An IoT Based Smart Parking System

To cite this article: Mehala Chandran *et al* 2019 *J. Phys.: Conf. Ser.* **1339** 012044

View the article online for updates and enhancements.

An IoT Based Smart Parking System

Mehala Chandran[1], Nur Fadila Mahrom[2], Thennarasan Sabapathy[3], Muzammil Jusoh[4], Mohd Nasrun Osman[5], Mohd Najib Yasin[6], N.A.M Hambali [7], R.Jamaluddin [8], N.Ali[9], Yasmin Abdul Wahab[10]

[1,2,3,4,5]Biolectromagnetic Research Group, School of Computer and Communication Engineering, [Universiti Malaysia Perlis]
[6,7,8,9]Biolectromagnetic Research Group, School of Microelectronic Engineering, [Universiti Malaysia Perlis]
[10]Nanotechnology & Catalysis Research Centre, Deputy Vice Chancellor (Research and Innovation Office), [Universiti Malaya]

* mehalachandran@ymail.com

Abstract. In the past, there have been many works done on smart parking system approaching an even smarter system in where researches have been done and still being done to create a system which is not technologically savvy but also at ease. This paper proposes a design of smart parking system where it helps the users to reserve parking slots using Android application. This project is aimed to create a system that helps people with personal vehicles to find for parking easily at selected areas. Both software and hardware platform have been developed in this system.

1. Introduction

In this current era of modern world, almost everyone owns a personal vehicle and it has become a basic need for the humans. Hence, it has been proven statistically that the usage of vehicles is increasing rapidly yearly [1]. Due to the growth, it is very difficult to find parking slots in cities, especially during the peak time.

This creates a necessity to introduce an automated system that allows users to book their spot just by making a few clicks through a custom made Android Mobile Application. This serves to hassle free situation for each and every users. The main motivation behind the Smart Parking System is to help the drivers to find areas where parking is available in that area [2]. Prior to his expected arrival, drivers can book a slot in the area if it is available. Drivers can search the parking slot through the mobile application installed and book the available slot. Besides that, user can also view the duration of parking usage through the application and charges can be calculated through the online application sent to the user for notification. Not only this, user can opt to extend their duration by simply requesting on the application by few clicks. All you need is a working Internet.

The system works primarily on the detection of parking slots through sensors that are mounted on every parking slots which facilitates the information. Then this is then processed by microcontroller which helps to serve as a medium of communication between those peripherals or devices. The final

stage would be when user uses their smart phones to retrieve the slot occupancy in selected areas prior to reservation

2. Literature Review

According to previous related works, there are several methods used to develop the system. It is highly crucial to have knowledge on the systems that have been developed in order to ensure a better enhancement of the proposed system in this project. In some studies [3], image processing is given more importance instead of sensor based system. Driver's number plate is captured by Image processing is used to capture the number plate of the drivers and the information is stored in database. This is to avoid theft and illegal car entry. The users must register first before using the Android application. This application consists of basic information of the drivers which will be stored for future references. After registration, the driver is required to select the parking location and the server will immediately process the data received and sends back the information needed to the user.

Next, an innovative approach came as a solution for the reservation traffic in where QR code is taken into account for reservation confirmation. In research paper [4] "Smart Parking System based on Reservation", states that the expansion of monetary conduct for everyday comfort has rapidly increases the ratio of people who owns vehicles giving boost to busy cities traffic. This is commonly why traffic congestion and air pollution occurs. The management will system will broadcast the details on the available parking slots to drivers.

Then, the drivers will select a particular parking slot to book. As soon as the driver reserve the slot, the server generates a unique QR code and quickly sends it to the drivers. After placing the reservation, the host will demand for the QR code sent to the user to verify details sent before and let the user to use the reserved place. This code stores in information such as parking charge and the availability of the slot for the both user and provider for reference. The hardware part of this system is divided into three main parts; QR scanner, server and mobile phone. Figure 1 illustrates the layout of the parking system in brief.
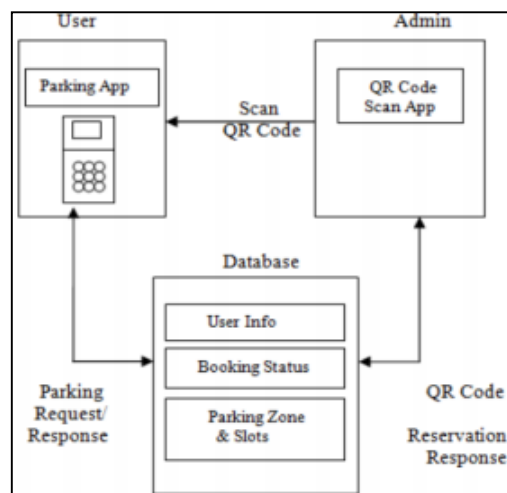

Figure 1: Layout of Parking System

3. Methodology

Methodology is a model to explain the methods or techniques used to design, develop or plan a project. This chapter explains about the software and hardware that will be used for developing this project further. The results are going to be analyzed to achieve the objective of this project.

3.1 System Overview

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 area of the parking, where the parking availability are shown through user's smart phones. IR Sensors will be attached in each slot for detecting the vacancy. The signal from the sensors captured by Arduino and these signal 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 wall of the parking lot. The output from Arduino depends on the measurement of 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.

Besides reservation, user also will be notified on details of parking such as extending or making payment via a simple text message with the help of GSM. The parking area are sensed by using the sensors which are placed in each slot. The sensors will detect each slot as input and the output of the sensors is preceded to the Arduino. Arduino will process the input of the sensors, analog to digital conversion are made and by tracking the user using the details of the parking slots given to the user. The components needed for this project are sensing device, communication platform and mobile application. Figure 2 shows the proposed block diagram of smart parking system.

3.2 Block Diagram

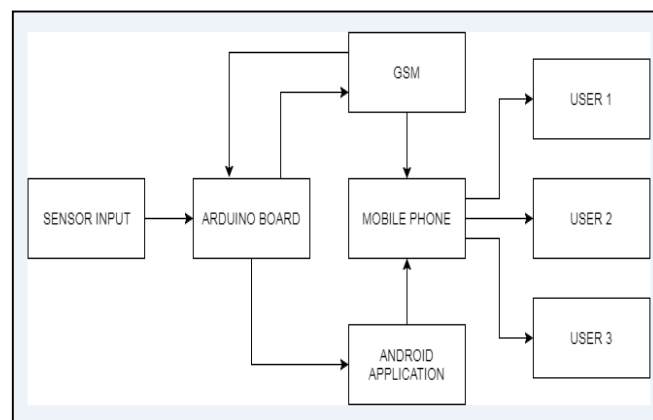Figure 2 shows the block diagram of the proposed smart parking system.

Figure 2: Block Diagram
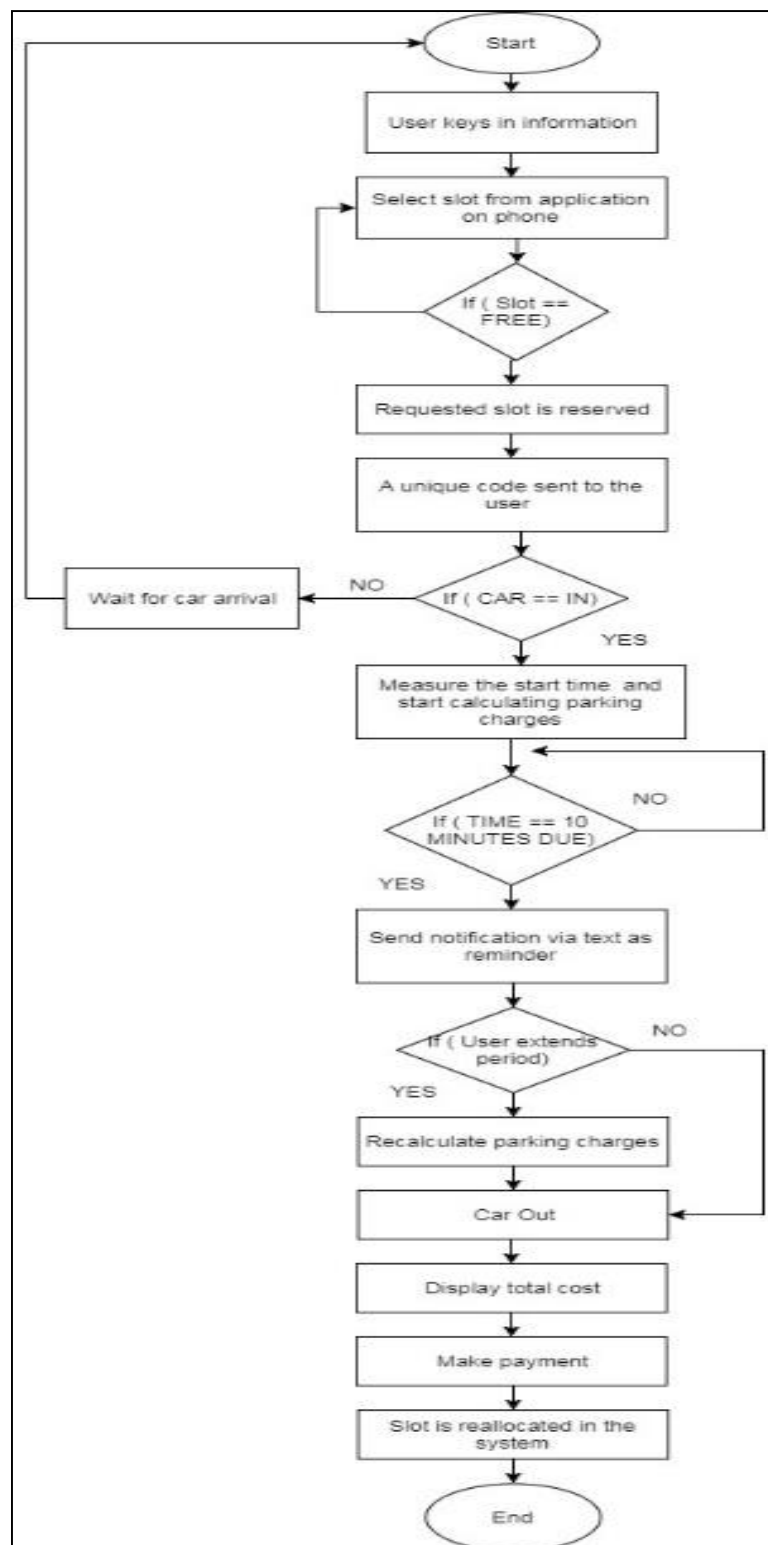
3.3 Flowchart

Figure 3: Flowchart of the System

Figure 3 explains the flowchart of the project. The process flow of the smart parking system when users start initialization through mobile application. Users are required to key-in important details such as name, vehicle's plate number, contact number and duration they want to park for. Once registered, users are taken into the next window where availability of slots based on real time. Red indicates the slots are occupied whereas green indicates free occupancy, thus users can choose to reserve them.

Normal users go through the normal ticketing process. Once the car enters in the parking bay, it starts to calculate the time and also parking charges. Else, wait for the car arrival within the time allocated. Next, when the time of the parking is 10 minutes due, a notification is sent to the user as a reminder where user can opt to extend their parking duration for a certain time and parking charges are recalculated. If no, car must exit from the parking lot. This is where the Android app will display the total cost, user can make payment. The slot will be reallocated in the system again.

3.4 MIT App Inventor

This helps in the application development for Androids by either using the application in a browser, phone or emulator. It also stores the data where you will be able to save it into the Google driven database which operates on Cloud based [5]. An app can be simply built by finishing the template of your app by using The App Inventor Designer and then completing your application's work flow or the way it works on a phone by using The App Inventor Block Editor prior to running on an emulator or a phone. Smart parking reservation system would be developed using this platform.

Searching for publications using several criteria, these criteria can be seen in Table 3. Thereafter, an extraction of the research publication on the assumption of attribute independence on Naïve Bayes required to obtain data relating to RQ is presented in Table 4. Furthermore, we conducted a quality research assessment to help interpret the quality of the findings and to determine the strength of the conclusions described. The last step, synthesize the data in which the purpose of collecting evidence from the survey paper that has been obtained to answer RQ. Synthesis data used in this study, will generally be a narrative synthesis. Some tables and visual tools will be used to support the explanation in this study.

3.5 Arduino IDE Workspace

Arduino Integrated Development Environment or also known as Arduino IDE Software is an open source platform which has a text editor to write coding with a series of functions and tools [6]. This software is connected to Arduino development board to communicate with them. This software has console which displays all errors in the coding and other information. Arduino boards are less expensive compared to other microcontroller. Arduino Software almost runs in all operating systems including Windows and Linux. This workspace is easy to use for the beginners as the complexity level is very low. Furthermore, it has built in examples for the beginners to play around with the coding. Figure 3.4 illustrates the built in examples found in the software. Since this software is open source, extensions are available. There are several Arduino boards found in the market.

3.6 Related Hardware Tools

IR Sensors will be attached in each slot to detect the presence of the vehicles. [7] This sensor detects the presence of a vehicle in terms of the amount of light reflected back from the obstacle and in this case it will be the wall of the parking slot. If no obstacle is present, IR light cannot be detected by the sensor. The typical Infrared Transmitter found is a Light Emitting Diode (LED) which functions by emitting infrared pulse.

Arduino Uno Wi-Fi board is integrated with Wi-Fi module which will be used in this project. This board is based on integrated ESP8266 Wi-Fi Module and ATmega328P. The Wi-Fi module has TCP/IP Protocol stack which gives direct access to the Wi-Fi network [8]. This board is programmed by using Arduino IDE software. This board is ideal as it can run both in online and offline mode.

A GSM module is used to communicate between a mobile device and a computer. GSM operates at 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands to transmit mobile data services. GSM has many features such as international roaming, high quality speech, SIM phonebook and also short message service (SMS) [8]. GSM is considered very secure telecommunication available now. GSM is used to transmit SMS from sender to receiver. In this project, SMS is sent to the user to notify them that the duration of the parking hours is going to end.

4. Result

The process flow of the smart parking system when users start initialization through mobile application. Users are required to key-in important details such as name, vehicle's plate number and contact number. Figure 4 shows the layout of the Android Application for the login page.
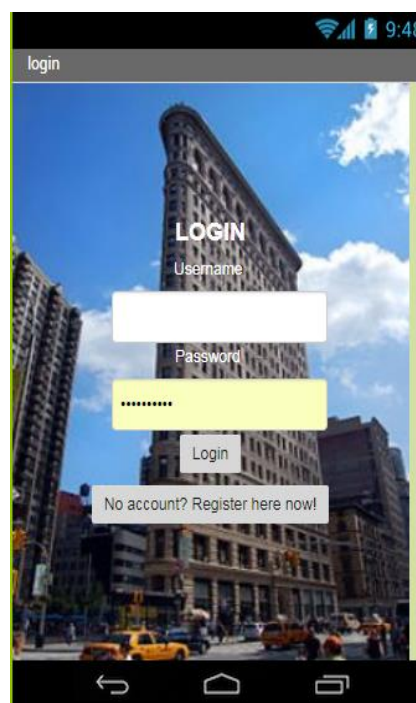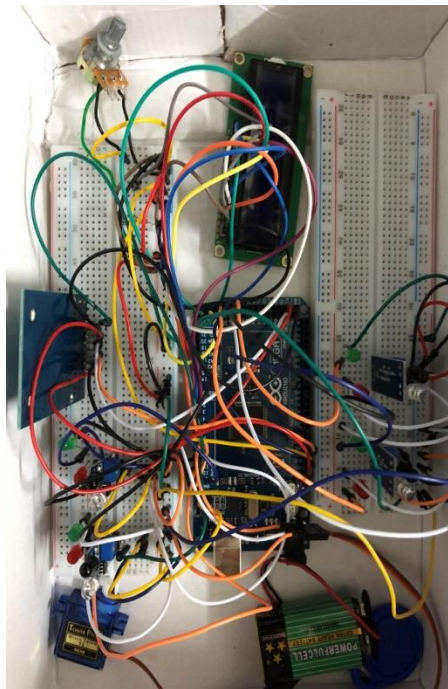

Figure 4: Layout of Android Application

The process flow of the smart parking system when users start initialization through mobile application. Users are required to key-in important details such as name, vehicle's plate number, contact number and duration they want to park for. Once registered, users are taken into the next window where availability of slots based on real time. Red indicates the slots are occupied whereas green indicates free occupancy, thus users can choose to reserve them. Then, user will be sent a unique code which later on they have to scan at the entrance of parking bay within the time given. The unique code differentiates between the mobile users and normal users. Normal users go through the normal ticketing process. Once the car enters in the parking bay, it starts to calculate the time and also parking charges. Else, wait for the car arrival within the time allocated. Next, when the time of the parking is 10 minutes due, a notification is sent to the user as a reminder where user can opt to extend their parking duration for a certain time and parking charges are recalculated. If no, car must exit from the parking lot. This is where the Android app will display the total cost, user can make payment. The slot will be reallocated in the system again. Figure 5 shows the hardware components used for this project.

a.   Figure 5: Hardware used in the Project

5. Conclusion

This system is to ease the drivers to find parking slots during peak hours by using Android Application. This is an efficient system as it helps to solve heavy traffic congestion and reduces the driver's frustrations. The system can be more enhanced by providing the route to the selected parking location with the help of Global Position Search (GPS) System.).

6. Acknowledgment

References

[1]   P. Mane, R. Deoghare, S. Nagmote, S. Musle, and S. Sarwade, "Android based Smart Parking System," pp. 3981–3985, 2015.

[2]   R. Renuka and S. Dhanalakshmi, "Android Based Smart Parking System Using Slot Allocation & Reservations," vol. 10, no. 7, pp. 3116–3120, 2015.

[3]   M. Computing, "Smart Car Parking Using Arduino," vol. 5, no. 2, pp. 230–234, 2016.

[4]   M. S. Rahul Patil,"Smart parking system based on reservation,"vol.2, Mumbai,India, 2014.

[5]   T. N. A. M. Pham, M. Tsai, and D. U. C. B. Nguyen, "A Cloud-Based Smart-Parking System Based on Internet-of-Things Technologies," pp. 1581–1591, 2015.

[6]   S. A. El-seoud, H. El-sofany, and I. Taj-eddine, "Towards the Development of Smart Parking System using Arduino and Web Technologies," no. 978, pp. 10–16, 2016.

[7]   R. H. Giva Andriana, Anak Agung, "Sensor Comparation for Smart Parking System," pp. 4–9, 2012.

[8]   N. Hazrin, H. Mohamad, M. H. Badiozaman, and H. Daud, "Smart Parking Reservation System using Short Message Services (SMS)," 2008.

[9]   M. N. M. Yasin and S. K. Khamas, "Measurements and Analysis of a Probe-Fed Circularly Polarized Loop Antenna Printed on a Layered Dielectric Sphere," in *IEEE Transactions on Antennas and Propagation,* vol. 60, no. 4, pp. 2096-2100, April 2012.

[10]   Ismahayati Adam, M. Najib M. Yasin, Hasliza. A. Rahim, P. J. Soh and M. Fareq Abdulmalek, A compact dual - band rectenna for ambient RF energy harvesting, *Microwave and Optical Technology Letters*, 60, 11, (2740-2748), (2018).

[11]   SUBRAMANIAM, Devakumaran et al. A Stacked Planar Antenna with Switchable Small Grid Pixel Structure for Directive High Beam Steering Broadside Radiation. *International Journal of Engineering & Technology*, [S.l.], v. 7, n. 2.5, p. 122-127, mar. 2018. ISSN 2227-524X

[12]   S. A. Z. Murad, S. N. Mohyar, A. Harun, M. N. M. Yasin, I. S. Ishak and R. Sapawi, "Low noise figure 2.4 GHz down conversion CMOS mixer for wireless sensor network application," 2016 *IEEE Student Conference on Research and Development (SCOReD),* Kuala Lumpur, 2016, pp. 1-4.

[13]   Adam, I., Malek, M.F., Yasin, M.N., & Rahim, H.A. (2015). RF ENERGY HARVESTING WITH EFFICIENT MATCHING TECHNIQUE FOR LOW POWER LEVEL APPLICATION.