

# INTELLIGENT PARKING SYSTEM

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**Abstract**—Parking is a problem for almost everyone today so there has to be a solution, which helps getting rid of problems arising due to the lack of a proper parking management system. Although various traditional PGIS (Parking Guidance Information System) exist, they can serve only a few users because it is difficult for such static systems to disseminate information on a wider scale. So, the aim of this study is to provide a dynamic solution by introducing the concept of parking guidance system over the internet and also using one of the latest techniques available today i.e. the QR code for the user's ease. The system is basically designed for a parking which can further be extended as required. This system enhances the components of existing parking system available in the colleges. This system runs on a mobile phone platform and provides a visual display of parking lots available to the user so that the user can book or reserve a space. The Quick Response QR code is affixed at every parking space. The user can thus select the parking space from the visual display. The user needs to scan the QR Code while parking and unparking the vehicle. The action of the user is then reflected in the database. The android application was thus developed that can incur the parking information which was uploaded on the web map server. This system reduces the time which is involved in searching the parking space thus reducing the fuel consumption, user's frustration. It reduces vehicle travel time and parking time.

**Keywords**— Android, Shortest Path First Algorithm, Neural Networks.

## I. INTRODUCTION

Use of automobiles is increasing day by day which leads to various parking issues. Vehicular population is shooting out the roof, no amount of space is sufficient to accommodate stationary vehicles. Management of parking has grown to large extent. The main problem is to manage parking in congested areas. One of the congested areas is college campus. However, improving parking on campus is important. The problem is parking spaces are either insufficient according to the demands of students or these spaces are poorly allocated. Colleges have to try almost every possible way to deal with problem of campus parking. Parking on campus needs improvement. Users entering the university are allowed to have a car on campus. With every new freshman entering parking possess a problem in campus. Problems in parking campus results in users' inconvenience, which results in frustration.

Parking the car today need parking policies for safety and security reasons. There is always competition for the parking space. A good solution to overcome parking crises would be by increasing the number of parking spaces or else enlarge the parking lots, but this will lead to huge investment. However better management of existing parking spaces will be wise method. The availability of parking spaces should be improved. Another approach for managing parking in campus is by improving the efficiency of the use of existing parking spaces, by informing user about available parking space and guiding him accordingly. Daily, it is estimated that 30% of vehicles in the central area of cities travel around for finding parking slots, which takes an average of 7.8 minutes to find parking slots. Travelling around on streets for parking does not only waste time and fuel for drivers but also contributes to additional traffic congestion, gas emissions, and traffic accidents. Not only the scarcity of parking area but also the lack of well-designed reservation system for parking services is another parking problem. Since past few years, on-street and garage parking management problems attract attention from transportation science, operational management and computer science fields. Some researchers design and implement various smart parking systems. The automatic allocation or reservation approach is a key element in parking management systems. Many researchers combined parking reservation and pricing models to minimize the drivers' costs and maximize the resource utilization.

Now a day there is growing popularity and affordability of internet-enabled smartphones and because of data available online we can step to solve parking problem. Android smartphone enables user to virtually carry the internet with him. According to the traditional approach, Drivers have to waste time for finding a parking spot in a new area or a crowded area and finding an empty parking space in that selected parking slot is a tedious job. Not finding a parking space sometimes is indeed a critical issue and can cause congestion on streets. The number of vehicles is also increasing each day, adding to the parking issues faced at public places. Drivers in metro cities face difficulties on a daily basis to find a parking space especially during peak hours, the difficulty roots from lack of knowledge of where the parking spaces are available at the given time. Even if it is known, many vehicles may pursue a small number of parking spaces which in turn leads to traffic congestion. The traffic on roads and parking space has been an

area of concern in majority of the cities. To avoid these problems, recently many new technologies have been developed that help in solving the parking problems to a great extent. Availability of a parking spot is unknown to the drivers, hence after finding a parking lot it is uncertain whether the driver will get a parking spot or not, due to unavailability of parking spaces. This could result in wastage of time, money and fuel since travelling to such a parking lot will be useless. Sometimes while paying for the parking there is a shortage of exact change available at both the sides i.e. at the customer side and as well the parking manager side. So, it is a hectic job to find the exact amount or change required.

## II. BACKGROUND AND RELATED WORK

**Vision Based Method:** Monitoring detection technology can be divided into two categories. The first estimates the number of remaining vacant spaces for the entire parking lot by counting incoming and outgoing vehicles. The second monitors the status of each individual space and can be used to guide a car to a vacant space. To detect the status of an individual parking space different methods have been utilized, such as ultrasonic sensors placed at each, or surveillance cameras placed at a high position.

**Sensor Based Method:** Another detection technology uses sensors to detect vacant spaces in a parking lot.. Intrusive sensors need to be installed directly on the pavement surface, so digging and tunneling under the road surface are required. Non-intrusive sensors only require fixing on the ceiling or on the ground. They use the reflected energy to analyze and detect the status of a parking space. Ultrasonic waves are emitted from the head of an ultrasonic vehicle detection sensor every 60 milliseconds, and the presence or absence of vehicles is determined by time differences between the emitted and received signals.

**Two Tier Parking & Automatic Multilevel Car Parking System:** Two Tier Car Parking System is ideally suited for people having 2 cars They can use parking space for a single car to park both their cars using the Two-Tier Parking System one above the other. The system consists of a single platform which allows the car that is not used very frequently to be parked on the upper level and the one that is used frequently on the lower level.

**Performance Metrics:** In order to evaluate the performance of the strategies implemented in smart parking systems, we introduce the following metrics, which reflect the willingness of drivers, and our concerns on traffic congestion and environmental protection.

**Walking Distance:** The driver commonly wants to choose the most convenient parking space where it is closest to his destination. In the proposed model of SPSR, the drivers select the parking spaces depending on this factor, which indicates their satisfaction.

**Traffic Volume:** In our proposed model, traffic volume is specifically defined as the amount of traffic generated by parking searching. This factor is not negligible and associated with the traffic congestion and air pollution. The proposed reservation-based smart parking system is design to reduce the traffic volume caused by parking searching, as well as satisfy the need of drivers. We investigate performance of the proposed smart parking system using these performance metrics.

## III. LITURATURE SURVEY

### State-of-the-art Parking Management

Traffic searching for parking comparison under different parking guidance strategies. Many parking guidance systems have been developed over the past decade. In this subsection, we study several existing parking guidance approaches and explain their limitations. Furthermore, we simulate these different parking management strategies under realistic traffic and parking conditions, compare their performance, and show results.

### Blind Search

Blind searching is the simple strategy applied by users when there is no parking information. In this case, the drivers keep cruising for parking spaces within a certain distance to their destination. The drivers will stop searching until finding any available space. Otherwise, the drivers will extend the searching area and continuously look for vacant spaces in the neighboring parking lots.

### Parking Information Sharing (PIS)

This mechanism is commonly adopted by the current state of the smart Parking system design. After the smart parking system publishes the parking availability information to the drivers in certain area, the driver will decide their desired parking destination where the parking lot has available spaces, according to the obtained parking availability information. However, if the number of vacant spaces in a parking lot is very limited in busy hours, it is likely that the number of drivers in demand for these parking spaces, which is based on parking information. This phenomenon is called “multiple-car-chasing-single-space”, which may cause severe congestion.

### Buffered PIS (BPIS)

To address the problematic “multiple-car-chase-single-slot” phenomenon, some designers of smart parking systems modify the PIS mechanism. They intentionally reduce the number of vacant spaces, when publishing the live availability information to keep a buffer. Therefore, though there may be more drivers pursuing the limited available spaces, the system has some extra spaces to avoid the conflict. But it is difficult to determine the number of the buffer spaces. If the buffer is too small, the problem of “multiple-car-chase-single-space” will not be eliminated. If it is too large, the utilization of parking spaces will be low. As alluded to above, the blind search system is an open loop system, where users make decision without looking at the state of the system. The PIS and BPIS strategies allow drivers to make decisions based on the system state (e.g.,

parking availability information). However, the phenomena of multiple car-chase-single-spaces cannot be fully eliminated. To reduce the traffic searching for parking, we suggest a reservation based system, where drivers make reservations through the parking management system. If a driver makes the reservation successfully, it guarantees an available parking space for him, and the driver can park at the reserved space without searching. The reservation-based system allows drivers to select the most convenient parking space under their budget constraints.

#### IV. PROPOSED SYSTEM

There are three components in the smart parking model, including parking zones, users and the database smart parking system. The management system determines the parking prices and broadcast lives parking availability information to users (also drivers). Upon receiving parking information, the user selects desired parking lot and reserves a space. As soon as user reserves a parking space, System generates a unique QR code and sends it to the user. As a result, the state of parking resources is changed by users parking decisions. The parking lot consists of a group of parking spaces. The state of a parking lot is the number of occupied spaces versus total spaces. Every parking lot has access to the Internet to communicate with the management system and users, and share parking information with other parking lots. In each parking lot, the reservation authority is deployed for authenticating the individual user's identity and reservation request

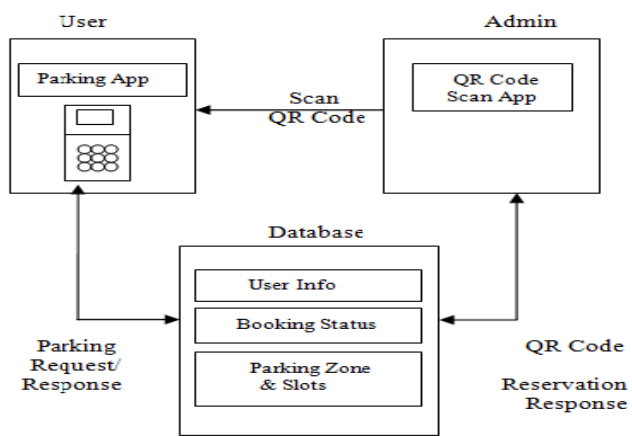


Figure 1: System Architecture

In this case, Reservation authority identifies each user by the unique QR code which has been send by the management system to the user at the time of reservation. Once the reservation order is confirmed, the reservation authority updates reservation information to hold the related space for the user. Upon retrieving the parking information, the system updates the state of the parking lot. Based on the state of parking lots, the system analyzes their occupancy status and congestion level, determines the parking prices according to their pricing scheme, broadcasts the prices to all users periodically, and stores the parking information, QR code and prices for further analysis. The system serves as the centralized decision-making

body in a planned economy. It makes all pricing decisions regarding the state of parking lots and user demands. This system is a closed-loop system to dynamically adjust parking price, balance the benefits between users, and service providers and reduce traffic searching for parking. By placing the reservation authority on the gate each user has been identified by the QR code, when user reaches the parking spot. Host demands for the QR code and verify the details by scanning the QR code. Since user does not need to communicate with his desired parking lot host to make his reservation, rather he directly scan the QR code by host QR code scanner and verify the details just like a centralized system. Due to this the communication overhead of reservation is highly reduced. Also, since each parking lot manages its own reservation information, it makes the reservation requests from users easily to be synchronized, comparing with reservation synchronization in the system.

**Hardware:** The system hardware is organized into three main components, the QR code scanner, the central server and the mobile device, as shown in Fig 2. In the following, we discuss the detailed design and implementation of each component, along with the specification of communication between them.

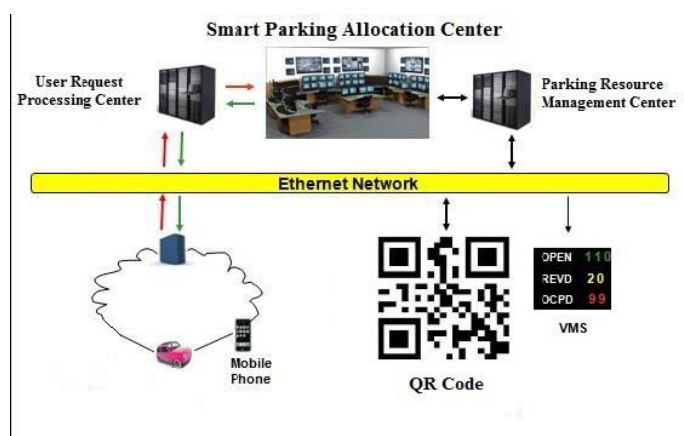


Figure 2: Design and Implementation

Android Smartphone's and a Central Server. One Android Smartphone is for user which would have parking App and another one is for the admin at the parking lot for Scanning QR code. Both the Phones should have internet connection. The Central Server is connected to both the Smartphone's for performing various SQL operations.

#### Software

Fig. 3 shows the design of software architecture of user API, primarily defining the Android application, which is the central location of the system to user applications and functions also the Host application as the point of control and configuration for the distributed system. Primary software elements are discussed in the following.

Main System Architecture shows the parking of Smart Parking System based on reservation. The applications are built on Android Platform. Two different apps are used in our System. One is at the user end and another one is for the admin at the parking lot. The Parking app in the user's phone is used to

reserve space in desired parking lot. User has to first create an account to be able to use the services provided. Once account is created, user can login with its mobile no as username and password. User can then select appropriate parking lot and check availability. If free spaces are available then user can proceed with space reservation. One user is allowed to reserve only one space. For booking, user has to enter its vehicle's identification number with the start time and end time of reservation. Once Parking space is reserved, a QR code is generated which is used for authentication at the admin end. User is provided with a service that allows user to delay the start time (arrival time) by 15 minutes. If the user is not able to arrive within the extended time then the reservation is discarded. User is also given a chance to delay the ending time. Prior notifications are sent to users phone to indicate that reservation time is about to expire (ending time is about to reach). User is then given a chance to extend the ending time. Additional Fares are calculated accordingly for the extended hours. The app at the admin Fig.4 end is used to scan QR code generated in users parking app at the time of reserving space. This makes sure that only users with reservation are allowed to park vehicle. Once QR code in user phone is scanned and is found to be authenticated, database is automatically updated and respective Parking slot status is changed from RESERVED to OCCUPIED. Admin can see all parking slot details. Parking slots would be displayed as graphical boxes colored as Red, Green and White. Each color indicates one of the constraints. Green Indicates slot is reserved, White indicates that the slot is free and Red indicates expired slots. Such expired slots have the option of delete which would turn them into free slots.

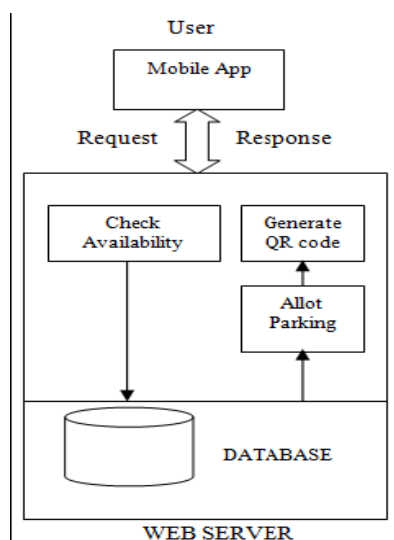


Figure 3: User API

Fig. 4 shows the Admin API which is an android base application, in this application the parking lot manager registers and enters various essential details related to parking lot. The managers will get their respective user id and password for accessing the module. When a vehicle enters into the parking and is being allocated a parking spot, the status of that parking spot is updated by the manager using the application so as to

keep real-time status of the parking spot. When the customer (i.e. User using the Customer module) enters the parking lot, the manager scans the QR code for authenticating the user. Another QR code scan is done while the user exits the parking lot for confirmation of payment.

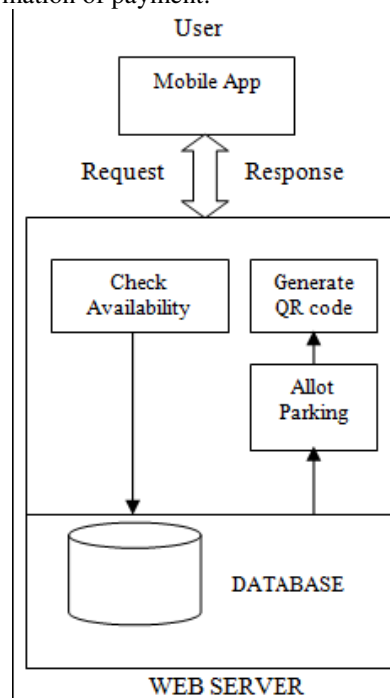


Figure 3: Admin API

## V. COST ESTIMATION

Since the team size required is adequately small, the problem is well understood and has been solved in the past and also the team members have a nominal experience regarding the problem, hence, the software project is said to be an organic type. Considering organic value, the basic COCOMO can be calculated as follows:

Effort estimation is required to find the number of persons working on project, number of duration and lastly cost.

### Efforts

$$E = ab(KLOC)^{bb} E = 2.4(3.2)^{1.05}$$

$$E = 8.14 \text{ person per month} \sim 8.$$

### Project Duration

$$D = cb(E)^{db} D = 2.5(8)^{0.38}$$

$$D = 5.509 \text{ months} \sim 5.$$

### Number of Person

$$N = E/D$$

$$N = 8.14/5.50$$

$$N = 1.51 \sim 2 \text{ persons.}$$

Since, major project is software based only the cost required to complete the project is the effort required to design and code the system. If we assume cost per person monthly is Rs: 250.

Estimate cost = Efforts \* 250 \* number of persons.

$$\text{Estimated cost} = 8.04 * 250 * 3 = 6030$$



## VI. CHALLENGES FACED

Given the design objectives of smart parking systems that require the coordination among multiple parties, we summarize the main design considerations as follows:

### Fake Parking Requests:

The system collects and stores the data about the performance metrics including the status of parking space, reservation time, parking location, driver's identity. All data stored by the system is at least stamped with time metadata. As the user is allowed to book only one parking space at a time from one id, it is a big challenge for us if user is trying to book one or many requests at a time from one id. To overcome this problem, we implemented a queue buffer which persistently checking the new request and compare it with the existing id requests. If any request id matches existing id then the request is directly discarded and a message showing 'no more parking spaces available' is displayed.

### Users Identity Verification:

Verifying user's identity is a major security concern as users with no reservation can enter and occupy someone else's parking space. In our proposed system, the user can open the application and verify their identity via the received QR code. Reservation authority sends a QR code to the user as soon as user reserves the parking space. At the parking lot host identifies the user by scanning the QR code generated by authority management system.

### Delay in parking:

User reserves a parking space for specific time duration (Starting time & ending time). What if the user is unable to reach the parking spot at the aforementioned time? To overcome this challenge, we provided the time extend option to the user, but user can only extend the time by 15 min from the specified time. User has to pay some extra money to extend the time.

### Timer:

As soon as reservation time is about to expire, user must be notified about this. To deal with this, SPSR gives prior notifications at regular intervals to the user. For example, if there are only 30 minutes left to reach the expiration time, SPSR will give notification when 20 minutes are elapsed and when 10 minutes are elapsed a final notification is given.

## VII. CONCLUSION

In this project, we have developed a new system of parking reservation. In this system, we implement parking reservation policy to balance the benefit of service providers and requirements from the users. Moreover, we have presented the detailed design, implementation and evaluation of the system. Based on the obtained results from our simulation study, we conclude that the proposed reservation-based smart parking system can alleviate traffic congestion caused parking searching and reduce the amount of traffic volume searching for parking.

The application provides a solution to overcome the problem of finding a parking space. The system implements a dynamical allocation of parking slots to the users as well as gives a pricing model based on the timeslot required for parking. User authentication and payment authentication can be formulated using QR code present in the system. Due to real-time nature of database and use of cloud functions, the system has a real-time and updated status of parking lots. This system helps user to not only find and reserve a parking space but also to save time, fuel and energy. Due to simplicity of GUI, portability of smartphones & android application and system being online, any registered user can login and use the system from anywhere at his/her own convenience.

## VIII. FUTURE SCOPE

This app is a small step to make city a 'smart city'. This can be developed in future for wide area so that it can help people on large scale. In future this application can be implemented on the existing operation systems like ios and windows. And also, it would be viable to add some extra features like extend the time period of booked slot and should be possible to send message to user before expired time period.

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