

# Innovative Parking Solution Based on IoT: A Survey

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**Abstract:** *With the increase in population and rapidly growing economy, the use of private means of transportation is also increasing. In Metropolitan Cities people prefer to travel by own vehicles as a convenient means of transport. With this, finding a proper and safe parking space is difficult. Thus, there is a need to find an assistive and efficient technology which would reduce the effort of searching a parking lot in highly dense areas. This paper focuses on various methods proposed to provide parking solutions.*

**Keywords:** *RFID; Parking; Internet of Things; Cloud Computing; Android; GSM; Sensors*

## I. INTRODUCTION

Internet of Things is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or external environment. An IoT system involves web enabled smart devices that use embedded processor, sensors and communication hardware to collect, send and act on data they acquire from their environment.

A lot of time and fuel is wasted searching for a decent parking spot. This is because of increased sales in vehicle, thus increasing the number of vehicles on road. This paper focuses on several techniques that have been proposed to help the car owners/drivers tackle this humongous problem.

## II. LITERATURE SURVEY

According to [2] the proposed smart parking system based on IoT provides low cost, faster, reliable and efficient way of parking of the vehicle. User will get to know the available parking slot using a webpage. This can reduce manpower and traffic congestion. Access to all the parking slots is provided which are available in a particular area. This reduces the delay to find a parking slot, provides security and aids to reduce the manpower requirements.

Due to the increase in population, the number of vehicles is also increasing rapidly. Thus, there arises the problem of traffic congestion and also improper management of the available spaces for parking. Thus, a new system is proposed in [4] in which, the parking space is categorized into different sections based on the time spent in at a particular building complex. Different individual has different timing based on their purpose. Thus, categorizing the parking space based on the time spent is the main aspect of this system. This system is equipped with internet so that access can be obtained

through any internet connected device. In order to make the system efficient and cost effective, Zigbee is being used. The important components used in this system are Ultrasonic sensors and RGB led. The status (engaged or free) of the parking space is sensed by the ultrasonic sensor and the information is bounced to the Centre Control Unit. Later this status is displayed through the RGB led. The user can access the system through their device when connected to the internet. Thus, this system provides an efficient reservation and scheduling system into the present-day parking system. The implementation cost is reduced using wireless sensor networks.

The above system can be integrated with a mobile application or a webpage in order to enable easier usage of the system. Also, authentication to the parking space can be provided.

The different Sensor Technologies that can be implemented in the Smart Parking System is discussed in [5]. Also, a framework is being proposed for Smart Parking System. The research also says that, 28%-45% of drivers were struggling in search of a parking slot in Manhattan at a given time interval. The sensing system proposed here detects the vehicle sized objects passing over the sensors. This also involves a system called Auto Count which will count the number of vehicles entering and leaving the parking space. This information can be used for real time analysis.

In order to determine the empty space for parking, Infrared Sensors and Ultrasonic Sensors can be used. The sensors emit light or sound waves respectively. If the wave reflects back to the sensor, it indicates that the parking space is engaged. An alternative sensor that can be used for this purpose is, In-ground inductive Loop Sensor which detects the metal objects present over it. All the above systems are one-to-one mapping which is not cost effective. Thus, topological mapping (mapping multiple parking spaces to a single sensor) can be implemented using camera sensor. Usage of Topological mapping provides more versatility when compared with one-to-one mapping. This is also cost effective and at the same time proper optimization is provided.

The method proposed in [6] provides better detection of improper parking system and also aids to automatic collection of parking charges. Parking meter is a device used for efficient parking management. Using RFID technology, automatic check-in and check-out process can be implemented in parking area. The information about available parking space is provided and reservation using GUI can be done. This detects the improper vehicle parking within a particular area and also estimates the

time period for which the parking area is engaged. Using smart payment automatic collection of parking charges can be done. The mobile app can be used, which is a best way of collecting parking charges.

According to [7], along with the increase in the number of car users, carnapping is also increasing rapidly in recent years. Thus providing a security system against this issue is highly necessary. To achieve this objective, RFID – Radio Frequency Identification Technology can be implemented. In RFID Technology, each and every vehicle consists of a unique RFID Tag. This is registered to the database that contains owner's and the vehicle's details. The technology also involves a RFID reader which would scan the RFID Tag attached to the vehicle. Through this, easy detection of the carnapping can be achieved when the particular vehicle passes by the RFID reader.

This technology can be used to provide authentication to the users into the parking space. This section also gives us information regarding two types of RFID Tags. i.e., 'Passive RFID Tags' and 'Writing RFID Tags.' In order to design this system, High Frequency Structural Simulator (HFSS) is the software being used. To obtain the information regarding the vehicle, the user is provided with a mobile application. To develop this application IDE-Integrated Development Environment is used. Thus, RFID Technology acts as one of the best means to detect carnapping. HFSS-High Frequency Structural Simulator is the software used to simulate an antenna of 920MHz.

Cloud computing is a technology which is built on virtualization, utility computing, service-oriented and parallel computing. Cloud services are provided to the users by companies like Yahoo, Google and Amazon etc. Cloud is an infrastructure provided to the users for sharing and storing of data. Cloud service is the service which is completely based on internet. Agility, scalability, security, reliability, resource pooling are the features of Cloud computing. Cloud computing consists of three services that is Software as a Service, Platform as a Service and Infrastructure as Service. The Cloud is of four types that is Private Cloud, Public Cloud, Community Cloud and Hybrid Cloud.

The paper [8] deals with the fundamentals of Cloud computing. It provides knowledge about security issues, storage issues, data related issues, policy issues, legal issues, trust issues and attacks on Cloud. A more efficient model can be developed in order to provide better security. A scheme can be introduced to enable the users to detect faults and to handle it. Model to prevent data loss and also a new access control model for more efficient data accessing can be developed.

According to [10], the market areas like automobiles, navigation and surveillance which use GSM and GPS technology have their great applications. GSM and GPS are can be used for various wireless applications in which they are integrated into the board SIM808 SIMcom. The developed module is connected with PC to know feature of GSM and GPS by sending the AT command. This module can be implemented in various applications like

automobiles, tracking etc. The GPS provides us the details about the objects latitude, longitude and altitude through GPS technology. To know the exact location the SIM808 module is used to receive co-ordinates from satellite. The GSM module helps us to send or receive SMS and even to make calls. By interfacing module Microcontroller or computer tracking or message can be achieved. One of the GSM and GPS services is M66 which gives good accuracy in SMS, audio services and data transmission in harsh condition of environment. It has the size of 15.8\*17.7\*2.3mm.

SIM900 by SIMcom can also be used for voice, SMS and data with low power consumption. The GSM is used for mapping and tracking purposes. The GSM/GPRS module works under various frequency GSM 850MHZ, DCS 1800MHZ, PCS 1900MHZ and EGSM 900MHZ and has coding schemes of CS, CS2, CS3 and CS4. SIM808 also supports USB port which can be implemented for software upgrade and also for audio interfaces. GSM and GPS module is developed using SIM808. It is connected to PC through serial port and the module is tested by sending AT commands from the PC. It helps for mapping and tracking applications.

Paper [11] proposes the knowledge of how the same app can be used in different platforms and also study on mobile application pairs. Since the iOS and Android Apps are dominating the market, here it focuses on these two platforms. For the data collection in Android, Google Play Store Crawler is an open source crawler that is used. In iOS, Apple Store Crawler is an open source crawler that is used. This provides a study on cross platform mobile apps. It provides knowledge about some of the differences in app-pair attributes like update frequencies, prices, AUR rates and top-rated apps that exists only on a platform. In future this technology can be used for testing and analysis of apps in multiple platforms. The features of an app can be compared in different platforms.

Android app can be developed using Android SDK, MIT App Inventor and also using IDEs such as Android studio or a browser based platform called App Inventor [12]. The second version of Google's App Inventor is MIT AI, it is a simplest web browser used to deploy and develop Android Apps. The Android Studio is the tool which has been provided by Google for Android development, debugging, testing and packaging. Communication between the apps developed using AI or AS are straightforward. App Inventor is for beginners, where as App Studio is for Advanced Programmers since it provides more functions when compared to App Inventor. This provides a technique for android inter-app communications which has been developed in two different platforms. In future this technique can be used for complex apps, which will work together when they are designed by using two different platforms.

Applications are available on wide range of platforms such as Android, iOS, Windows [14]. Each of the platforms uses different programming environment, APIs and programming languages for app development. The Cross Platform Framework provides the app developer to

design the app in one platform. Later, this design will automatically get converted into the versions of the other platform. This section mainly deals with challenges faced while developing such Cross-platform frameworks. Basically, there are two different cross-platforms available for app development. They are “Web based Framework” and “Native framework”.

- a) Web-Based framework- The developers can develop an application using languages such as java-script and HTML5. This framework provides standard libraries with which the mobile apps are integrated. Such apps are known as Hybrid apps.
- b) Native Framework-This platform uses languages such as #C and APIs of Windows Phone SDK. These platforms include home platform and one or more target platforms. In this approach, the app is designed for the home platform and the framework, automatically produces the app for the target platforms.

Thus, different platforms that can be used to develop a mobile application are discussed in this section.

Booking is a system that is used to reduce the queue system and to allow users to book the desired seats [15]. Booking can be done online by using Internet. The booking transactions can be made as a part of transfer to network and thus resulting in the reduction of on-site manpower requirement and also services can be improved. The website will provide all the information about the movie and the seats that are available so that the user can book the seats. By this efficient and low-cost ticketing network management will be achieved. It is to achieve remote ticketing. It deploys number of routine management functions. An app can be used for booking purpose. Web page crash can be avoided by using an android app.

### III. SUMMARY

The following table (Table 1.) summarizes the survey carried out.

Table 1. Literature Survey Table

Year	Author	Advantages
Feb 8, 2018	[2] Pranav Chippalkatti, Ganesh Kadam, Vrushali Ichake	This smart parking system based on IoT provides low cost, faster, reliable and efficient way of parking of the vehicle. This can reduce manpower and traffic congestion. This reduces the delay to find a parking slot, provides security and aids to reduce the manpower requirements.
2018	[4] Mohammad Saifullah Bin Mohd Salman, Dr Mohd Noh bin Karsiti, Noor Amin Shahriz Bin	This provides an efficient reservation and scheduling system. The implementation cost is reduced using wireless sensors. The above system can be integrated with a mobile application in order to enable

	Rozly-Azni	easier usage of the system.
2017	[5] Eric Telles, Praveen Meduri	In order to determine the empty space for parking, Infrared Sensors and Ultrasonic Sensors can be used. The sensors emit light or sound waves respectively This is also cost effective and at the same time proper optimization is provided.
2017	[6] Pampa Sadhukhan	This provides detection of improper parking system and collection of parking charges. Parking meter is a device used for efficient parking management. Using RFID technology, automatic check-in and check-out process can be implemented in parking area. The information about available parking space is provided and reservation using GUI can be done
2017	[7] Jessie R. Balbin, Ramon G. Garcia, Brian Christopher F. Aaron, Christopher John D. Celimen, Juan Carlos K. De Peralta.	In RFID Technology, each and every vehicle consists of a unique RFID Tag. This is registered to the database that contains owner’s and the vehicle’s details. The technology also involves a RFID reader which would scan the RFID Tag attached to the vehicle.
2017	[8] Suyel Namasudra, Suyel Namasudra, Balamurugan Balusamy	Cloud is an infrastructure provided to the users for sharing and storing of data. Cloud service is the service which is completely based on internet. Agility, scalability, security, reliability, resource pooling are the features of Cloud computing
May 20, 2017	[10] Bharavi U, Suresh Rae	The market areas like automobiles, navigation and surveillance which use GSM and GPS technology have their great applications. GSM and GPS are can be used for various wireless applications in which they are integrated into the board SIM808 SIMcom. It helps for mapping and tracking applications.
2017	[11] Mohamed Ali, Mona Erfani Joorabchi, Ali Messiah	This proposes the knowledge of how the same app can be used in different platforms and also study on mobile application pairs. Since the iOS and Android Apps are dominating the market, here it focuses on these two platforms.
2016	[12] Lance A. Allison, Mohammad Muztaba Fuad	An Android app can be developed using Android SDK, MIT App Inventor and IDEs such as Android studio or a browser based platform called App Inventor
2011	[15] Bo Hang	Booking of a desired seat can be

		done using a webpage this reduces queue system, efficient and low-cost ticketing network management is achieved
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#### IV. CONCLUSION

In this paper, a solution for the problems faced in parking system is discussed. Though the techniques mentioned in the above papers enhance the existing parking system, some of the problems that are being faced are time consumption, fuel consumption, data management and safety and security issues. By employing a mobile application, the above problems can be resolved. To implement safety measures against fire breakdown, an alert message is sent.

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