Parking in Big Cities using Machine Learning

Akshata Chougule1, Dr. Rashmi Rachh2

1Department of Computer Science and Engineering, Visvesvaraya Technological University, Belagavi, Karnataka, India
2Faculty in Department of Computer Science and Engineering, Visvesvaraya Technological University, Belagavi, Karnataka, India

Abstract— parking in big cities is becoming a big problem due to increased usage of four wheelers. People throng cities during weekends and holidays and have to wait unnecessarily for parking. If the parking information in various applications is available online, drivers can use this information to manage their parking. Many web service based online parking information services are available for malls, theaters, parks etc but the problem is they are very real time and they don’t consider the case that many people may see this information and if they throng to same place no parking spot will be available. In this paper we propose a machine learning based solution to avoid this thronging problem and also help users to find parking location easily. The results are demonstrated using real time parking data in the areas of Belgaum city.

Keywords: Parking Guidance and Information System, Spatiotemporal models.

I. INTRODUCTION

Cities host all major recreation and social needs of people by providing malls, theaters, shopping centers, theme parks etc. and people come to cities from other places on holidays. Due to economic growth in countries like India, there is increasing usage of four wheelers. People travel using four wheelers and there is a parking rush when many people drive to same places. If the parking information is available for each parking spot in the cities, people can manage their parking. Many parking spots have online services for providing the current parking space availability. But these systems suffer from a thronging problem. Based on the live parking space available many people throng to same places again creating a parking problem.

The thronging problem is created because the decision to parking is based only on the parking space availability and not on how many people are looking to park in same spot. Also it is difficult to collect the information of people intension to parking and advertise to all others. Because some people may give false information and would totally confuse the parking decision. So the parking decision must be made without collection of people intension about parking. To solve this we have proposed machine learning based parking information providing system. With this challenge, use of machine learning to predict the parking availability of place is used and it is clubbed with real time information to make correction and based on that parking spot availability is given.

One of the important and growing fields in ITS is parking assists and Parking Guidance and Information (PGI) Systems. Finding parking in large urban cities is characterized by frustration and waste of time and money due to the lack of accurate information about where parking spots are available at the time they are needed. Many of the ITS application Scenarios [1] has enabled engineers to develop custom-made software for each car.
II. LITERATURE SURVEY

In recent years, there have been several research efforts and advancements in PGI systems [1]–[10]. A PGI system is to be designed to assist drivers in finding parking space more efficiently, by acquiring the necessary data from infrastructure, processing them, and communicating the results to the driver in a non-distracting fashion [4]. Caicedo et al. [10] proposed a prediction system for parking garages which involves probabilistic models as well as simulations. Rajabioun et al. [9] implemented a PGI system which is personalized and takes into account individual driver preferences and involves a prediction algorithm based on probability distributions of parking availability. In another study, Wu et al. [11] proposed a prediction algorithm based on autocorrelations between different time lags. These studies are focused on the parking lots/garages data, where the data are available and more predictable. The studies reported in [10], [11] view the parking data as a one dimensional time series, however as demonstrated in this paper, parking data have multi-dimensional dependencies and correlations.

The prediction of parking availability at the time of arrival is strongly connected with both the traffic situation and the estimated arrival times based on predicted traffic flows and travel times. An extensive range of prediction models have been studied in the literature and used to predict traffic flows in transportation networks. Short-term forecasting models include non-linear models such as neural network models [12], [13] and linear models such as Kalman filters [14], [15], state space models [16], [17] Auto-Regressive Integrated Moving Average Models (ARIMA) [18], [19], and simulation based methods. The nature of data and the type of application determine the modeling method used for traffic prediction. Vlahogianni et al. [20] developed a logical flow for selecting the proper forecasting approach based on the input and output data and the quality of data.

In this paper, we propose a system which analyzes the available information from the infrastructure ranging from real time parking occupancy data to parking limitations/regulations and provides the driver with guidance regarding the likelihood of finding parking at the Estimated Time of Arrival (ETA). Our approach uses historical and real time data to make online predictions regarding the availability of parking in the area where the driver is planning to park. In our approach, we first analyze the parking availability data characteristics and then, develop a model for parking availability prediction. We use trending and descending techniques employed in time series analysis for financial applications in order to separate the deterministic part of data from the random parts.

III. PROBLEM DEFINITION

Given N parking spot distributed evenly in a city and each parking spot has a limited parking spot of Np. Vehicles arrive at a rate of vp in the city and want to park in any of N parking spot, the objective of the project is to recommend the parking spot with more space available to the vehicles in such a way once the vehicle reaches the parking spot, it gets the parking space or get the parking space with limited queue wait.
IV. PROPOSED SYSTEM

We propose a spatiotemporal parking space information system. In this algorithm, we collect the historical parking space availability and parking queue at each spot over a period of time. Based on this information an ARIMA time series model is built. Each of parking spot availability over a period of time is compared with other parking spots and the spots which are correlated to the spots are selected. Say suppose parking spot A’s availability is correlated to B’s and C’s. Then B and C are selected. Correlation function is learnt. Also real time parking space availability information is also collected. From these three information a parking space information prediction model is learnt as follows.

\[ P(X,t) = w1*R + w2 * Arima(X,t) + W3 * \text{Sum of all Correlation}(X,y,t) \]

Where \( P(X,t) \) is the parking space available in spot X at time t.

R is the real time parking space availability information.

Arima(X,t) is the parking space availability information predicted using ARIMA time series model. Sum of all correlation of X with all other spot found using correlation function is also used.

V. RESULTS

We simulated the proposed solution in java. Vehicles arrival rate is modeled as passion function and continuous vehicle traffic is sent to the parking information server. We situated the parking space uniformly in the city and measured the average parking queue length. We compared our solution with [1].

We varied the vehicle arrival rate and measured the average parking queue length. From the result below we see that queue length is less compared to [1].
We varied the number of parking spot and measured the average parking queue length and from the result we see that queue length is less compared to [1].

VI. CONCLUSION

In this work, we have implemented the Parking Guidance and Information (PGI) framework to find parking place in a given town. Spatiotemporal based parking spot availability information system is used to recommend the parking location with the highest probability used in real time parking data from given city to recommend the drivers.

REFERENCES