



# A Review on Intelligent Vehicle Parking System

Ashy Jose Kachapilly<sup>1</sup>, Santhosh Kumar M S<sup>2</sup>

M.tech - Embedded Systems, Dept of ECE, Sahrdaya College of Engineering and Technology, Thrissur, India,  
jkashy111@gmail.com<sup>1</sup>

Asst. Professor, Dept of ECE, Sahrdaya College of Engineering and Technology, Thrissur, India,  
santhoshkumarms@sahrdaya.ac.in<sup>2</sup>

**Abstract:** Due to the increase in world population and production of vehicles, more and more parking areas and facilities are needed. It also leads to problem of finding the parking space in public areas. It is found that during peak hours, drivers feel difficulty to find a parking space easily. Also the primary cause for parking difficulty is the lack of knowledge of driver about the availability of parking spaces. In recent times, many new techniques have been developed that help in solving the parking problems and there by nullify these inconveniences. This paper is an overview of different techniques used to implement efficient parking system. First section in this paper gives general idea about the parking system and its associated problems. Second section discusses the latest developments in implementing parking system using various techniques. Third section includes performance comparison of different techniques.

**Keywords:** Smart Parking System (SPS); Global Positioning System (GPS); Radio Frequency Identification (RFID); License Plate Recognition (LPR)

## I. INTRODUCTION

In the world today, quick development is achieved by the movement of both things and people; it results in manufacturing many cars and every one use either private or public transport. This leads to high pollution and traffic congestion as well as consumption of time all over the world [1].

Parking is one of the main challenges most people suffer from. Parking causes traffic congestion in various cities, results in pollution, and causes frustration among drivers in the most of the cities around the world. Considering globally, the average time used by the owners of the vehicles searching for a parking space is 20 minutes, 30% of city traffic consists of people looking for parking and recently 60% of drivers have given up on an activity due to the difficulty in finding a parking area. As we look at the methods to solve some of the most important issues faced by our cities today, parking is one among them [2].

Today in parking lots, there is no standard system to find the space for parking. The system mostly depends on human interaction. This leads to wastage of human manpower and becomes inefficient [3]. It also weakens the security of such areas.

Due to the increase in population leads in increase in

the number of vehicles, it becomes very difficult to manage the parking, especially in offices, institutes, and other public places [4].

The main parking lot problems are difficulty in finding the vacant space, improper parking and parking fee payment. When the users go to malls and shopping complex, they face difficulty due to the limited space for parking especially in peak hours.

Parking is one thing where many drivers struggle because of several reasons; such as the traffic jam, the small spots reserved for parking, and poor driving skills [5].

Also all the companies and institutions provide protection and security through proper management and organization of their parking spaces. There comes the need for implementing an Intelligent parking system which can manage the security of the parking area. The purpose of this paper is to review the works done in implementing various intelligent vehicle parking systems.

## II. RELATED WORK

Various techniques have been developed by the researchers to implement an intelligent parking system.

Ming-Yee Chiu et al. introduced a method for measuring the number of vehicles at the entry and thereby



the number of vacant space for parking can be calculated [6]. The calculation is done by installing induction loop sensors under the road surface. Although these sensors are less costly, they are not affected by environmental conditions, and they sense accurately.

Wan-Joo Park et al. described the method in which the ultrasonic detectors are mounted on the cars to search for a free space for parking [7].

R. Yusnita et al. proposed a method in which a brown color round patch was drawn in each parking space for parking the vehicle manually [8]. When the system is on, it checks for the round patch in each parking lot, if that shape is detected that particular space is considered as vacant and will be indicated to the driver. When that shape is not detected due to the presence of objects such as vehicles then the system considers that the slots are not vacant. This system was appropriate for managing the parking space efficiently.

Mamta Gahlan et al. describe the technique to manage the parking by using the GPS (Global Positioning System) [9]. This GPS based system can detect and indicate the free parking slot. Coordinates are used to detect the vacant slot. The architecture includes several modules such as driver module, communication module and function module. In driver module, when GPS is turned on it will find the present location of the user and send the coordinates of the present location to the communication module. The coordinates of the parking system is already stored in the database. Communication module is used to find the distance between the two places. Haversine formula is used to calculate the distance between the coordinates. The server will compare the present coordinates of the driver and the existing coordinates of the parking system.

Amin Kianpisheh et al. proposed a smart parking system (SPS) to help drivers to find free spaces in a parking area within less time. This system uses ultrasonic detectors to detect the occupancy of parking space and improper parking [10]. For each car park, it needs a detector placed on the ceiling above each parking space. This detector is working based on echo-location. The detector transmits ultrasonic sound and it hits on objects such as vehicle/ground and then reflected back to the detector. The distance is calculated using the time between the transmitted signal and the reflected signal. This time will be more in a free slot than in an occupied slot, hence the detector can detect when a slot is free. LED lights are

attached to the sensor or mounted separately. If the space is vacant, the led indicator displays green. If the space is not vacant, the led indicator displays red. In a handicapped parking area, free spaces are indicated using blue LED and occupied spaces are indicated using red LED. Reserved spaces are indicated using yellow LED.

R. C. Hanche et al. describes an automated vehicle management system using radio frequency identification (RFID) technology [11]. This automated system includes the stage which consists of inserting the code into a RFID tag and giving this tag to each vehicle. Then RFID reader read the data from the RFID tag. In the next stage, the data from RFID reader is stored in the database. This is done using RS232. In the final stage, a record about the free space in the parking area is made. The number of vehicles in the parking area needs to be found out for the proper usage of the parking area. Thus whenever a vehicle enters the parking area the number of vehicles in the parking area is incremented and whenever a vehicle leaves the parking area the no of vehicles in the parking area is decremented.

D. J. Bonde et al. proposes a system which is controlled by the mobile phone with the help of an Android application [12]. This system presents an automated vehicle parking system which can manage the number of cars at any given time in a parking space based on the vacancy in the parking space. This automated system is a way of parking and leaving cars using different sensors. The entry and exit of the vehicle from the parking space is controlled by an Android application. This system is initiated by the driver sending a message "Park My Car" with the help of an Android application. This message will be in encoded form. This message will be retrieved using GSM at the parking area unit and GSM will send this message to microcontroller. Depending up on the information stored in the controller, a reply will be sent to the driver. If a parking space is available, then the vehicle can park at the free space.

Anees Abu Sneh, Wael A. Salah presents the system based on image recognition technology that can be used to effectively control various parts of a parking system [13]. This automotive parking system is effectively developed by using image processing technologies and an Arduino controller. In this system, the vehicle number is captured from the image using license plate recognition and compared with the vehicle numbers which is stored in the database. If the captured number already present in the



database, the system sends a command to the Arduino controller to open the parking gate. A sensor and two led placed in each parking space, namely, red and green and they are located inside the parking area. The sensor will sense the presence of the car in each position. If a vehicle is present, the red light is illuminated. A green light is illuminated if vehicle is not present. Meanwhile, an LCD located outside the parking area will be showing the number of the free spaces present in the parking area.

Komal R. Pardeshi proposes a system in which whenever a user wishes to park his car, he must initiate the android application [14]. The android application will have two modules namely Availability and View Parking. First user has to click on availability option to check whether parking slot is available or not. As soon as user clicks on Availability option, application will be connected to web camera and the web camera will take the snapshots of the parking space and will send it to the Raspberry-Pi. The main task of the raspberry pi is image processing. The raspberry pi is coded with pattern detecting algorithms which will give integer count of the vacant places. If Raspberry-Pi does not detect any vacant place then it will return 0 showing that no vacant space is available. Otherwise a non-zero integer is returned to the user to indicate the number of vacant places. If user gets non-zero count from availability then user can move further to check which parking slot is available? In view parking the user can watch the exact image of the parking area and park the car accordingly.

Aswin Sayeeraman et al. use a Zigbee technique with GSM for managing the parking system [15]. This technique contains three modules namely checking for vacant parking slot, booking the slot and password enabled security system after the vehicle is parked in the booked slot. If a slot is found to be free the driver can book the slot through SMS and a password will be given to him. The driver can park the car in a secure way by entering the password at the entry gate. Also, each slot contains a Zigbee Module.

### III. PERFORMANCE COMPARISON

In the previous section, the various methods for developing intelligent parking system have been discussed.

TABLE I  
 THE COMPARATIVE PERFORMANCE ANALYSIS OF EXISTING SYSTEMS

Technique	Advantages	Limitations
Induction loop sensors [6]	-Accurate -Less expensive -Not affected by environmental conditions	-Difficult Installation -Cause damage to roads
Ultrasonic Sensors [7] [10]	-Greater Accuracy -Low Cost -Easy installation	-Easily affected by weather condition -Sensitivity to temperature changes
Image Processing using MATLAB [8]	-Less cost -Better accuracy -More Efficient	-It doesn't work properly in heavy rainfall and snow
GPS [9]	-Cost Effective -Easy to use	-Always need an internet connection.
RFID [11]	-Reliable -Response time delay is less -Efficient -More Security	-If the tags are destroyed, entry will not be granted
Android application [12]	-Less human dependent -More efficient	-Difficult to install in every vehicles



License plate recognition using MATLAB [13]	-High security -Less expensive	-Human intervention is present
Image processing using Raspberry pi, Android Application [14]	-More security -Efficient	-Should have a internet connection -More expensive -If the network goes slow, the system will not work
Zigbee with GSM [15]	-High Security -Slot can be reserved	-No guidance to the reserved slot

#### IV. FUTURE TRENDS

Even though significant progress has been made during the last decade in the field of developing and implementing efficient parking systems, there are a lot of challenges faced by the researchers. Also there is a need for developing an intelligent parking system which is fast, efficient, simple and accurate. Intelligent vehicle parking system using automatic number plate recognition is a new technology to implement an efficient parking system with high security and researchers are showing great interest towards this technology. This parking system will be able to have less interaction of humans. Also this can develop and implement a parking system that will increase convenience and security of the public parking lot.

#### V. CONCLUSION

In this paper we have introduced the various methods that have been proposed by the researchers to develop intelligent parking systems by a detailed review of techniques used in existing systems. Also the performance of these techniques is compared in terms of advantages and limitations. We hope that this paper will serve as an introductory review to those who are new to the topic.

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#### BIOGRAPHY



**Ashy Jose Kachapilly** received B.Tech degree in Electronics and Communication from Sahrdaya College of Engineering and Technology, Kerala in 2017 and pursuing M.Tech degree in Embedded Systems at Sahrdaya College of Engineering and Technology, Kerala.



**Santhosh Kumar M S** is currently working as faculty of Electronics and Communication Department in Sahrdaya College of Engineering and Technology, Kerala. He received M.Tech degree in Applied Electronics. His subjects of interest include Embedded Systems,

Digital Electronics, Network Security and Power Electronics.