



IoT-Based Parking Space Detection System Employing Android Software

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ABSTRACT

With the increase in extent of population in Urban and Metropolitan cities, the problem of parking the vehicles are increasing day by day and it has become a major task to identify the parking spaces in markets, malls and multiplex etc., which consumes the driver's time as well as fuel. If the driver is unable to find any parking space and parks the vehicle in a road side, then the problem of traffic arises. Further, the security of the vehicle is also a major issue. In order to overcome this aspect, in this study, an IOT based parking slot detection utilizing the android application is proposed and reported. Internet technology is utilized so as to connect the physical objects by using a mobile phone with Arduino UNO, sensor's, wi-fi module, cloud database to store the user data. The mobile application acts as an interface between the end user and the system. Infrared (IR) sensor is installed at the parking slot along with Arduino. The sensor is utilized to detect the occupancy or non-occupancy of the parking slot and is updated to the cloud by utilizing Wi-Fi based Internet service. The Arduino is utilized to track the number of vehicles that are parked in the parking area. With the help of this technology, the user can be able to check the availability of the parking space near to him and reserve the parking slot utilizing the mobile application.

Keywords: Arduino UNO, Infrared Sensor, RFID, Servomotor, Wi-Fi

1. INTRODUCTION

In general, every human visit certain places like cinema halls, malls, markets etc., and the one common problem for everyone is parking of vehicles. With the increase in extent of population in Urban or metropolitan cities, the problem of parking the vehicles are also increasing day by day. Identification of suitable parking space has become a tedious task for the vehicle drivers and it consumes more time and also fuel. If the driver is unable to find any parking space and parks the vehicle in a road side, then the problem of traffic arises [1]. Further, the security of the vehicle is also a major issue. In order to

solve the problem of parking in urban or metropolitan cities, a smart parking system should be developed and implemented by which the user/driver can be able to park their vehicles. In this study, an IOT based parking slot detection utilizing the android application is proposed and reported. Internet technology is utilized so as to connect the physical objects by using a mobile phone with Arduino UNO, sensor's, wi-fi module, cloud database to store the user data[2]. The mobile application acts as an interface between the end user and the system. Infrared (IR) sensor is installed at the parking slot along with Arduino. The sensor is utilized to detect the

occupancy or non-occupancy of the parking slot and is updated to the cloud by utilizing Wi-Fi based Internet service. The Arduino is utilized to track the number of vehicles that are parked in the parking area. With the help of this technology, the user can be able to check the availability of the parking space near to him and reserve the parking slot utilizing the mobile application[3]. The utilization of internet technology in order to preserve the parking slot is more feasible and this technology decreases the efforts of the drivers and time to identify the parking space. Further, as the payment is done via online, there will be no human contact which reduces the burden to the end user . With the implementation of designed automatic smart parking system, the carbon foot print within the atmosphere can be reduced and it decreases the risk of identifying the parking slots in any parking area and also it mitigates the unwanted travelling of vehicles across the filled parking slots. The slot allocation method is found to be very effective for the pre-booking of parking slot and it has the ability to resolve the problems that are associated with parking[4-5]. In this paper, the step by step management of smart parking systems, identification of parking slot, method of payment by utilizing a mobile application and how the utilize can reserve the parking space in advance by checking online availability will be reported.

2. LITERATURE SURVEY

2.1. Developing a Smart Parking Management System Using the Internet of Things

Searching for parking consumes a large amount of time and effort, as well as incurring major financial expenses. This is especially true for persons who are constantly pressed for time. Smart cities use a variety of current technology to properly manage and increase resources. Parking garages in cities are one of the most important assets to manage. As a modern solution for managing parking and saving consumers time, effort, and money, we developed a smart parking management system (SPMS)[6]. In today's modern world, it has become vital to improve search methods for available parking and reduce traffic congestion at the parking gate. Searching for or booking available parking online ahead of time is a better alternative to looking for it at a parking lot.

- Manage parking and solve problems efficiently using technology

- Apply technical solutions to improve the smart cities concept

The suggested system makes use of a number of technologies to assist with parking management. It provides consumers with important services such as parking search, bookings, and payment[7]. It has been expanded to include more complex features such as getting notifications, statistics, and parking status monitoring.

2.2. An IoT-based E-Parking System for Smart Cities

The massive growth in the number of vehicles on the road, along with poor management of limited parking spaces, has resulted in parking issues and increased traffic congestion in urban areas. As a result, an automated smart parking management system is necessary to not only assist a motorist in finding a suitable parking place for his or her vehicle, but also to cut fuel consumption and air pollution[8]. It has been discovered that a driver's search for a suitable parking space takes nearly 15 minutes, resulting in increased vehicle fuel use, traffic congestion, and air pollution.

2.3. Smart Parking based System for smarter cities

India is becoming more motorised, with private vehicles outnumbering public transportation. As the number of individuals who own cars grows, so does the demand for parking spaces to accommodate them. However, the current situation is that there are insufficient parking spaces available, or that individuals are unaware of the legal parking spaces available in their neighbourhood[9]. To address the aforementioned issues, we propose a solution in the form of a bilingual Android application that would assist individuals in digitally locating parking spaces. By digitally, we mean that this system will assign a parking slot depending on the user's current position and the parking slot that is available.

2.4. Smart parking system to reduce traffic congestion

Transportation is critical to any country's success. Many people nowadays have the option of travelling in their own vehicle. This will undoubtedly enhance trading demand, but one of the issues caused by road traffic is "parking." Parking all of these automobiles in big metro centres is a laborious and demanding operation, and it has become an issue. In order to adopt better and smarter parking management methods, a lot of research and development is being done all around the world[10-11]. Wireless Sensors or smart parking systems are currently available. Network Wireless sensor networks module,

Embedded web-server, and Central Web Server are all required for parking. Infrared (IR) Sensor nodes are used in sensor networks to verify the status of parking slots and communicate data.

2.5. An IoT-Based Intelligent System for Real-Time Parking Monitoring and Automatic Billing

New technologies are transforming the parking market today, allowing cities to drastically lower congestion rates. The core intelligence underpinning smart parking systems is provided by sensor networks that detect car occupancy[12]. It is now feasible to know the location of free parking spaces in real time, thanks to Smart Parking technology, and to assist drivers in getting to their final destination. In order to obtain parking information, a number of car detectors have been deployed. The inductive loop, acoustic sensor, infrared sensor, or ultrasonic sensor are the most common vehicle detectors.

3. METHODOLOGY

3.1 OVERVIEW

The proposed technology is about to identify a space for parking of the vehicles by utilizing mobile application. The drivers or end users can be able to find a desirable parking spot with a mobile application which monitors the availability or non-availability of the parking space and can pre book the parking slot for the desired time of the end user or driver. Infrared (IR) sensors are utilized to identify the space of the vehicle parking and its availability or non-availability and transmit the data to the controller and store the information in the cloud platform with the help of Wi-Fi module[13-15]. The end user can be able to access the data from cloud in order to identify the parking space availability or non-availability in the mobile application and can perform online payment to the parking space for the stipulated time period by which the time of the driver will be saved.

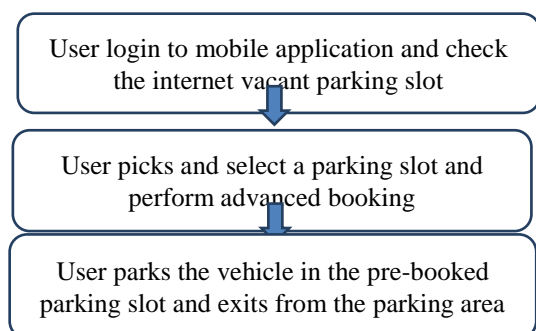


Fig.1 Methodology adopted in the study

3.1.1. PROCESS

The sequential process is as follows:

- The driver/end user registers in the mobile application and login into it. Later, the drivers checks for the nearest vacant place for parking of the vehicle. A mobile application which enables the monitoring of the parking area to identify the availability or non-availability of the parking space[16]. The availability is represented by green colour and non-availability is represented by red colour.
- The driver/end user selects the parking slot and books it in advance and parks the vehicle. In real time, the space of the parking is update immediately on the mobile application[17]. As and when the driver parks the vehicle in the selected area, and then a notification is raised in the application and asks the drive to fill the details of the driver. Later, the position of vehicle timer and online payment is performed.
- The driver/end user exits the parking space after the stipulated time period and immediately the application will be updated.

3.2. ANALYSIS OF DATA

In this study, the analysis of data is done by collecting data via google forms and is analysed by using chi-square method[18].

3.3. HARDWARE COMPONENTS AND MODULES

(a) ARDUINO UNO:

It is a microcontroller board which utilizes AT mega32p. It contains 14 input/output and 6 analog inputs and it acts as an interface in between the components of hardware and software components with in this study[19]. It has the ability to read input such as detection motion, light and gives output on it. In this, we can store the programming code which acts like a brain.

(b) ETHERNET SHIELD:

It is utilized to connect Arduino with internet and it enables the exchange of data in World Wide Web.

(c) RFID :

It stands for radio frequency identification tag which is an electronic type of tag which exchange data from an RFID reader. An RFID active tag is utilized and is basically utilized for tracking and it has chips, memory and antenna. It scans and collects the information from RFID and is utilized to track and trace the objects.

(d) INFRARED SENSOR:

This is an electronic device which emits to identify any object around the surroundings and it identifies the motion and measures the object's heat.

(e) GSM MODULE:

This is a circuit which is utilized to set up communication in between the micro controllers and phones and is utilized to send SMS, voice messages and it allows high transmission of data.

(f) MOBILE APPLICATION:

End user or driver downloads the application in their mobile phone by which they can be able to track the parking area to check the availability or non-availability of the parking and can be able to pre book or pay amount after parking in the desired parking slot.

(g) ONLINE PAYMENT METHOD:

During the time of exit, the parking slot user can pay the parking fee online or the driver can pre book the parking slot for a stipulated time period and it depends on the time duration of parking and the payment is done through net banking or UPI.

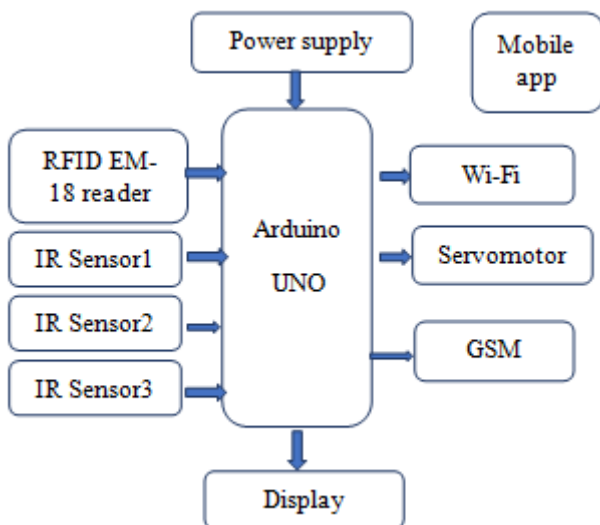


Fig.2 Block diagram for parking slot detection

3.4. SOFTWARE SPECIFICATIONS: -

ARDUINO IDE:

The Arduino IDE is a programme that allows you to programme with the Arduino microcontroller. The Arduino Integrated Development Environment (IDE), also known as the Arduino Software, includes a text editor for creating code, a message box, a text console, a toolbar with buttons for common functions, and a series

of examples. Menus[20]. To upload programmes, it connects to the Arduino and Genuine hardware and keep in touch with them.

4. ALGORITHM

Step 1:

Install the smart parking application on your mobile device.

Step 2:

On the 16*2 display the number of vacant and filled spots are displayed so that the user can see the status of parking zone.

Step 3:

Once the user login into the app he would see the parking architecture with the cars filled at which position and positions which are empty.

Step 4:

When the user is near to the parking IR detect sensor, he would receive a notification on his app on which side he can park his vehicle if there is a empty slot.

Step 5:

If there is no empty slot the user will be displayed with an appropriate message on the mobile application.

Step 6:

On availability of parking area and user parking into the respective slot he/she would receive a message which states the start time of the parking and the slot is which he/she has parked.

Step 7:

On successfully un-parking your vehicle from the parking slot the user will receive a message which states the start time and end time of his parking time and an amount which he needs to pay for the parking duration.

5. RESULT

5.1. INITIAL SETUP

The below diagram shows the initial case of the system when we turn on your project, which indicates the number of vacant and filled spots on a 16*2 display LCD and similarly on the mobile app.



Fig.3 Shows the empty parking slots

5.2. PARKING VEHICLE AND ONLINE PAYMENT

The below diagram shows the status of the parking zone when a single vehicle is parked in the parking zone. Once when the user enters the parking detect sensor he would receive a parking slot number on his mobile application which he is supposed to park his vehicle. On before entering the parking slot the RFID reader can scan user card and detect the amount in both the mobile application and the 16*2 display LCD.



Fig.4 Shows the parking slot and payment method

APPLICATIONS

1. Residential parking
2. Public parking spaces
3. Airport / Railway parking
4. Mall parking. etc

6. CONCLUSION

The concept of smart cities has always been a dream for humanity. Since the past couple of years ago large

advancements have been made in making smart cities a reality. The growth of Internet of Things and Cloud technologies have give rise to new possibilities in terms of smart cities. Smart parking facilities and traffic management systems have always been at the core of constructing smart cities. In this project, we address the issues of parking and present an IoT based Cloud integrated smart parking system. The system that we propose provides real time information regarding availability of parking slots in a parking area. Users from remote locations could book a parking slot for them by the use of our mobile application.

7. FUTURE WORK

- The future of smart parking system is expected to be significantly influenced by the arrival of automated vehicles (Avs).
- Several cities around the world are already beginning to trail self-parking vehicles, specialized AV parking lots and robotics parking valets.
- This project can be enhanced for tracing vehicle speed on the roads.
- Developing a smart parking solution within a city solves pollution problem.
- Addition of Machine Learning to store various other information of the vehicle like its color, design and number which would further add security.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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