

## Smart Parking System for Green Computing

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### ABSTRACT

A “smart city” is one that makes use of info and comm technologies (ICTs) to increase the awareness, interaction, and effectiveness of city services and monitoring. It might be smart technology, smart design, smart mobility, smart utilities, smart housing, smart healthcare, smart transportation, smart lighting, smart phone detection, smart road, smart traffic management, and smart parking etc. The solicitation of smart cities will increase unexpectedly with the rapid increase in IoT infrastructure. Smart city idea notably going up to city lifecycle. The focal point of this paper is to present an intelligent parking system consuming a novel iOS app-based implementation for smart cities’ demands, which permits a driver to determine a parking lot and a vacant slot in that lot indoor a municipality. This paper additionally focuses on reducing the searching time for determining the parking lot using our proposed method, namely, the booking method. This, in short, lessens the gasoline deployment which in turn cuts carbon trails in the weather; as a way of life, additionally averting useless traveling via packed parking lots in a parking lot that can be useful in decreasing illegal parking and in a way help with the traffic jams we see in our city.

*Keywords:* iOS; smart parking; parking lot; booking method; cloud database

### INTRODUCTION

In modern years, transportation has gradually become a vital cost-effective, green, and political affair. As the city populace is increasing, heavy city motility is transported around and numerous transport difficulties originate. The important interest realized by both governments and the public is to concern to the reckless necessity to mitigate the transportation bottleneck. There are many logical reasons for this, and a lot of data supports the idea that searching for parking is one of the main causes of congestion. Such as, it has been stated that drivers searching for parking lots add to nearly 29.99% of urban transportation in big city ranges (Hans 2015). Regularly, every car on the street loses 10-22 minutes of traveling to a vacant lot (Hans, V. 2015), (Shail, Shubhda 2019). This originates not only as a waste of time, currency, and work for the parkers searching for parking, but it additionally confers an added waste of time, currency, and work for other parkers as a consequence of transportation blocking (Bonde 2014). An analysis by the Texas Transport Institutions’ the 2015 City Motility Article discloses that in 2014, blocking triggered city Americans to drive an additional 6.9 bn hrs.’ and purchase an additional 3.1bn gill of fuel which depicted a financial fall of over ¥260 bn, a hike of over 105% from 2005 (Kotb 2017). Another analysis (Gandhi 2016) shows that throughout the peak hour

in maximal enormous urban metropolises’, forty percent of all-out traffic are produced by vehicles searching for parking lots. In this manner, in these deeply populated metropolitan regions, the precise amount of gridlock and deferral is as for parking. A new report (Hans 2015) shows that automobiles searching for parking consumed 48,000 gallons of fuel in the corporate region of St. Louis and created 830 jillions of CO<sub>2</sub>, which is identical to 39 outings throughout the planet. The acknowledgment of the universal and native effect in light of these data emphasizes the importance of the difficulty that this paper explores to discourse. As well as, our country like Bangladesh has progressed technologically very rapidly in recent times. Nowadays we have more furnished highways, buildings and more cars (Parmar 2020). When we want to park these growing cars we use the existing manual system, e.g., figure 1. But having the opportunity to park the car in this way, people think that if they park the car there, a huge disorder will appear. Due to this, there will be a lot of congestion in those places. When parking and exiting the park, according to such a malpractice, no order is accepted and people compete with each other to get parking. So, there will be a lot of congestion at that location. Thus, people will be exposed to financial loss, fuel loss and traveling in different directions to get and leave the park. The resulting traffic congestion will waste people’s precious time badly. It will cause problems for everyone including patients, officials, and students (Shail, Shubhda 2019).



FIGURE 1. Present Car Parking System(Gopal, D. Ganesh 2019)

Parking of this manual system in industrial area causes a lot of financial loss and at the same time this system takes a lot of time (Gopal, D. Ganesh 2019) (Parkhi, P. 2014). So as a way out of this system we proposed a new iOS-based parking system. Our proposed system will not only save time but also help park owners to earn more money and income.

#### LITERATURE REVIEW

Proper parking management to provoke parkers to equilibrium their parking requests is one of the objectives for smart parking scheme. An active system resource sharing significant financial method is a costing strategy. In (Kelly 1998), Kelly et al. illustrates that, when egoistic parkers' search for to exploit their advantages, the scheme is able to offer motivations to touch the optimization of universal system. In (Xin Wang 2005), researchers projected a rationally broad DiffServ costing model incorporated a costing configuration for diverse facility group and the request activities of parkers. They illustrate that, when diverse facility groups work at dissimilar mark utilization, they offer dissimilar grades of facility, and parkers' get a steady facility cost and uphold steady. Furthermore, Feldman et al in (Michal Feldman 2005) express the static financial plan resource sharing game and revision the reality and conduct of a scattered exchange-oriented resource sharing scheme. Authors at (Faiz S. 2015) proposed a software related method based on android apps'-oriented design and there is no mechanism for handling advanced booking in this research. Also, in (Shubham H. 2018), authors proposed android apps based smart parking system but there are no resource sharing methods.

#### LIMITATIONS

Parking booking method, the fixed cost was utilized and profits were not considered, and simply a unique option of the target was taken into account. Materially, parking booking in truth could be more valued if it is for the high-period (for example, booking for a week in the future to join an occasion). Additionally, urban bodies or individual parking businesses may not finance such methods if their parking profits are not enhanced. And lastly, apps-based parking methods only consider Android-oriented and not incorporating resource sharing, booking, or any other mechanism.

#### PROPOSED SYSTEM AND METHODOLOGY

Figure 2 graphically shows our proposed system. From the figure, we see that our proposed system has three main components. Admin, parking apps and parking lot. The parking admin controls the parking lot with the help of the implemented iOS parking app. The parking apps are designed according to following the different methods of booking policy, which is the main focus of our proposal. With the help of booking policy, we can see that our proposal can gain a lot of advantages over the existing system, especially reducing the searching time to discover a parking lot which in turn reduces gasoline and fuel cost/consumption which makes our environment healthy.

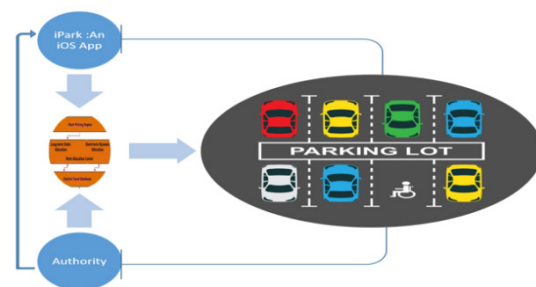


FIGURE 2. Proposed Parking System

Different parts of our developed iOS app named iPark are discussed here one by one after that in the next section from the simulation results, we can infer that how our developed apps' are superior:

#### LOGIN INTERFACE

The login interface is designed for driver verification. It is intended to avoid illegal practices in the smart car parking app. Figure 3 displays the login interface. The driver can enter the account utilizing the user's name and password if he/she has registered already, if not, the user can register using this interface.

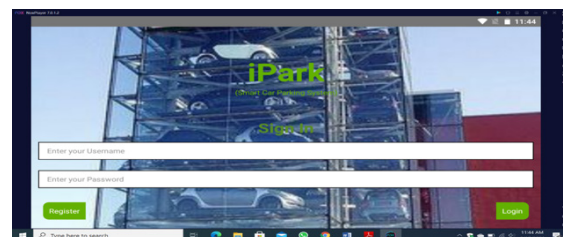


FIGURE 3. Login Interface

#### SELECTING THE VACANT SLOT INTERFACE

This interface as presented in Figure 4, shows all vacant spaces for choice. The slots are recognized in dissimilar shades. The blue slots are for booked parking, the grey slots show slots accessible for parking, the red slots indicate the

chosen slot by the client, and the dark slots are for effectively saved slots by different clients. The interface likewise shows the adjacent structures.

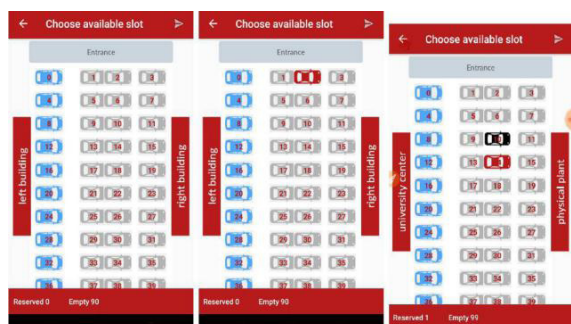


FIGURE 4. Selecting Parking Slot

After the choice, the client can continue to press their 4-digit operational puzzle with the attached keypad. In the wake of choosing a slot, a dialog is shown which contains data with respect to how long the parking is saved. The selection of vacant slot interfaces is demonstrated in Figure 5. Using this interface, a driver can advance and book a parking slot for his/her future use.

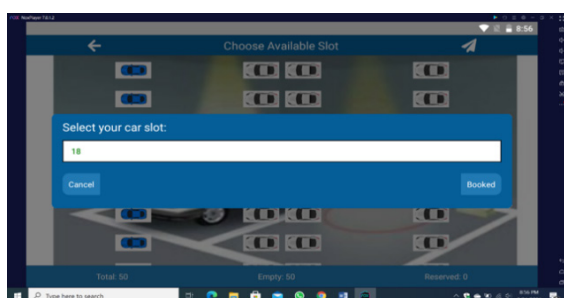


FIGURE 5. Interface for choosing a vacant slot

In this application, we pick the time booked for a slot as 15 minutes.

LOGOUT INTERFACE

At the point when the driver has finished utilizing the application, they can tap on the logout button. Figure 6 shows the graphical view of the logout interface of our developed iOS app. To utilize the application once more, the client needs to log in for a second time.

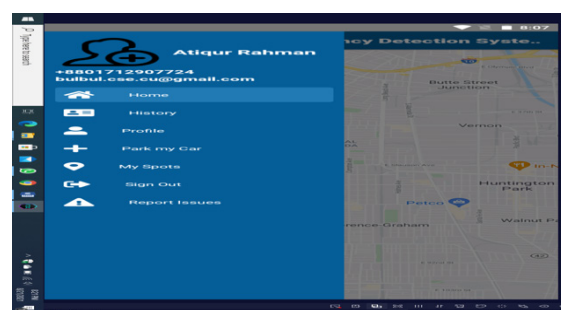


FIGURE 6. Log-out Interface

SIMULATION RESULTS OF OUR PROPOSAL

SIMULATION SETUP FOR IPARK/ DATA AVAILABILITY

We used the map of Dhaka city as the aimed space in our simulation as displayed in Figure 7, and the map is enclosed by the national highroads, b-99, b-111, b-11, and b-05.

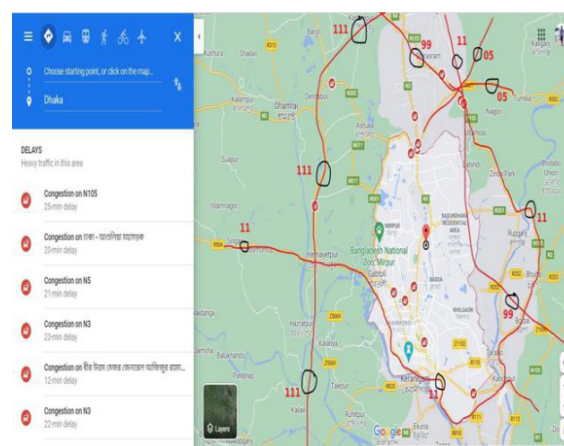


FIGURE 7. Map of Dhaka city/Simulation Case Study Environment

b-n this region, numerous distinctive areas including principal commercial area, housing area, and entertaining places, which is one of the demanding regions in Dhaka city. This region is highly illustrative of large towns. In addition, Figure 8 shows the arriving and departing traffic at two dissimilar times. As we understand, the rush hour of arriving traffic is from clock time 6.00 to 10.00, and the rush hour of departing traffic is from 16.00 to 20.00 clock time. It equals the public's daily timetable in the a.m. most public outing to the job and goes back house after clock time 16.00. As a result, throughout the simulation time, there is a rational traffic search to make the parking request. In addition, the Gaussian distribution at a definite scale from 1 to 10 is our consideration for the parkers' financial plan disposal. We insist on the financial plan being 1 if it is lower than 1, and we fix the financial plan to 10 if it is greater than 10.

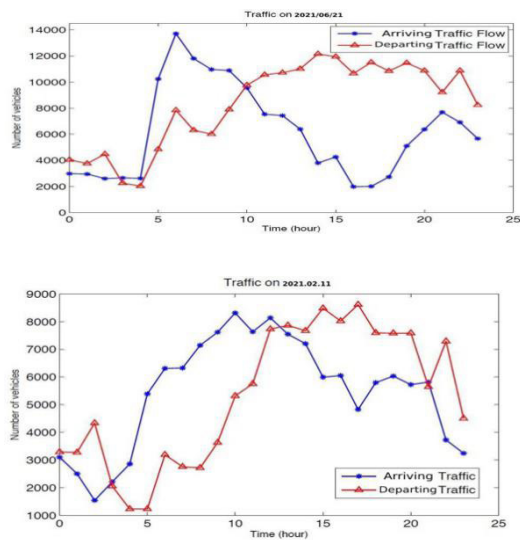


FIGURE 8. Arriving and Departing Traffic Flows

SIMULATION RESULTS FOR iPARK

The subsequent experimental results that have been found compared with other existing methods prove the efficiency and likelihood of our proposed iOS-based smarter parking direction, supervision, checking, and booking-oriented smart parking system solutions named by iPark in an economical method. We assess the efficiency of the booking strategy concerning the succeeding viewpoints compared with other existing methods.

TRAFFIC SEARCHING FOR PARKING

Now we present some existing parking searching methods and illustrate their drawbacks. After that, we simulate these parking methods' performances along with our proposed booking methods and demonstrate the outcomes/differences in this section.

**Blind Search:** This type of searching is agreed upon by operators when there is any information about parking is not exist. Hence, operators seek parking spots randomly within a definite area of their terminal. If an operator gets a vacant space, the operator will end searching; if not, the operator will constantly trace in the adjacent parking spots up to he discovers spots. In this instance, there is no curb sign to direct operators' activities.

**PARKING INFO SHARING (PIS):** This method shows the present status of the smart parking scheme design. When a parker gets the parking accessibility info nearby his/her terminal, the parker will know if the wanted parking spot has vacant slots. Therefore, different parkers make the choice conferring the parking accessibility info. If a parking spot has insufficient parking slots accessible in rush hours, it is expected that more parkers fight for a smaller amount of parking slots. This paradox is known as "multiple-car-chasing-single-space" that could originate from serious blocking.

**BUFFERED PIS (BPIS):** When broadcasting the alive accessibility info, some inventors of intelligent parking methods have invented a way out to sanction a buffer to improve the "multiple-car-chase-single-slot" paradox. Hence, the scheme will display that the parking spot is totally engaged when a parking spot has fewer vacant slots than a threshold. However, defining the threshold for the buffer is really a difficult job. The difficulty of "multiple-car-chase-single-space" will not be removed if the buffer is too little. The use of parking slots will be less if it is excessively big.

**BOOKING METHOD:** To resolve the above-mentioned problem and also decrease the traffic searching for garages, herein we proposed the booking-oriented method, where parkers make the booking over the parking managing scheme. If a parker makes the booking effectively, it assures a vacant parking slot for him, and the parker can park at the booked slot without searching. The booking-oriented method permits parkers to choose the best suitable parking spot considering their economical limits. To point out the model confrontations, we used a dynamic costing method to decide the booking price for parking. This will control the parking activities of parkers and satisfy the requirements of the parking admin.

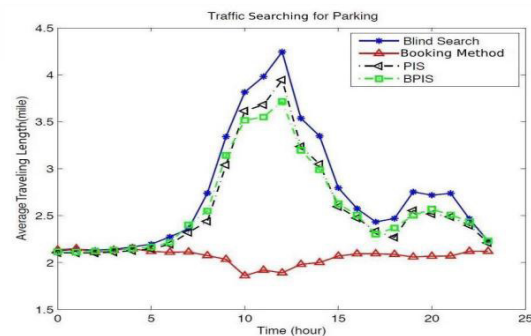


FIGURE 9. Comparison of different methods parking searching traffics'

As we presented above, Figure 9 displays that blind search travelling length is the worst, mostly during the rush hour; when vehicle flows rise the BPIS and PIS are superior to blind search; as well as the Booking Method which is incorporated in our system is leading in comparison with others. Remind that, herein the simulation, there has been no costing method development in the booking process. A remarkable reflection of our proposed Booking Method is that at rush hour the avg. Traveling length is reducing, rather than growing.

To wit because, after operators study the status of parking spots, they have tended to book the adjacent parking spot to his/her target. Throughout the rush hours, maximum parking spots are more or less totally unavailable in the prime region. As a result, operators have to choose the parking spots in the adjoining regions, which are adjacent to their entry edge. As a consequence, it marks the decrease of avg. traveling length throughout the rush hours.

Connected to the dynamic costing method, the static costing method is an option for parking admins. We perform the following simulation to compare the road traffic searching for parking under dynamic and static costing choices that are the names of two dissimilar costing methods, in which the dynamic costing method is used in our proposed system for calculating parking spot cost and the static costing method is used in other existing systems.

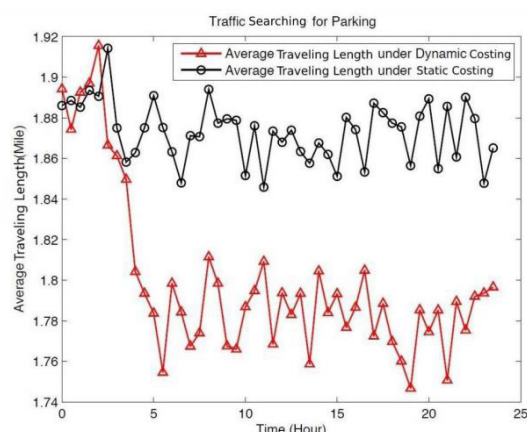


FIGURE 10. Comparison of Travelling Length Covered by Searching for Parking under Dissimilar Costing Methods

Throughout the simulation, both the static cost and dynamic costing's primary cost are fixed as ¥1 for each time slice. On behalf of the costing method of dynamic,  $\beta_u$ ,  $\beta_s$ ,  $\beta_c$  are fixed to 0.6, 0.4, and 0.3 that signify the dissimilar weights for diverse cost modules. As displayed in figure 10, via employing the dynamic costing method, the avg. the traveling length of all operators for parking searching might be decreased.

In common, based on dynamic parking cost an operator will choose a parking spot which can give the maximum profit. In disparity, under static costing, every operator cannot learn the associated parking info from the cost and is simply interested in the traveling length. It permits self-centered operators to track the adjacent parking spots to their target without any constraint. As a consequence, the parking spots in rush regions are completely unavailable, which vigor a part of operators to drive extra and unused petrol. In different circumstances, the unavailable ratio in adjoining regions is greatly inferior. It additionally originates from the difficulty of load equity. Figure 10 displays that, throughout the early stages, the performance of traveling length is analogous under dynamic and static two dissimilar methods. After that, with the traffic flow growing, the parking cost is increasing and the congestion cost is accused of avoiding additional jamming. In reply, few operators change their choices from costly parking spots to the next at low-priced costs. As per the consequence, the parking request is more balanced throughout all parking spots, causing the decrease of traveling length in comparison with the static costing method.

## CONCLUSION

The ease of smart parking methods is somewhat a challenge in the present day. Since the beginning of technologically advanced cities, the number of cars has been growing and day-by-day individuals are fronting higher suffering while trying to cope with their cars in a parking lot. This picture of parking emergencies provides rise to innovative results with the aid of iOS apps' therefore handling car parking systems. This paper focuses on the emergency of car parking across an isolated city and comes out with an iOS-based secondary cellular application system. The recommended research result provides real-time info of a smart car parking lot and is able to harmonize with the iOS mobile application, therefore, giving users the likelihood of booking a parking lot residing at a far distance. From the simulation results, we can conclude that this research lessens the outcomes in all sectors like searching time, gasoline redeemable, and GHG outflow decrease when compared with other existing systems.

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## DECLARATION OF COMPETING INTEREST

None

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