



## Survey paper on Smart Parking System based on Internet of Things

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**Abstract**—This paper proposes a Smart Parking system which provides an optimal solution for parking problem in metropolitan cities. Due to rapid increase in vehicle density especially during the peak hours of the day, it is a difficult task for the drivers to find a parking space to park their vehicles. The aim of the paper is to resolve the above mentioned issue which provides the Smart Parking system. This system uses cloud computing and Internet of Things (IOT) technology. A suitable shortest path algorithm is used to find the minimum distance between the user and each car park in the system. Thus, the waiting time of the user is minimized. The paper also introduces the usage of android application using smart phone for the interaction between the Smart Parking system and the user. RFID technology is used in this system to avoid the human intervention which minimizes the cost.

**Keywords**— Smart Parking system, RFID Technology and Android.

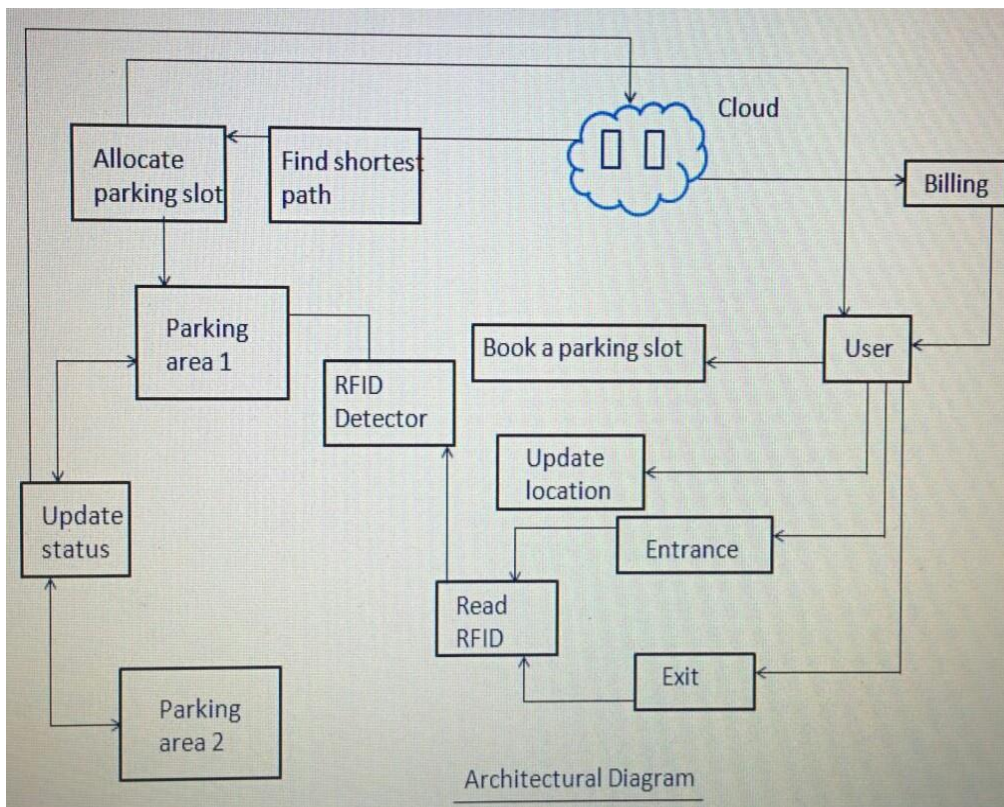
### I. INTRODUCTION

In recent research in metropolitan cities along with increase in population there is high vehicle density on roads. Hence this leads to annoying issue for the drivers to park their vehicles as it is very difficult to find a parking slot. The drivers usually waste time and effort and end up parking their vehicles finding a space on streets through luck. In worst case, people fail to find any parking space especially during peak hours and festive seasons.

However, in current parking system a better but not an optimal solution is being provided. It does not provide economic benefit, vehicle refusal services and there is no resource reservation mechanism leading to queuing system which is again time consuming. It also lacks to provide large scale parking system. There are android applications available where the cost is calculated from the time the parking slot has been booked which is not economically beneficial for the users. Parking Guidance and Information (PGI) systems for better parking management is also available. PGI systems will provide the drivers with effective information on parking within controlled areas and lead them to empty parking slots [2][3]. And parking management system is also available which is using ZigBee technology [4].

To resolve the above mentioned issue, further we propose a cloud based smart parking system which uses Internet of Things (IoT) [1][5]. In this system, all the physical objects like smartphone, GPS location, cloud based servers and all car parks are connected to form network architecture and it is an automatic system where we use a Radio Frequency Identification (RFID) technology. We use RFID reader which is a sensor that reads the RFID tag and authenticates the user information. All the car parks in the intended area are connected to form a parking network. Here, each car park in the parking network is an IoT network which is connected to its neighboring car parks through WiFi [1]. First, the parking manager should register his car park in the portal (cloud server), if he wants to provide the service in smart parking system and then login to the portal. The user has to register first to get the service from the smart parking system which returns him the RFID tag which contains a unique number.

After the registration is done, the user has to download the android application for booking a parking slot. The below diagram shows the architecture of the system:



The user books the parking slot using the android application by specifying his destination and the type of vehicle which is updated to the cloud. The cloud finds the shortest path which is the distance between the car park and the vehicle and allocates the parking space and this information is sent to the user. When the user starts from his place to destination, the GPS location is updated to cloud server periodically. Then, when the user reaches the car park the RFID tag is read and authenticated by the RFID reader after which the user is allowed to use the parking space. This information is updated to the cloud and to the neighbor car park. When the user exits the car park the RFID tag is read again by the RFID reader which is further updated to the cloud. Then billing process will take place in the cloud server and this information is sent to the user.

## II. RELATED WORK

### A. A Cloud-Based Smart-Parking System Based on Internet-of-Things Technologies

This paper provides a unique algorithm which increases the capability of the current cloud based smart parking system [5] and it also develops a network architecture based on the Internet of Things technology. This system helps the users to find a free parking space with minimal cost based on new performance metrics which is automatic. This metrics will calculate the user spaces in each car park. To enhance the parking management, an intelligent parking system was developed which reduced the purpose of hiring people to maintain the parking system [1].

In this paper it proposes an effective cloud-based Smart parking system based on the Internet of Things. The data that includes the vehicle GPS location and distance between car parks and number of free parking space in car parks will be sent to the data center. Here the data center is presented as a cloud server which calculates the costs of a user parking request and this information is regularly updated and is made available to the vehicles in the network at any time. In this proposed system, each car park is an IoT network and it operates independently as a regular car park. This paper

implements a system model with wireless access in an open-source physical computing platform based on Arduino with RFID technology. It uses smartphone that acts as a user interface between the cloud and the vehicles to check the feasibility of the proposed system [4].

**Advantages:**

1. Better performance.
2. Low Cost.
3. Includes resource allocation mechanism.
4. Provides large scale parking system.

**Disadvantage:**

1. Car park should be registered in the smart parking system to provide service.
2. The service cannot be provided if there is no smartphone.

## **B. Smart Routing: A Novel Application of Collaborative Pathfinding to Smart Parking Systems**

In this paper smart parking system provides guidance to the drivers to find available parking spaces to avoid increasing parking issue. Traffic authorities in many metropolitan cities have initiated parking guidance and information (PGI) systems [2], providing drivers with up-to-date information on the available parking spaces and direct the drivers accordingly. The information is provided to the driver over the internet. The systems provide the location of the available car park spaces based on the driver's current location in intended area or his final destination. Global Positioning system (GPS) is used to trace the driver's route to the parking destination, after the parking space is reserved [3]. This results in traffic congestion as multiple users are being directed toward the same parking area at the same time.

In this paper, a standard A-star path-finding algorithm is been implemented to trace multiple users concurrently, while taking into account one another's nearest distance to the parking area in their respective routes. In this approach the user avoids over occupying the same parking space by taking different decision on the respective shortest route. A selection technique is used to identify and provide the most efficient solution for all users at any particular time. A Smart routing scheme which will use a PGI system is beneficial which provides less congestion and journey times for users are also reduced [2]. This approach is also economically beneficial and efficient.

**Advantages:**

1. It improve efficiency of smart parking systems
2. It reduces traffic congestion in metropolitan environments, while increasing efficiency of parking areas.

**Disadvantages:**

1. It is a complex system protocols to domains of commercial interest.

## **C. A New "Smart Parking" System Based on Optimal Resource Allocation and Reservations**

In this system a new smart parking system is implemented for cities. This system assigns and reserves a parking space for a user (driver) based on the users distance from the parking area and parking cost and also ensures that the overall parking capacity is effectively utilized. Their approach solves a Mixed Integer Linear Program (MILP) problem at each decision point in a time-driven sequence [3]. For each MILP there is a solution which gives an optimal allocation based on user's current state information and also supports random events such as new user requests and parking space availability. The allocation is updated at the next decision point which ensures that there is no parking slot reservation conflict and that no user is ever assigned a parking slot with higher than the current cost function value. This mechanism ensures a better response from the system along with assured reservations.

**Advantages:**

1. They can receive a quick response from the system and have guaranteed reservations.

2. An upper bound on the cost this user is willing to tolerate for the benefit of reserving and subsequently using a resource.

**Disadvantages:**

1. This parking system is efficient for urban environment only.

**D. The Research and Implement of the Intelligent Parking Reservation Management System Based on ZigBee Technology.**

With the increasing development of economy and city modernization level, traffic congestion and parking have become major social issue due to the increasing amount vehicle density. In order to overcome this parking issue a smart parking system has been proposed in this paper which is composed of ZigBee network which sends the user requested information to PC through a coordinator and further updates the database [4]. Using the internet, the parking information is provided to the application layer to make it convenient for the people seeking for the parking position with the help of web-services. The system consists of mobile client and server side parking lot. The client requests the server for parking information through web-service interface. Then the server searches for the requested information in the available database and returns the required information to the client using the web-service interface. The real time update status is available to the mobile client to ensure the correctness of the required information in the process [6].

**Advantages:**

1. It uses an effective database.
2. It is simple and based on android.

**Disadvantages:**

1. The system choices are more expensive.

### III. COMPARISON ANALYSIS

*Table: Comparison on Method used, Technology and GPS*

SURVEY PAPER	METHOD USED	TECHNOLOGY	GPS
Smart routing	A-star path-finding algorithm	Parking guidance and information system	To plot the driver's route to parking destination
A New "Smart Parking" System Based on Optimal Resource Allocation and Reservations	Dynamic resource allocation using queuing model	Parking guidance and information system	Accurate localization and speed estimation of vehicle
A Cloud-Based Smart-Parking System Based on Internet-of-Things Technologies	Shortest path algorithm	Internet of Things , Cloud computing and Android	For identifying and tracking the vehicle
The Research and Implement ofthe Intelligent Parking Reservation Management System Based on ZigBee Technology.	Real time client server	ZigBee technology and Android	For navigation

### IV. CONCLUSION

In this paper, the implementation of cloud based smart parking system using Internet of Things is discussed. This system includes RFID technology with Android application which provides user interface for control system and vehicles. The average waiting time of users for parking their



vehicles is effectively reduced in this system. The optimal solution is provided by the proposed system, where most of the vehicles find a free parking space successfully. This smart parking system provides better performance, low cost and efficient large scale parking system. Security measure to ensure that the users do not misuse the parking system can be implemented.

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