

# Design and Development of a Smart Parking System

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**Abstract**—Due to increase in population of the world, the cities are becoming more crowded, and consequently numbers of vehicles on the roads are increasing day by day. One of the major challenges in the cities is to manage the parking of vehicles. Some studies have been conducted in the past to organize the parking systems. However, smart parking systems are still in demand and draw the attention of researchers for up gradation according to modern need and requirements. To enhance the security system in the world, it is important to monitor and control the access of vehicles in the parking areas of Government and private sector. Hence, this research intends to develop and design a smart parking system using mobile application technology. The developed system has capability to control the entry of authorized vehicles in parking area and block unauthorized vehicles. Furthermore developed a payment mechanism for the parking fees.

**Index Terms**—parking system; Arduino Uno; GSM module; payment mechanism; SMS

## I. INTRODUCTION

In the smart cities the need for new and effective technologies are increased to solve many of problems that lies on the surface as well as make the cities less crowded [1], [2], [3]. Finding place to park the car is one of disturbing problem for drivers [4]. Especially when you visit a public places like shopping malls, 5-star hotels, multiplex cinema halls ...etc. The drivers waste time and fuel looking for a slot to park their cars even within the park itself [5]. This will affect the driver's mood as well pollution the surrounding environmental during the search for the slot to park [6], [7]. In this paper we develop and design a smart parking system that can solve those problems efficiently. Furthermore, the developed system provides a new payment mechanism of the parking fees [8].

In the last few years there have been many studies that aim to reduce the car parking problems and make it more easily and human less. Faiz Shaikh et al., [9] has proposed a survey on smart parking system. They focus on effective smart parking technologies developed to overcome the exiting problems by using of wireless

sensor network and providing real time data analysis form the sensor.

Yashomati R. Dhumal et al., [10] has proposed android based smart car parking system. The system use an android application to let the users book place within the parking after making the registration and give information like car plate number, phone number etc. The system defines the time that the user needs to park his car at the parking. It uses a plate recognition technology at the entrance of the parking to allow authorized driver enter the parking. The system is seems to be unfixable and use a complex access technology, farther more there is no guidance provided mechanism to the parking slots.

Suvarna Nandyal et al. [11], has proposed smart car parking system using Arduino Uno. The system detects the empty slots within the parking by using ultrasonic sensors placed at the slots of the parking and helps the driver to find parking in unfamiliar city. The system does not provide payment mechanism and also does not have guidance technology to automatically identify the available parking slots.

The literature review highlights that the available technology in parking systems has limitations to give a parking access to authorized cars and the available system does not provide information to the driver about available parking slots. Also, the parking fee payment mechanism is also time consuming. To overcome these issues, this paper attempts to develop a smart parking system with following features:

- An access mechanism only for authorized drives to park their cars
- The guidance mechanism for drives about available parking slots.
- A smart payment mechanism for parking fees.

## II. THE DESIGN OF THE SMAR PARKING SYSTE

In this parking system the driver need to make reservation into the system. Based on that the driver will get a unique android application. This application will allow the driver to enter or leave from the parking after making a wireless connection with a Bluetooth at Enter or Exit doors. While the driver entering the parking, will receive an SMS message with information about the available slot within the parking. On the other hand when

he need to leave the parking , will receive an SMS message with information of how much time he spend and how much money will discounted form his reservation fees. The system is based on the following modules: smart phone, android application, Arduino Uno microcontroller, Bluetooth module, GSM module and Ultrasonic sensors. The developed smart parking system will provides an easy access way into the parking. The flow chart of the developed system has been shown in Fig. 1.

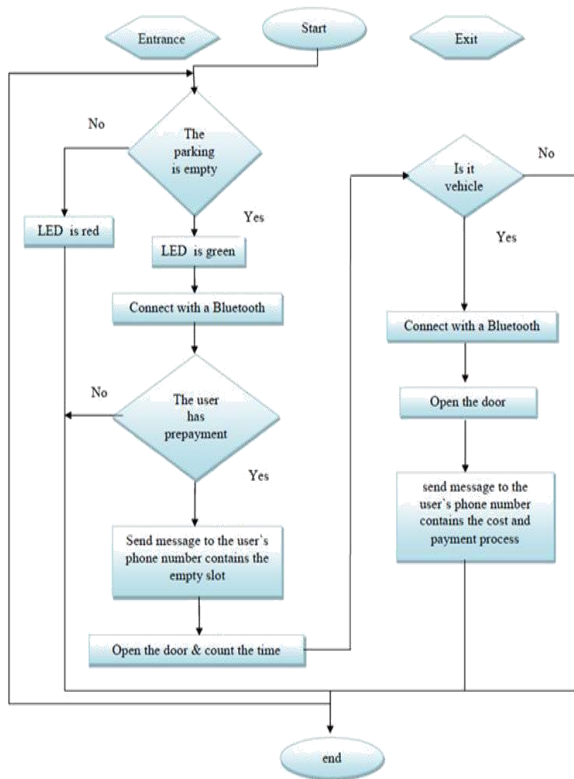


Figure 1. The flow chart of the developed system.

The block diagram for the arrangement of the components of the developed system has been shown in Fig. 2.

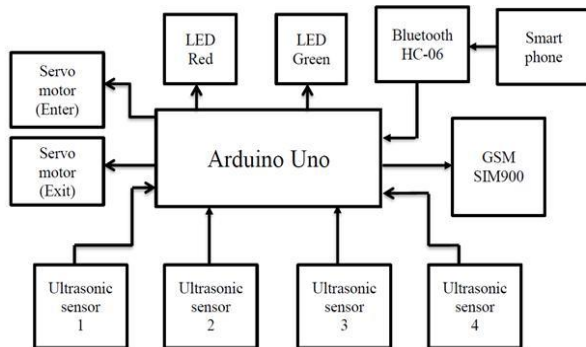


Figure 2. The block diagram of the developed system.



Figure 3. The designed phone application.

The phone application is designed with a unique code which gives to certain driver to allow him to enter in or leave from the parking. The driver will be able to get this application after he pays the parking fees and give his identity information like name, phone number to the manager of the parking. The designed application has been shown in Fig. 3.

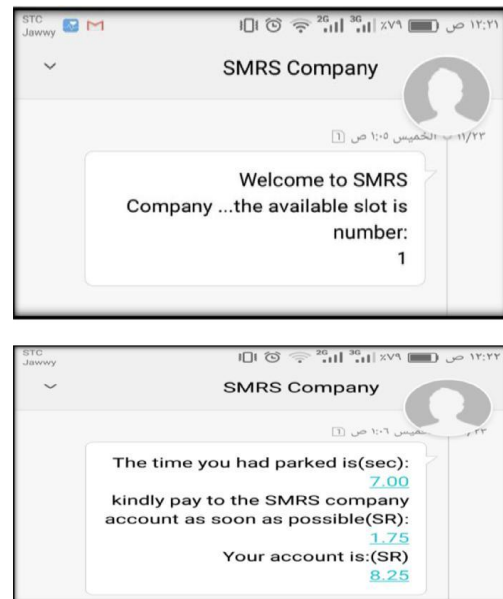


Figure 4. The mobile communication system indicating (a) available parking slot (b) parking time and parking fees.

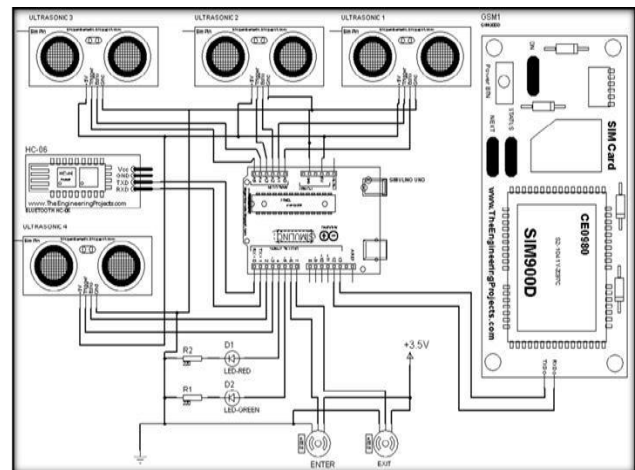


Figure 5. The schematic diagram of the developed system.

Servo motors has been used to operate the entrance and exit gates. The Bluetooth is used to make a wireless connection between the driver phone and the system.

The Ultrasonic sensors are place at the slot of the parking to detect the cars entering and leaving the slots. The LEDs are placed at the entrance and exit of the parking to show the status of the parking. Green led indicates that the parking has available slots. Red led indicates that the parking is busy. The schematic diagram of the developed system has been shown in Fig. 5.

Ultrasonic sensors placed at the parking slots send signal to Arduino with information about empty or full slots. Echo reversing the emitted high frequency sound wave from trig of the sensor when vehicle closed to it. The Arduino process that signal and display green or red LED. If all slots are full, the LED will display red. If it isn't the LED will be green at entrance of the parking.

At the entrance, the driver makes a phone connection with Arduino by Bluetooth. When driver presses the Enter button at his phone application, the Arduino receives that signal and check if the driver has prepayment of the parking fees. If he has, the Arduino will send two signals. One signal to the servo motor at the entrance to open the door .The another signal will send to GSM module for sending SMS message to the driver with information about place of empty slots and the Arduino will start counting the time until the vehicle leave from the parking.

At the exit, there is Ultrasonic sensor to detect if it is vehicle. The driver connects Bluetooth and use his phone application by presses Exit button. The Arduino receives that signal and sends two signals. One signal to the servo motor at the exit to open the door .The another signal will be sent to GSM module for sending SMS message to the driver consist information about the total time that he spent within the parking, and the amount of cost deducted from total parking fees and the remaining fees in his account. The developed system has been shown in Fig. 6.

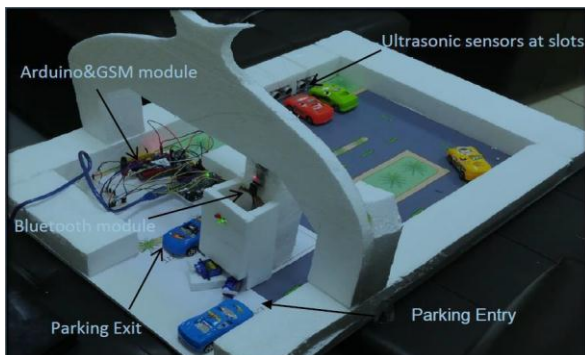


Figure 6. The developed smart parking system.

#### A. Hardware Connection.

The hardware connection of the implemented circuit is shown in the fig 7.

- Connect the Vcc stick to the positive rail on breadboard.
- Connect the God stick to the negative rail on breadboard.

- Connect the Trig stick of Ultrasonic sensors 1,2,3,4 to pins A1,A3,A5,D3 of Arduino , respectively.
- Connect the Echo stick of Ultrasonic sensors 1,2,3,4 to pins A0,A2,A4,D2 of Arduino , respectively.
- Connect TX, RX of the Bluetooth HC-06 to RX, TX of the Arduino, respectively.
- Connect the signal stick of the servo motor "Enter"," Exit" to pins D6, D7 of the Arduino, respectively.
- Connect TX, RX of GSM module SIM900 to pins D13, D12 of the Arduino, respectively.

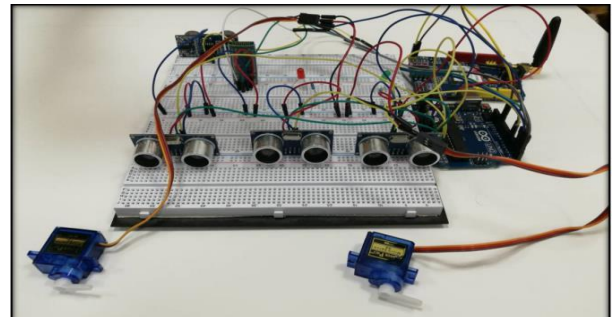


Figure 7. The hardware connection of the implemented circuit.

### III. RESULTS

After making the prototype of the project and implement it, the following results are obtained:

1. Allow to a specific drivers to enter the parking who had registered their identities within the parking admiration and prepayment the parking fees. Based on that each driver will get a unique phone application which allows making a wireless connection between the driver and the Bluetooth.
2. Counting the time that the driver spent at the parking from the moment he had enter the parking.
3. The driver receive a SMS message whiling he enter the parking let him know where is the available slot within the parking that can park his car as shown in Fig. 4.
4. Counting the amount of money that the driver should pay after leaving the parking. The driver will receive a SMS message let him know how much time he spent and how much the driver should pay as show in Fig. 4.
5. Developing an easy and effective payment method where the client prepays for required amount of time that he need to park.
6. Facility enters and exists for the driver by developing the phone application where the driver needs just one press.

### IV. CONCLUSION

This project enhances the capability of the smart parking systems by including additional features. The mobile security application has been developed to allow only authorized vehicles to enter into the parking area.

The driver receives the information on his mobile about the available parking slot. This feature saves the time and fuel required to search for the parking slot. This project also provides a new payment method where the driver prepay the parking fees where a part of the fees is deducted in each time he park his car. It has been foreseen that the developed technology for smart parking system will ensure the facility and security for both the users and the parking companies.

#### V. FUTURE WORK

- Provide a Wi-Fi technology to the project where the user can know the position of the parking and if there is an available slot within the parking even he is far away from it.
- Provide a face detection technology into the parking system for more security and save privacy.

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