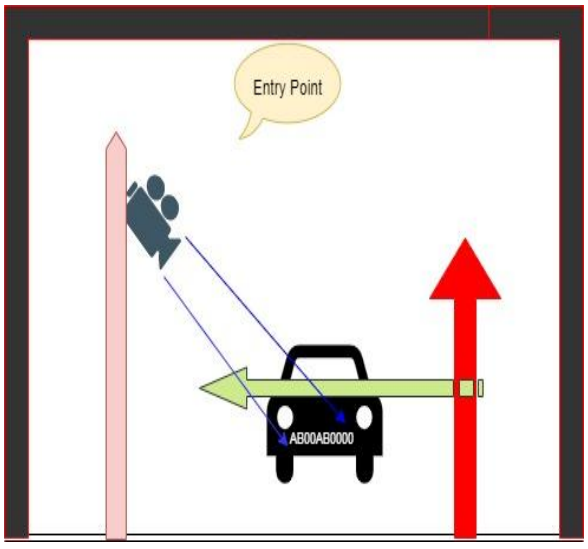

Figure2 (b)

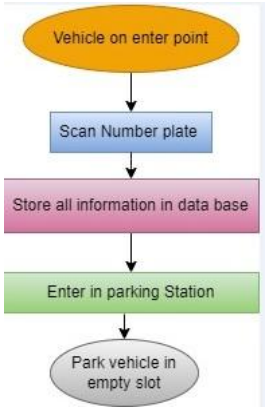

Figure2 (c)

Third face:

Third face work on parking station exit point. Again, scan the vehicle number plate through the camera and match with entry gate information, count the total stay time in the parking station, and finally work the auto payment gateway for the payment and vehicle go out of the station. Figure 3(a) represents the station exit point activity, and figure 3(b) describes the data flow activity on the exit point.

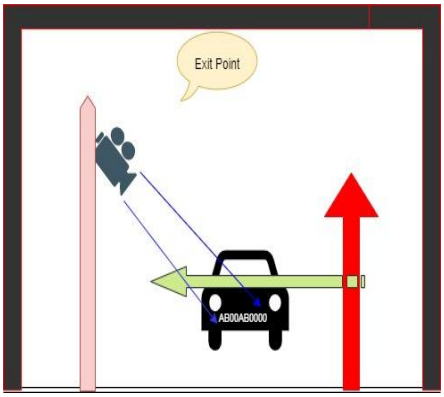

Figure3 (a)

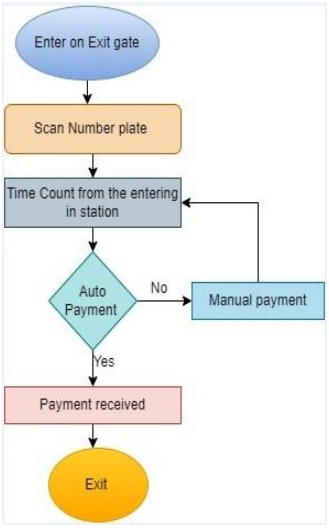

Figure 3 (b)

Cameras take pictures of the vehicle number plate and store this information with the help of character recognition technique and store it in the database. For the payment gateway, many methods have already been used. The parking station used any payment gateways comfortable for the vehicle owner or station authorities.

5. TESTING AND RESULT

Result is also in three faces:

In first face vehicle driver enters the PSS system and finds the nearby parking station for the vehicle, the driver shows the information in the PSS system as in table 1.

Heuristic value is utilized as the foundation for the algorithm to find the shortest way, and prior history is saved for future route selection.

GPS location access automatically access through the GPS sensor which is already installed in vehicle.

The approximate time (T) to go to the parking station is computed using the vacant slot (E), prior heuristic value (H), and approximate distance from the station (D). Which is calculated in minutes and distance is also measure in meter.

$$T = \frac{D}{E} * H$$

As indicated in table 1, this algorithm determines the approximate time and then gives the user or driver with a GPS position link based on distance and fastest route.

Table 1

Station Name	Location Address	Total slot	Empty slot	Heuristic values	Distance	Approximate time	Direction
A	-------	500	20	2	200M	20M	
B	--------	900	110	4	490M	17.81 M	
C	---------	450	120	6	1000 M	50M	
D	---------	780	221	8	650M	23.52 M	
E	--------	920	325	5	500M	7.69M	

In table 1 clearly show the station E has maximum empty slot available and time to reach is also very low, then the driver select that location link and reach the parking station fast and park the vehicle.

Measure distance in meters and time in minutes. According to table 1, suppose station A is near the vehicle driver and reach approximate time is also minimum. Then, the driver selects this parking station.

In the Second face test and result, the vehicle enters in parking station and store some information of vehicles like vehicle registration number, owner name, and address of the owner (This information is automatic access from the RTO database on the bases of vehicle registration number) and store this information in the database and provide permission to the vehicle driver to park the vehicle in an empty slot. Table 2 shows the data which is stored in station database A.

Table 2

S.No.	Vehicle No	Total slot	Previous empty slot	Present empty slot
1	AB 01 CD1234	500	20	19
2	BC 01 VS1234	900	110	18
3	ND 01 JD01234	450	120	17
4	JD 01 TH1234	780	221	16
5	AA 01 AA1234	920	325	15

In the third face, the Vehicle exit from the parking station rechecked the vehicle registration plate and counted the total time to stay there. The Autopay system received the payment from the vehicle driver and opened the door for exit. The charge count is supposed to be 20 rs/h. Received amount and updated the empty slot count present in a parking station, shown in Table 3 according to station number A.

Table 3

Vehicle number	Entry time	Exit time Total stay time	Amount per Hour	Total amount	Empty slot
AB 01 CD1234	11.00 am	3.00 pm	20	80	16
BC 01 VS1234	2.30 am	4.00 am	20	80	17
ND 01 JD1234	4.20a m	7.00 am	20	60	18
JD 01 TH1234	5.00 am	7.00 am	20	40	19
AA01A A1234	8.00a m	10.00 am	20	40	20

6. CONCLUSION

Vehicle parking is a huge problem, especially in megacities in India, and finding a nearby parking station with an empty slot and reaching that location is another problem. Through the proposed system, try to provide a solution for the parking problem through station location and provide the link for reach that location based on the shortest route.

An advanced parking system in the parking station and advance payment facility may be implemented in the future.

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