An Approach to Smart Parking Algorithm using ant Colony Optimization and Decision Tree Algorithm

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Abstract: This research is conducted in order to deal with the main problem of traffic congestion and road accidents that is basically caused because of the improper parking management. . Hence, it is important that cities have a well-managed parking system. In the past various researches has been done to design a suitable smart paring algorithm. However, each research had their own pros and cons. Our research leads to a smart algorithm that is secure and is convenient enough to develop a system that can be manage the available slots and can notify the users about the available parking slot beforehand to the client. The result analysis clearly shows that the algorithm proposed and designed is more accurate than other algorithms used in the past. The proposed algorithm is designed using ACO, decision tree, and GPS mapping. The idea of working on this research was to provide a solution that is cost effective, helps people on large scale and maintains the laws and order.

Keywords: Ant colony optimization, decision tree, smart parking system, GPS mapping, smart parking algorithm.

I. INTRODUCTION

As per the Indian Ministry, the governing body, of Road Transport and Highways, that maintenance and administrations the rules and laws relating to transport ha reported increase the in the transportability and proficiency of the road transport system in India. Moreover, in referring to the aforesaid statistics provided by the ministry of India, the present-day transportation framework and vehicle park solutions are expected to be restricted in defending the incursion of automobile on the road. Therefore, even if we consider the statistics, and data, problems like vehicle overcrowding and limited parking spots will always remain the top post problem by default.

India is ranked 2nd in terms of having the largest population in the world. However, where the rise in population is the root cause of many problems like extreme poverty, unemployment, shortage of land, pollution, and so on, it is also responsible for an increase in private vehicles and that leads to PARKING PROBLEM in India. Vehicle Drivers are not aware of the vacant space in the parking areas and hence they abruptly park their vehicles on the road that further leads to congestion and traffic. As per the track of the past records the traffic and parking management system does not work in an organized way in India. Where people from cities like Delhi, Mumbai, Kolkata, and Lucknow go through everyday struggle of searching for a car parking zone, just imagine the problem faced by people living in small towns. From years researchers are working on this problem and are providing the best suitable solution. Even, various steps have also been taken in the past to defeat the problems caused by improper management of vehicle congestion. In addition, there are numerous examinations done in the past about the brilliant stopping approaches that have utilized different innovations, for example, the web of things, remote sensor organize, cloud frameworks, and versatile based application.

A. Smart parking system built using proposed algorithm

The work presented in this paper combines various algorithms to create an intelligent algorithm that is compatible with user's smartphones and that it is able to trace the vacant areas via monitoring the latitude and longitude with the help of GPS. The data is collected in the cloud database and is then analyzed to provide the optimal solution to all the registered users. As per the mechanism, the users need to register themselves to take the privileges of an empty parking spot in any parking area user. The mechanism is to trace the location of the vehicle driver and as per their location; they will be notified about the parking zones available near them and will also be informed about the vehicles that are taking an exit from the parking zone. Hence the vehicle drivers not only get to know the parking areas near them, but they also get to know the vacant spaces in those parking areas. Moreover, all the requirements will be taken from the user on the basis of different parameters like vehicle type, preferred timing, and distance. These requirements will be the pheromones for the newly designed algorithm (proposed algorithm). Once, the data is collected it will be processed by an intelligent algorithm (Combination of Genetic Ant Colony and Decision Tree). And based on the data inputted by the user, the algorithm will predict the best and optimal solution.

B. Advantages of smart parking system

1. The algorithm does not require any extra device apart from their smartphones and the users will not be charged for using this algorithm.
2. The vehicle drivers do not need to wait to find the vacant spaces in order to park their vehicles.
3. Once the users get to know where to park the vehicle, they will not use road and pavement for parking which will not choke the roads, and hence traffic and accidents caused by this will not be the problem anymore.
4. This research is all about using an algorithm that can be easily implemented and will be easily used by the common people.
5. The drivers are directed straight to an available parking spot. Hence, they waste a few kilometers driving around in a loop and looking for a vacant space.
6. When a vehicle driver knows, where he is headed, he feels less distracted and hence pays full attention to the road. In this way, accidents will decrease and safety will increase
7. A person is already having a lot of stuff going on his mind; imagine him worrying for a parking spot? With the utilization of smart parking, a vehicle driver are going to be conscious of the situation of the available parking lot. They will drive straight to an open, and nearby parking spot, stress-free.

C. Security limitations in the system built using the Proposed Algorithm

1. In our system, we have generated a key for each candidate at the time of their registration.
2. The key is a unique key and is generated with the help of user's mobile number and Aadhar Id number.
3. The key is then stored in encrypted form in our cloud.
4. Whenever the user initiates the login process, the users are going to be asked to enter the key so as to authenticate and validate the user credentials. If in case the car is stolen, the key are often wont to trace the situation.
5. If anyone wants to deactivate the location tracing, her/she will need the key.

II. LITERATURE REVIEW

This paper [1], could be a useful paper to prompt the total information with respect to the reasonable stopping framework. The creator has to sum things up depict stopping as a rich strategy as far as money, time and vitality for the "free spot pursuing." The Authors state that their build is to blend ongoing reservations (RTR) with share time reservations (STR) so the thought process power will save a spot while heading thereto. The RTR are accomplished by acting powerful asset assignment (like aptitudes based for the most part directing in choice focuses) while the STR are accomplished by acting static asset allotment that is upheld time arranging. The intention power will pick the popular asset and in this way the time period to at that it'll be involved whenever in future. [8]However, there will be distinctive rating arrangements for each the classifications of reservations that are honest for drivers and stopping directors. The rating arrangements are arranged during this paper. Likewise, the creators have moreover outlined the dynamic worth motor that may irregularly refresh the stopping costs bolstered

continuous asset usage.[5] The framework is plot as iParker by the creators and it choices conventional and impaired parking spaces that the drivers are given the freedom of choosing various goals and conditions. The creators ended inside the wrap up by the raw numbers that top to bottom reproduction results demonstrate that the arranged framework extensively cuts the whole viable cost for all parkers by the greatest sum as twenty eighth, boosts the whole use by up to twenty first and in this way the complete income for stopping the board up to Sixteen Personality Factor Questionnaire when contrasted with the non-guided stopping framework. The paper [2] speaks about the framework utilizes the WSN comprising of RFID innovation so on watch car leaves. The RFID peruse checks the portion of free stopping territories in each part. The usage of the RFID innovation encourages the execution of an enormous scope framework at low cost. Inside the completion the creators ended that their arranged framework has been effectively mimicked and implemented in an extremely genuine situation. The arranged calculations lessen the standard sitting tight time of clients for stopping. the main con of this examination was that the arranged framework can't be upheld in goliath scales inside the significant universes. The explanation of paper [3] states certain downsides like the proposed technique burns through a great deal of time of individuals at the stopping space. In paper [4] we came across a completely versatile and circulated engineering that can be effectively incorporated with numerous detecting sources. The paper is about sensor based stopping framework where a brilliant camera model for vision based savvy stopping is likewise introduced. The primary accentuation is given to the vision board, which is a custom PCB produced explicitly for the sensor.[7] At long last, the creators have closed their exploration by the way that their proposed approach is very successful in being applied to regular urban conditions as the organization of such foundation happens continuously after some time and with totally different geological separations. Moreover, paper [6] was a presentable work that has brilliant stopping framework gives direction to the drivers to search out accessible parking spots to abstain from expanding stopping issues. GPS is utilized to follow the driver's course to the stopping goal once the parking area is held. What's more, this prompts gridlock as different clients are being coordinated towards an identical parking garage at a comparable time. [9] A run of the mill A-star way discovering calculation is executed to follow numerous clients simultaneously, while thinking about each other's closest separation to the parking garage in their individual courses. This methodology encourages the client to stay away from over possessing a comparable parking area by taking diverse choice on the separate most limited course. The paper likewise clarifies an assortment procedure which is utilized to spot and flexibly the preeminent productive answers for all clients at a specific time. In this paper [10], a reasonable Parking System abuse Wi-Fi and Wireless identifier Network, this investigation work bolstered the vehicle parking spot recognition module, the Wi-Fi indoor situating module and a foundation worker. They embraced the locator to discover the car parking spot, the foundation worker can utilized for correspondence and preparing.

In this paper[11], exemplification of IoT based for the most part car leaving the executives framework for reasonable urban areas, here writer conquer the changed gifts like client will see the vehicle parking spot comfort, inside which IoT offer the data stockpiling ,handling and variety of data ,driver will book space, anyway the restriction for indistinguishable is Absence of illegal leaving discovery administration this methodology can't be investigated to open leaving framework for example exclusively fitting just if there should be an occurrence of indoor and structure stopping and the paper [12] is about a Reservation based for the most part Multi Objective reasonable Parking Approach for reasonable Cities, received a multi objective reasonable stopping abuse the mimicked solidifying based for the most part meta heuristic to improve the stopping area.

III.   MATERIAL METHOD

The algorithm that we have used to design a smart parking system is made by combining Genetic Ant colony algorithm and decision tree algorithm.

A. Methodology

- In the first step I have created a data set of a city Which will include different parking location and their slots? Each slot will be stored as parking labels and these labels will be defined by their latitude and longitude.
- In this step I have taken the requirements of the users, on the basis of different parameters like vehicle type, preferable timings and distance.
- In this step all the requirements will be processed by Algorithm (Ant Colony and Decision Tree)
- The users have to register themselves using their Contact number and Aadhar Id. By doing so they will be provided with a unique Key.
- The key will be stored in our cloud database in Encrypted form.
- After that the Algorithm predicts the best solution According to user's requirement.

B. Proposed Algorithm

1. Input

a. GPS based parking matrix where the data set is stored in d
b. Number of parking data will be stored in a variable named n
c. Number of running vehicle data will be stored in m
d. The statistical significance threshold is p
e. Initial pheromone is taken as k. For now we will be considering initial pheromone for vacant spaces and time required reaching that spot.

C. Proposed Algorithm: step by step

Step 1: we will run a for loop from i is equal to 1 to i is less than equal to N, for number of parking areas
Step 2: now, we will calculate the distance and time based on the clients requirement. The data will be stored in the form of array H[d] [t]
Step 3: In this step we will run another loop for j=1 to j= M, just for the calculations of the number of running vehicles that are either parked inside or are near parking areas.
Step 4: now, one by one we will select a parking set with K set and this K set will act as pheromones. The data will be stored in the form of array.

Step 5: we will now calculate the value of x2 for each parking and this data will be updated every time the vehicle enters or leaves the system.
Step 6: After calculating the value of x2 for each parking system we will now update the pheromone i.e. K
Step 7: For operation gets terminated.
Step 8: Now, we will record the k set with the highest value of x2 as a PARKING SLOT.
Step 9: After the value is being recorded we will now check for the following condition:
if $(H[i] - H[i-1] > 0)$
This condition helps us to understand if the spot in a parking area is available or not.
If the above "if condition" is satisfied:
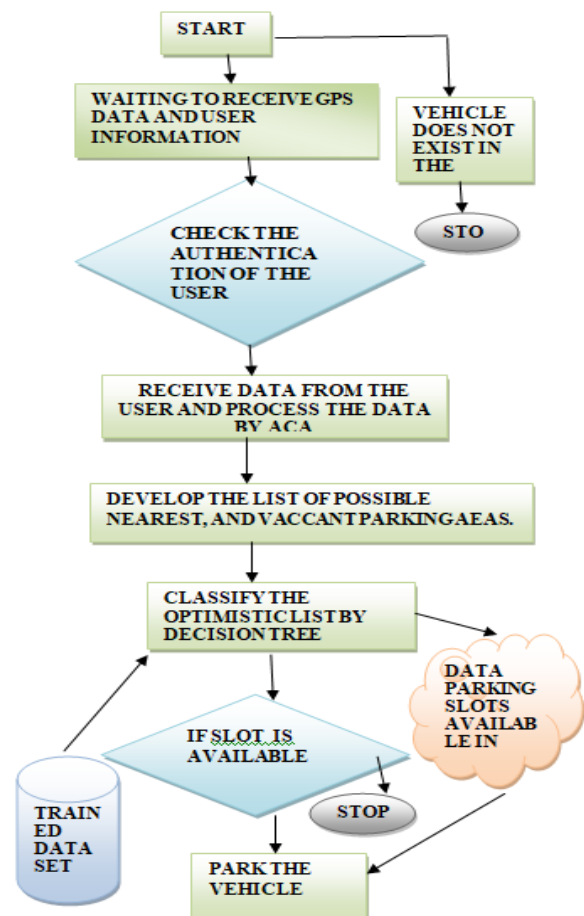Step 10: Select the Slot
If the above "if condition" is not satisfied
Step 11: else
Step 12: The slot is not available and hence the access will be denied.
Step 13: if operation gets terminated
Step 14: For operation gets terminated.

D. Flowchart of the system designed using the proposed algorithm

### E. Explanation for the flowchart

1. The system will start to function only if it receives GPS data and user information.
2. As soon as the user enters the data, the system will check for authentication.

3. If the authentication fails, then the vehicle does not exist in the system or is not registered. Now, the user needs to register into the system using theor contact number and Aadhar number.
4. If the authentication succeeds, the system will receive data from the users. These data will act as pheromones and will be processed by Ant Colony Algorithm.
5. The algorithm will then develop the list of possible nearest parking areas.
6. The list will be then classified using the Decision tree algorithm. The data will be taken from the tainted data set.
7. If the slots are available then the user can happily park the vehicle. Else, the user will need to wait for another slot.
8. The taken slot will then be updated in the cloud which will help the system to classify the optimistic list by Decision tree Algorithm.

IV. RESULT ANALYSIS AND FINDING

### a) When user needs to enter the destination
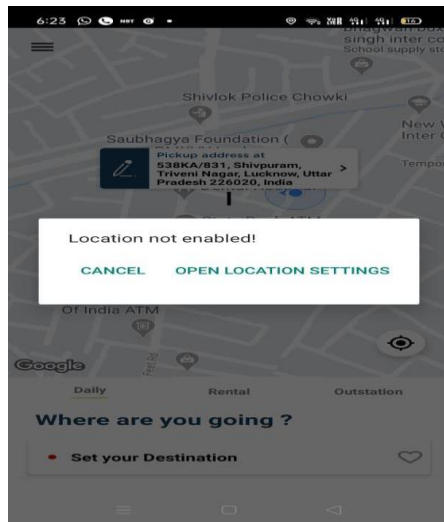
After the user logs in into the proposed system, he needs to verify the credentials. The system will ask for the contact number and Aadhar ID. Once the user authentication process is done, the user has smartly entered into the smart parking system. Now, he needs to open the Google Map. The Google Map will declare a pop up notification and will ask the user to enable the locations by making changes to the location settings. Once the user has enabled the location access we move to b).

### b) Optimal parking zone found
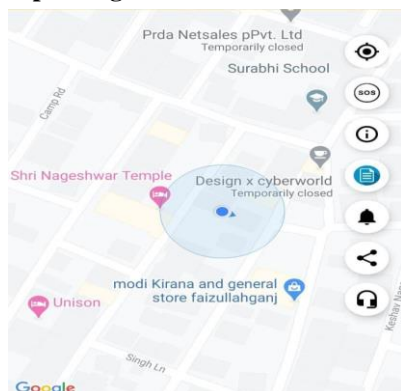
As soon as the user enters the data into the system and enables the location on Google Map, the algorithm processed the data and found the best spot available close to the user's stopping place. The circled part in the map shows the parking slot that is nearest to the user's destination. To see the distance we move to c).

c) Minimum distance
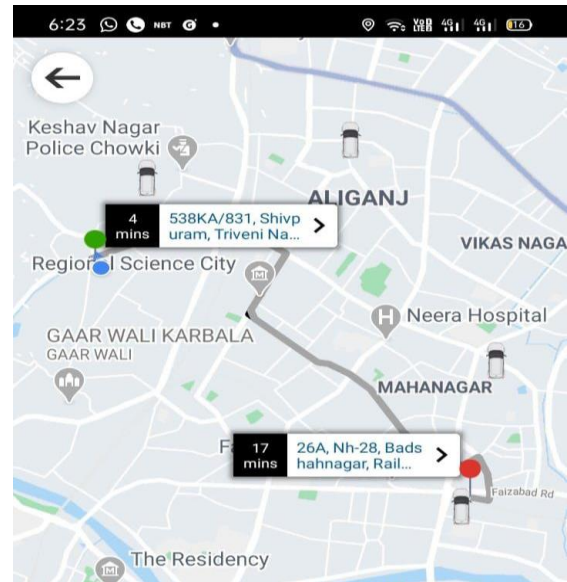
Now, the user knows the location of the vacant parking slot which is nearest to his destination. He can book that slot for himself and he can even see the duration at which he will be reaching to that area. He gets to know about the time as well as about the number of kilometres that he needs to travel in order to reach that spot.

d) Graph
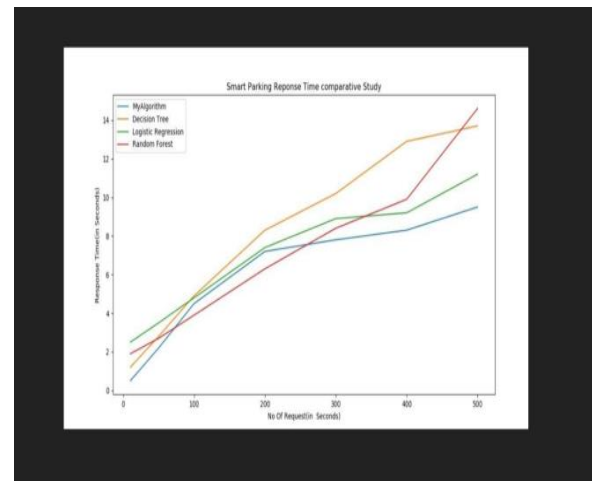
i. Proposed Algorithm
The algorithm that we have used in designing the smart parking system can process 800 requests in 9.5 seconds.
ii. Decision tree
The decision tree alone can accomplish a proportionate work however it'll take 13.7 seconds to process 500 solicitations.

iii. Logistic regression

In this case if we consider logistic regression to predict a parking slot then on an estimate it will take approximately 11.2 seconds to process 500 requests and will only be able to give response in binary.

iv. Random Forest

This supervised learning algorithm is usually trained with bagging method that is basically combination of learning models. However, because of its simplicity and diversity it is one of the most used algorithms.

In our graph, the red line depicts the line of Random Forest algorithm. This algorithm takes more than 14.6 seconds to process 500 requests. Though, the algorithm is simple, yet it takes the maximum time to process the requests.

On the basis of performance MY ALGOROITHM is more convenient and faster than other algorithms.

Proposed algorithm> decision tree> logistic Regression>random forest
e) Smart parking response

TIME COMPARITIVE STUDY

SMART PARKING COMPARATIVE STUDY				
REQUESTS(PS)	MY ALGORITHM	DECISION TREE	LOGISTIC REGRESSION	RANDOM FOREST
10	0.5	1.2	2.5	1.9
50	2.2	2.8	3.5	2.7
100	4.5	4.9	4.8	3.9
200	7.2	8.3	7.4	6.3
300	7.8	10.2	8.5	8.4
400	8.3	12.9	9.2	9.9
500	9.5	13.7	11.2	14.6

As per the comparative study shown in the table it is clear that algorithm, designed by us to built a smart parking system is more accurate as compared to other algorithms.

Proposed algorithm can process 10 requests in 0.5 seconds, 50 requests in 2.2 seconds, 100 requests in 4.5 seconds, and 500 requests in just 9.5 seconds.

Whereas, the decision tree algorithm is turned out to be the second best algorithm that takes 1.2 seconds to process 10 requests, 2.8 seconds to process 50 requests, 4.9 seconds to process 100 requests and 13.7 seconds to process 500 requests.

The third and fourth algorithm that we have used for comparison is logistic regression and Random forest algorithms. The Logistic regression algorithm takes 2.5 seconds to process 10 requests, 3.5 seconds to process 50 requests, 4.8 seconds to process 100 requests and 1.2 seconds to process 500 requests. Whereas, the random forest algorithm can process 500 requests in 14.6 seconds. This comparison table clearly depicts that algorithm is fast enough to process with n number of requests. The algorithm takes less time to find the vacant spaces in the nearby parking zones. The algorithm is convenient and fast.

ACCURACY PERCENTAGE THE PROPOSED ALGORITHM = 86.7%

V. CONCLUSION

With the help of Smart Parking Algorithm, it is easy to build software or use of software with the minimal effort and at a reduced cost that provides services at each level to all the users. The smart parking Algorithm is designed to help the mankind by limiting the traffic and congestion. A smart Parking System is used to serve unlimited users in the parallel way to fulfill their requirements in the form of available parking slots. User satisfaction is the main aim of Smart Parking Algorithms. There are many researches done on the same and each research has considered the fact that user satisfaction is the main aim of designing Smart Parking Algorithms. However, all these researches have their own advantages and disadvantages. The Future scope gives us an idea that in future an algorithm can be designed that can remove all the defects of the past algorithms used.

The paper summarizes the algorithms used and what that algorithm holds with respect to benefit and advantages. The accuracy percentage and comparison gives a clear idea about the perfection of the algorithm and the system built using that algorithm. The current situation states the alarming rate of need of a proper parking system and also a system that is beneficial to maintain social distancing. The current system is destined to benefit the people, a nation or a city in which it will be implemented as it is the best way to maintain the laws and order. On compared with several algorithms it turned out that the proposed algorithm is more beneficial and holds more goodness in terms of efficiency and speed. The accuracy percentage of the proposed algorithm is 86.7%

FUTURE SCOPE

The prospects of an excellent parking system are predicted to be considerably influenced by the arrival of automobiles. Many cities round the world are already commencing to trial self-parking vehicles, specialized Jewish calendar month parking tons, and robotic parking valets. However, there are countries wherever automatic vehicles are still not launched and other people still struggle to park their vehicles. For those countries associate degree algorithmic program ought to be designed that considers user needs and supply the provision of parking slots for the vehicle drivers.

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