Low cost Intelligent Parking management and Guidance System

Nikhitkumar[1], Abhijith S[2], Shruti Jajoo[3], S G Raghavendra Prasad[4], Dr. Jitendar Mungara[5]

[1] student,[2] student,[3] student,[4] Asst Professor, [5] Professor and Dean PG Studies

Information Science and Engineering

R V College of Engineering

Bangalore, India

nikhitkumar@gmail.com, abhijithshreesh@gmail.com , shruti19937@gmail.com , raghavendrap@rvce.edu.in,
Jmungara66@gmail.com

Abstract: *In this paper we propose an intelligent parking system which aims to avoid wastage of time and fuel to find an empty spot in a parking lot. Many of the existing systems only provide details about the number of empty spots in the parking area, which is insufficient as the user still has to find the parking spot to park his vehicle the parking lot. Our system not only indicates the number of empty spots but also guides the driver to the nearest parking spot to him/her through an android based application. The system also comprises of a booking feature through which the user can book his parking spot beforehand*

Keywords: *Intelligent parking, IOT, Sensor Network, microcontroller, Android application, Guidance.*

1. Introduction

The exponential growth in population has led to increase in demands. Since automobile is a basic necessity, the number of automobiles has also increased drastically which has resulted in increased traffic and parking issues, especially in metropolitan cities. Due to lack of information regarding parking facilities, it is difficult for drivers to locate the empty parking slots and those that are nearby. According to a study that measured traffic in Los Angeles 15-block area for a year, the study indicated that drivers drove more than 950,000 miles, produced 730 tons of carbon dioxide and used 47,000 gallons in search of parking[1]. This scenario not only occurs in Los Angeles but in all the cities round the world. Hence a system that provides information regarding the nearest available parking space along with directions to the driver would reduce fuel consumption and also the human effort required.

Wireless Sensor Networks have found application in many fields including military, healthcare and security surveillance, automotive industry and many more. Generally a wireless sensor network consists of a number of sensors each performing a particular function, deployed over a geographical area of interest. The Intelligent Parking System that is described in this paper is built on this Wireless Sensor Network Technology. The use of this technology would make the system cost-effective, accurate and scalable for range of reasons, such as ease of deployment in parking lots without the installation of expensive cabling , the option to collaborate these sensors with other types of sensors and also their low power consumption.

Existing solutions

- The Intelligent Parking Lot Application developed by University of Southern California, Los Angeles[2] uses a combination of magnetic and ultrasonic sensors for detection of vehicles in a parking lot. They also described a modified version of the minmax algorithm for detection of vehicles using magnetometers, and an algorithm for ultrasonic sensors as well.
- SmartParking: A Secure and Intelligent Parking System Using NOTICE [3] - This paper describes a system that is based on the concept and framework of NOTICE, a secure and privacy-aware architecture to notify traffic incidents. This is a service oriented intelligent parking system through which drivers can view and reserve a parking spot on the go.
- Another solution Automated Parking Slot Allocation System [4] proposes using RFID technology for allocation free parking slot. In this system the driver is informed about free parking place using SMS communication channel. The driver can use this channel to reserve his parking slot as well.
- The design proposed by Trusiewicz, P, Legierski [5] describes an application that uses Unstructured Supplementary Service Data (USSD) as a communication channel between driver and parking system and uses telecommunication API for Parking Reservation.

All the above mentioned systems are either very expensive or they lack certain features like the guidance to the parking spot

The rest of the paper is organized as follows. In Section II, we discuss the design. In Section III, we describe the proposed system and the various sub modules in it. Section IV provides the user Interface details. And finally we conclude in Section V.

2. Design

The proposed system works in this manner. The system provides two options to the user i.e.

1. book a parking spot on the "ParkMyCar" application well in hand before going to the destination
2. use the application to reach the nearest parking spot

area, the driver is first informed about the availability of parking space in the lot through a screen which shows the number of parking spaces available. If the parking lot isn't full, the driver can then launch the "ParkMyCar" application either to be guided to the pre-booked spot or the nearest spot if he has not previously booked. The "ParkMyCar" application not only shows the parking lot's layout but also highlights the path to the parking space allocated to the driver.

The system not only helps the drivers with the application but also the drivers who do not possess it, through the display screens that are placed at suitable points to guide the driver to the nearest parking space at any particular moment. Apart from these features, the system shall also provide an interface to the administrator who manages the parking lot. This interface shall display the status of each parking spot (empty/engaged) dynamically, thereby enabling the administrator to monitor the parking lot.

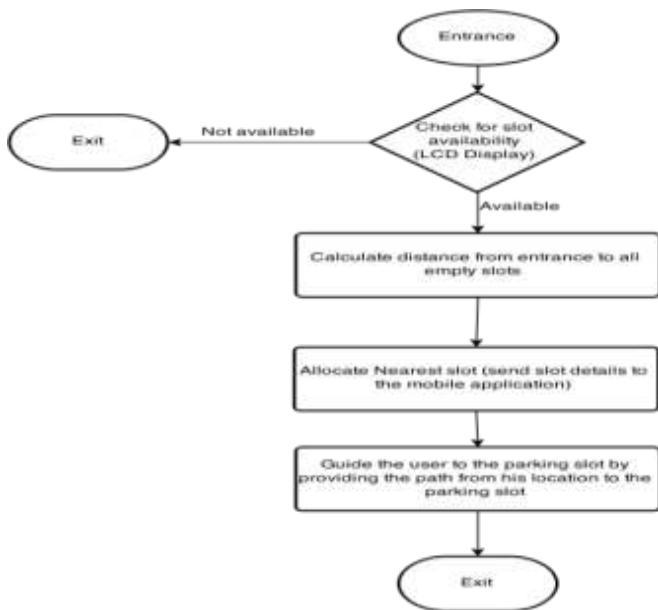The flow of the parking spot allocation is as shown in figure 1

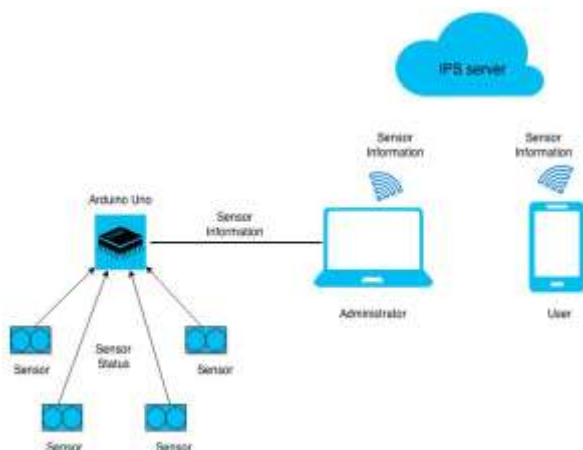**Fig 1**. Parking spot flow diagram

3. Proposed System

Fig 2. System Architecture

Our system uses ultrasonic sensors to detect the parking spot occupancy status. The range of the ultrasonic sensor is set in accordance with the average ground clearance level of cars. Each parking zone consists of a microcontroller (RSU) and ultrasonic sensors connected to it. The microcontrollers communicate with each other through Bluetooth, this provides scalability i.e. the number of parking zones doesn't affect the functioning of the system since the system can be scaled according to the layout of different parking lots by just increasing/decreasing the number of microcontrollers and sensors.

In our system we have setup two parking zones 'A' and 'B,' each of which has eight parking spots. Sensors of zone A are connected to one arduino board and the sensors of zone B are connected to another arduino board and these two arduino units communicate with each other using Bluetooth (HC-05).

Now the information from these sensors is sent to a java application which communicates with the arduino using the RxTx library. Rxtx is a library that allows serial communication between the arduino and the java program i.e. the sensor data from the arduino is read by the java application in a input buffer through a COM port. The java application secures (encrypts) the data and forwards it to the online server. The server identifies each sensor with a unique id and updates the sensors' status (empty/engaged) according to the information from the Java application.

This information on the IPS (Intelligent Parking System) server can be accessed by the management application as well as the user application anytime and anywhere.

3.1 Device Specification

We use arduino uno (microcontroller) as a RSU in our implementation as it provides an easy way to interface with the sensors. It provides 14 digital pins, has a flash memory of 32KB, SRAM of 2kb and clock speed of 16MHz which help in faster processing of sensor information.

The arduino IDE is easy to use and learn for all kinds of users, from experienced developers to programming novices. The IDE includes a code editor which has features such as syntax highlighting, brace matching, and automatic indentation, which makes programming very easy and the IDE is also adept of compiling and uploading programs to the microcontroller with just a single click.

Fig 3. Arduino uno(microcontroller)

3.2 Sensing Technique

Sensing is one of the crucial parts of the implementation of intelligent parking system. The time interval of sensing the

occupancy status should be very short as it should consume as less energy as possible, hence we have used ultrasonic sensors which have a transmitter and a receiver. The sensor sends ultrasonic waves through the transmitter and receives the reflected waves through the receiver when it comes in contact with an object. Hence the distance at which the object is calculated by the time difference in sending and receiving of the waves. The sensor specification is as given in table 1.

Fig 4. Ultrasonic sensor

Ultrasonic sensor (HC-SR04)

Power Supply	+5V DC
Quiescent Current	<2mA
Working Current	15mA
Effectual Angle	<15°
Ranging Distance	2cm – 400 cm/1" - 13ft
Measuring Angle	30 degree
Trigger Input Pulse width	10uS
Dimension	45mm x 20mm x 15mm

Table 1

B. User Application module

3.3 User Application Module

The user application fetches the parking space information from the IPS server in the form of a JSON (JavaScript object notation) object. Then parses it accordingly to calculate the distance of the user from each of the empty parking spaces and then guides the user to the nearest parking spot. The user application also possesses the feature of booking a parking spot in advance i.e. when a user books a parking spot the system get the mac address of the user's device and assigns a particular spot to him for a certain amount of time. The booking is cleared after the lapse of the allocated time. This is to account for the case of a car not arriving to the parking spot in the specified time. For our prototype we have created our own parking lot model with two parking zones. A real-time implementation of this system would require the Google maps api to guide drivers to the allocated parking spot.

For the users who are not familiar with the application for parking, they are informed about the total number of empty spots through a LCD display as shown in fig 6 and also guided to the nearest parking spaces with the help of LCD screens indicating the directions to reach the nearest empty parking spot.

4. User Interface

The system has two user interfaces
- Admin Interface (Java Application)
- Mobile Interface (Android Application)

The admin view basically shows the parking lot layout with buttons indicating the status of each parking spot. This interface also indicates the number of parking spots along with

the count of the empty parking spots. The information regarding booked parking spaces is also displayed on the interface.

Like the Admin interface the mobile interface also displays the number of empty spots. This interface provides the user with two options –a) to book a spot before reaching the destination b)book the nearest available spot after reaching the destination, along with the parking fare. On reaching the destination this application also guides the driver to the nearest available parking spot.
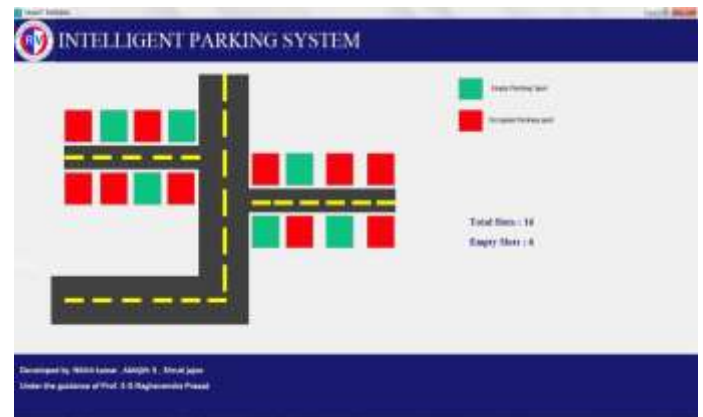

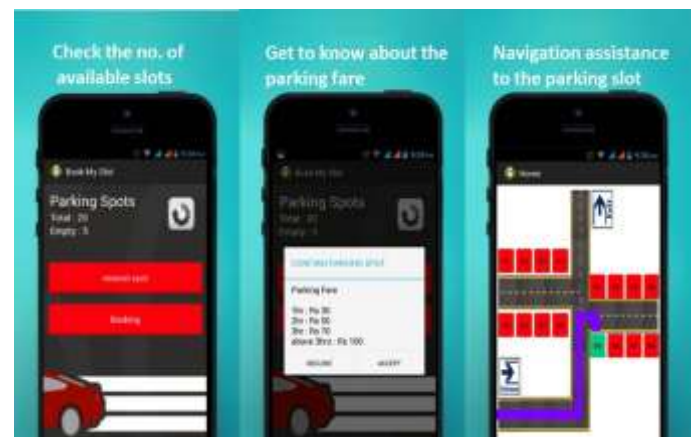**Fig 7**. Admin Interface

Fig 8. User Application Interface

5. Conclusion

The proposed system helps in reducing traffic congestion due to parking and also minimizes the pollution that is usually caused while parking as the user has a clear picture of where to park his car. Intelligent Parking System is a low energy, cost effective robust system built keeping in mind the environmental impact of wastage fuel, air pollution and human efforts on unwanted issues. This system can be scaled according to the requirement making it solution to any kind of parking area be it malls, hospitals, lanes, tech parks and so on.

References

[1] Bo Xu, Ouri Wolfson, Jie Yang, Leon Stenneth, Philip S. Yu, Peter C. Nelson, "Real-time Street Parking Availability Estimation 2013 IEEE 14th International Conference on Mobile Data Management

[2] Sangwon Lee, Dukhee Yoon, Amitabha Ghosh "Intelligent Parking Lot Application UsingWireless Sensor Networks" 2008 IEEE

[3] Gongjun Yan, Stephan Olariu, Michele C. Weigle, Mahmoud Abuelela "SmartParking: A Secure and Intelligent Parking System Using NOTICE

[4] K. Ganesan, and K. Vignesh, "Automated parking slot allocation using RFID technology," Signal Processing and Its Applications, ISSPA. 9th International Symposium on, February. 2007, pp. 1-4.

[5] Piotr Trusiewicz, Jarosław Legierski "Parking Reservation – application dedicated for car users based on telecommunications APIs" Proceedings of the 2013 Federated Conference on Computer Science and Information Systems pp. 865–869. 2013, IEEE

[6] Hanif, N.H.H.M. Badiozaman, M.H.; Daud, H., Smart parking reservation system using short message services (SMS) International Conference on Intelligent and Advanced Systems (ICIAS), 2010, Kuala Lumpur, Malaysia

[7] V.Venkateswaran, N.Prakash " Intelligent approach for smart car parking reservation and security maintenance system" IJRET: International Journal of Research in Engineering and Technology, Volume: 03 Issue: 02 | Feb-2014