Declaration

I, Beni Iyaka, confirm that the work submitted for the following assessment is my own and is written in my own words. Any words, figure or table from other authors are properly referenced and acknowledged. A page of references which were used to write this work is included.

Name: Beni Iyaka

Date:

Signature:
“This piece of work is dedicated to my lovely family and everyone who have been of help and also inspirational to me throughout my academic life.”
Abstract

The aim of this project is to create a prototype of a parking, android application and a web application known as Smart Parking System. This system will be used by the university, mall and any parking area around. The main purpose of this project is to develop a system that will ease the parking process around malls, schools and anywhere around. The system will help control the parking slot availability and also allow drivers to book for a parking slot before reaching the parking area. The reservation will be for a certain period of time of which if the driver does not reach the parking area, their reservation will be expired. The android application will help people book and see available parking slots. While the website, which can be accessed anywhere around will be used to see the available slot and also renew the reservation when they are expired. For this project, tools and programming languages needed for successfully build the system will be provided and discussed.
# Smart Parking System

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Chapter one: Introduction

1.1. Introduction

With the great increase in cars, finding a parking around have been a major problem in our days. Therefore, people make use of two different sort of parking managements systems namely: The Automatic Parking System and the Marshaling Parking System.

The Marshaling Parking System is a type of parking whereby an officer or officers are required to be on ground so as to indicate to drivers where there is a slot available. The Automatic Parking System is a type of parking that is designed to help the driver and administrators of the parking status which is either putting screens to notify drivers of the number of space available.

Looking at the widespread of internet technology, most organization prefer to handle their systems online. By doing so, their users can have easy access of the system wherever they may be. It is clear that the internet has become a critical issue. Therefore, it is used in various sectors such as education, health, tourism and business; of which each administrator tries to make some profit from it. Therefore, the internet has become easier to use and also it has been developed into a virtual community which is larger than many countries.
1.2. Aims and Objectives

The aim of this project is to create and implement an Automated Car Parking System. This is to facilitate the traffic flow within the parking. The sole purpose is to develop a computer system that will allow users to book for a parking and also check the availability of parking within their area.

Furthermore, a parking prototype will be built so as to demonstrate the use of the parking, the mobile application will be used by android users to know the status of the parking slots within the parking. The website will be used to get the full control of the parking and also develop public awareness among the parking users. Users will be able to supply their details such as email, username and the slot they would like to book; then the user will receive a confirmation email stating the slot booked.

The following points are the summaries of the objectives:

➢ To build an android application known as Smart Parking System.
➢ To build a website that allows users to book for a parking.
➢ To implement a parking prototype to demonstrate the use of the parking.
➢ To allow the administrator to have good control of the parking.
➢ To allow users to be aware their parking status.

1.3. User Requirements Analysis

Looking at the Automated Car Parking, there were some questionnaires and interviews that were conducted in order to help create concrete user requirements. The identified requirements were divided into two groups namely: functional and non-functional requirements; of which the questionnaires and interviews that were created helped in analyzing and identify the functional requirements. While the non-functional requirements are used to identify the technical needs of the project.
1.4. Dissertation Structure

The dissertation is made up of seven chapters of which, the first chapter is the introduction. The second chapter is the literature review. The third chapter is the project requirements. The fourth chapter is the project design. The fifth chapter is the implementation. The sixth chapter is the evaluation and the seventh chapter is the conclusion and future application.

1.4.1. Chapter One: Introduction

The introduction chapter gives the main idea of the project and describing the aim and objectives of the project. In the same chapter, the user requirements analysis is described and introduced.

1.4.2. Chapter two: Literature review

This chapter looks at different parking systems that are related to the Automated Parking System. Three different types of parking systems will be discussed which are: Automated Parking System, Semi-Automated Parking System and Parking Marshal System. The topics will be discussed in the particular order that it has been mentioned.

1.4.3. Chapter three: Project requirements

This chapter elaborates on the project requirements and also the different methodologies that will be used to collect and evaluate them. This chapter is formulated by combining all the project components and their functionalities. This chapter will also address all the user requirements so as to clarify the nature of the project.

1.4.4. Chapter four: Project design

This chapter will look at the project design by converting the system requirements into designs which will be incorporated in the website as well as the android application. For the Smart Parking System to meet the expected requirements, there will be a detailed explanation on how the requirements are being implemented.
1.4.5. Chapter five: Implementation

The chapter is divided into five stages. The first stage was implementing the server to control the whole system, the second stage was implementing the database system to manage both the application and the website. The third stage was designing the website based on the requirements and the fourth stage was to design the android application to facilitate the use of the system. The last stage was building the parking.

1.4.6. Chapter six: Evaluation

This chapter is to test and also evaluate the Smart Parking System. The evaluation of the system will be done in order to find out if the users’ requirements are met or not. To find out if the users expectations matches the system’s structure, the usability and functionality of the Smart Parking System will have to be examined. In this chapter, various strategies, methodologies and results will be elaborated.

1.4.7. Chapter seven: Conclusion and Future application

This chapter analyzes all the chapters of this report and then summarize it by outlining the difficulties that was faced when developing the system. Finally, the future application will be describing features that could be added to improve the project.
Chapter two: Literature review

2.1. Introduction

Chapter two will look at different parking systems that are related to the Automated Parking System. Three different types of parking systems will be discussed which are: Automated Parking System, Semi-Automated Parking System and Parking Marshal System. The topics will be discussed in the particular order that it has been mentioned.

2.2. Context

Intelligent Transportation Systems are advanced applications which are developed to improve the quality of transportation and also successfully reach other outcomes based on the transportation system. Intelligent Transportation Systems provides ways to manage traffic and also car parking by using various advanced technologies. Looking at our world today, a lot of advanced systems are developed and also implemented. The use of sensors in addition to their implementation will thoroughly analyzed so as to get a better understanding. That’s why the focus is more on the fully automated parking system.

In this thesis, different car parking systems will be presented by outlining their usefulness during the parking reservation process. An introduction to the fully automated car parking will be analyzed; in which different features that may be used to implement the system will be mentioned. A little discussion will be made on the automated parking since it is mostly used around

Automated Car Parking Systems is widely known to be more complex and computer based. That’s why the Semi-Automated Car Parking which is not that complex will be also analyzed.
2.3. Car Parking System

2.3.1. Smart Car Parking System

Parking facilities have always been important by allowing drivers to safely leave their car while they can go on to their daily activities. Mostly the information provided together with guidance implemented by the smart parking system has been extremely useful by assisting drivers to find an available space [1].

The payment of the parking has also been made easier with the implementation of the new technology. Sensors are used to help detect the presence of the car. This is absolutely necessary when it comes to the development of the smart parking system because information of the parked vehicle is required. From the sensor, the information can easily be gathered so as the system can use it and the same information will also be sent to the driver.

2.3.2. Advantages of Implementing Smart Car Parking System

While implementing the Smart Parking System, the car owner, the parking operator and also the environment benefits from it. When looking at the parking operator, the future parking pattern can easily be predicted from the information gathered from the Smart Parking System [2]. The parking price can also be based on the information obtain so as to improve the organization profits. When looking at the environment, the level of pollution can be reduced by decreasing the air pollution in the air. The amount of time spent to find a parking is reduced resulting to the time saving and also fuel consumption. The car owners also benefit from the System because the system automatically indicates parking space available which directly reduces the amount of vehicle travel and the time to search for an available spot. With information provided by the system, car drivers can easily avoid parking that is full and locate the parking which is vacant [3]. The number of illegal parked cars is also reduced. Also, the traffic congestion is reduced. Other advantages that come with the Smart Parking System is that it provides safety, security. These advantages make it easy for the users. Some more advantages can be economical and efficiency in space and friendly environment in the parking [4].
2.3.3. Safety and Security

While making use of a car parking system, drivers don’t have to spend time searching around for an available spot instead they can directly move to an available space which is either shown on the board, indicated by the sensor or shown in their mobile depending on the type of parking system being implemented. Driving around searching for parking can be dangerous because drivers do not have a full concentration on the road because their focus is on seeing an available spot. Therefore, reaching a parking slot definitely makes it easy for drivers and also removes tension and frustration which increases safety around the car parking. The parking system also monitors the driver's' vehicles which also increases safety [5].

2.3.4. Space Efficiency and Economical

In some parking system such as the conveyor belt parking, client do not have to be worried about how to park or where to park. All they have to do is to leave the car at a certain spot and the car will be carried through the conveyor belt to a free space. This system can contain at least 40% more cars than what a normal car parking would contain. This system removes the need of car owners to move around the parking looking for space to park and climbing stairs or the exercise of remembering where they parked their car. Even though this system is known to be costly in term of maintenance, and other expenses, this system just provides efficient space around. This type of system will be discussed further in Chapter 3.
2.4. Types of Automated Parking System

The automated parking system can mostly be divided into five different types namely: Parking Guidance and Information System (PGIS), Electronic Parking, Automated Parking, Smart Payment System, Transit Based Information System. Looking at the names, different types have different functionalities of which they address various issues related to the car parking facilities. Later on, the report will explain the implementation and characteristic mixed with examples that can be found around the world.

2.4.1. Parking Guidance Information System

PGIS can be categories into two different aspect. This can be implemented to monitor an entire city or just a specific parking. The mentioned categories are mostly implemented in big cities around the world such as Japan, UK and USA. PGIS offers basically the same benefit as the Smart Parking System which was mentioned previously. The major similarity comes in decision making. The information which is provided by the system helps the drivers to make decisions on how to reach their intended destinations and also in locating available parking space in the parking facility [6].

PGIS can be broken down into four different aspects namely: Information Disseminating Mechanism, Information Gathering Mechanism, Control Center and Telecommunication Networks. In PGIS, Variable Message Signs are used so as to provide drivers with ways to take when looking for an empty spot. An example will be the system in Weymouth England, the town parking is labeled with number of available spaces and also the direction of the parking slot as shown in Figure 1. [7].
Looking at this town, various sensors are placed at the entrance, exit and also in the individual parking space so as to detect the presence of the car. LED lights are linked together with the sensors which are then placed in every parking space within the parking. This is used to give the occupancy status [9]. Depending on the sensors, the occupancy of each spot is then counted before giving an output of available spots. From the information obtained, the process implemented will then analyze the information so as to display accurate information for drivers to see; whereby the telecommunication network enables the transfer of the processed data to other modules as shown in Figure 2.
2.4.2. Transit-Based Information System

Transit Based Information System in the type of parking which is mostly implemented in the UK, France, USA, Germany and Japan. It functionality is similar to the PGIS [3]. But the difference is that Transit Based Information System focuses more on facilitating drivers to easily park and drive by providing real time information on the parking slot, schedules of public transportation and also road traffic condition. Those additional information is used to provide drivers with better road planning by eliminating inconveniences. Looking at Transit Based Information System, the other benefits are as follow:

➢ It increases the use of public transport,
➢ Facilitates the transaction to public transportation by using the park and ride method.
➢ Increase in the revenue of transits.
➢ Before implementing the Transit-Based Information System, good planning needs to be done. Because many aspects need to be taken into consideration such as:
  ➢ The geographical location
  ➢ Network
  ➢ Time to travel from the point of demand to the park and ride facilities

![Figure 3: Transit-Based Information System](image)

2.4.3. Smart Parking System

This is a type of parking system that helps overcome limitation of the usual payment method which is done via parking meter and replacing it a more technological approach. This method is seen to be better because the usual
Smart Parking System

payment method causes delays and problems for drivers because they have to deal with cash (1). Looking at the new payment system, when it comes to maintenance and staff requirements for handling payments, and also controlling traffic is reduced [17]. The Smart Payment System is mostly used in countries such as: Italy, UK, USA and Finland. This system involves different methods such as:

➢  **Contact Method**: This is one of the method that involves the use of smart cards, debit cards and credit cards. This requires a direct contact of the card with the meter placed at the parking.

➢  **Contactless Method**: This is one of the method that does not require any card to do the parking transaction.

➢  **Mobile devices**: This is one of the method that all the transaction is done using mobile devices.

![Figure 4: Smart Parking System](image)
The main problem with the Smart Payment System is the doubt on the privacy and security issues. This is mostly because the driver’s private information is being exposed. But with numerous threats arising in our days, it is really understandable for one to be worried about their information. But these problems are usually handled by the use of cryptography, fault detection and evasion.

2.4.4. Electronic Parking

This is the type of parking system that allows drivers to select or enquire about the availability of a parking slot. And if a spot is available, then they can reserve for the space as they wish so as to make sure that they do not have problems parking when they arrive at their destination (2). The Electronic Parking System enables drivers to book for a spot in various ways such as: Sending SMS, Phone call and online. This system is mostly used in airports (Airport Parking Reservation Systems).

The benefits of using the Electronic Parking System is that drivers are free from all the hassles of finding a spot.
2.4.5. Counter Based Parking

This is one of parking types whereby sensors are placed at the entrance and at the exit of the parking so as to count the number of cars that are entering and exiting the parking \(3\). This type of parking calculates the number of available parking slot by subtracting the number of cars that are registered every time by the sensor placed at the entrance to the total number of space registered in the system.

![Figure 6: Counter Based Parking](image)

2.4.6. Image Based Parking

This is the type of parking that uses cameras to register images of the parking. This system is mostly used around because when an image is registered, when a car parks to a certain spot, automatically the image of the parking is changed. Therefore, a new image is store with new data stating the changes within the parking. \(4\) \(5\)

An example of the type of parking is shown in below.

![Figure 7: Image Based System](image)
2.4.7. Wired Sensor-Based Parking

This is the type of parking that uses ultrasonic sensors at each point of the parking which are connected with wires to carry their signal to the server. This system is commonly used to retrieve data about the parking from each individual parking slot. But this type is known to be expensive. (6) (2)

![Figure 8: Wired Based Parking](image_url)

2.4.8. Wireless-Based Parking

This type of parking is similar to the wired based parking but the only difference is nodes are communicating wirelessly (7) (8). The advantage of such system is that it reduces the installation and maintenance cost which therefore makes the system more flexible. An example of such system is shown in the image below. This system uses component such as temperature sensor, light and acoustic to send data to an online server which processes the data and also to the parking users to check availability of the parking online.

![Figure 9: Wired Sensor](image_url)
2.4.9. Convey Belt Parking

This is a more advanced and sophisticated type of parking system that uses a conveyor belt to carry a vehicle to its allocated parking slot. A little history about the conveyor belt.

This was first introduced in the 1800. Of which some are made out of leather, canvas and rubber. (9). Then in 1970, the largest conveyor belt system was introduced in the Sahara Desert. This is used to move cars horizontally without the need of a driver and at the same time, the car engine is also off, the gear in parking mode and all the doors are locked. (10). This system is pretty simple; the car tires are connected to two conveyor belts which are narrower so that they should fit under the tires to facilitate the movement of the car while being pulled forward.

When comparing the conveyor belt parking system to other parking systems around, it is clear that the conveyor belt parking is simpler and straightforward. This system has the facility to move many vehicles at the time. (11)

But it is costlier to implement a Convey Belt Parking compared to other parking systems. When it comes to maintenance, the Convey Belt Parking is very difficult to maintenance compared to other parking systems.

The image below illustrates the conveyor belt parking from Gylet.

![Conveyor Belt Parking Diagram](image-url)
2.4.10. Pallet Parking System

This is similar to the conveyor belt parking system but the difference is that the driver parks the car in a pallet cabin and then the car will automatically be transported to a lift which will take the car to an available slot via roller conveyors. The main advantages of using this type of parking system is that the use of space within the parking is flexible. It is highly recommended for office buildings and residential areas. (12)

![Figure 11: Pallet Parking](image1)

2.4.11. Tower Parking System

This is the type of parking that also uses the conveyor belt to store vehicles but this parks cars one on top of the other. This type of parking saves a lot of space and time because cars are dropped to the conveyor belt and then a spot is automatically assigned to the car. Then it will be carried to the spot. (13)

![Figure 12: Tower Parking](image2)
2.5. Vehicle Detection Systems

Car parks are widely used in our days and for automation of those car parks, there are two types of sensors that can be used to help detect vehicles entering or exiting the parking. These are: Intrusive and Non-Intrusive sensors. With the intrusive sensors, cars vehicles are detected one at the time and then they are placed below the vehicle. While the non-intrusive sensors can detect more than one vehicle at the time.

2.5.1. Intrusive sensors

These are the type of sensors that requires a certain type of modification to the road so as it should be able to detect cars. The type of modification that the intrusive sensor requires can be making a hole in the road, creating a tunnel under the road or making a certain attachment beside the road. The main problem about this type of sensor is that since it has to be placed by the road, it is prone to be damaged by cars. Some of the intrusive sensors are: Magnetometer, rode tube, Magnetic System sensors and Weigh in motion.

➢ Magnetometer Sensor

This is a type of sensor that generate signal that is proportional to the magnetic field strength around it.
➢ **Rode Tube Sensor**

This is the type of sensor which know to be inexpensive. The road tube sensor is designed to be placed in the middle of the road and every time a car passes over it, depending on the use of the sensor, a certain function will be called to perform a certain task. The main disadvantage of this type of system is that the sensor is sensitive to temperature which will cause the system to produce inaccurate results. And it can also be easily vandalized.

![Figure 14: Rode Tube](image)

➢ **Magnetic System Sensor**

With this type of sensor, cars are detected using the magnetic field generated by their own generated disturbance.

![Figure 15: Magnetic Sensor](image)
Smart Parking System

➢ **Weigh in motion**

This is the type of sensor that makes use of a piezoelectric sensor which is then laid across the road: mostly in a specific location for access control. To use this type of sensor accurately, it has to be combined with either another non-intrusive or intrusive sensor so as to provide additional cross-checks while collecting data.

![Figure 16: Weigh in motion](image)

2.5.2. **Non-Intrusive Sensors**

These are the type of sensors that does not require any type of modification to the road before it could be operational. This can easily be placed without disrupting the flow of traffic. This is commonly used around because it doesn’t require extra ordinary component before it should be placed. Some of the non-intrusive sensors are: Ultrasonic Sensors, Microwave Radar and Active Infrared sensors.

➢ **Ultrasonic Sensors**

This is similar to the microwave infrared sensor and its frequency is known to be above the human hearing range.

![Figure 17: Ultrasonic Sensor](image)
Smart Parking System

➢ *Microwave Radar*

This is the type of sensor that is known to be better than other sensors. It can easily detect cars travelling across multiple lines and then calculate their speed. This is done by emit electromagnetic signals and then detect object through the reflection of the signal. The disadvantage of this system is that stationary cars cannot be detected without the aid of additional sensors.

![Microwave Radar](image18.png)

*Figure 18: Microwave Radar*

➢ *Active Infrared Sensors*

This is one type of sensor commonly used around to help detect vehicles. They have a lower frequency compare to the microwave radar sensor. They are very sensitive to the environmental conditions like fog, snow and heavy wind. This type of sensor is good because it can emit multiple beams so as to detect the position and velocity of the passing vehicle. This sensor will be used in the current project to detect the presence of the car in the parking slot.

![Active Infrared Sensor](image19.png)

*Figure 19: Active Infrared Sensor*
2.6. Signal Processing and Data Processing Devices

These are devices which are used to convert signals and data that are being emitted by sensor in a digital form so that computers could be able to process them. In our days, most sensors are equipped with components that handles the process of converting data into readable data for the computer. But for those that are not equipped with those devices, the sensors are connected to a microcontroller; which is a mini-computer that is used to take the data sent by the sensor and then process it and transfer to the computer. Looking at this project, the signal processing device will help in processing data collected from the sensors.

![Cheap Microcontroller](image1.png)
![Breadboard with Wireless Module](image2.png)

2.7. Conclusion

As seen, we have various methods of parking implementation which is then combined with different technologies to make them efficient and accurate. With the reservation system, various approaches can be observed in a way that when booking for a parking slot, drivers do not usually have to state the exit time which means they can park for an unlimited amount of time. With all the electronic system, when it comes to accessing the parking, the driver is required to produce a receipt which proves that they have a spot reserved. Some more sophisticated methods can be implemented such as making use of smart cards and Bluetooth devices so as to gain access to the parking slot.
Chapter three: Project requirements

3.1. Introduction

This chapter will elaborate on the project requirements and also the different methodologies that will be used to collect and evaluate them. This chapter is formulated by combining all the project components and their functionalities. This chapter will also address all the user requirements so as to clarify the nature of the project.

3.2. Purpose

The purpose of this section is to elaborate on the user requirements for the Car Park System in much understanding and consistent manner as asked by the client. The system will have an android application which will enable users to book for an available parking from anywhere for a certain period of time. The Android application should be able to collect information on the parking from the Arduino component and also send the booking report to the Arduino so as to confirm the parking reservation.

Every project requirements will be link to their objective discussed in the objectives section and also determine their priorities of which H represent High, M represent Medium and L represent Low.

3.3. Target Users

Looking at the Smart Parking System, the main targets for the system are the drivers and different car parking. The main goal of this system is to allow users to book for parking and also save them time when looking for a place to park. This project will be created to meet user requirements as accurate as possible.
3.4. Methodology

In our days, many methodologies have been created of which can be applied and used depending on the project. For this project, the “waterfall” model will be used; because as this project incorporate three different concepts, therefore requirements do not have change. By using the waterfall model, the way of gathering some requirements will be through interviews, surveys and questionnaires. The purpose of questionnaire is to gather what users are expecting from the Smart Parking System. The purpose of the interview is to have a good idea on how the booking and parking process work and also how to improve these processes by making use of the internet. From the feedbacks that will be collected, the prototype of Smart Parking System will be built so that users may evaluate the system.

![Waterfall Model](image-url)
3.5. Requirements Analysis

The requirements are divided into two different types namely functional and non-functional requirements. The functional requirements represent what the system should do. Therefore, their priorities are mostly high. The non-functional requirements represent the look and feel of the system. Even though the speed and stability of the system are very important, these requirements are considered to be lower because the system is still in the design stage.

3.5.1. Functional requirements

These are the type of requirements that defines the functionalities of the system. Looking at the parking system, the parking should be automated. Automated which means include artificial intelligent aspect to it so that it should perform most of the tasks without the aid of the human being. These include recording status of the parking and also indicate to the user when the parking is full. Allow the user to book for the parking using the android application from anywhere around the city but the parking should allow the user a minimum time to reach the parking slot before the reservation should be cancelled.

3.5.2. Non-Functional requirements

These are requirements that illustrate aspects that can be used to analyze the operation of a system. Looking the parking system, the features added within the parking should be clear and easy to use so that users should not waste their time trying to use the system. Unnecessary features should be avoided so that the system should not be slow while processing data. Features such as parking booking should be simple to utilize and also effective so as to minimize the data processing speed.
3.5.3. Requirements classification

<table>
<thead>
<tr>
<th>No</th>
<th>Requirements</th>
<th>Objective</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Design the parking</td>
<td>A</td>
<td>H</td>
</tr>
<tr>
<td>2</td>
<td>Develop automated parking System</td>
<td>A</td>
<td>H</td>
</tr>
<tr>
<td>3</td>
<td>Connect the parking system to a web server</td>
<td>A</td>
<td>H</td>
</tr>
<tr>
<td>4</td>
<td>Send parking status to the server</td>
<td>A</td>
<td>H</td>
</tr>
<tr>
<td>5</td>
<td>Update server every time data is received</td>
<td>C</td>
<td>H</td>
</tr>
<tr>
<td>6</td>
<td>Develop an android application</td>
<td>B</td>
<td>H</td>
</tr>
<tr>
<td>7</td>
<td>Book a parking from Mobile application</td>
<td>B</td>
<td>H</td>
</tr>
<tr>
<td>8</td>
<td>Set time limitation for slot booked</td>
<td>B</td>
<td>M</td>
</tr>
<tr>
<td>9</td>
<td>Check parking availability from the android application</td>
<td>B</td>
<td>H</td>
</tr>
<tr>
<td>10</td>
<td>Android application send parking status to the server</td>
<td>B</td>
<td>M</td>
</tr>
<tr>
<td>11</td>
<td>Give booking acknowledgement</td>
<td>B</td>
<td>M</td>
</tr>
</tbody>
</table>

**Functional Requirements**

<table>
<thead>
<tr>
<th>No</th>
<th>Requirements</th>
<th>Objective</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>No delays in the application</td>
<td>D</td>
<td>L</td>
</tr>
<tr>
<td>13</td>
<td>Fast data processing</td>
<td>C</td>
<td>H</td>
</tr>
<tr>
<td>14</td>
<td>Simple booking process</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>15</td>
<td>Consistent features</td>
<td>D</td>
<td>H</td>
</tr>
<tr>
<td>16</td>
<td>Fast system training</td>
<td>D</td>
<td>M</td>
</tr>
<tr>
<td>17</td>
<td>Easy to use</td>
<td>D</td>
<td>L</td>
</tr>
</tbody>
</table>

Table 1: Requirements Listing
4.1. Introduction

The Smart Parking System should be designed to be more user friendly and easy while using it. This chapter will look at the project design by converting the system requirements into designs which will be incorporated in the website as well as the android application. For the Smart Parking System to meet the expected requirements, there will be a detailed explanation on how the requirements are being implemented.

4.2. System Overview

The main objective of this project is to implement a parking system that will enable users to be aware of what is happening within the parking. Users can have these information from the website, android application or the parking itself. The system will enable users to book for a parking; of which the booking last for a certain period of time before it expires.

In the Smart Parking System website, users are able to view the details of the person who booked the slot and also when the booking will expire.

The project database is divided into two tables namely: Parking and Booking. The parking table which is known to be the main table because it handles the status of all the slots find within the parking. The booking table handles all the booking while updating the parking table. The views of the project are just to make the query tasks easier.

---

*Figure 23: User Interaction Design*
4.3. System inputs and outputs

The Smart Parking System provides different inputs and outputs services. These services will be explained in details according to their use.

➢ Users

Users can make use of the website or android application to book for a parking or check the status of the parking slot wherever they are. While booking for the parking, users are required to provide their details.

➢ Administrator

The administrator is responsible in handling every request sent from users regarding the parking. Depending on the status of the parking, the administrator can either approve or reject the users request.

➢ Parking area

The parking area is equipped with sensors and light to show the status of the parking slot. These sensors send and receive signals from the database. When a car is parked, the sensor will update the database and website to indicate that the slot is taken. When the car moves, the sensor will update the database and website to indicate that the slot is available.
Smart Parking System

➢ Database

The Smart Parking System uses the relational database to store all data necessary within the project. As mentioned previously, there will be two tables namely Booking and Parking. The parking table is used to display the status of the parking as it happens. The booking table is used to store all the booking of the parking from users.

Figure 24: Database
4.3.1. Three tier architectures

This is a client-server architecture pattern. This has three different layers namely: top layer which is known as the user interface, middle layer which is known as the process layer and then bottom layer which is known as the data layer. The Smart Parking System project uses various tools to develop the three tier architectures. Of which the top tier is based on the PHP scripting language and the middle tier is used to interpret every request coming from the top layer and then transfer to the bottom tier of the architecture. The bottom architecture built using MySQL to execute every query coming from the middle tier of the architecture.

➢ **Top tier**

This is known to be the presentation tier of the architecture. The top tier is used to display information based on the services related to the website. Looking at the Smart Parking System, the top tier are the user interfaces from the website and the android application. The website top tier is built using html and php scripting language. The main function of this tier is to communicate with other tiers in the architecture. It sends results to to and receives results from other tiers within the network.
Smart Parking System

➢ Middle tier

This is known to be the application tier of the architecture. The middle tier is used for processing requests coming from other tiers within the architecture. Looking at the Smart Parking System, the middle tier is the server side which processes every query coming from the top tier. This is built using php scripting language.

➢ Bottom tier

This is known to the data tier. The bottom tier is used to store and retrieve information based on their commands. Looking at the Smart Parking System, the bottom tier is handle by MySQL server through Wamp.

4.4. System design

4.4.1. Server design

Smart Parking System server is built using PHP and MySQL database. Therefore, some external programs will be needed to make sure that the database is well managed before using the website.

Figure 26: Server Design
Chapter five: Implementation

5.1. Introduction

The Smart Parking System will be implemented based on the results of the requirements that were described Chapter 4. The project implementation was divided into five stages. The first stage was implementing the server to control the whole system, the second stage was implementing the database system to manage both the application and the website. The third stage was designing the website based on the requirements and the fourth stage was to design the android application to facilitate the use of the system. The last stage was building the parking.

The implementation process will be explained based on the three tiers of the system architecture namely: Top tier, middle tier and bottom tier.

5.2. Top tier implementation

The top tier implementation is divided into three sections. The first section will show the website implementation, the second section will show the android application implementation and the third section will show the building of the parking.

5.2.1. Website

➢ Home page

This is the most important page of the website because it keeps the users aware of what is going in the parking. The main importance of this page is to display the parking details and set a link to the booking.

This page consists of a button named Booking, a side bar, the main bar with boxes and the footer. The booking button allows the user to go to the booking page. The side bar contains instructions related to the parking slots. The main bar contains boxes that illustrates the parking slots. The footer contains details of the website developer.

Figure 27 shows the home page displaying all the parking slots with one slot taken while Figure 28 shows the home page with all the parking slots available.
Figure 27: Home page with a Taken parking

Figure 28: Home page with all slot available
Smart Parking System

 Booking page

The booking page enables users to book for a parking depending on the slot they prefer. The page is made simple as possible. All required is to select the parking slot, provide the email address and then put in the identity number. As the parking system is mostly focused on Heriot-Watt University, users are required to provide their Heriot-Watt identity which starts with “H00” and the email address should only be from the heriot-watt domain which are “@hw.ac.uk” or “@macs.hw.ac.uk”. While selecting the parking slot, users will be prevented from selecting the occupied slot as.

Once the user has inputted all the required information, a confirmation email will be sent containing the booking details and the time that the booking will be expired.
Once the booking expires, an email will be sent to the user informing them about the status of their booking.
The detail page enables the users to view details of a parking and also when the slot will become available. This page is accessible from the home page by clicking of the red box illustrated in Figure 27.

![Detail page](image)

Figure 33: Detail page

5.2.2. Android Application

- **Main Activity**

This is the most important activity of the application because it keeps the users aware of what is going in the parking. The main importance of this activity is to display the parking details, set a link to the booking activity.

This activity consists of three buttons namely Booking, Exit and Refresh and the footer. The booking button allows the user to go to the booking activity. The Exit button allows the user to exit the application. The listbox below the buttons displays details about the parking. The footer contains details of the website developer.

Figure 34 shows the main activity of the application by displaying all the parking slots.
Figure 34: Main Page
Booking activity

The booking activity enables users to book for a parking depending on the slot they prefer. The activity is made as simple as possible. All required is to select the parking slot, provide the email address and then put in the identity number. As the parking system is mostly focused on Heriot-Watt University, users are required to provide their Heriot-Watt identity which starts with “H00” and the email address should only be from the heriot-watt domain which are “@hw.ac.uk” or “@macs.hw.ac.uk”. While selecting the parking slot, users will be prevented from selecting the occupied slot as.

Like the website, once the user has submitted the request, a confirmation email will be sent to show details of when the booking will be expired.
5.2.3. Parking Development

The parking is made up of six parking slot which are equipped with light detecting resistor sensors, led light and a servo motor. The parking is connected to the internet using a ethernet shield for communication with the website and the android application.
Smart Parking System

➢ **Parking slot**

In the Smart Parking System, each parking slot has a light on it: when the slot is taken, the red light comes on to show that the slot is busy. When the slot is free, the light goes off to show that the slot is available.

➢ **LDR Sensors**

The Smart Parking System is equipped with LDR Sensors which receives and sends signals to the server. When a slot is taken, the LDR sensor send the signal to the LED light to go on which signals that the slot is busy.

In the parking, the LDR sensor is placed right in the middle of the parking slot because when a car occupies the slot, no enough light will be reflected on the sensor therefore it will send the signal to the server that the slot is taken.

*Figure 38: LDR Sensors*  
*Figure 39: Parking sensor*
Smart Parking System

➢  *LED Light Sensor*

The Smart Parking System is equipped with LED Light Sensors which receives signals from the sensor to either go on or off. When a slot is taken, the LDR sensor sends the signal to the LED light to go on which signals that the slot is busy and when the slot is available, the light goes off.

Since the LED light are shorts, straws are used to act as streets lights so that they can be visible to users.

*Figure 40: Parking Light*
Smart Parking System

➢ **Servo Motor**

The Smart Parking System is equipped with a Servo Motor which acts as the gate of the parking. The Servo Motor receives signals from the light sensor which is placed right in front of the gate. The sensor located in front of the gate has the same functionality as the sensors located on the parking slots. Compared to the other sensors, the led sensor located in front of the gate sends a signal to the servo motor to either open or close depending on the presence of the car.

![Figure 41: Parking gate](image)

➢ **Ethernet Shield**

The Smart Parking System is equipped with all the component mentioned above; but for those components to successfully communicate with the website and the android application, the ethernet shield has to be connected to the Arduino. This component has to be connected to the router using a the RJ45 cable.

![Figure 42: Cable connections](image)
5.3. Middle tier implementation

As mentioned in Chapter 4, the middle tier is used for processing requests coming from other tiers within the architecture. Looking at the Smart Parking System, the server side must be ready for the system to run successfully. In order for it to process every query coming from the top tier.

Smart Parking System was developed using HTML, PHP and MySQL; of which, HTML was used for the top tier, PHP for the server side and MySQL for data storage. In order for the system to successfully operate, the server side of the Smart Parking System needed Apache server together with MySQL and phpMyAdmin.
5.4. Bottom tier implementation

5.4.1. phpMyAdmin

For the Smart Parking System, the database was created and managed using phpMyAdmin. This tool allows the system administrator to have control of the database by editing, deleting, viewing or adding anything within the database. As shown in Figure 44, phpMyAdmin offers a simple interface.

![phpMyAdmin Interface](image)

*Figure 44: phpMyAdmin Interface*

5.4.2. Database creation

The system database contains two tables which were created to store and retrieve data. The system database creation is shown in Figure 45.

```
CREATE DATABASE parking;
```

*Figure 45: Parking database creation*
5.4.3. Table creation

Smart Parking System is made up of two tables namely: Booking and Parking. Each of the table holds different data. The Booking table holds all the booking that is made through the system. Whenever a user books a slot in the parking, the information of the booking will be added in the booking table. The information will stay until the booked slot is expired. Once the booking expires, the information will be deleted automatically. The Parking table holds the live data which is displayed to the user. Once a slot is booked, the table will be updated which automatically displays the updated data to the user.

```
CREATE TABLE IF NOT EXISTS `booking` (
    `bookingId` int(11) NOT NULL AUTO_INCREMENT,
    `bookingName` varchar(50) NOT NULL,
    `bookingEmail` varchar(50) NOT NULL,
    `SlotId` varchar(11) NOT NULL,
    `Time` time NOT NULL,
    PRIMARY KEY (`bookingId`),
    UNIQUE KEY `bookingName` (`bookingName`),
    UNIQUE KEY `bookingEmail` (`bookingEmail`),
    UNIQUE KEY `SlotId` (`SlotId`)
) ENGINE=InnoDB DEFAULT CHARSET=latin1 AUTO_INCREMENT=1 ;
```

![Figure 46: Booking table creation](image)

```
CREATE TABLE IF NOT EXISTS `parking` (
    `ParkingId` int(11) NOT NULL AUTO_INCREMENT,
    `ParkingSlot` int(11) NOT NULL,
    `Status` enum('Available', 'Taken') NOT NULL,
    `Time` timestamp NOT NULL DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP,
    PRIMARY KEY (`ParkingId`)
) ENGINE=InnoDB DEFAULT CHARSET=latin1 AUTO_INCREMENT=1 ;
```

```
-- DUMPING DATA FOR TABLE 'parking'
```

```
INSERT INTO `parking` (`ParkingId`, `ParkingSlot`, `Status`, `Time`) VALUES
    (1, 1, 'Available', '2017-06-27 18:08:46'),
    (2, 2, 'Available', '2017-06-27 18:09:10'),
    (5, 5, 'Available', '2017-03-03 18:09:13'),
    (6, 6, 'Available', '2017-06-27 11:55:16');
```

![Figure 47: Parking table creation](image)

5.5. Conclusion

In this chapter, the implementation process was discussed. Different methods that were used to successfully complete this project was also discussed; including all the architecture implementation were also explained.
Chapter six: Evaluation

6.1. Introduction

The main purpose of this chapter is to test and also evaluate the Smart Parking System. The evaluation of the system will be done in order to find out if the users’ requirements are met or not. To find out if the users expectations matches the system’s structure, the usability and functionality of the Smart Parking System will have to be examined. In this chapter, various strategies, methodologies and results will be elaborated.

6.2. Strategy of evaluation

The strategy used for the evaluation of the Smart Parking System was to test the functionality, usability and the reliability of the system. The process of evaluating the usability of the system was to discover the struggles faced by users while using the Smart Parking System. The process of evaluating the functionality of the system was to find out if the system meets the users’ expectations.

6.3. Methods of evaluation

The choice of methodology used to evaluated the Smart Parking System depends on the type of users that were involved with the evaluation by performing various tasks on the system. The methodology such as observation, users’ opinions, questionnaires and surveys. The observation method was performed while users were performing various tasks within the system, the administrator was observed them and took notes on the usability of the system. Users’ opinion was performed by collecting feedbacks from users after they finished performing their tasks on the system. The questionnaires were given to all the users after using the system. The questionnaire was based on: the usability, functionality and the design of the system.

These evaluations helped in finding out whether the system meets the expected performance and also the users’ satisfaction with the system.
Smart Parking System

6.4. Evaluation Tasks

6.4.1. Website evaluation

During the evaluation process of the Smart Parking System website, users were asked to achieve different tasks. Firstly, users were asked to browse through the website to check if they were able to view the parking slots on the main page. Then users were asked to book for a parking by providing their correct details. After booking, users were asked to check their email and check if they received a confirmation email. After which, users were asked to return to the home page to check if the slot they picked has turned red. After which users were asked to click on the red slot to check if the details of the booked slot are shown correctly. After the expiration of the parking, users were asked to check their email if they received an expiration email.

6.4.2. Android application evaluation

During the evaluation process of the Smart Parking System android application, users were asked to achieve different tasks. Firstly, users were asked to check the design and layout of the application. Then to browse through the application to check if they were able to view the list of parking slots on the main activity. Then users were asked to book for a parking by providing their correct details. After booking, users were asked to check their email if they received a confirmation email. After which, users were asked to return to the main activity to check if the slot they picked has turned red on the list.

6.4.3. Parking evaluation

During the evaluation process of the Smart Parking, a toy cat was used to check whether the parking is performing what is expected from it. Users were asked to move the car in front of the gate and see whether the gate will open; after which when the gate opens, users are free to park anywhere within the parking. Users were asked to place the car to the slot and check if the light goes on to signal that the slot is taken.
6.5. Evaluation questionnaire

After the group finished analyzing the Smart Parking System, they were asked to answer question which evaluates the system. The aim of the questions was to get the user’s satisfaction and impressions about the system. There feedback helped in improving the system as shown in Appendix C.

6.5.1. Types of questions

Many types of questionnaires were asked depending on the criteria. Questions such as “Open” and “Closed” questions were used for the evaluation of the system. Of which open questions were used to allow the user to have control while answering. Users were given time to reflect and think before answering. Closed questions were used to gather more concrete information from the user.

6.5.2. Questionnaires evaluation

This section will help analyze all the feedbacks collected from users based on the type of questions that were asked. This section is divided into three namely: website questionnaires, android questionnaires and parking questionnaires.

➢ Website questionnaires

Question 1

Was the information on the Home Page relevant and helpful?

□ Yes
□ No

If no, tell us what is expected?

![Feedback](image)

*Figure 48: Result question 1*
Question 2

Was the side bar providing useful information of the parking?

☐ Yes
☐ No

If no, tell us what is expected?

![Feedback](image)

*Figure 49: Result question 2*

Question 3

Was the button placed in a correct place?

☐ Yes
☐ No

If no, tell us what is expected?

![Feedback](image)

*Figure 50: Result question 3*
Smart Parking System

Question 4

Was the layout of the website good enough?

☐ Yes
☐ No

If no, tell us what is expected?

![Feedback](image)

*Figure 51: Result question 4*

Question 5

Did you encounter any difficulty accessing the links?

☐ Yes
☐ No

If no, tell us what is expected?

![Feedback](image)

*Figure 52: Result question 5*
Smart Parking System

Question 6

Were you satisfied with the font size?

☐ Yes
☐ No

If no, tell us what is expected?

![Feedback Chart]

*Figure 53: Result question 6*

Question 7

Was the Booking Page responsive to the request?

☐ Yes
☐ No

If no, tell us what is expected?

![Feedback Chart]

*Figure 54: Result question 7*
Question 8

Was the booking process easy?

☐ Yes
☐ No

If no, tell us what is expected?

Figure 55: Result question 8

Question 9

Did you receive a confirmation email?

☐ Yes
☐ No

If no, tell us what is expected?

Figure 56: Result question 9
Smart Parking System

Question 10

Was the email received on time?

☐ Yes
☐ No

If no, tell us what is expected?

Feedback

0%
100%

Figure 57: Result question 10

Question 11

Were you able to view the booking details from the website?

☐ Yes
☐ No

If no, tell us what is expected?

Feedback

0%
100%

Figure 58: Result question 11
6.5.3. Android application questionnaire

Question 1

Was the information on the application relevant and helpful?

☐ Yes
☐ No

If no, tell us what is expected?

![Feedback](image)

*Figure 59: Result question 1*

Question 2

Was the providing relevant data about the parking?

☐ Yes
☐ No

If no, tell us what is expected?

![Feedback](image)

*Figure 60: Result question 2*
Smart Parking System

Question 3

Were the links placed in a correct place?

☐ Yes
☐ No

If no, tell us what is expected?

Feedback

Figure 61: Result question 3

Question 4

Was the layout of the application good enough?

☐ Yes
☐ No

If no, tell us what is expected?

Feedback

Figure 62: Result question 4
Question 5

Did you encounter any difficulty accessing the links?

☐ Yes
☐ No

If no, tell us what is expected?

![Feedback Chart](image)

*Figure 63: Result question 5*

Question 6

Were you satisfied with the font size?

☐ Yes
☐ No

If no, tell us what is expected?

![Feedback Chart](image)

*Figure 64: Result question 6*
Smart Parking System

Question 7

Was the Booking Activity responsive to the request?

☐ Yes
☐ No

If no, tell us what is expected?

![Feedback](image1)

*Figure 65: Result question 7*

Question 8

Was the booking process easy?

☐ Yes
☐ No

If no, tell us what is expected?

![Feedback](image2)

*Figure 66: Result question 8*
Smart Parking System

Question 9

Did you receive a confirmation email?

☐ Yes
☐ No

If no, tell us what is expected?

Figure 67: Result question 9

Question 10

Was the email received on time?

☐ Yes
☐ No

If no, tell us what is expected?

Figure 68: Result question 10
6.5.4. Parking questionnaires

Question 1

Was the built appropriately?

☐ Yes
☐ No

If no, tell us what is expected?

![Feedback](image1)

*Figure 69: Result question 1*

Question 2

Was the main gate responsive to the car presence?

☐ Yes
☐ No

If no, tell us what is expected?

![Feedback](image2)

*Figure 70: Result question 2*
Smart Parking System

Question 3

Was the parking responsive to the presence of the car?

☐ Yes  ☐ No

If no, tell us what is expected?

![Feedback](image1)

*Figure 71: Result question 3*

Question 4

Did you encounter any difficulty accessing the parking?

☐ Yes  ☐ No

If no, tell us what is expected?

![Feedback](image2)

*Figure 72: Result question 4*
6.6. Results Evaluation

Looking at the results from users, it shows that the evaluation differs from users’ opinions and also reflection on the Smart Parking System. While evaluating the website, users agreed that the Main Page contained useful information, easy to understand and was also straightforward. Everyone seemed satisfied with the overall layout and disposition of the website; although some were not satisfied with the font size and others had a problem with the booking process. When evaluating the system android application, users were satisfied with the whole process but same with the website, some users had problems with the font size. When evaluating the parking, users requested that the layout of the parking should be changed due to the fact parking slots were too close to each other which made it difficult for cars to park. Overall, users were satisfied with the way the system links three different technologies. Some of the users provided ways of which the Smart Parking System could be improved. Of which this is detailed in Appendix C.
6.7. Smart Parking System Maintenance

After receiving various feedbacks from users who evaluated the system, different modifications were made to the system based on the feedbacks. The modifications had many aspects of the system such as the parking layout, the font size and some functionalities.

- **System font size:** The Smart Parking System Android Application and Website font size was modified so that it should meet the users’ feedback.

- **Reduce empty spaces in the website:** The Smart Parking System Website was modified to meet the users’ requirements.

- **Parking layout:** The Smart Parking System layout was changed to a sixty-degree angle.
Chapter seven: Conclusion and Future application

7.1. Introduction

This chapter will be analyzing all the chapters of this report and then summarize it by outlining the difficulties that was faced when developing the system. Finally, the future application will be describing features that could be added to improve the project.

7.2. Conclusion

Looking at the world in our days, Internet Technology has played a very important role in various aspects such as Marketing, Business, Banking and many more. Internet Technology has helped people in building web application. A good example is the Smart Parking System. The first step of this project was to build a prototype that is connected to the internet to facilitate users to make use of the system. Step two of this project was to make a website to allow the parking prototype to communicate with the website of this system. Many technologies were used to help build the system such as HTML, PHP, JavaScript, Android and MySQL. The project has been implemented in different stages such as Literature Review, User Requirements, Design and implementation, System Evaluation, System Maintenance.

The expectation of this research is to show some ways in which automated parking system may help improve the life style of many car owners and also save their time while needing a parking around a certain area such as mall, school, or any way around.

Although all the objectives and requirements were met, some of the objectives still needs to be implemented in the future so that the project could be more efficient and work effectively.
7.3. Difficulties

While developing the Smart Parking System, various obstacles were faced in different areas of the project. The obstacles were mainly with the Literature Review and learning different programming languages such as HTML, PHP, Android, Arduino and MySQL. Other obstacles were faced in creating the questionnaires, interview and writing the report by also keeping in mind the language difficulties.

7.3.1. Literature review

While writing the report, most of the time was spent on writing the literature review. Due to the fact that appropriate information needed to be collected for all the environments involved in the project. The most difficult part was analyzing different types of parking systems.

7.3.2. Programming languages

While developing the system, different programming languages needed to be learnt due to the fact that most of those languages such as PHP, HTML and Arduino were not familiar to the developer.

7.3.3. Questionnaires, Interview and Survey

For this project, two sets of questionnaires had to be drafted. Of which both set of questionnaires took a long time to design because of the audience. Various things had to be kept in mind such as culture, language barrier and also age group.

7.3.4. Report writing

For this project, the report writing was the most difficult section. Due to the fact that not enough time was allocated to it and also knowing that the person who wrote the report is not a native English speaker. Therefore, much time had to be spent on grammar checking and analyzing the style of writing.
7.4. Future Application

Software based on Artificial Intelligent is becoming applied all over as technology is being improved on a daily basis. Methods to use real-time learning are being used all around. Algorithms that help in real-time data processing together with learning processes are being used and when it comes to parking related technologies, self-park vehicles, speech parking; sensor-based parking and robotic parking are being used so as to improve our lives on a daily basis.

Successful development and findings of the proposed project will be utilized to further car parking studies on which the focus will be more on self-parking vehicles based on the location of the vehicle. The main aim of the further study be to have a deeper understanding on how technology can improve the lifestyle of human beings even with the cars we drive on a daily basis. So far, some research done in the literature review indicates that due to limited space within the parking, most parking may have the tendency of expanding their space which will result in a setup of small parking slots just to accommodate enough cars. Therefore, drivers may have difficulties to getting down the vehicle once they have parked. An implementation of a self-parking vehicle will make their lives easy by allocating an available slot and just going to park there without the aid of a driver.
7.5. Professional, Legal and Ethical issues

Looking at the Smart Parking System, every component involved with the system is based on the experience of the users and developers. Therefore, the system will be evaluated by students and staffs of Heriot-Watt University. Due to that fact, no personal information will be recorded. Resulting to not needing the ethical approval for the project and it also does not include any ethical or social issues. If there is anything in the system that might implies some ethical or social issues, it will be mentioned in the appendices.
Bibliography


11. Gylet. Robotic Parking. [Online] Gylet, June 16, 2011. [Cited: March 12, 2017.] data:image/jpeg;base64/9j/4AAQSknZJRGABAQAABAAD2wCEAAkGBxISEhU5EhQWfhUXGDbGRgYGRoaGhkYGSAhGheGB4dhHzQGBsmGxbITEmJSorLs4uGh8zRDYsnNygtLisBCgoKDg0OGxAQGy4ICUtLS0tLy0tLS01Ky0vLS0vLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tLS8tL...
Smart Parking System

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Smart Parking System


Smart Parking System

Questionnaire

The aim of this project is to create and implement an Automated Car Parking System. This is to facilitate the traffic flow within the parking. The sole purpose is to develop a computer system that will allow users to book for a parking and also check the availability of parking within their area.

Furthermore, a parking prototype will be built so as to demonstrate the use of the parking, the mobile application will be used by android users to know the status of the parking slots within the parking. The website will be used to get the full control of the parking and also develop public awareness among the parking users. Users will be able to supply their details such as email, username and the slot they would like to book; then the user will receive a confirmation email stating the slot booked.

**Question 1:** What is your level of education?

- □ High School
- □ Bachelor’s
- □ Master’s
- □ PhD
- □ Other

If so, please mention _________________________

**Question 2:** Have you ever used a booking system before?

- □ Yes
- □ No

If Yes, please mention ___________________________

**Question 3:** How often do you interact with any online system?

- □ Once or Twice
- □ More
Question 4: How much do you enjoy interacting with online systems?

☐ Very Much
☐ Moderately
☐ Not at all

Question 5: Have you ever faced any difficulties with the online systems?

☐ Yes
☐ No

If yes, please mention ____________________________

Question 6: If you have never used an online system, what are the reasons?

Question 7: Do you agree that we should incorporate technology is all the parking?

☐ Very Much
☐ Moderately
☐ Not at all

Question 8: Do you make use of the internet?

☐ Yes
☐ No

If no, please mention ____________________________

Question 9: What do you use to access the internet?

☐ Laptop
☐ Desktop
☐ Mobile
☐ Tablet
☐ All
Question 10: On an average, how many hours daily do you spend on the internet?

- Less than an hour per day
- 1-3 hours
- 4-6 hours
- More than 6 hours

Question 11: Do you agree that we should educate people to make use of technology in all aspects of their lives?

- Agree
- Disagree

Thank you for your participation
Appendix B
Smart Parking System

Interview Release Form

I understand that Beni Iyaka is preparing and writing a work that will be published on the subject of the dissertation, which is titled Smart Parking System.

In order to assist the writer in the work preparation, I have agreed to be interviewed so as to provide information and other materials to be used in the work. This includes my personal experiences, remarks and recollections that I may share with the writer.

Agreed and confirmed:

Signature: ___________________________  Date: ______________

Name: _______________________________

Thank you for your participation
Smart Parking System

Smart Parking System
Interview

The aim of this project is to create and implement an Automated Car Parking System. This is to facilitate the traffic flow within the parking. The sole purpose is to develop a computer system that will allow users to book for a parking and also check the availability of parking within their area.

Furthermore, a parking prototype will be built so as to demonstrate the use of the parking, the mobile application will be used by android users to know the status of the parking slots within the parking. The website will be used to get the full control of the parking and also develop public awareness among the parking users. Users will be able to supply their details such as email, username and the slot they would like to book; then the user will receive a confirmation email stating the slot booked.

Dear __________,

Question 1: Can you please introduce yourself?
Question 2: What is the importance of technology in our everyday life?
Question 3: Why is it important to incorporate technology in everything we use?
Question 4: Do you have difficulties finding parking slot in a parking area?
Question 5: Can you give reason behind the issue?
Question 6: Do you think malls, schools and other business centers will benefit from this new technology?
Question 7: Would you prefer booking a parking from the comfort of your home?
Question 8: Would you prefer emails to be sent to you with updates on the parking?
Question 9: Do you think this technology will increase the customer satisfaction?
Question 10: Is there anything you would like to add?

Thank you for your participation
Smart Parking System

Evaluation Tasks

The aim of this project is to create and implement an Automated Car Parking System. This is to facilitate the traffic flow within the parking. The sole purpose is to develop a computer system that will allow users to book for a parking and also check the availability of parking within their area.

Furthermore, a parking prototype will be built so as to demonstrate the use of the parking, the mobile application will be used by android users to know the status of the parking slots within the parking. The website will be used to get the full control of the parking and also develop public awareness among the parking users. Users will be able to supply their details such as email, username and the slot they would like to book; then the user will receive a confirmation email stating the slot booked.

➢ Website and Android

Step 1: Opening the system website

➢ Start your browser.
➢ On the search bar, type “localhost/myparking”
➢ This will redirect you to the Smart Parking System home page.

Step 2: Browse the website pages

➢ In the Smart Parking System website main page, there is a button on the top left which is named “Book Parking”. Click on it and it will take you to the page you can book for a parking.
➢ The main page also provides the slot details and also instructions on when the parking is taken and available.
Smart Parking System

Step 3: Parking Booking

➢ After clicking on the booking button in the home page
➢ The user will be directed to the booking page.
➢ The page will ask the user to input their details such as email, student ID and select the parking of their choice.

Step 4: Booking confirmation

➢ After clicking on “Book the parking” in the booking page,
➢ An email will be sent to the user confirming their booking.
➢ In the email, details include the time before the expiration, the name and the parking slot.
➢ To give the user more time to reach the parking, 30 min extra is given to the user from the time of booking.

➢ Parking prototype

Step 1: Gate opening

➢ In the parking prototype, the car is brought close to the parking gate
➢ The gate should acknowledge the presence of the car and open automatically.

Step 2: Parking Slot

➢ When the car is in the parking, if the red light is not on, it means the parking slot is free
➢ Then the user can park to the available slot.
➢ When the car is parked at a slot, the light automatically goes red. Showing that the slot is taken.

End of the evaluation tasks

Thank you for your participation

Beni Iyaka, MSc Software Engineering
Smart Parking System

Website

Instructions

> If the box is **GREEN**, it means that the parking is available.

> If the box is **RED**, it means that the parking is not available.

Slot 1 Available, Slot 2 Available, Slot 3 Available

Slot 4 Available, Slot 5 Available, Slot 6 Available

This website was developed by Beni Iyaka.

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Beni Iyaka

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System Installation Guide

Step 1: Smart Parking System server installation

➢ Download the wamp apache server from http://www.wampserver.com/en/
➢ Install the package which comes with: Apache server, MySQL and phpMyAdmin.
➢ While installing the server, a screen will appear asking for the administrator password and username. Insure that the installation is done on the computer that the administrator username and password is known.
➢ Once the installation is done, open the wamp folder located in the C:/ drive.
➢ Copy the Smart Parking System folder find in the provided CD in the www folder.

Step 2: Smart Parking System database configuration

➢ Click on the wamp icon to start the server.
➢ On the task bar, click on the “^” to view hidden arrows.

➢ As the wamp server shows green, it means the server is on.
➢ Open your browser and write “localhost”.
➢ Once the page is loaded, click on phpMyAdmin.
On the new page displayed, there is a tab called “MySQL localhost”. Input the name of the database which is “parking” and then click on “create”.

Once the database is created, click on import, then locate the database file in the folder from the CD. The database is called “parking.sql”.

Beni Iyaka
Once that is done, then your database will be ready to be used.

Step 3: Launching the website

➢ From the browser, type http://localhost/myparking
➢ Which then takes you the website.
Smart Parking System

Step 4: Installing the android application

➢ Make sure that the mobile phone is an android with a min API of 18 and there is internet connection.
➢ Connect the mobile phone to the computer.
➢ Select the apk file from the android folder.
➢ Then send it to the mobile.
➢ Click on the apk file from your mobile and install the application.
Project Plan

This section will elaborate further on how each task of the project will be managed depending on their size. Looking at the Car Parking System, this section will be used to break down in details various steps to follow so as to successfully meet the requirements.

➢ Purpose

The purpose of the research plan is to show how the research will be outlined and how long it will take. This will be done by identifying tasks that’s required to accomplish the research and also point out various problems that may arise during the development of the project so as it could help in managing the risks.

This project is divided into four main tasks which are represented in green. Each of them have subtasks which are represented in blue and the last one which is the report.

The project is set to run from April to August 2017 of which each task has a certain timeframe depending on their priorities and also importance in the system.

As shown, the first aspect in the project plan below is the Arduino programming because the project is based on it and it is also seen as the backbone of the project and then comes the android application. To facilitate the use of the parking to users, the use of an android application will be important because users can know the parking status and also book the parking prior to their arrival to the parking. After that, then the evaluation of the system will take place to see whether all the requirements are met or if they can be any new ideas to implement.