PREDICTIVE ANALYTICS: PARKING PREDICTION USING SENSORS AND GPS

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ABSTRACT
Urban commuting has become a nightmare for a common man who travels to and from work daily in a city. The traffic gets even worse on weekends, as almost half the road is occupied by cars searching for parking. The enjoyment of a holiday becomes frustrating, owing to the congestion. The proposed system thus takes care to relieve traffic congestion by making parking easier and efficient. Due to planned parking the entire road can be available exclusively for moving vehicles. Technology like GPS, Infra-red and RFID will thus be deployed to develop an easy, quick and efficient parking system. The proposed system also aims to conserve natural resources.

Keywords: Prediction, Sensor, Parking, GPS, Regression Tree**.**

I. INTRODUCTION

We live in an urban environment where commuting from point A to B is a daily occurrence. Yet the way we commute makes a difference in terms of time. Supposing that we use a car to travel everywhere, it often happens that the actual drive takes lesser time than finding a place to park the car. The parking system that will be explained in this paper aims to combat that very nuisance of parking.

Let us take a look at example of a regular road on a weekend evening, suppose the road consists of three lanes of traffic flow, it is often found that only two lanes actually have moving traffic, whereas one lane is blocked, or moving very slowly. The reason behind that is simple, the leftmost lane often consists of drivers looking for a spot to park their respective cars, seemingly, a third of the entire road is not moving because of this. Due to this, the moving traffic suffers and it takes them a longer time to get from one point to another. When the car is parked in a large or multi storied parking lot, it can be difficult for the user to find their vehicle again, after parking it hours before.

As the RFID [10] sensor detects the vehicle occupying the parking, it can log where exactly the vehicle in parked, including the floor and number of parking, for example, P1/ Lot-86. The system explained in this paper will have the ability to compute sense and interact with the physical environment in detail, leading to generation of huge amounts of data.

II.RELATED WORK AND EXISTING DATA

A city in the United States of America, San Francisco [4] has already adopted a system of giving parking lot information to the public so as to make parking an easier task. This paper will take a closer look at the system implemented in San Francisco, as well as how our project aims to improve on that.

Melbourne, one of the largest cities on the Australian continent also uses a similar type of parking system which reduces the time and energy wasted on parking otherwise.

The parking Prediction system that we are building will have a part as a mobile application, which increases the scope of its usage and ease for people from all walks of life.
In this section we describe the possible method of implementing the system. The section also describes the existing systems in detail which are in use in Melbourne and San Francisco.

Dataset used.

1. Parking information about San Francisco system [4].
2. Parking information about the Melbourne model of implementation [7].

Firstly, we look at San Francisco. According to data publicly available on the Internet, there are 8200 sensors deployed in the city solely for the purpose of parking. These range between sensors on the street parking as well as in controlled areas of parking .Figure 2. Depicts the city of San Francisco. The map is divided into two colors depicting the availability of information. The yellow streets do not provide information about parking; whereas blue streets have parking availability information in real time The scale of parking availability is from red zones to blue zones. A red zone signifies very low parking availability whereas blue shows the opposite. An informed driver will avoid the red zones and take a different route to the blue zone to where they are assured parking. : The simplest function to calculate occupancy is given by Occupancy Rate (OR).
OR = Slots occupied/ slots in operation.

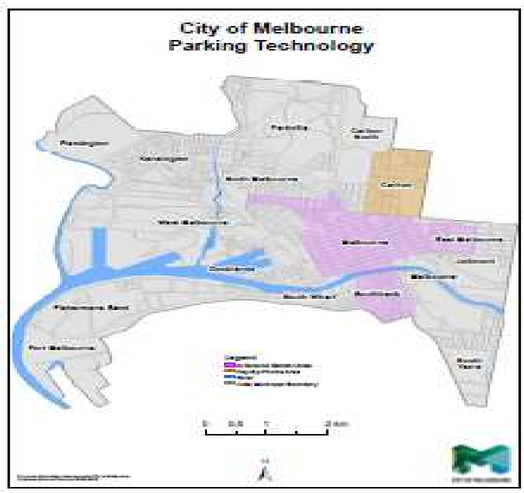

Figure 1.Melbourne Metropolitan area [8]

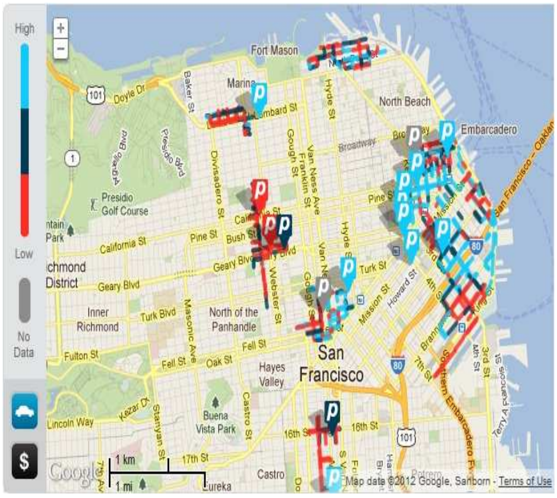

Figure 2. SFpark [1]

Now we take a look at the data provided in the public domain by the City of Melbourne. In the above Figure 1, of the City of Melbourne, the areas with working sensors are highlighted in pink.The city has come up with an innovative way of keeping track of the vehicles parked and at the same time an efficient way to bill them for the parking, although initially it led to confusion due to drivers not being educated about the system, now it works efficiently and the city is planning on expanding the areas implanted with the sensors. Approximately 4600 parking bays have been outfitted with sensors between August 2011 and May 2012.The sensors used by the City of Melbourne are implanted in the group i.e. In Ground Sensors. These sensors are placed directly underneath where a vehicle is meant to be parked.If a vehicle exceeds the time that has been paid for by ten minutes, a parking offices will receive a notification about it. They will then decide whether an offence has occurred to fine the offender.

III. PROPOSED SYSTEM DESCRIPTION

In this system, the ultimate aim is to ease the traffic congestion by making parking quicker and easier than ever before. The proposed system involves a Parking Prediction algorithm which will predict the availability of parking in a particular area. If a driver checks the system and learns that there is no parking available where the destination is, they may alter their plans for the sake of an easy commute.

The greatest difficulty about building a prediction system is the accuracy of the final prediction made. The longer this system is active, the better its accuracy will be. The performance of this model directly depends on historical data that it collects for the purpose of future prediction. The use of GPS will be in determining the location of the user with respect to their destination, the GPS will also work simultaneously with the server to accurately know when a vehicle enters the parking lot.A prerequisite of the system is that the user must always be in possession of the mobile device with the application running.

When a user has a trip to a particular location in mind, they will input the time and date of when they plan to make the trip. The system will then calculate the probable parking availability at that time, for the specific input. The user can then make their decision based on the availability of parking and can totally avoid congested areas.

IV.PROPOSED ALGORITHM

In this section we describe the algorithm to be used in the proposed system .Namely, Regression Tree. Regression tree is a type of classification tree with the end result of a constant integer value, rather than a class that emerges from using regular classification tree. Mean square error is used for node splitting rather than the conventional system entropy. The interpretation for this model is easy once the data has been input. Along with the ease of use, the missing values need not be left empty in a node, rather we can use the average of the previous and next node of the corresponding level in the tree.

Regression Tree

j feature of node.

s split point of node.

Let, the data is split into R1 and R2.

$R_1(j,s) = \{X|S_j \leq s\}$ and $R_2\ (j,s) = \{X|S_j > s\}$. To find the best splitting point and feature, we need to solve

$$Regression\ Tree$$

$$\min_{j,s} \left[\sum_{xi\ \epsilon\ R1(j,s)} (y_i - c_1)^2 + \sum_{xi\ \epsilon\ R2(j,s)} (y_i - c_2)^2 \right]$$

The average values of the corresponding regions are c_1 and c_2.

We need to impose stopping criteria to avoid an endless loop. The node splitting will be repeated till this criteria is met. The size of the tree is an important factor in data prediction. If the tree is too small, it may not reveal the characteristics we require and if it is too large, over fitting is a disadvantage. The stopping criteria we impose can be either of the following:

- Maximum depth
- Maximum leaf nodes
- Minimum samples at the leaf node, etc.

V.CONCLUSION

The analysis of this vast amount of data is important to make future smart cities intelligently manageable. From the success of the implemented systems in Melbourne and San Francisco, we plan to employ the best suited mathematical technique i.e. Regression Tree for the prediction of parking, using historical data that measures occupancy of every day of the week along with the use of Infrared sensors, Global Positioning and RFID.
Thus the proposed system shall help us to:

1. Reduce urban congestion.
2. Will save fuel and contribute to a better environment.
3. Reduce time spent searching for parking spots.
4. Provide the driver a hassle-free experience.

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