

IPARKER - A New Smart Car-Parking System Based On Dynamic Resource Allocation and Pricing

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ABSTRACT: Parking in main cities, particularly with more traffic, which directly effects the flow of traffic and the life of people in the city. In this paper, we are introducing a new smart parking system. This system is based on intelligent resource allocation, reservation, and pricing. The proposed system solves the problems with the present parking by providing assured parking reservations with the minimum possible cost and searching time for drivers and the maximum revenue and resource utilization for parking managers. New pricing policies are also proposed which are fair that can be enforced in practice. The new system is built based on mathematical modeling using mixed-integer linear programming (MILP) with the goal of reducing the total financial cost for the drivers and increasing the utilization of parking resources.

KEYWORDS: Static resource scheduling, dynamic resource allocation, pricing, Parking reservation.

I. INTRODUCTION

PARKING is an expensive process in terms of either money or the time and effort spent for the "free spot chasing." Current studies reveal that a car is parked for 95 percent of its lifetime and only on the road for the other 5 percent [1]. If we take England in 2014 as an example, on average a car was driven for 361 hours a year according to the British National Travel Survey [2] yielding about 8404 hours in which a car would be parked. Now where would you park your car for these very long hours? Cruising for parking is naturally the first problem caused by the increase of car owners globally.

On average, 30 percent of traffic is caused by drivers wandering around for parking spaces [3]. In 2006, a study in France revealed an estimation that 70 million hours were spent every year in France only in searching for or parking which resulted in the loss of 700 million euros annually [4]. In 2011, a global parking survey by IBM [5] states that 20 minutes is spent on average in searching for a coveted spot. With these statistics, we can assume that a great portion of global pollution and fuel waste is related to cruising for parking. Parking spaces are found to be more than plenty in some places and very rare to find in others. Pricing policies had played an important role in the overall parking availability for decades [6].

Here comes the important question: do we need to have more parking spaces or do we need better parking management? We believe it is the later and thus the motivation behind this work is about better parking management with fair and profitable pricing policies. The work presented in this paper combines parking reservation and pricing models to overcome the parking problems. On the parking reservation side, Mouskos et al. [7] modelled the reservation process as a resource allocation problem. Their model is based on MILP with the objective of minimizing driver cost. Their model offers real time reservations with fixed pricing. Geng et al. [8] had extended their work by taking into account the user's cost in terms of pricing and walking distance. In addition, they had expanded the model by adding fairness constraints and applying extensive simulations. Although the system proposed in [8] is very good, their model is still limited by being suitable only for short-term reservations and the parking revenue was not considered. On the pricing side, Shoupet al. [3] introduced new concepts which led to the development of San Francisco Park (SFPark) [9] in San

Francisco which aims to overcome the traffic congestion by dynamically changing prices based on sensor historical data. In SFPark, sensors are deployed on the asphalt to gather parking information that are stored in a database and processed weekly or monthly. According to historical data, the prices are increased and decreased proportional to the expected utilization. Although dynamically changing parking prices shall balance the supply and demand for parking and increase overall utilization, it is based on historical data and statistics which may not be accurate enough to have the proper effect. In this paper, we present a new smart car parking system, named iParker, with static resource scheduling, dynamic re-source allocation and pricing models, to optimize the parking system for both parking managers and drivers. The contributions of our work include: 1) increasing parking resource utilization, 2) increasing parking revenue, 3) improving parking experience of drivers by lowering cost, parking spot searching and walking times. Our work is different from the one in [8] where a dynamic resource allocation model was proposed. The main limitations of that model are that only reservation for limited period of time (e.g., few minutes) was allowed, fixed price was used and revenue was not taken into account and only a single choice of destination was considered. Whereas our model allows a driver to reserve a parking space for any time in future, the revenue is considered and new pricing models are introduced. In addition, a parking solution with their individual journey planners is proposed.

II. METHODOLOGY

Existing System

For as far back as two decades, there have been various re-inquiries and interests in the car parking space. Some of them had been conveyed by and by like Parking Guidance and Information (PGI) frameworks [3]. PGI frameworks furnish drivers with constant data on parking inside controlled spaces through factor message signs. They utilize conveyed sensors principally on the passages and ways out of parking areas to assemble data about aggregate inhabitation. Different usage commonly utilize one sensor for every one parking space which has been found in business shopping centers and in business locale to additionally use parking spots and decline looking time. The vast majority of the investigates have concentrated on the most proficient method to recognize the inhabitation condition of parking spaces [4]– [5]. Be that as it may, those frameworks still have not settle all the problems. For occasion, Trusiewicz utilized Unstructured Supplementary Service Data (USSD) as a correspondence medium amongst drivers and parking reservation framework. In spite of the fact that it isn't allowed to utilize USSD for the majority of system administrators, it is as yet a shoddy and dependable innovation to embrace in parking reservations. Wang et al. [6] had presented a model for a circulated framework at which there is one focal processor which assembles the reservation asks for and diverts them to the significant neighbourhood processors. Their framework uses Blue-tooth and WiFi to identify the inhabitation states inside parking areas, and tell the drivers with accessible spaces as needs be. Short Message Services (SMS) reservations were exhibited in numerous examination papers. Reservation over the web was shown in [7] by utilizing a sensor system of ZigBee and weight sensors to distinguish the inhabitation condition of parking spaces. Reservations were permitted utilizing a site. These reservation frameworks could decrease the general parking issues without a doubt Hashimoto et al.[8] proposed a reservation framework that is closeout based, at which there is a n interim for the reservation procedure, drivers would need to enlist before the due date at which the framework will designate the spaces in light of the most elevated offer. By and large, the closeout based techniques could prompt numerous decency issues.

Disadvantages

- SMS may be delayed due to network issues.
- Parking fee is fixed

Proposed System

Our new concept is to combine real time reservations (RTR) with share time reservations (STR), thus a driver can reserve a spot while heading to it (e.g., few minutes away) and also can reserve it at any time earlier (e.g., many days away). RTR are accomplished by performing dynamic assignment which is like abilities based steering in call focuses. On account of RTR, drivers are always dispensed the best parking spaces accessible until the point that they achieve their goals. While STR are accomplished by performing static resource allotment that depends on time booking where a driver can unequivocally pick the favoured resource and the time period at which it will be involved whenever later on. Distinctive evaluating arrangements for the two sorts of reservations that are reasonable for drivers and parking supervisors are proposed in this paper. What's more, a dynamic estimating motor which occasionally refreshes the

parking costs in view of continuous resource use by inhabitancy and reservations and different occasions is presented. iParker highlights the typical and impaired parking spaces and drivers are given the opportunity of picking different destinations and the framework will allocate the ideal resources as indicated by their picked goals and conditions. All through this paper, we will utilize the expression "parker" to allude to a driver or an car, "resource" to allude to a gathering of parking spaces, "D-Type" to allude to a dynamic reservation, RTR or the kind of a driver asking for a dynamic reservation and "S-Type" to allude to a static reservation, STR or the sort of a driver asking for a static reservation.

Advantages

- Increasing parking resource utilization.
- Increasing parking revenue.
- Improving parking experience of drivers by lowering cost, parking spot searching and walking times.

III. SYSTEM REQUIREMENTS AND SPECIFICATION

SOFTWARE REQUIREMENTS

| | |
|-----------------------|---------------------------|
| OPERATING SYSTEM | : WINDOWS95/98/2000/XP/7. |
| JAVA | : JDK 1.5 |
| FRONT END | : AWT/SWINGS, CSS |
| DATABASE | : MYSQL 5.0. |
| DATABASE CONNECTIVITY | : JDBC. |

HARDWARE REQUIREMENTS

| | |
|-----------|-----------------------------|
| PROCESSOR | : PENTIUM –IV |
| SPEED | : 1.1 GHZ |
| RAM | : 1 GB |
| HARD DISK | : 80 GB |
| KEY BOARD | : STANDARD WINDOWS KEYBOARD |
| MOUSE | : OPTICAL MOUSE |
| MONITOR | : SVGA |

IV. SYSTEM DESIGN

System Architecture

iParker is a semi-dispersed framework as appeared in Fig. 1: there are one central request center (CRC), one parking manager (PM) and various neighborhood smart allocation systems (SASs). The CRC gets parkers demands, forms them and redirects them to the pertinent nearby SAS. The ask for process is as following: parker picks one to numerous destinations and on the off chance that he/she is a S-type, favored parking space can be chosen. The two sorts need to appoint a weight parameter from 0-1 which mirrors their want between resource goal vicinity and resource cost. The two kinds additionally set the most extreme cost.

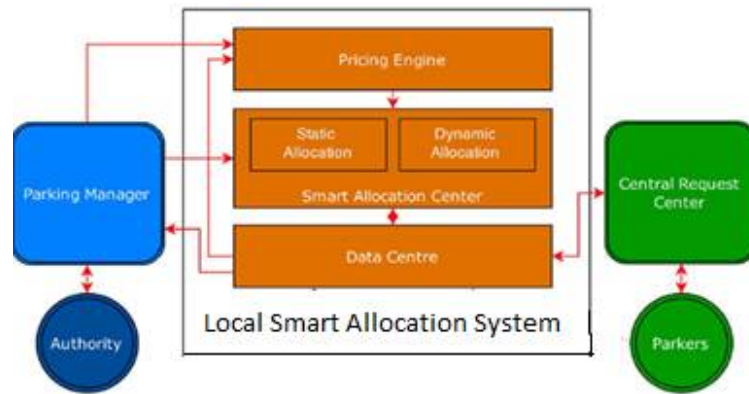


Fig 5.1: iParker framework

For S-type, the spot inhabitancy interim must be characterized. For D-type, the GPS arranges are estimated and appended to the demand. At last the parker recognizable pieces of proof (i.e., driver and car permit IDs) are went with the demand. CRC likewise reacts back to all parkers with reservation offers and in a similar manner informs the neighbourhood SAS with parker's response. The PM is a focal parking director who is an interface among parking experts, parking resource managers, SASs and nearby evaluating motors. Parking authorities can utilize the PM to physically refresh the applicable estimating motor or data centre.

Pricing Engine — Pricing engines are little applications that run a valuing model on web-servers. The obligations of a valuing motor are to bring parking use information and updates from parking specialists each predefined time interim and to set the new parking costs appropriately. The motor runs autonomous on the SAS, computes the new costs and updates the data centre.

Data Centre—Holds all the data from all iParker segments and store them in an organized information compartment. It's comprised of an estimating table which contains the progressive data on valuing per resource every moment, usage table which holds the use information, lastly expert table which stores different parameters that is set by parking specialists (e.g., events related) .

A Data Center is likewise in charge of refreshing various kinds of virtual message signs and open gadgets of up and coming evaluating data and parking accessibility.

Smart Allocation Centre — A web benefit that runs a refined MILP show that ideally and decently doles out stores parking resources to the parkers. The task depends on key factors that are not restricted to driver imperatives, momentum resource use, exceptional valuing data and occasions events. The centre gives constant parking reservation administration to the parkers and is depicted in subtle elements in the following area.

Flow Diagram

Initially car is arrived at the parking slot, then the user/parker is asked whether he/she needs static or dynamic allocation. If the allocation is of type dynamic, then the then the parker is sent to DWAIT queue. Now the user is provided with the dynamic allocation type of parking. If a slot can be allocated for the parker then dynamic reservation type of parking is given to the parker and the request is ACCEPTED. Finally the block is shown with the OCCUPIED state. If the allocation is of type STATIC allocation, then the parker is sent to the SWAIT queue, now the allocation of static type is provided. Once the allocation of slot is available the user request is accepted then the block is shown with the blocked state.

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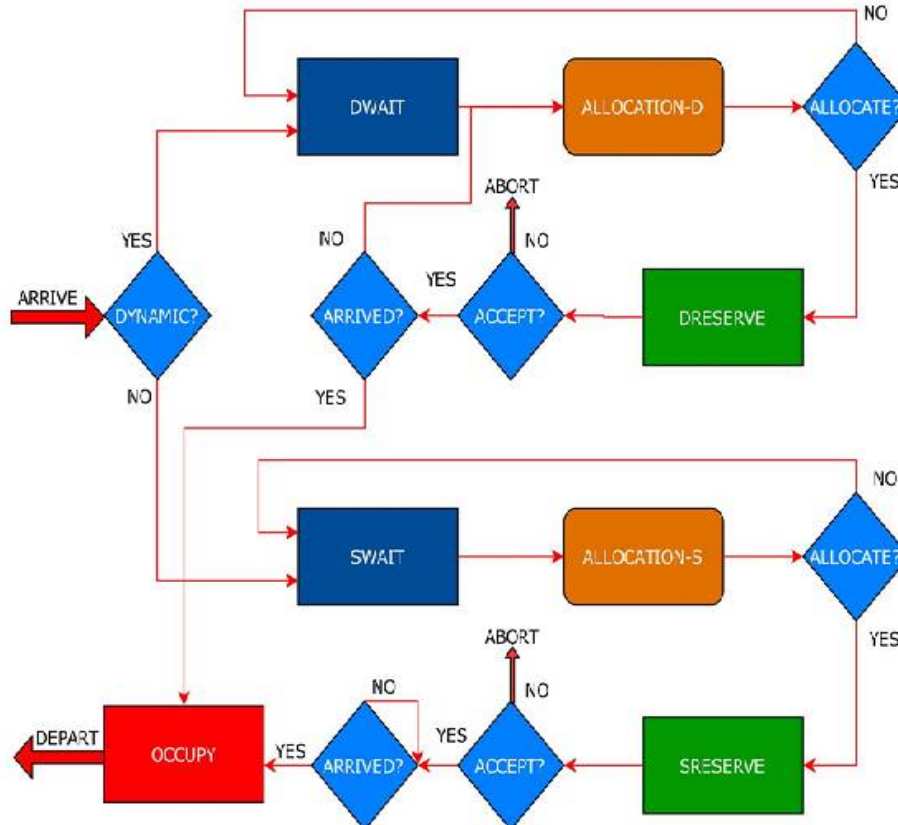


Fig 5.2: Flow diagram

Use Case of Testing Product

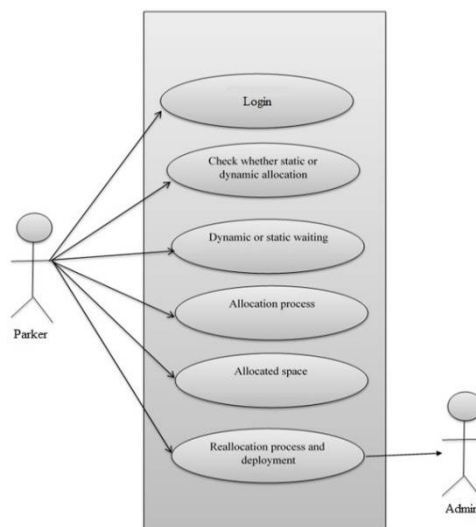


Fig 5.4: Use case of testing product

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Actors involved are:

- ❖ Parker
- ❖ Admin

Usecases:

1. The Parker initially has to login into the system.
2. The user has to select for allocation(Static or Dynamic).
3. In case of waiting in the queue, the wait can be of type DWAIT or SWAIT.
4. The parker can go for allocation(Static or Dynamic).
5. In case of static allocation the slot is fixed, whereas in Dynamic allocation the slot is allocated dynamically.

REFERENCES

- [1] D. C. Shoup, "Cruising for parking," *Transp. Policy*, vol. 13, no. 6, pp. 479–486, Nov. 2006.
- [2] D. C. Shoup, "The high cost of free parking," *J. Plann. Educ. Res.*, vol. 17, no. 1, pp. 3–20, Fall 1997.
- [3] T. Rajabioun and P. Ioannou, "On-street and off-street parking availability prediction using multivariate spatiotemporal models," *IEEE Trans. Intell. Transp. Syst.*, vol. 16, no. 5, pp. 2913–2924, Oct. 2015.
- [4] K. C. Mouskos, "Technical solutions to overcrowded park and ride facilities," City Univ. New York, New York, NY, USA, Tech. Rep. FHWANJ- 2007-011, 2007.
- [5] M. Idris, Y. Leng, E. Tamil, N. Noor, and Z. Razak, "Park system: A review of smart parking system and its technology," *Inf. Technol. J.*, vol. 8, no. 2, pp. 101–113, Mar. 2009.
- [6] H. Wang and W. He, "A reservation-based smart parking system," in *Proc. IEEE INFOCOM WKSHPS*, Apr. 2011, pp. 690–695.
- [7] C. Shiyao, W. Ming, L. Chen, and R. Na, "The research and implement of the intelligent parking reservation management system based on zigbee technology," in *Proc. 6th ICMTMA*, Jan. 2014, pp. 741–744.
- [8] S. Hashimoto, R. Kanamori, and T. Ito, "Auction-based parking reservation system with electricity trading," in *Proc. IEEE 15th CBI*, Jul. 2013, pp. 33–40.
- [9] K. Mouskos, J. Tsvantzis, D. Bernstein, and A. Sansil, "Mathematical formulation of a deterministic Parking Reservation System (PRS) with fixed costs," in *Proc. 10th MELECON*, 2000, vol. 2, pp. 648–651.
- [10] Y. Geng and C. Cassandras, "New smart parking system based on resource allocation and reservations," *IEEE Trans. Intell. Transp. Syst.*, vol. 14, no. 3, pp. 1129–1139, Sep.