

GPS Based Parking System for Unplanned Metrocities with Visualization of Request Data

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Abstract

With the ever increasing number of automobiles in metro cities, there is an acute shortage of parking space to fulfill the demand. Moreover, paid parking facilities are charging hefty parking fees even for small durations due to their monopoly. In the proposed system we take a crowd sourced approach to identify free parking spots in streets and at curbs where the risk of the vehicle being towed away is minimum. These spots will be marked by the users and will be rated up or down to identify genuine and bogus spots. The system will also highlight nearby free alternatives to paid parking spots. This paper demonstrates the implementation of the GPS parking based system using Google API for locating the nearest free parking spot. Data mining performed on the request data received from the users will help us perform correlation analysis on interesting patterns in the most requested parking spots.

1. Introduction.

India is experiencing rapid economic growth^[1],. This is marked by the increased affluence of the burgeoning Indian middle class culminating in a huge growth in private vehicle ownership. The annual rate of increase in vehicle population is 7-12 per cent. Thus the number of cars are increasing without adequate infrastructure in the metropolitan cities. Parking policies in India are struggling to keep up with the growing demand and it comes as no surprise that one of the biggest woes of a car owner is to find a comfortable and secure parking spot for his vehicle. Several systems and applications have been proposed to facilitate finding a quality parking spot but all of them require some kind of infrastructure to yield acceptable results.

In 2011 IBM carried out a parking survey^[2], in which they created a parking index on the basis of longest amount of time spent looking for a parking place; inability to find a parking place; disagreement over parking spots; received a parking ticket for illegal

parking and number of parking tickets received which gave Delhi and Bangalore the embarrassing distinction of the top two. The survey concluded that apart from the typical traffic congestion caused by daily commutes and gridlock from construction and accidents, "over 30 per cent of traffic in a city is caused by drivers searching for a parking spot". The economic vitality of the communities depends on access. Cruising for a spot is reduced when parking is readily available, which greatly reduces carbon emissions and contributes to sustainability, another area where parking is undergoing a transformation.^[3]

2. Existing Systems.

There are several applications for Android and iOS based devices that help find a parking spot and reserve a parking spot in the parking lot. You can search for car parks near you, near some predefined areas or just simply search by the address or building name using these apps and each of them is capable of displaying real - time availability status. The most common features that these apps include are –

- Get a reminder before the parking session expires.
- Extend parking session from any location
- Easy payment methods
- Multiple cell phone numbers to a single account
- Multiple vehicles to a single account

These apps are all primarily for cities that have existing parking infrastructure.

J. Wolff et al^[4] used magnetic field sensors at each parking lot to track the exact locations of the empty parking in the multi-storied parking lots.

An indicator is installed with this vehicle sensor above each parking space. It shows green light when not occupied and red light when occupied to assist the driver to find parking space. One shortcoming of vehicle sensor system is driver may not have the luck to park their car near the entrance. They maybe lead by the

indicator to park their car far away and this does not benefit the driver anymore. Another possible situation is when there is only one available space; there will be more than one car driving towards it. Competing on an available car parking space is a waste of time and petrol. Furthermore, a lot of sensors have to be used inside a car park. This will be costly for a huge parking area and it also added up to the sensor maintenance cost.

Some parking systems in many countries are providing online reservation services^[5] to customer with which they can reserve a car parking space for a period of time. Anyhow, problem arise when they park over the limit of reserved time, their reserved parking space has been parked by others and etc.

One of the major problems faced in online reservation systems is wasting resources. Some drivers may reserve the parking spaces but do not come to park or miss the parking period. So, the system will hold the reserved parking spaces until the drivers come or do not come. This will waste the parking spaces because the system cannot utilize the available parking spaces all the time in the car park.

In the mobile-based car parking system^[6] the available parking spaces inside the car park by using SMS service of their mobile phone. The assignment of the vacant parking space is based on the shortest path distance by using BFS algorithm, taking into consideration the entrance to the car park used and the nearest entrance into the car park to make the drivers feel convenient. The limitation of this is that it only functions if it has knowledge about the total number of parking spots and for a car park, the driver will be able to receive information about the parking lot.

Existing Systems	Online Reservation System	SMS based System	Existing Android Applications	Proposed Application
Infrastructure Independent	✗	✗	✗	✓
Zero Installation Cost	✗	✗	✗	✓
Zero Maintenance Cost	✗	✗	✗	✓

Table1. Comparison of Existing Systems

3. Proposed System.

To use the services of the proposed system the user will need to download the system onto their Android device. On the initial start-up users are required to provide authentication credentials in the form of their Facebook ID and password. The application will make use of OAuth 2.0 and not store passwords in any form. Once the user is authenticated as human, he can perform two operations. He can either tag parking spots to the best of his knowledge or search for parking spots in his area of interest.

3.1. Tagging Phase.

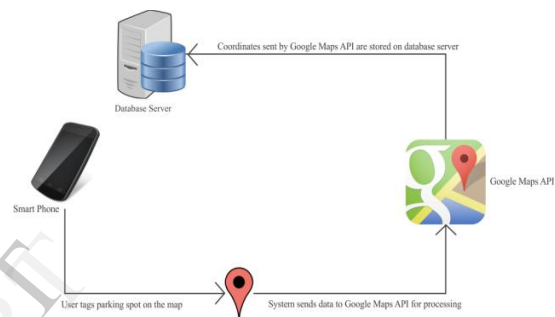


Figure 1. Tagging Phase

The proposed system makes use of the concept of crowdsourcing to enable users to tag free or paid parking spots in their vicinity and other areas using GPS. It will enable the users to provide the starting and ending coordinates in the form of latitude and longitude of the area. This spot will be assigned a unique id and stored in the database along with its coordinates. The user will also have an option to add additional information in the form of some landmark that will enable easy identification of the parking spot and the parking restrictions for the particular area, such as parking only on even days, no parking during 1500 – 1800 hrs.

A feedback system will be implemented in the form of rating parking spots to distinguish between bogus and genuine parking spots. A threshold will be set and if a parking location's rating falls below the threshold then it will be unmarked.

3.2. Request Phase.

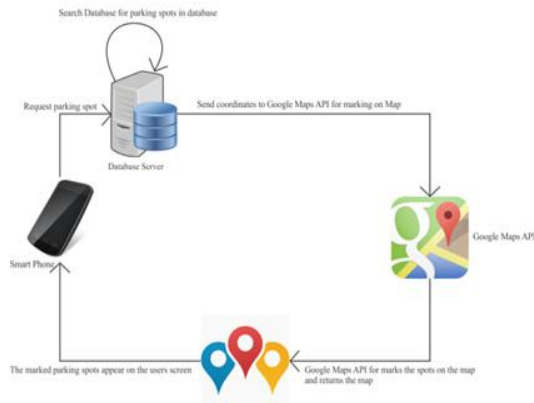


Figure 2. Request Phase

In this phase the user will request data regarding free or paid parking spots available near his current location or a location of his choice. The request will be sent to the server that will search for available parking spots in the database according to the area specified by the user. An SQL query will extract all the parking spots in that area from the database and this list will be displayed to the user on the map as geotags.



Figure 3. Parking spots in a certain neighbourhood

The user can select a parking spot, which will be sent to Google API and it will return the distance and path to reach that location.

The user is encouraged to contribute to the community by providing a feedback about the parking spot. A positive feedback will signify a genuine tag and increase the rating of the spot while a negative feedback will signify a bogus parking spot. The user is also encouraged to tag parking spots that he thinks will be helpful to other users.

3.3. Visualization phase.

This phase is transparent to the user. The users will request and tag parking spots using the system. Once we have enough request data, we will mine this request data to extract patterns and gain knowledge about which parking areas are the most popular amongst users.^[7] At what times of the day are the parking request the highest, in which months of the year are the users most active, which are the areas in the city that require a parking infrastructure to meet the demands are some of the questions that will be answered by extracting information from the mined data. The possibilities of the types of knowledge we can extract from the request data are endless.

4. Components.

The system relies on several different components to achieve its goal

4.1. Mysql Database.

The system relies heavily on a Mysql database that stores all the user data, request data, and data about the parking spots.

The user table will store the details about each user. No information like age, sex, etc will be stored. Only the username will be stored to make sure that the parking spots being marked are marked only by humans.

The request data table will store all the request from users of the system. This storing of requests will help us mine the data and find areas for which the requests are the most. We can then publish these results to show the areas where there is a need for parking infrastructure. The requests will be time-stamped so that we can create visualizations of request data with recognizable patterns at different times of the day, month, year etc.

The parking spot data will be stored in a separate table and will store the latitude and longitude of the parking spots along with the username of the user who submitted that spot. Each parking spot will have a rating. The people who use the system will rate the parking spot based on their experience. As a result, the parking spot with the highest rating is the most genuine one. Similarly, the parking spots with a low rating can be inferred to be "risky". The users can also report bogus parking spots marked by users. The bogus parking spots will be eventually removed from the system.

4.2. Google Maps API.

Instead of wasting time and energy in making maps and finding the nearest path to locations by ourselves, we have used the Google Maps API to do that for us. Google maps is the most widely used mapping application and it comes preinstalled with any android phone and android phones have the largest market share in the world.^[8]

The Maps API will help us get latitude and longitude from the application and we will store those coordinates in the database. When the user requests a parking spot, we will pass the coordinates we have extracted from the database to the API and it will plot the coordinates for us on the map.

4.3. OAuth.

OAuth is used in this application to authenticate users as humans before they are allowed to tag parking spots on the map. This step ensures that the entity that is tagging the spot is indeed a human and not a bot. OAuth will also keep a future scope of adding a social element to our system.

4.4. GPS.

Every Android based smart-phone is equipped with a GPS chip. By using the GPS facility we can get the coordinates of the user. Using these coordinates we search for free parking spots nearest to these coordinates using Maps API.

5. Conclusion and Future Scope.

The proposed system will provide convenient and hassle free parking to users with a few touches on their smart phones. The users will not have to walk long distances^[9] from the parking spot to their destination. The system will also ensure that genuine spots are rated the highest and bogus spots are removed as their rating drops. The visualization phase will provide various insights when we mine the request data.

In future, a social media element can be introduced in the system. Each user is given a base rating and their rating is incremented or decremented when the spots marked by them are reviewed by users as genuine or bogus respectively. A reward system can be implemented in which users who have marked the highest rated parking spots in a certain week or month receive vouchers for shopping, dining, etc. This will encourage users to mark genuine and useful parking spots.

References.

- [1] BANERJEE, Ipsita; WALKER, Joan L; DEAKIN, Elizabeth A, KANAFANI, Adib "New Vehicle Choice in India: Household Choice among Motorized Vehicle Segments"
http://metrostudies.berkeley.edu/pubs/reports/Walker_Working_IpsitaWCTR.pdf
- [2] IBM parking survey
<http://www03.ibm.com/press/us/en/pressrelease/35515.wss>
- [3] Casey Jones, CAPP, IPI Chair and Director of Transportation and Parking at Boise State University in Idaho
<http://www.parking.org/media/parking-industry-responds-to-ibm%E2%80%99s-global-parking-survey-.aspx>
- [4] J. Wolff, T. Heuer, H. Gao, M. Weinmann, S. Voit and U. Hartmann, "Parking monitor system based on magnetic field sensors," in Proc. IEEE Conf. Intelligent Transportation Systems, Toronto, 2006, pp. 1275-1279.
- [5] Munich Airport. Online parking reservations [Online].
<http://www.munich-airport.de/en/consumer/anab/auto/parken/online/index.jsp>
- [6] Soh Chun Khang; Teoh Jie Hong; Tan Saw Chin; Shengqiong Wang, "Wireless Mobile-Based Shopping Mall Car Parking System (WMCPs)," *Services Computing Conference (APSCC), 2010 IEEE Asia-Pacific*, vol., no., pp.573,577, 6-10 Dec. 2010
doi:10.1109/APSCC.2010.116
URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5708623&isnumber=5708546>
- [7] Ming Wang; Longkun Qin; Qingwu Hu, "Data mining and visualization research of check-in data," *Geoinformatics (GEOINFORMATICS), 2012 20th International Conference on*, vol., no., pp.1,4, 15-17 June 2012
doi:10.1109/Geoinformatics.2012.6270328
URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6270328&isnumber=6270256>
- [8] Apple Cedes Market Share in Smartphone Operating System Market as Android Surges and Windows Phone Gains, According to IDC [Online].
<http://www.idc.com/getdoc.jsp?containerId=prUS24257413>
- [9] Wang Shu-chun; Chen Jun; Zhang Hui, "The Optimization Model of Setting the Curb Parking Facilities," *Information Management, Innovation Management and Industrial Engineering, 2008. ICIII '08. International Conference on*, vol.1, no., pp.416,421, 19-21-Dec-2008
doi:10.1109/ICIII.2008.101
URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4737575&isnumber=4737477>