

**iParking: a Parking Management Framework**¹Madhuri Ghyar, ²Suvarna Khanekar, ³Pratiksha Kharabi, ⁴Gayatri Khare.^{1,2,3,4} Department of Information Technology, Nutan Maharashtra Institute of Engineering and Technology.

Abstract - Indoor positioning technologies are wide studied with variety of solutions being projected, however substantial applications and services square measure still fairly primitive. Taking advantage of the rising thought of the recognition of smartphones and mobile net, and precise indoor locations, this study presents the event of a unique intelligent parking service known as iParking. With the iParking service, multiple parties like users, parking facilities and repair suppliers square measure connected through net during a distributed design. The shopper software package may be a light-weight application running on a smartphone, and it works basically supported a certain indoor positioning resolution. The positioning accuracy, accessibility and responsibility of the projected positioning resolution square measure adequate for facilitating the novel parking service. The iParking service might improve the parking expertise and increase the potency of parking facilities. The iParking may be a novel service in terms of cost- and energy-efficient resolution.

Keywords- GPS, Pricing engine

I. INTRODUCTION

The changes in economic structures and social living structures have inflated life vogue diversity. New data and communication technologies (ICT) accelerate such changes during this method. Living isn't restricted from now on too solely home environments. Folks travel daily to and from work, pay their time at varied points of interest (POI) like searching malls and attractions, and acquire product and services in intensive environments. Therefore, town scheme, together with metropolitan workplace buildings, urban environments, searching malls, museums and hospitals is currently enjoying necessary roles within the fashionable data society. Additionally to on-road navigation, that's wide used, an efficient parking service is very important to boost the expertise and potency of daily quality. Though parking technologies are used in parking facilities all round the World, it's still common that individuals have difficulties to park their cars. For instance, it's troublesome for drivers to search out timely vacant parking areas, and navigation help isn't accessible once world Positioning System (GPS) doesn't work well. As a consequence, parking difficulties end in unessential driving around eye to merely search for an automobile parking space. This thus, on the one hand, causes additional dioxide emissions and deteriorates the setting of town scheme. This is often very true once many of us are at the same time searching for parking places in a very downtown space at peak rush hours. On the opposite hand, it additionally will increase the chance of traffic accidents once drivers ought to seek for parking areas whereas driving. Additionally, unpredictable parking things build it troublesome for folks to set up their quality. All of those degrade the fashionable town scheme expertise, and became a vital challenge within the development of future intelligent transportation systems (ITS).

Parking areas are found to be quite masses in some places and really rare to find in others. Valuation policies had competed vital role within the overall parking handiness for many years. Here comes the necessary question: can we get to have additional parking areas or we would like higher parking management? We tend to believe it's the later and so the motivation behind this work is regarding higher parking management with honest and profitable valuation policies. Consistent with historical knowledge, the costs are inflated and reduced proportional to the expected utilization. Though dynamically dynamic parking costs shall balance the provision and demand for parking and increase overall utilization, it's supported historical knowledge and statistics which cannot be correct enough to possess the right result.

II. LITERATURE SURVEY**1) Mathematical Formulation of a Deterministic Parking Reservation System (PRS) With Fixed Costs**

AUTHORS: K. C. Mouskos, J. Tavantzis, D. Bemstein and A. Sansil

A problem faced in major metropolitan areas, is that the hunt for parking lot that leads to tremendous loss in productivity time, excess pollution, and driver frustration. the foremost ancient ways utilized to alleviate the hunt for parking are figed signs to parking lots, variable message signs that ceaselessly update the quantity of accessible parking areas at specific parking lots, route designing algorithms from an origin to a selected parking zone, furthermore as disincentives to the utilization of private cars through parking rating and strict social control of parking violations. An innovative methodology to deal with a minimum of partly the hunt for parking is through a parking reservation system. During this

paper, a mathematical formulation is bestowed for performing parking lot assignment to the users supported the decrease of the system wide parking value subject to the assignment constraints and therefore the parking zone capability constraints. The matter is solved with any commercially accessible convergent thinker and it can be shown to yield binary integer solutions.

2) Cruising for parking

AUTHOR: Donald C. Shoup

Suppose curb parking is free however all the areas are occupied, and off-street parking is pricey however right away on the market. In this case, you'll cruise to search out a curb area being vacated by an outgoing driver, or pay money for off-street parking at once. This paper presents a model of how drivers select whether or not to cruise or to pay, and it predicts many results: you're additional probably to cruise if curb parking is affordable, off-street parking is pricey, fuel is affordable, you wish to park for a protracted time, you're alone within the automobile, and you place a coffee price on saving time. The model conjointly predicts that charging the value for curb parking—at least adequate the value of adjacent off-street parking—will eliminate cruising. As a result of the govt. sets curb parking costs, planners and elective officers powerfully influence drivers' choices to cruise. The failure to charge market rates for curb parking congests traffic, pollutes the air, wastes fuel, and causes accidents. Between 1927 and 2001, studies of cruising in engorged downtowns have found that it took between 3.5 and fourteen min to seek out a curb area, which between 8 and 74 % of the traffic was cruising for parking.

3. Understanding drivers' perspective on parking guidance information

AUTHORS: Yanjie Ji, Weihong Guo, Phil Blythe, Dounan Tang, Wei Wang

Parking guidance and knowledge (PGI) systems are thought to alter a more economical management and management of the traffic and also the use of the offered parking lot in urban areas. Despite the installation of PGI systems in several cities and their operation for variety of years, the amount of usage of PGI stay a lot of less than expected. To guide investment and operational choices, this study examines the present PGI systems from the drivers' perspective. The results show that PGI isn't expeditiously used and infrequently neglected by drivers attributable to the wrong or noncurrent nature of the data it's displaying. Habitual behavior conjointly played a vital role within the decisions of a parking lot. However, the results of the analysis conjointly show that there's a need for a lot of correct, dynamic and customized parking info through completely different suggests that at pre-trip stage and en-route stage. The results of this survey ought to give some steerage within the style of future PGI systems.

4. Effects of Parking Availability Information on System Performance: A Simulation Model Approach

AUTHORS: Yasuo Asakura and Masuo Kashiwadani

The objective of this paper is to judge the consequences of various kinds of parking availableness info on system performance employing a simulation model. The model consists of 3 sub-models; demand, performance and knowledge service models. The model is intended to explain the dynamic interaction between demand and system performance and it's attainable to look at the time to time fluctuation of driver's parking alternative selections aid ensuing congestion in automotive parks. The model cart distinguish the distinction of a driver 'sparking alternative behavior between with and while not availableness info, aid compare the consequences of the various kinds of availableness info. Numerical examples square measure calculated aid it's found that the distinction of effects among info varieties depends on the congestion level of the system.

III. PROPOSED SYSTEM

We gift an innovative sensible automotive parking system, named iParking, with static resource programing, dynamic resource allocation and analysis models, to optimize the parking system for every parking managers and drivers. The contributions of our work include: increasing parking resource utilization, increasing parking revenue, rising parking experience of drivers by lowering value, parking spot wanting and walking times. Our work is totally completely different from the one in where a dynamic resource allocation model was planned. The foremost limitations of that model square measure that exclusively reservation for restricted quantity of sometime (e.g., few minutes) was allowed, mounted worth was used and revenue wasn't taken into consideration and exclusively one different of destination was thought of. Whereas our model permits a driver to order an automobile car parking zone for any time in future, the revenue is taken under consideration and new analysis models square measure introduced. If the user must order a slot for parking then he/she ought to explore for the shut parking places that give the list of shut parking places with details then the user elect the parking place a lot of user pay the amount. Admin checks for the slot accessibility and allot the slot to the user. We've an inclination to use the User location to fetch the shut parking places.

IV. METHODOLOGY

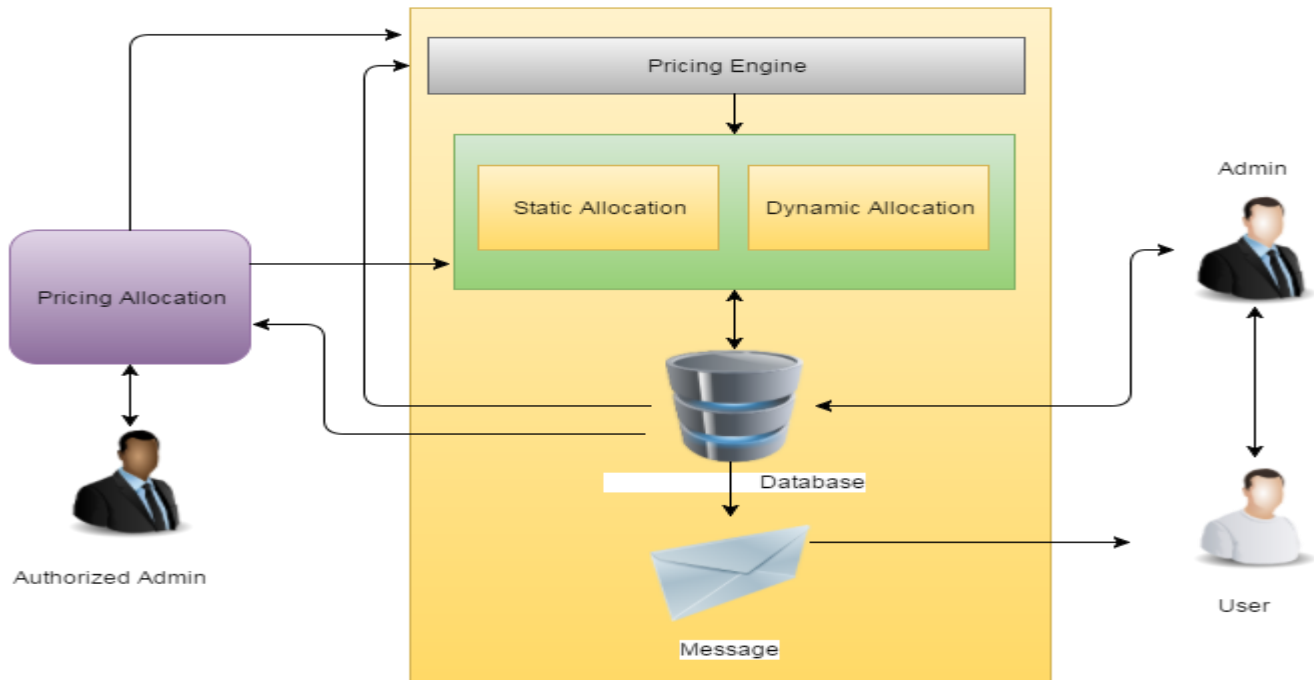


Fig 1: Architecture diagram of proposed system

iParking may be a semi-distributed system as shown in Fig. one it encompasses the Authorized Admin, Pricing engine, Admin, User, information etc.

The approved Admin may be a central parking manager who is an interface among parking authorities, parking resource managers, native pricing engines. Parking authorities will use the Authorized Admin to manually update the relevant rating engine or information center. As an example, fix rating values sure as shooting parking resource or update the information center with approaching events close to a relevant resource.

Below we have a tendency to describe the most parts of an iParking system

4.1 Pricing Engine

Pricing engines are unit tiny applications that run on valuation model on web-servers. The duties of a valuation engine area unit to fetch parking utilization information and updates from parking authorities each predefined amount and to line the new parking costs consequently. The engine runs freelance on the SAS, calculates the new costs and updates the information center.

4.2 Database

Holds all the data from all iParking elements and store them in an exceedingly structured data instrumentality. It's consisted of a rating table that contains the up to this point info on rating per resource per minute utilization table that holds the use information, and finally authority table that stores alternative parameters that's set by parking authorities (e.g., events related). Information is additionally answerable for change multiple varieties of virtual message signs and public devices of up to this point rating info and parking handiness.

4.3 Message

This updates parkers/public with up to this point evaluation and parking handiness data. It's vital to say that a parker can solely pay per the value rate fixed within the reservation supply. If the parker isn't exploitation the service, he/she can pay per the value rate displayed at the time of his/her parking.

4.4. Third-Party Provider Solutions

Last few years, a big range of third-parties providing to deliver alert messages (and different info services) via text electronic messaging services. The design of those systems is comparatively straightforward. Whether or not activated through an online interface, directly from a phone, or as software system running on a field administrator's laptop, these services act as SMS aggregators and inject text messages into the network. Within the event of Associate in Nursing emergency message is shipped to the service center from the victim or footer mobile.

4.4.1. Short Message Service

Short Message Service (SMS) may well be a text transmission service part of phone, web, or mobile communication systems, exploitation standardized communications protocols that modify the exchange of short text messages between fixed line and itinerant devices. SMS text transmission is that the foremost typically used information application among the planet, with 3.6 billion active users, or seventy eight of all itinerant subscribers. The term SMS is used as a similar word for all styles of short text transmission additionally as a result of the user activity itself in many parts of the world. easy user generated text message services - embrace news, sport, financial, language and placement based services, additionally as many early samples of mobile commerce like stocks and share prices, mobile banking facilities and leisure booking services. SMS has used on modern handsets originated from radio telegraphy in radio memoranda pagers exploitation standardized phone protocols and later made public as a vicinity of the planet System for Mobile Communications (GSM) series of standards in 1985] as a technique of inflicting messages of up to at least one hundred sixty characters, to and from GSM mobile handsets. Since then, support for the service has expanded to include various mobile technologies like ANSI CDMA networks and Digital AMPS, additionally as satellite and land line networks. Most SMS messages are mobile-to-mobile text messages though the standard supports various types of broadcast transmission additionally.

4.4.2. GSM Technology

GSM might be a cellular network, which suggests that cellphones connect with it by searching for cells among the immediate neighborhood. There are a unit 5 fully completely different cell sizes in AN extremely GSM network. The coverage house of each cell varies per the implementation atmosphere. Indoor coverage is in addition supported by GSM. GSM uses several crypto logical algorithms for security. A convenient facility of the GSM network is that the short message service. The Short Message Service – purpose to purpose (SMS-PP) was originally printed in GSM recommendation that's presently maintained in 3GPP as TS twenty 3.040. GSM 03.41 (now 3GPP TS twenty 3.041) defines the Short Message Service – Cell Broadcast (SMS-CB), that allows messages (advertising, public information, etc.) to be broadcast to any or all mobile users in an extremely nominal geographic area. Messages area unit sent to a short message service center (SMSC) that gives a "store and forward" mechanism. It makes a shot to send messages to the SMSC's recipients. If the subscriber's mobile unit is powered off or has left the coverage house, the message is hold on and offered back to the subscriber once the mobile is powered on or has reentered the coverage house of the network. This operate ensures that the message area unit planning to be received. Both mobile terminated (MT, for messages sent to a mobile handset) and mobile originating (MO, for those sent from the mobile handset) operations are supported. In Message delivery, delay or complete loss of a message is uncommon, typically affecting less than 5% of messages.

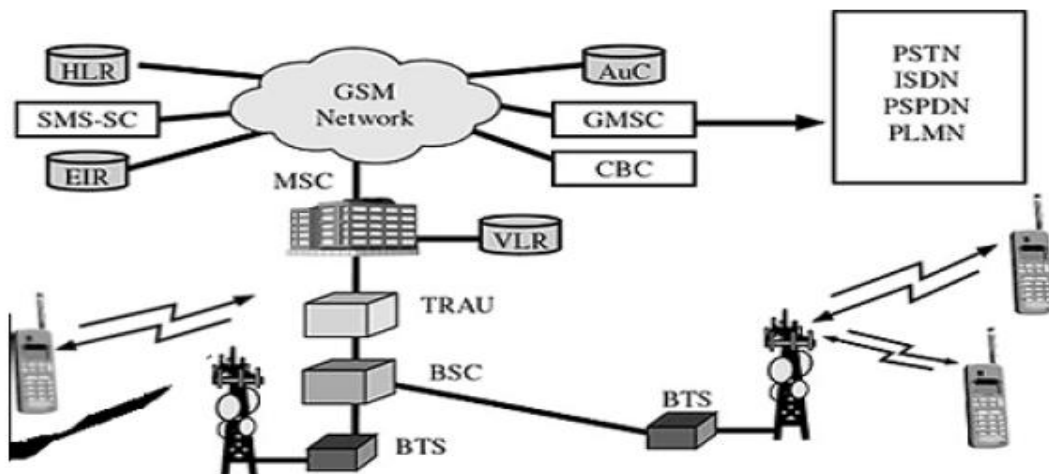


Fig 2: GSM Network along with SMSC

4.4.3. GPS Technology

The Global Positioning System (GPS), to boot stated as Navstar, might be a world navigation satellite system (GNSS) that has location and time information altogether atmospheric condition, anywhere on or near the world where there is academic degree unclogged line of sight to four or lots of GPS satellites. The GPS system operates severally of any telecommunication or internet reception, though' these technologies can enhance the utility of the GPS positioning information. The GPS system provides essential positioning capabilities to military, civil, and industrial users around the world. The federal government created the system, maintains it, and makes it freely accessible to anyone with a GPS receiver. The GPS conception relies on time and conjointly the celebrated position of specialized satellites. The satellites carry very stable atomic clocks that area unit synchronic with one another and to ground clocks. Any drift from true time maintained on very cheap is corrected daily. Likewise, the satellite locations area unit celebrated with nice exactitude. GPS receivers have clocks as well; however, they are usually not synchronic with true time, and area unit less stable. GPS satellites unendingly transmit their current time and position. A GPS receiver monitors multiple satellites and solves equations to visualize the precise position of the receiver and its deviation from true time. At a minimum, four satellites

ought to be visible of the receiver for it to figure out four unknown quantities (three position coordinates and clock deviation from satellite time).

V. MATHEMATICAL MODEL AND ALGORITHM

5.1. Mathematical model

Let 'S' be the system

Where

$S = \{F, O, P\}$

Where,

F = Set of input parking info

O = Set of output (response for parker)

P = Set of technical processes

- Let 'S' is the system
 $S = \{.....\}$
- Identify the input data $S_1, S_2, \dots, S_n$
 $F = \{\text{user location, request for parking, timing}\}$
- Identify the output applications as O
 $O = \{\text{location based parking slots info}\}$
- Identify the Process as P
 $P = \{\text{location capturing, searching records, recommending, filtering slots information}\}$

5.2. AES Algorithm

The AES-256 algorithm consists of 3 main parts: Cipher, Inverse Cipher and Key expansion. Cipher converts knowledge to an unintelligible type referred to as cipher text whereas Inverse Cipher converts knowledge into its original type referred to as plaintext. Key growth generates a Key Schedule that's employed in Cipher and Inverse Cipher procedure. Cipher and Inverse Cipher are composed of specific variety of rounds for each its Cipher and Inverse Cipher, the AES algorithm uses a spherical perform that's composed of 4 totally different byte-oriented transformations:

- 1) Byte substitution employing a substitution table (S-box)
- 2) Shifting rows of the State array by totally different offsets
- 3) Mixture the information inside every column of the State array
- 4) Adding a round Key to the State

The Cipher transformations are often inverted so enforced in reverse order to supply an easy Inverse Cipher for the AES rule. The individual transformations employed in the Inverse Cipher.

- 1) Inverse Shift Rows
- 2) Inverse Sub Bytes
- 3) Inverse combine Columns
- 4) Add spherical Key

The AES inverse cipher core consists of a key growth module, a key reversal buffer, an initial permutation module, a round permutation module and a final permutation module. The key reversal buffer 1st store keys for all rounds and also the presents them in reverse order to the rounds. The round permutation module can loop maternally to perform fourteen iterations (for 256 bit keys).

5.3. K-nearest neighbor's algorithm

In pattern recognition, the k-Nearest Neighbors algorithmic rule (or k-NN for short) may be a non-parametric methodology used for classification and regression. In each cases, the input consists of the k nearest coaching examples within the feature area. The output depends on whether or not k-NN is employed for classification or regression:

- In k-NN classification, the output may be a category membership. AN object is classified by a majority vote of its neighbors, with the thing being allotted to the category commonest among its k nearest neighbors (k may be a positive number, usually small). If $k = 1$, then the thing is solely allotted to the category of that single nearest neighbor.
- In k-NN regression, the output is that the property price for the thing. This price is that the average of the values of its k nearest neighbors.

K-NN may be a style of instance-based learning, or lazy learning, wherever perform is just approximated domestically and every one computation is delayed till classification. The k-NN algorithmic rule is among the best of all machine learning algorithms.

Algorithm:

- The coaching examples square measure vectors in a very multidimensional feature area, every with a category label.
- The coaching section of the algorithmic rule consists solely of storing the feature vectors and sophistication labels of the coaching samples.
- In the classification section, k may be a user-defined constant, it is AN untagged vector (a question or take a look at purpose) is assessed by assignment the label that is most frequent among the k coaching samples nearest to it question point.

VI. CONCLUSION

The iParking is associate degree environmentally-friendly resolution for society, a value and energy-efficient resolution for finish users, and an efficient resolution for parking operators and repair suppliers. The new ideas introduced during this square measure the mixture of time period reservations with share-time reservations. We tend to even have planned rating policies for each static and dynamic reservation that maximize the exploit parking. In depth simulation results indicate that the planned system considerably cuts the entire effective price for all parkers by the maximum amount as twenty eighth, maximizes the entire utilization by up to twenty first and will increase the entire revenue for parking management up to 16% as compared to the non-guided parking system. Finally we tend to plan a dynamic rating theme and by group action it to iParking model, we tend to found by simulations that it balances the employment across all the parking resources and therefore assist in eliminating the traffic congestion caused by parking.

VII. FUTURE SCOPE

Currently, the analysis focuses on a replacement parking sensing infrastructure and an internal navigation service for automobile parking. Within the future, we tend to aim to judge our system exploitation time period information and larger variety of resources and destinations. Additionally, a scalability analysis is to be performed to look at the efficiency of the projected scalability techniques. Last, it'd even be helpful to simulate completely different parking arrival situations in real world.

VIII. REFERENCES

1. Idris, M.Y.I.; Leng, Y.Y.; Tamil, E.M.; Noor, N.M.; Razak, Z. Car park system: A review of smart parking system and its technology. *Inform. Technol. J.* 2009, 8, 101–113.
2. Yang, J.; Wang, Z.; Wang, G.; Liu, J.; Meng, Y. On clock jumps of GPS receiver. *J. Geodes. Geodyn.* 2007, 27, 123–127.
3. Liu, J.; Chen, R.; Wang, Z.; Zhang, H. Spherical cap harmonic model for mapping and predicting regional TEC. *GPS Solut.* 2011, 15, 109–119.
4. Chen, R.; Pei, L.; Chen, Y. A Smart Phone Based PDR Solution for Indoor Navigation. In *Proceedings of the 24th International Technical Meeting of the Satellite Division of the Institute of Navigation*, Portland, OR, USA, 19–23 September 2011; pp. 1404–1408.
5. Liu, J.; Chen, R.; Pei, L.; Chen, W.; Tenhunen, T.; Kuusniemi, H.; Kroger T.; Chen, Y. Accelerometer Assisted Robust Wireless Signal Positioning Based on a Hidden Markov Model. In *Proceedings of IEEE/ION Position Location and Navigation Symposium 2010*, Palm Springs, CA, USA, 4–6 May 2010; pp. 488–497.
6. Liu, J. Hybrid positioning with smartphones. In *Ubiquitous Positioning and Mobile Location-Based Services in Smart Phones*; Chen, R., Ed.; IGI Global: Hershey, PA, USA, 2012; pp. 159–194.
7. Pei, L.; Chen, R.; Chen, Y.; Leppäkoski, H.; Perttula, A. Indoor/Outdoor Seamless Positioning Technologies Integrated on Smart Phone. In *Proceedings of the International Conference on Advances in Satellite and Space Communications*, Colmar, France, 20–25 July 2009; pp. 141–145.
8. Pei, L.; Chen, R.; Liu, J.; Chen, W.; Kuusniemi, H.; Tenhunen, T.; Kröger, T.; Chen, Y.; Leppäkoski, H.; Takala, J. Motion Recognition Assisted Indoor Wireless Navigation on a Mobile Phone. In *Proceedings of the 23rd International Technical Meeting of the Satellite Division of the Institute of Navigation*, Portland, OR, USA, 21–24 September 2010; pp. 3366–3375.
9. NOKIA Press Release. Available online: <http://press.nokia.com/2012/08/23/accurate-mobileindoor-positioning-industry-alliance-called-in-location-to-promote-deployment-of-location-basedindoor-services-and-solutions/> (accessed on 24 August 2012). *Sensors* 2012, 12 14628
10. Mimbela, L.Y.; Klein, L.A. A Summary of Vehicle Detection and Surveillance Technologies Used in Intelligent Transportation Systems. Technical Report for New Mexico State University: Las Cruces, NM, USA, 2007. Available online: <http://www.fhwa.dot.gov/ohim/tvtw/vdstits.pdf> (accessed on 12 August 2012).