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An approach for smart cities parking based on cloud computing and Machine Learning by Genetic Ant Colony Algorithm

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Abstract: This research deals with the major problem that we face in major part of India and across most of the world. The research deals with the main problem of traffic congestion and road accidents that is basically caused because of the improper parking management. So, it is mandatory for all the cities to have a well managed parking system. However, in the past many researches has been conducted to propose an solution that leads to suitable smart paring algorithm. On reading more about the researchers conducted in the past, it was clear that each research has its own pros and cons. This paper reflects on the research conducted to design an algorithm that leads to a cloud based smart algorithm that is secure and is convenient enough to develop a system that can be used to manage the available slots and can notify the users about the available parking slot beforehand to the client. The paper also focuses on the result analysis part that clearly shows that the algorithm designed is more accurate than other algorithms used in the past. We have designed our algorithm using ACO, decision tree, and GPS mapping over cloud. 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.

Terms— Machine Learning, Genetic Ant Colony Algorithm, Cloud, Smart Parking

1. INTRODUCTION

There is an alarming need for smart, better, and organized parking mechanisms. An outdoor smart parking system offers users with guidance and information with respect to parking areas in the city. It is simply done by monitoring parking area usage. And more importantly, the system should make people aware of all the vacant parking spaces available. Improper parking of vehicles on the road and pavement leads to traffic jams, accidents, and even restricts the space for pedestrians. All these problems will be solved if the proper parking management is done. Hence to provide an optimal, cost-effective, and user-friendly solution an algorithm will be provided to help the vehicle drivers. Not only this, but the aim of this research is also to record the amount of time for which the vehicle is going to be parked and based on that time it will be decided which slot is preferable for that particular vehicle for the smooth exit and entry of other vehicles in the parking area.

In order to build a smart algorithm that will help us to build a smart parking system, we will be using various technologies in our research process. The major technologies that we have used are named below.

A. Technologies used

2. Cloud computing

In terms of network security over the cloud, cloud computing is known to be defined as the requested availability of computer system supplies.[9] These resources can be categorized as data storage in the form of cloud storage and computing power. [4] These resources do not require the user's complete and active management. Distributed computing is the term that is commonly used to depict information centers available to a few clients over the web. Moreover, it may be related to a solitary institution or it may be accessible to many big organizations. The cloud available to a single institution is termed business clouds. [7] The cloud accessible to many institutions at the same time is termed as a Public cloud.

2. GPS

Each and each on-demand service needs an integrated location-based service. These services are needed so as to work out service locations, customer locations, track service providers, and help them navigate from their location to service location [5] GPS stands for Global Positioning System. It's basically a satellite-based radio navigation system. The system is owned by the us government and is operated by the us Space Force. This technique is made to supply geolocation and time information to a GPS receiver. [2]However, obstacles like mountains and buildings block the relatively weak GPS signals.

The Global Positioning System doesn't require the users to transmit any data because the system operates independently of any telephonic or internet reception. However, these technologies can enhance the usefulness of the GPS positioning information.[3] Speaking of Accuracy, GPS time is theoretically accurate to about 14 nanoseconds. GPS technology is majorly employed by taxi (OLA and UBER) services. [10-14]A number of the vehicle drivers use the app for navigation purposes and therefore the upcoming car models are coming with a built-in GPS tracker. During this way, vehicle security is maintained.

C. Advantages of smart parking system

1. Cost-Effective
2. Time Management
3. Traffic Management
4. Easy to use
5. Less fuel is wasted
6. Ensures Safety of Drivers
7. Reduce in Stress

3. METHODOLOGY

In the first step the data set of the city will be collected and stored on cloud. 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 the second step we have taken the requirements of the users, on the basis of different parameters like vehicle type, preferable timings and distance. Now, all the requirements will be processed by Algorithm (Ant Colony and Decision Tree). The latitude and longitude of the parking sot will be calculated using GPS mapping. All data will be stored over cloud. The users have to register themselves using their mobile number and Aadhar Id. By doing so they will be provided with a unique Key. The key will be

stored in our cloud database is in Encrypted form. After that the Algorithm predicts the best solution according to user's requirement

4. PROPOSED ALGORITHM

1. Input
a. GPS based parking matrix where the data set is stored in e
b. Number of parking data will be stored in a variable named o
c. Number of running vehicle data will be stored in n
d. The statistical significance threshold is q

Initial pheromone is taken as z. For now we will be considering initial pheromone for vacant spaces and time required reaching that spot
2. 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 O, 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= N, 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 Z set and this Z 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. Z
Step 7: For operation gets terminated.
Step 8: Now, we will record the Z 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

5. FLOWCHART OF THE SYSTEM DESIGNED USING THE PROPOSED ALGORITHM

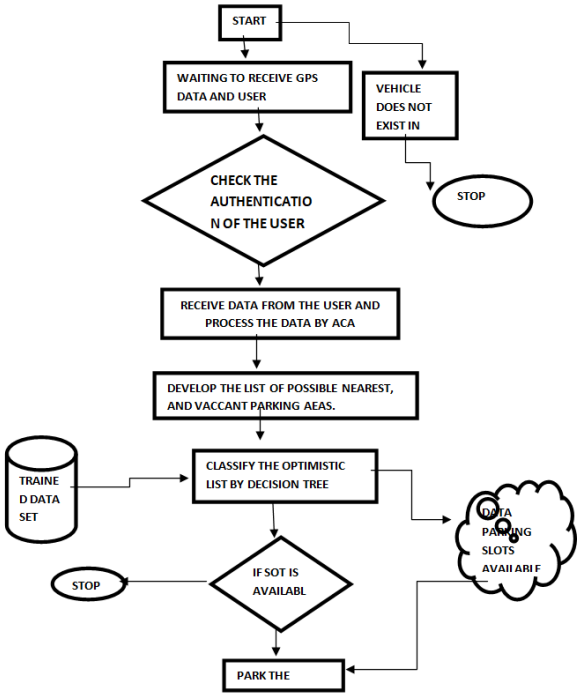
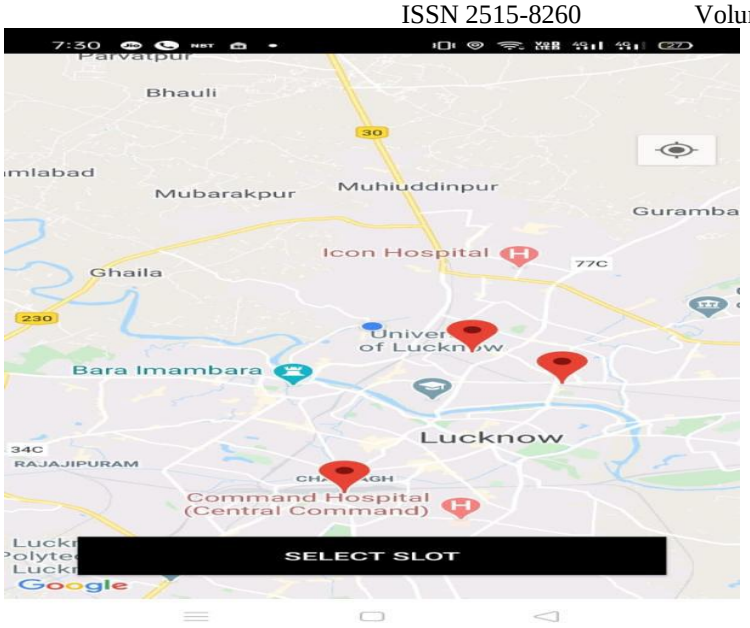


Figure 1: Flow chart of proposed work

6. 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 the or 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.

7. RESULT ANALYIS AND FINDINGS



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. 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. 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 kilometers that he needs to travel in order to reach that spot.

ACCURACY PERCENTAGE THE PROPOSED ALGORITHM = 86.7%

8. DISCUSSIONS

a) Graph

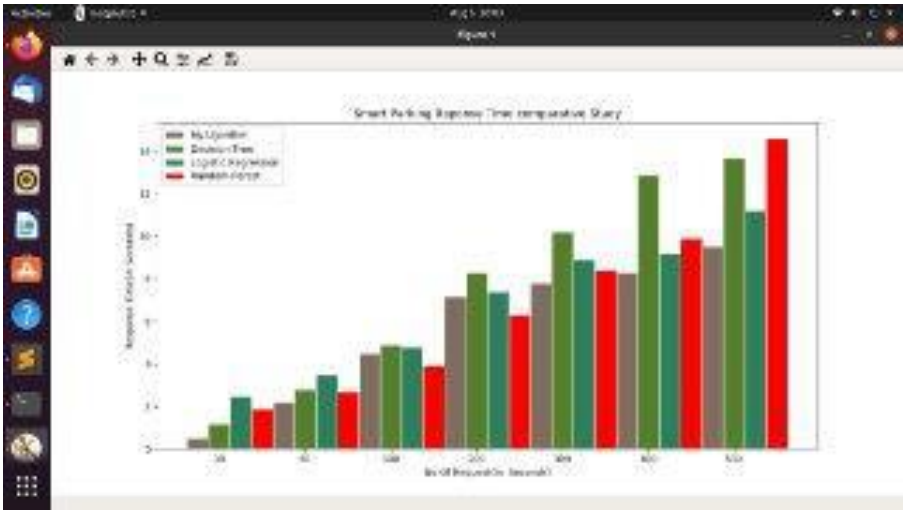


Figure 3: Result Graph

The proposed algorithm that we have used in designing the smart parking system can process 800 requests in 9.5 seconds. The decision tree alone can accomplish a proportionate work however it'll take 13.7 seconds to process 500 solicitations. However, the logistic regression algorithm can 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. Random Forest, a 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 the proposed algorithm that we have designed is more convenient and faster than other algorithms.

b) Proposed Algorithm>Other Algorithms

c) a) Smart parking response time comparative study

REQUESTS	PROPOSED ALGORITHM	*DT*	*LOGISTIC REGRESSION*	*RANDOM FOREST*
10	*0.5*	*1.2*	*2.5*	*1.9*
100	*4.5*	*4.9*	*4.8*	*3.5*
300	*7.8*	*10.2*	*8.5*	*8.4*
500	*9.5*	*13.7*	*11.2*	*14.6*

Table 1: Smart Parking response

As per the comparative study shown in the table it is clear that algorithm, designed by us to built a smart parking system over cloud is more accurate as compared to other algorithms. Proposed algorithm can process 10 requests in 0.5 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, 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, 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 the proposed algorithm is fast enough to process with n number of requests. The proposed algorithm takes less time to find the vacant spaces in the nearby parking zones. The algorithm is convenient and fast

9. 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. A smart Parking System is used to serve unlimited users in the parallel way to fulfil their requirements in the form of available parking

slots. User satisfaction is the main aim of Smart Parking Algorithms The algorithm that we have proposed in this paper is the best at accuracy level. Moreover, the comparison of the algorithm with various other algorithm clearly depicts the importance and convenience of the proposed algorithm.

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