VEHICLE PARKING SPACE RESERVATION SYSYTEM

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Abstract: - Competition for parking spots has intensified due to rising private vehicle usage and a finite number of parking resources. One of the biggest obstacles to efficient traffic flow is the inefficiency of parking space searches. Smart parking reservation provided by technology are considered a great solution to reduce traffic and improve parking efficiency.Scoping reviews are currently weak, despite the increased focus on parking reservation optimization and smart parking research. Consequently, this paper's goal is to present athorough analysis of the research literature on parking reservations.99 of the 438 papers that this search initially turned up were ultimately selected for examination.Parking reservations were divided into four research areas by the review: pricing strategies, performance evaluation, allocation decisions, and inventory control. A detailed examination is conducted of the components taken into account in various study areas, modeling approaches, and evaluation standards. Furthermore, the difficulties and potential improvements for optimizing parking reservations are examined. The results of this study are anticipated to be helpful in future investigations on parking reservations. The distribution of reserved and unreserved spaces ought to take the availability of parking spots into account. The allocation model takes fairness issues and driver preferences into account. By influencing demand, the price strategy can be connected with the allocation model. The entire transportation system's optimization performance for parking reservations is unknown.

Keywords: *Smart parking, Parking reservations, optimization*

1. INTRODUCTION

The growing number of cars and their limited supply exacerbate urban parking issues for commuters and traffic controllers in urban areas. On the one hand, the time drivers spend looking for places accounts for a significant portion of the cost of travel because of a lack of resources and erroneous parking information. According to reports, around 30% of cars in an average urban center look for parking, and each car takes an average of 8.1 minutes to cruise (Shoup, 2006). In addition to wasting drivers' time and gasoline, this ineffective parking search increases air pollution, traffic congestion, and accidents.

For instance, these searches cause up to 39 million vehicle miles driven, 1.9 million gallons of gasoline, and more than 29,000 tons of CO2 emissions annually in the Chicago metropolitan region (Ayala et al., 2012). However, because parking availability and demand vary both temporally and spatially, there are a lot of empty resources. During the day, 44% of private parking spaces in the Beijing metropolitan region are observed to be empty (Yan et al., 2021). These issues have led to increased investigation into practical parking alternatives.

The advent of mobile internet and information technology has enabled drivers to conveniently obtain up-to-date pricing and availability information about parking. Thus, a great deal of research has been done on several effective parking management techniques, such as shared parking.

Park and ride (Kurek and Macioszek, 2022; Macioszek and Kurek, 2021), parking guidance (Xie et al., 2023b), and Shaaban and Tounsi, 2022; Xie et al., 2022. In order to lessen driver competition, parking reservation (PR) technology in the intelligent transportation systems (ITS) domain has been created to give drivers guaranteed parking spaces. According to Kotb et al. (2017), the clear advantages of PR include shorter cruise times, more parking usage and income, and even less traffic congestion. Because it helps drivers, parking lots, and city parking managers all at once, this creative approach is seen as an effective way to relieve parking issues. The pricing and distribution of reservations have been the subject of extensive research, although this field has not yet had a scoping review. As a result, the purpose of this work is to review the research literature that particularly addresses parking reservations. This is how the rest of the article is organized. The subsequent section provides a description of the methodology and the review process. Every study topic and methodology for parking reservation optimization come next. The challenges and opportunities are then talked about. The paper is finally summarized.

II. METHODS

A comprehensive evaluation of the literature published between January 2000 and December 2022 was carried out. 438 recent articles were found using a literature search carried out on the Web of Science search engine with the keywords "parking reservation," "parking allocation," or "parking assignment" (WOS).

The relevance of the discovered studies was assessed by first assessing the title, then the abstract and/or full text, after duplicate records were eliminated.

Only research with an emphasis on optimizing car reservations was selected. Using this method, 99 papers were found to be worthy of additional examination (Fig. 1). These research fell into four general groups based on the subjects they covered: performance evaluation, reservation price schemes, allocation decisions, and inventory control (Kotb et al., 2017). When a study included more than one topic, each subject was assessed separately. Regarding every category, factors and optimization strategies were found. For every topic, table containing the essential elements of every study—such as data, methodology, and considerations taken into account—is prepared. Lastly, suggestions for new lines of inquiry and requirements are outlined and reviewed.
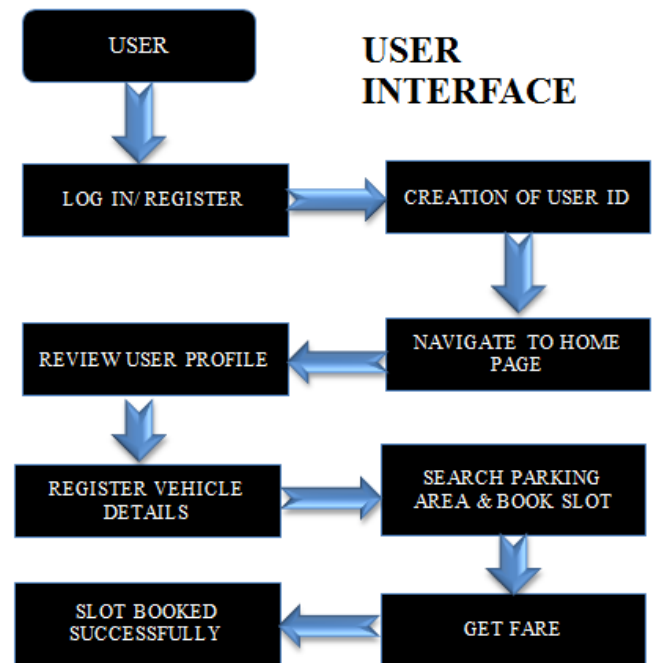

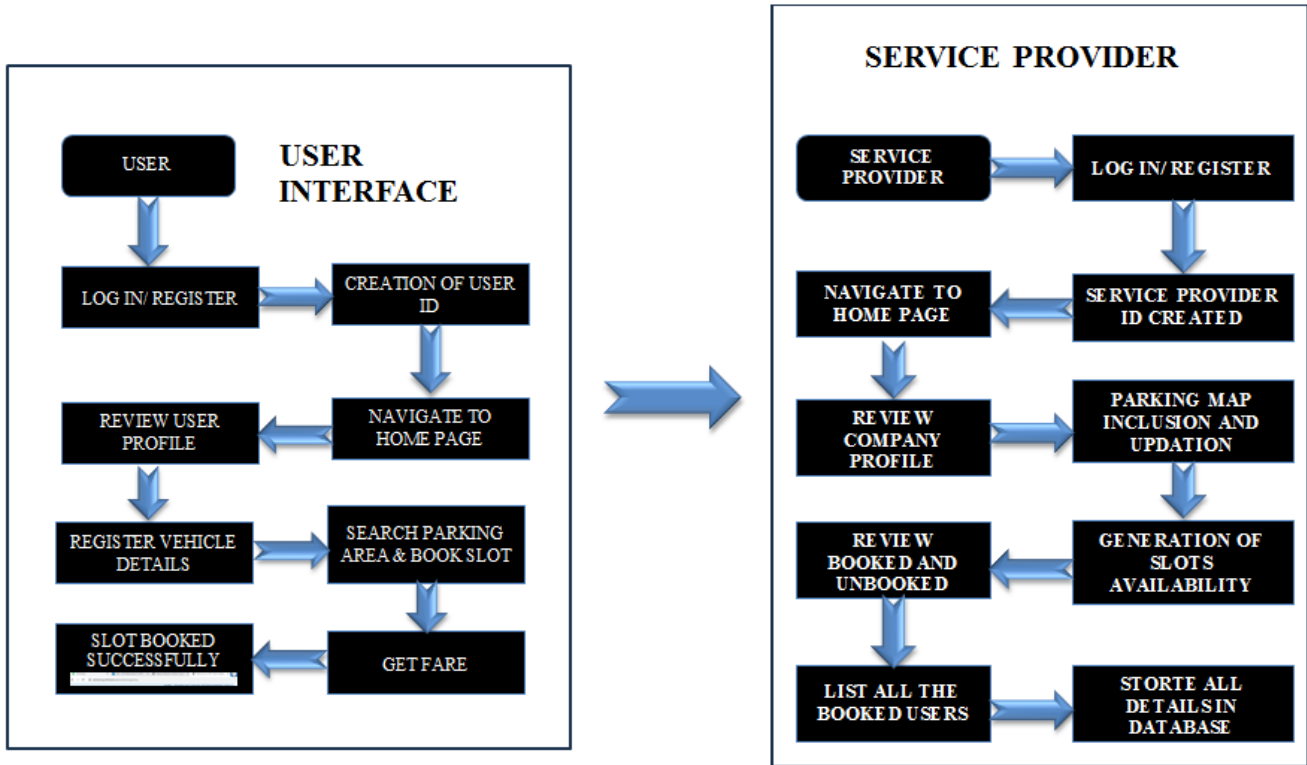
Fig.1. Flow chart for user interface

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Fig.2. Architecture Diagram

III. CONCLUSION

Parking reservations can enhance the city's general transportation system as well as certain localities. Specifically, parking reservation installation has been made easier by the recent advancements in advanced technology. Reviewing the most recent reservation optimization and procedures is the aim of this research. It is anticipated that this meticulous evaluation would assist scholars and professionals working in the transportation sector in developing intelligent, long-lasting parking reservation systems. Due to the authors' limited expertise, this study is limited in that it can only review recent, widely accepted studies and cannot cover every facet of parking reservations. The following are the general results drawn from this investigation.

First, capacity reservation control, which is a key component of inventory control, takes into account the classification of parking spots into various categories in order to enhance parking income or social welfare.

The current mainstream supply approach is to accomplish the joint supply of reserved and non-reserved parking spaces, taking into account the realities of the reservation system. Future improvements to inventory control might start with a more accurate classification of parking spots or vehicle types. For instance, in mall-style parking lots, this could mean separating commuting and recreational zones and separating cars into fuel-consuming and electric categories. Second, factors including parking requests, parking lot features, and traffic patterns must be taken into account when allocating reservations.

Static allocations have given way to dynamic allocations in allocation decision modeling, which now accounts for arrival and departure uncertainty. In order to derive more realistic parking demand, it is possible to investigate the use of different sources of traffic data. Currently, parking demand is frequently generated based on assumed mathematical distributions.

Additionally, allocation decisions are rapidly moving beyond merely meeting parking time demands to include additional equality and personalization factors. User categories may receive preference in the allocation process, and other factors for driver preferences may be defined. Third, there are three categories for pricing strategies: spatial-temporal pricing, negotiated pricing, and pricing difference. Through interaction or negotiation between user demand and price—which depends on bi-level programming or auctions—negotiation-based pricing arrives at an equilibrium price. To create differentiated prices, pricing differentiation separates parking spaces into different categories. These prices can then be paired with inventory control to provide a fair cost structure.

Allocation or other models based on location, trip cost reductions, or parking resource use frequently incorporate spatial-temporal pricing. Because different user categories have differing pricing sensitivity levels, there was, nevertheless, a lack of user heterogeneity. Future studies should take into account the pricing rivalry among nearby parking lots as well as the relationship between price and user demand. Lastly, simulation modeling, which evaluates overall journey time, traffic volume, and social welfare from a system perspective, serves as the primary foundation for performance evaluation. While reservations for parking can help shorten travel times and lessen traffic, there are other hidden expenses to consider. Driver noncompliance may incur penalties. Furthermore, the adoption of reservation systems can make traveling in personal vehicles more alluring.

Future studies ought to consider how reservation systems affect users' switching between modes of transportation. The study methodically evaluates and categorizes the research issues of parking reservations in previous publications into four areas: inventory control, price methods, allocation decisions, and performance evaluation.

These contributions are made by this article. The analysis highlights elements that could be further taken into account for improvement after looking at the optimization goals and considerations in the four categories. Furthermore, in order to aid readers in understanding the evolution and future direction of optimization,. commonly used methods and their evolutionary history.

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