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Smart Parking System

[1,*]P Abinaya and [1]P Swathika
Mepco Schlenk Engineering College, Sivakasi and 626005, India

Abstract - The Internet of Things (IoT) is the network of internet connected things or objects that are able to collect and exchange data with the other connected devices. Each thing is uniquely identifiable through its embedded system but is able to inter operate within the existing internet infrastructure. The Internet of Things (IoT) has fostered growing attention to real time applications which has been leading to development of smart city. Now days the smart cities concepts are being developing and growing in a grate work. To improve the efficiency and consistency of cities infrastructure, reliable efforts are being taken in the field of IoT. In this work, we propose smart parking system that is integrated with cloud based IoT. The system of smart parking is comprised of an IoT module which in-turn contains RFID module connected to arduino that is used to observe and notify the people about the availability of parking space. This work also focuses on the advanced-level of architecture about the smart parking system.

Index Terms - RF Module; parking; Arduino; smart parking, Cloud based IoT.

INTRODUCTION

In these days with the increase in the number of cars on road and current infrastructural changes, parking becomes difficult to manage and at the unavailability of parking space there is an increase in unwanted commotion on roads. One of the major reasons contributing to the unwanted commotion on the roads is the cars being parked on roads due to inadequate parking areas which makes the road narrow and cause traffic jams and also the cars rounding blocks searching for parking space. People tend to get frustrated due to the unavailability of parking slots at the time of need and their time being wasted in search of parking space. The purpose of this project is to show the users the availability of parking slots based on which the users can pre-book and cancel the parking slot. This can be done by developing a smart system that manages the parking slot availability using real time insights.

The project is designed with the aim to assist the people to find a parking space and to pre-book the parking slots based on the real time availability of those slots. In order to reduce the unwanted commotion of parking cars on roads and wastage of people's time in search of parking space, PARKERITE a smart parking application has been developed.

RELATED WORKS

Elakya R, Juhi Seth, Pola Ashritha, R Namith [1] have proposed smart parking because of growing road congestion. People usually waste their time and efforts in search of the availability of the free space in a specified parking area. So, to overcome these problems this smart parking is designed. The author has used RFID technology for preventing car theft and authentication and uses IR sensors to seek the parking slot availability and updates the status of parking slot availability by saving the IR sensed values in the cloud and alerting the user using the GSM module.

Mehala Chandran, Nur Fadila Mahrom, Thennarasan Sabapathy,Muzammil Jusoh, Mohd Nasrun Osman, Mohd Najib Yasin, N.A.M Hambali ,R.Jamaluddin, N.Ali, Yasmin Abdul Wahab [2] have proposed design of smart parking system where it helps the users to reserve parking slots using Android application that creates a system to help people with personal vehicles to find for parking easily at selected areas. Their proposed System works primarily on the detection of parking slots through sensors that are mounted on every parking slot which facilitates the information. Then this is processed by a microcontroller which helps to serve as a medium of communication between those peripherals or devices. The final stage would be when users use their smartphones to retrieve the slot occupancy in selected areas prior to reservation. The proposed system is used to indicate the user about the vacancy of the parking slots. A user can choose the parking slot in advance, instead of waiting in an area of the parking, where the parking availability is shown through the user's smartphones. IR Sensors will be attached in each slot for detecting the vacancy. The signal from the sensors captured by Arduino and these signals is then converted from electrical signal into another form to detect presence of vehicle in terms of the amount of light reflected back from the obstacle such as the wall of the parking lot. The output from Arduino depends on the measurement of the amount of light and based on that, slot's allocation is done. On the other hand, the output from Arduino is changed into text format and sent to the smart phones through a developed Android application. Now the users are provided with the parking details and can choose the appropriate slots to reserve.

T.Primya, G.Kanagaraj, V.Senthil Kumar [3] has worked on the system to reduce time consumption of parking for drivers, especially in places like shopping mall, companies in smart cities. Sensors are used to detect the presence of cars and Raspberry-pi is used to detect automatic recognition of cars and LED is used to exhibit the parking slot status. It also reduces the

traffic occurring during parking and messing up car parking space due to booking of cars using android application. Using this application, we can check whether parking space is available in that space and park accordingly and save our time. There is also the calculation of parking time and cost for the parking time is also developed for the use of this parking system in public places like shopping malls in cities. Our automatic parking system avoids traffic and confusion in the parking area and also there is no need for manual power which makes parking easy and in a timely and peaceful manner.

Ms. Megha D Hegde,Anusha,Arshitha M S,Anushri,Geetanjali Bishtannavar [4] proposed idea of consists of an onsite deployment of an slot module that is used to monitor and signalize the state of availability of each single parking space. A mobile application is also provided that allows an end user to check the availability of parking space and book a parking slot accordingly. Smart parking can increase the economy by reducing fuel consumption and pollution in urban cities. Their system is used by the user to reserve the parking slot. Here the user is able to reserve the car parking slot. Once he enters the slot the time period will get started and when the user leaves the slot he needs to pay the amount for the period of time he placed his car in the slot area.

Adil Hilman, Abderrahim Maizate and Larbi Hassouni[5] have the main objective is to treat imbalance in the daily mobility by developing parking services that avoids unnecessary driving around the city centre to simply search for a parking space. Their proposed system offers a solution based on an adaptable and hybrid self-organization algorithm for WSN networks, which allows to find a parking space in the two types of outdoor parking in a city. The first one is the "linear outdoor parking area" which is a parking area located mainly on the main streets, alleys, and the centre of the city, where all parking spaces of the parking area form a single line. There are currently three types of linear outdoor parking areas. Slash-type parking is the easiest to park while the horizontal is the most difficult, followed by the vertical one. The second type is "Mass outdoor parking" which has a larger parking space than the linear car parks and are in the peripherals of the city and in larger areas like a technological park, shopping centre. [6] Gongjun Yan et. al, proposed a novel, secure and intelligent parking system by providing a non-stop service to predict the business promotion that has been made. S. Abdullah [7] proposed the wireless networks systems by integrating RFID for real-time monitoring, controlling and updating information. J. L. Adler [8] proposed a methodology to improve the acceptance of a user while improving the performance of the network to vehicle routing. I. F. Akyildiz [9] introduced a key technology for future generation on wireless networks that is named as wireless mesh networks and it is abbreviated as WMN.

PROPOSED WORK

The proposed system designs a parking system that uses the RFID tag value to monitor the slot availability and manages the parking. Cars with registered RFID tag values manage to show the availability of slots by mapping the tag with the slot number. Here the RFID tag alone is sufficient to automate the entire parking process. In this project, there are three sections namely collection of RFID tag values and IR sensor values, Detection of parking slots availability through IR Sensor, Developing application for booking and cancellation of parking slots.

A. *Material and methods*

The hardware module consists of RFID reader and scanner (RC522), servo motor with the Arduino UNO board. Web application is designed with Angular js and node js for a responsive application which allows users to make car parking slots reservation. The application uses serial port library of node js for the transmission of RFID tag values to the system. RFID reader's scanned RFID tag value is mapped with the slot at the time of reservation which allows the parking slot availability to be updated from time to time.

B. *Design of the system*

A sequence of modules is used in the system design that are discussed in the following sections. The system is designed in such a way that, initially using the RFID tag the users are authenticated. The tag value is sent to the MySQL database using the serial port library of the node application which accesses the serial port of Arduino. This application shows the slot availability on a real time basis. When the tag is read, while the car enters the parking site the slot is filled and likewise when the tag is read, while the car exits the parking site the slot turns available again. Hence based on this the slot availability is shown in the application. The application provides the facility to pre-book the parking slot. A web application is developed with node js and angular js to show the availability of parking slots, book and cancel the parking slots and view the bookings.

The design of the system is depicted in Figure 1 and the flow depicts the working and the design of the system, where the system monitors the slot availability status using the RFID tag read at the entry and exit of the parking spot. Along with that the scanned RFID tag value controls the allowance of the cars into the parking site using the motor operation of a servo motor that is connected to the Arduino.

Arduino is interfaced with the RFID reader RC522 module and the servo motor to support the parking system. Arduino's read output of the RFID reader is accessed by using the node js library serial port with which the RFID tag value is stored onto the database. With the mapping of the booked slot number with the respective RFID tag value read from the user, the slot availability is maintained.

The parking slot availability, booking of slot, cancellation of slot are the provisions to the user. Hence, they are designed in the user interface. The application is designed in a way that

user has their use case as register, login, view available slots, book a slot, cancel slot and review their previous and current bookings.

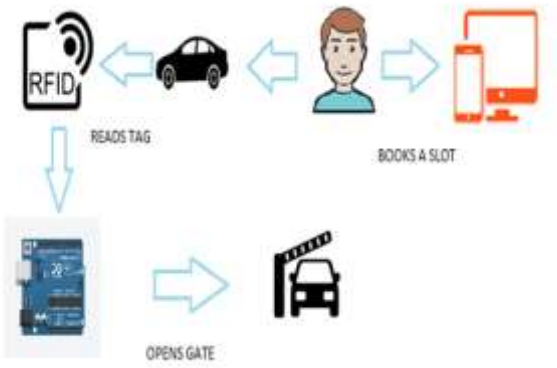

Fig. 1. System Design

C. *Configuration of parkerite system modules*

RFID reader RC522 module is used for scanning the RFID tag of the cars and the servo motor is used to perform the open and close operation of the parking gate for the users with the valid RFID tag. Both the reader and the motor are set up with the help of Arduino that helps in controlling the hardware setup at the parking. The RFID reader can be placed at the entry and exit of the parking area. A car's registered RFID tag value being read at the entry point of the parking station will help the application to block the slot in the available slot status and will authenticate the booked user while the Reader set up at the exit point of the parking station updates the status of the slot availability from reserved to available. The parking gate is controlled by using the servo motor connected to the Arduino which opens on successful scan of the RFID tag. The control is designed in such a way that it allows only the valid RFID tag owners to enter the parking so authentication is done. This can be done by controlling the function of the motor based on the RFID tag value read.

The RFID tag values are collected from the reader connected to the Arduino. The tag values are available on the serial monitor of Arduino that has to be sent to the database for mapping the vehicles with their respective RFID tag. The data read from the RFID reader is stored in the MySQL database using the serial port library of node js.

All hardware of IoT uses serial port for communication and the serial port package of the node js allows JavaScript to access the serial port of Arduino. Through this the RFID tag value is fetched and stored to the database through node js. This package can be installed from the node package manager(npm).

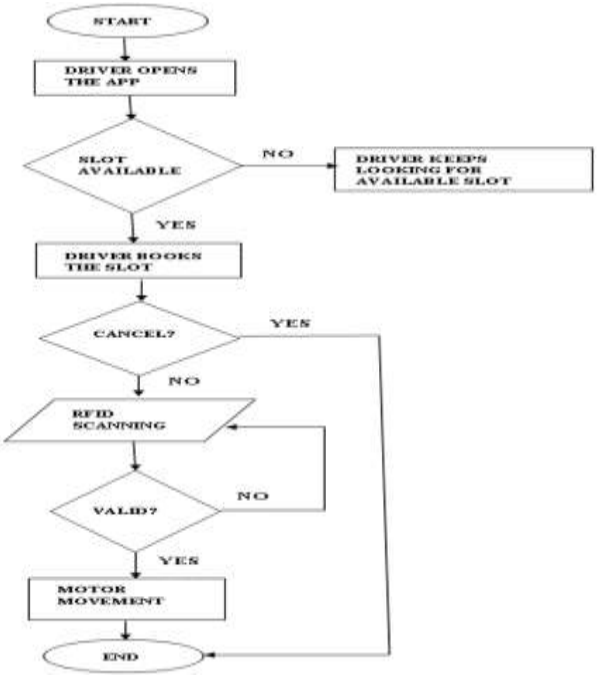

Fig. 2. Flow Diagram for Parkerite System.

D. *Hardware and software setup for the system*

The Arduino is interfaced with the RC522 module and the servo motor as shown in Figure 3 and 4. The reader scans the tag registered with the vehicle and performs the open operation of the parking gate for valid tags with the help of servo motor. Servo motor operates based on the pulse width modulation and is used for small rotations. The Arduino serial monitor is accessed by the application using the serial port library, a feature provided by the node package manager by which the tag value is read and stored directly onto the system. The tag value is then mapped onto the vehicle and the slot status is then updated from time to time as a result. The user can cancel the reservation made. Arduino interfaced with the RC522 module and servo motor combinedly forms the hardware setup. The application design for the system which provides a portal for the user to view the parking slot availability and the option to reserve/cancel the parking slot collectively forms the software part of the system. The user has to register with the application providing the details of the vehicle such as vehicle number and the registered tag value of the vehicle. An efficient way of parking of cars can be achieved by using the application for monitoring the slot availability and for making prior booking purpose.

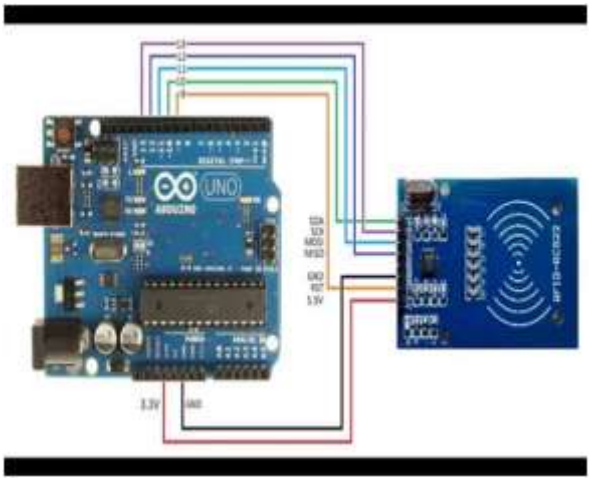

Fig. 3. Interface of RFID(RC522) module to Arduino.

Fig. 4. Interface of Servo motor to Arduino.

4. RESULTS AND DISCUSSION

In our System, the user can check the slot availability to park the vehicle. Based on the availability of the slots, the user can book the slot and park the vehicle. User can choose which vehicle to be parked during booking. User can also cancel his booking for the slot.

RFID will be attached to each vehicle. While entering the slot area the tag will be scanned by RFID reader. Only if it is authorized tag the gate will be opened and the user will be allowed to get into the slot area.

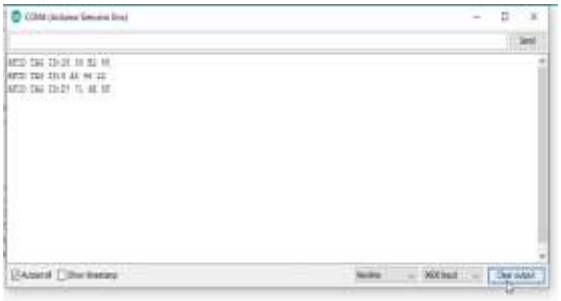

Fig. 6.1. Arduino Output

The above figure shows the output of the Arduino reading the RFID tag value using the RFID reader RC522 connected to the Arduino. The RFID tag values are read as shown in the above figure.

Fig. 6.2. Slot Availability page of Application

The availability of the slots can be checked by the user before entering the location. Based on the availability status, users can do bookings for the slot to park their vehicles as shown on the above figure.

Fig. 6.3. Vehicle selection by user

The above figure shows how users can select the vehicle to be parked. The dropdown lists the vehicles which are already registered.

Fig. 6.4. Slot booking for vehicle.

Fig. 6.5. Successful Booking output

The above figure shows the successful booking of the slot. The slot colour will be turned to red after successful booking to indicate that the slot is not available for other bookings.

5.CONCLUSION

——In this work we have designed a hardware prototype and developed a web application for a smart parking system. The system allows the user to reserve parking slots using application and using RFID technology it monitors the parking slots. By implementing this system parking can be made smarter which results in the direct reach to the parking area without searching for a parking slot at the time of parking. The implementation of smart parking through our PARKERITE will be feasible and could save fuel as it provides the facility to reserve parking slots prior to reach of the parking site and reduces the waiting time in the parking area.

FUTURE WORK

- In this implemented smart parking system the parking reservation facility is at a single parking area but in the future, we will enable parking reservation at multiple parking sites so that when the user does not find a free slot one could be recommended to reserve a slot at a nearer parking site where the slot is free.

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