Final Year Project

TBB 3012

Parking Guidance System mobile application

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ABSTRACT

This paper represents a report on approach for the car park guidance system mobile application. It is currently found that in urban areas even with buildings having the parking guidance systems installed, many drivers are still not fully utilizing due to factors like unfamiliarity and. The car park guidance mobile application utilizes the existing car park guidance system to provide information to the status of available car parks in a building to users through mobile devices. The system prototype is designed to capture information from designated building with car park guidance system and return real time feedback in specific terms as in which unit of car park is vacant, which area and which floor it is located to users who are accessing the mobile application. The scope of study will be in android platform smart phones. The design of the mobile application is through AppInventor or Eclipse. Quantitative and qualitative research through surveys and interviews were chosen as research methodology and conducted to receive feedback on the development of end product.

CHAPTER 1

INTRODUCTION

1.1 Background Study

Car park is a designated area for a car to park for a limited time. As cars are the main forms of transport in the world nowadays, in fact there are even different types of car parks ranging from public, private, multi-storey and even automated car parks which are developing in urban areas. Some might also require payment in return for the service of parking.

The emergence of technology and development of infrastructure has also contributed different type of parking systems. This includes parking guidance systems, automated car park systems, vehicle built in parking assist and so on. The aim for these parking is to decrease the time and petrol spent on finding and parking a vehicle.

In a developing country like Malaysia, the use of parking guidance system is getting more and more popular. Shopping Malls especially in city areas are starting to use this system, such as Kuala Lumpur City Center (KLCC), Sunway Pyramid Shopping Mall, The Gardens and Mid Valley Megamall, The Mines Shopping Fair and even in less developed parts of Malaysia like Boulevard Shopping Mall in Kuching, Sarawak, eastern peninsular of Malaysia. It is a rising popularity as traffic congestions are starting to leave significant impact and through efficient regulations in car parks, revenue can be increased with a little investment.

1.2 Problem Statement

1.2.1 Problem Identification

Drivers tend to a hard time finding a parking space in buildings especially during peak hours. This causes congestion in traffic in the building and even confusion for drivers who are not familiar with the car park layout of the building despite with the aid from parking guidance system. This results in the wastage of time and petrol to the different drivers who are searching for car park.

1) Confusion of drivers

   Drivers with lower navigation capability or drivers who are not familiar with the layout of the car park sometimes get confused on which way to go even though they are aided with the parking guidance system

2) Wastage of time and petrol

   Even with the aid of parking guidance systems, users sometimes still circle around to find parking as there are competitors in find car parks especially during peak time. With the aid of parking guidance systems, the time to find available car park slots has been reduced however it is still not enough.

3) Pressure of other drivers

   Some drivers even with the aid of the parking guidance systems are unable to see clearly and make decision quickly enough on which parking level and area to go to due to pressure of other vehicles behind of them.

1.2.2 Significance of Project

The project is significant with the aim of reducing the problem addressed above through the end product prototype.

1) Early planning

The application allows user to plan earlier and reduce time consumed in hassle of looking for a parking. Drivers are able to know the condition of the car park they are heading and have enough time to decide where to park. Eg. If the car park is heavily congested, then drivers can opt for an alternative place to park.

2) Reduced time and money consumption

Through the use of the application, users are expected to have reduced time spent on finding a parking space and thus directly also reducing the petrol consumption.

3) Portability and accessibility

The application also provides significant portability and accessibility to information which is currently only available on site, in this case the designated car park. Thus by converting the system into a mobile application form, users are able to access and secure the required information before hand.

1.3 Objectives and Scope of Study

1.3.1 Objectives of Study

The Project has the following objectives:

- To research on the suitable theory of mobile devices to aid parking guidance system
- To develop a mobile application for a parking guidance system
- To conduct user acceptance testing on Mobile Application for parking guidance system

1.3.2 Scope of Study and Limitations

The end product of the project is an Android OS based application prototype. Only smart phones which run on the Android are able to download and use the application for the time being.

The application is aimed at users of designated car parks equipped with parking guidance systems. The application will be designed to return real time information about the car park space availability as well as more specific details such as level, area and unit.

The application will not replace the parking guidance system but acts as a tool which assists it and further leverage and enhance on the usability of the system. This will in return produce a more efficient result than the original parking guidance system.

1.4 Relevancy of Project

The mobile application designed for parking guidance system will no doubt be useful to the people who have a problem at finding car parks especially during peak times. The research project is making effort in shortening the time wasted by drivers to search for a car park space as well as reducing the wastage of petrol consumption and pollution. The result of this study will provide a more feasible approach to utilize the existing parking guidance system which brings the desired results intended by the parking guidance system.

1.5 Feasibility of Project

The research project consists of two major phases. The initial phase is focused on the planning phase where clear objectives are set as well as the scope of study of the project, research and literature review of the subject, and also the learning of the application tools to build the project. The time frame for the first phase is approximately twelve to fourteen weeks or four months. The second phase will be magnifying on the developing, testing and perfecting of the designed project. The second phase has a similar time frame as the first phase which is twelve to fourteen weeks or four months. Through using the android platform which is open-source, the development of the project is simplified through references and tutorials aside from the skills which the student already possess.

CHAPTER 2

REVIEW OF LITERATURE

To reduce traffic congestion especially in areas such as car parks, it requires more than just a wide road or traffic officers to direct the flow of traffic. A more systemic approach should be done and aspects in more microscopic models should be studied and not only view things in macroscopic models (R. Arnott, 2005.)

Even with the aid of parking guidance systems, most well informed drivers are unable to find a parking space instantaneously as it all depends on the preference of drivers parking habits and availability of parking space at the moment of time (Axhausen, 1990). A further microscopic study into the mechanics of parking guidance system, feasibility and need of mobile applications as well as parking guidance systems are needed to create proper understanding on why the problems persists.

2.1 Parking Guidance systems Framework

There are a few types of parking guidance systems which are currently installed in some buildings. In Malaysia, a more common example type would be one comprised of easily installed patented vehicle detection processors (VDPs), variable message sign (VMS), control processor and management software suite. This system captures the count of vehicles at entrance and exits which then displays the information on the VMS outside the building (Keng, 2006)**.**

Other types of parking guidance system available such as the more advanced Single-space Recording in Multi-storey car parks uses a system where designated car parks are each allocated a sensor on the ceiling above the parking bays as well as indicators on the occupancy of the parking bay. USS 300 single space sensors are commonly used for this system. This system is able to display real time information and direct drivers to different areas of car park for available parking space with the aid of traffic lights which varies in different versions but usually red signifies occupied while blue or green signifies vacant. The system is able to support different sizes of car parks and can be programmed to zone control for numerous zones at a control center (PC) which provides flexibility (Keng, 2006). This project will be mainly focusing on leveraging on this particular system.

Figure 1: Example of Parking Guidance System

2.2 The need for Parking Guidance systems

The search for a car park is becoming a more and more severe problem especially in urban areas. With the increase of population as well as cars in a city, the parking area of a shopping mall however is rarely extended. Through interviews with random people in shopping malls, it is found that in worst case scenarios, there are quite a number of people ever spent half an hour or even an hour just to find a parking space in a shopping mall. The reason being not that they are not able to find empty parking spaces, just that they are a tad too late without the aid of parking guidance systems. Arguments on assistive information can benefit users to achieve their desired behaviors as well as reducing traffic congestion (David, 2006).

Experiments were designed by (A.Hester, 2002) to see effects of implementation of parking guidance system with different driver behavior and parking availability. In experiment 1, three different versions of utility theory were tested. This experiment results show that drivers show higher tendency to reduce travel time either in minimizing walking distance or maximizing the parking availability. This however is only applicable after drivers enter a car park. In experiment 2, results show that drivers tend to only park in a car park with

certain criteria number of empty car park spaces. This lessens the pressure on drivers thus showing the importance of the aid of parking guidance systems.

Experiments conducted by (Asakura Kashiwadani, 1995) in Japan shows similar result. The relationship found between average waiting time and the amount of information drivers have about the current situation of the designated car park are directly proportional. This shows a decrease in average waiting when drivers have more information on the car park.

2.3 Parking Guidance systems review

According to (B.J. Waterson), parking search can be explained in a queuing model. Consider a series of checkout counters in a large supermarket. Users will tend to look for shorter lines and the rate of the lines going although it might not be so useful during busy times. Users will change lanes if they perceive that they can reduce their waiting time by changing lanes. The difference in car park is that users cannot see at the entrance of car parks. Thus in the queuing model the distribution is kept at a more optimum rate.

Besides that, drivers also need to be categorized based on their familiarity with designated car park and the frequency of the drivers parking there. Surveys conducted by (B.J. Waterson) show that humans are habitual in choosing car parks and 80% of drivers will park at the initial car park in mind which they had.

Studies from (A, 1993) show the impacts of different parking guiding systems. The study shows about 4% of respondents are unaware of the systems while 47% are aware but do not use the system, whereas 49% of respondents are aware and utilizes the system. In a separate survey, it is found that some of the reason the users who are aware but not using the system is due to habits as well as pressure from other drivers from behind, thus concluding that the implementation of parking guidance system cannot be fully optimized to its optimum potential. A more mobile and accessible approach should be considered.

CHAPTER 3

METHODOLOGY

3.1 Research Methodology

The chosen methods to conduct the research were through surveys and interviews. Two questionnaires were drafted and will be distributed to potential users. The questionnaires consist of both open ended and closed ended questions. The research and information gathering aim at acquiring both quantitative and qualitative aspects to secure more accurate results.

3.2 Project Activities

3.2.1 Exploratory Research

Exploratory research was first conducted through observations and informal interviews to define the problems which the project aims to address. The chosen interviewees were 10 close piers as well as random connections.

3.2.2 Empirical Research

In order to get deeper understanding, observations were made at a chosen shopping mall which is Sunway Pyramid Shopping Mall. Random shoppers were also interviewed and asked to complete a survey to collect specific data.

3.2.3 Application Development

Rapid Application Development method was the chosen method for application development. There are four stages in this application development method which are Planning, Analysis, Development and Implementation.

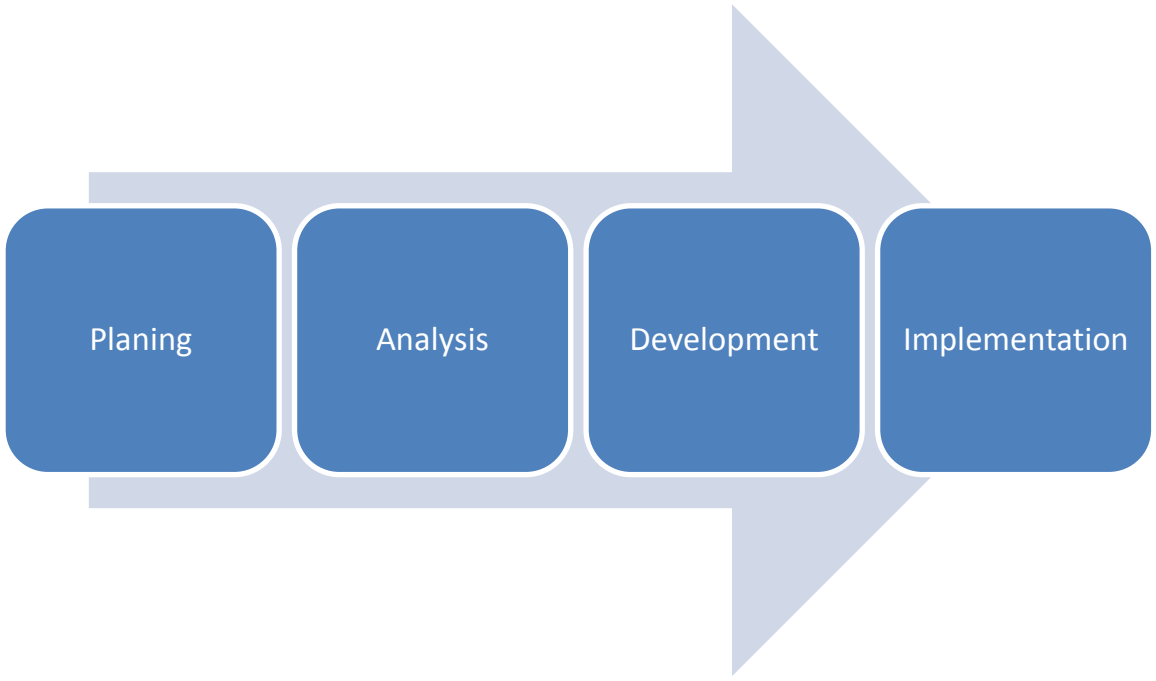


Figure 2: Rapid Application Development Phases

i. Planning

In the initial stage of the project, the planning process will first be engaged. Generation of idea was first done and followed by clarity of problem statement and objective to be addressed. Further focus on to the scope of study as in how the project will aim to solve the identified problem will be engaged and a rough solution will also be drafted in this stage.

The project identified that although parking guidance system have been implemented in some buildings, however it is not fully utilized due to some factors such as unfamiliarity, habit and others. Thus a solution was drafted to revert to this matter. The chosen solution to address this matter is by creating mobile applications which is the current trend as it provides the benefits of portability.

The proposed mobile application will aim to display real time information to users on the availability or situation of a designated building installed with parking guidance system. The portability in passing information to users will aid in faster decision making thus reducing the time taken to find a parking space as well as reduce pollution and unwanted stress.

ii. Analysis

For the analysis phase, research work such as data collection, information gathering and further analysis are done in this stage. For data collection, several methods were implemented to gain quality and practical information which can contribute to the project.

To obtain qualitative and quantitative information, surveys, questionnaires and interviews were done to obtain the information and feedback needed for the development of the project.

Deeper studies on the mechanism of current existing parking guidance system were done to analyze more on the factors which contribute to the problem addressed. A study on the functionality and operations of the parking guidance system was also analyzed before proceeding to the development of prototype stage of the project. Specifications to be included in the PGS App are also included in this stage. Studies including which buildings and how many of the buildings are actually installed with Parking Guidance Systems are also done as further studies are needed with these buildings to be able to understand how the Parking Guidance system functions and how well is it accepted, maintenance etc.

iii. Development

The development stage will be in the latter half of the overall project activities. This stage would be the longest stage as technical activities as well as learning will be done at the same time to develop the project. Specific details on the designing of the prototype will be applied in this stage.

The system architecture of the Parking Guidance System Mobile Application (PGS App) is done here as well as the system design. Furthermore, coding of the PGS App is done through the android platform which is through AppInventor and Eclipse SDK. A story board was initially drafted to get an idea on how the PGS App will actually look like. Through the story board, a home page will be the initial page with a list where users can choose the specified shopping malls and view the availability of parking spaces as well as the floor plan of the parking space.

iv. Implementation

The implementation stage will be the final stage of the project where activities such as user acceptance as well as system testing will be conducted in this stage. This stage will be conducted in the second major phase of the project. Further evaluation on the feasibility and user friendliness of the system will be done in this stage.

3.3 System Architecture

3.3.1 System Framework

The system framework of the project will be broken down into two parts. First will be the Parking Guidance System framework and the other will be the extension of the PGS to mobile application system.

In a basic Parking Guidance System, an ultrasonic detector will detect whether or not the parking space is occupied or not. When the parking is space is occupied, the indicator on the ceiling will change color from either blue or green to red. This information will first be sent to the zone control which will then calculate the total count of the available parking spaces and then display it in the LED displays and indicators. This information is later sent to the server and is displayed and can be controlled through the main control centre.

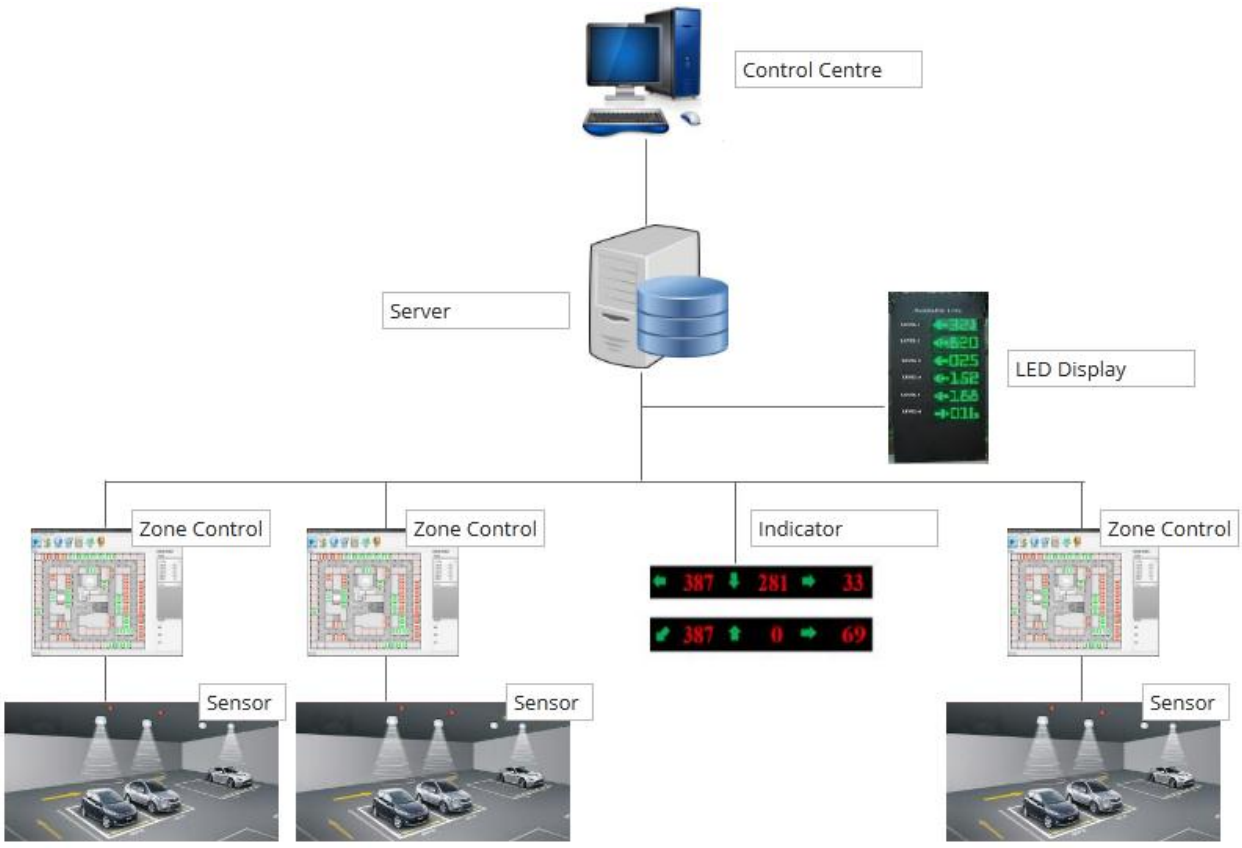


Figure 3: Basic Parking Guidance System Architecture

In this project, the mobile application will be an extension from the above shown architecture. The Main control centre or the server connected to it will be connected to the data network or internet allowing part of the information to be accessible by users through smart phones or tablets with internet access no matter where the user is physically.

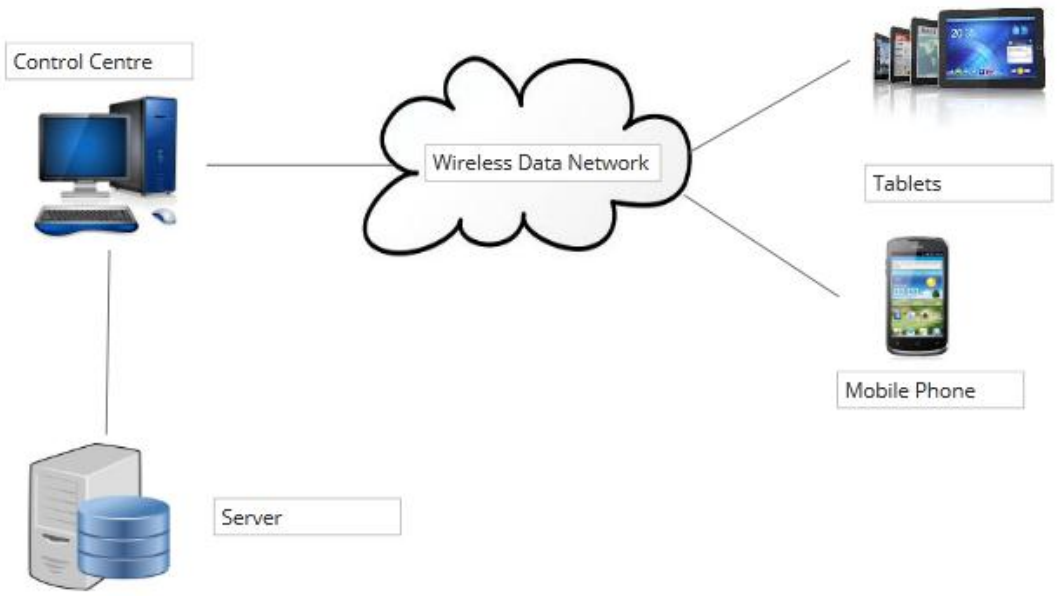


Figure 4: Proposed Extension of Parking Guidance System to Mobile System Architecture

3.3.2 System Requirement Analysis and Specification

In the users' perspective, the focus of users in using the PGS App will be dependent on the current existing Parking Guidance System which is already installed in the building. This will affect the management of the shopping mall, the person in charge of the parking system as well as the general parking users.

In terms of functionalities of the PGS App, the application mainly acts as a medium to transfer information from the PGS which is at the site to mobile phone access which can display the required information by the users. This will then aid the users to have earlier planning and opt for alternative parking or place to do their shopping.

However in order for the user to have access to the information from the PGS server, the users will be limited and required to have an Android based smart phone or tablet of their own. Besides that, they will also need to have data plan from their service providers or access to the internet to be able to view the information on the car park availability of the selected shopping malls as the transfer of information from the PGS to mobile phones are all done through the internet.

3.4 System Development

In the initial half phase of the development of product, the layout of the home screen is done with an added dropdown spinner list where it will prompt the user to choose one of the shopping malls which are equipped with Parking Guidance Systems and then direct them to the second screen which will display the levels and availability of parking. From there users can tap on the button of a specific level and be directed to another screen which is developed in the second half of the development phase.

In the second phase of the development, connection to database was established in alignment with the car park floor plan. In the second screen, there is a display which shows the number of availability of parking on different levels and a view button which will direct the user to the final screen which is the screen showing the parking floor plan which shows which parking is available and which is not.

Currently due to compliance issues, companies are unable to disclose the server information for this project thus a simulation database is created to test on the functionality and testing for the application. The data are kept in an Excel (.csv) format where it can be stored and edited online and reflect the parking availability on the second and third screen.

The parking floor plan on the third screen is a simple floor plan which was taken from Google image and used as background while the icon of cars showing occupied parking bays are hard coded into position in array functions through true false statement thus reflecting a simple simulation of the parking guidance system. Below are screenshots of the developed prototype for the Parking Guidance System Mobile Application.

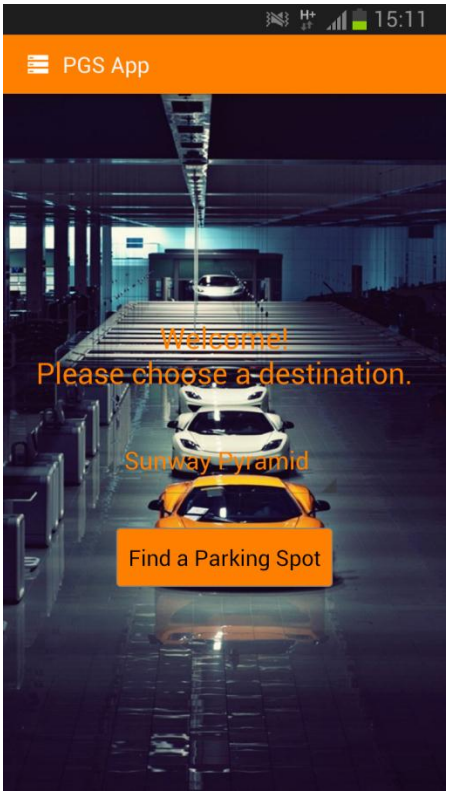


Figure 5: Screenshot of developed Home page of PGS App

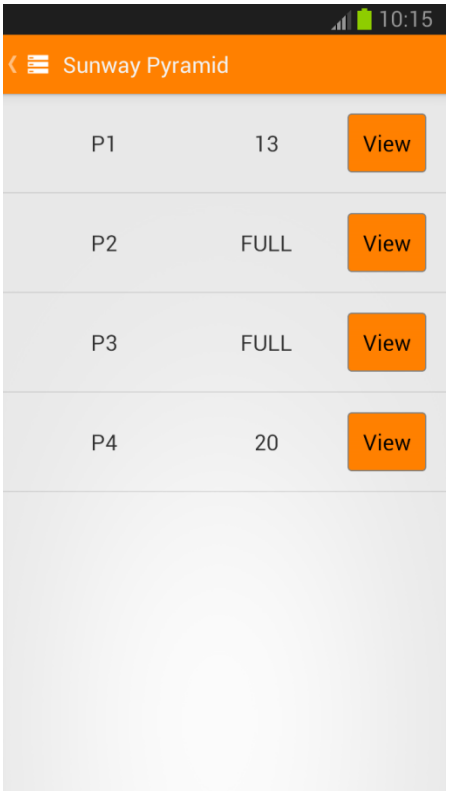


Figure 6: Screenshot of developed Second page of PGS App showing parking levels and availability

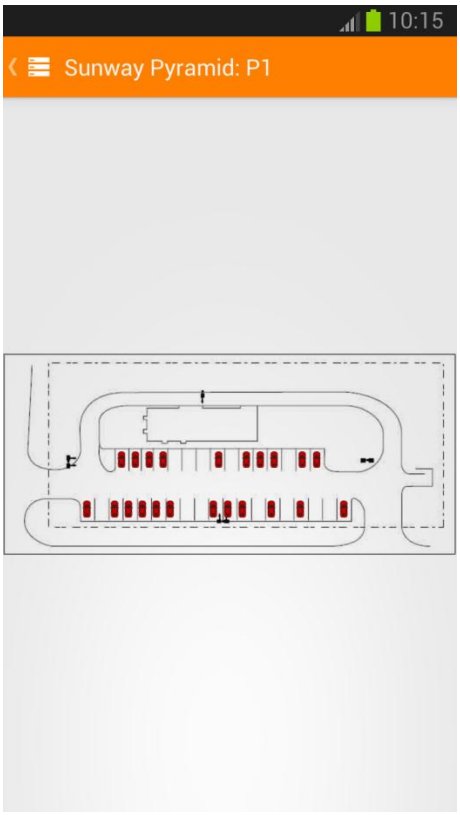


Figure 7: Screenshot of developed Floor Plan page of PGS App

As shown above, the floor plan is just a simple floor plan to simulate the scenario of parking availability. This floor plan is linked to the (.csv) file which had specific parking bays assigned on the file. Thus changing the different true false statements on the different columns and rows of the (.csv) file will immediately change the floor plan image as well thus returning a simple simulation of parking guidance system.

3.5 Key Milestones

Key milestones are presented through the Gantt chart which consists of deliverables solely in either or in a mixture of both document submission as well as presentation. Past milestones are highlighted in Red while future milestone is highlighted in Yellow.

3.6 Gantt Chart Phase 1

Detail/Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Project Title Selection/ Proposal														
Proposal Submission														
Project Planning														
Extended Proposal Submission														
Project Analysis														
VIVA: Proposal Defense and Progress Evaluation														
Project Designation														
Interim Report Submission														
Project Designation														

Table 1: Gantt Chart Phase 1

3.6 Gantt Chart Phase 2

Detail/Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Coding Phase 1														
Progress Report Submission														
Coding Phase 2														
Pre-SEDEX														
Dissertation														
SEDEX														
Online Submission of Technical Report and Dissertation														
VIVA														
Final Dissertation														

Table 2: Gantt Chart Phase 2

CHAPTER 4

RESULT AND DISCUSSION

4.1 System Prototype Model

In the system prototype model, the basic interface will be discussed although the functionalities of the prototype is still being developed. Below are shown the interface of the developed interface.

Figure 8: Home Page

When the customers open the application, they will be directed to the home page. In this page it is very simple, there will a dropdown list for the users to choose the shopping mall which they desire to go to. By selecting the selected shopping mall, they will be directed to the next page which is the selected parking page.

Figure 9: Selected Parking page

In this particular, users will be able to see on the available parking spaces currently at the designated shopping mall. There will buttons for users to view further in on the layout of the parking. In this page, there is also an added back button which will direct the users back to the home page. This is for users who might have accidentally chosen the wrong shopping mall or might want to see the parking position of other shopping malls.

Figure 10: Parking layout information page

If the user has chosen to view the parking layout, the user will then be able to view the current condition of the parking through this layout form as shown above where red indicates occupied parking while green indicates available parking. This feature is mainly for users who are new in to the designated shopping mall or have parking habits meaning he or she will only park at certain parking spaces.

Overall, there are only 3 pages which are needed for the mobile application which is very simple to navigate and does not create confusion to the users. It is still being considered whether to add another page for FAQs and reports for users who have problem with the application. This will be considered when the project prototype is finished and whether or not the time frame of the project allows for the extra feature.

4.2 System Design

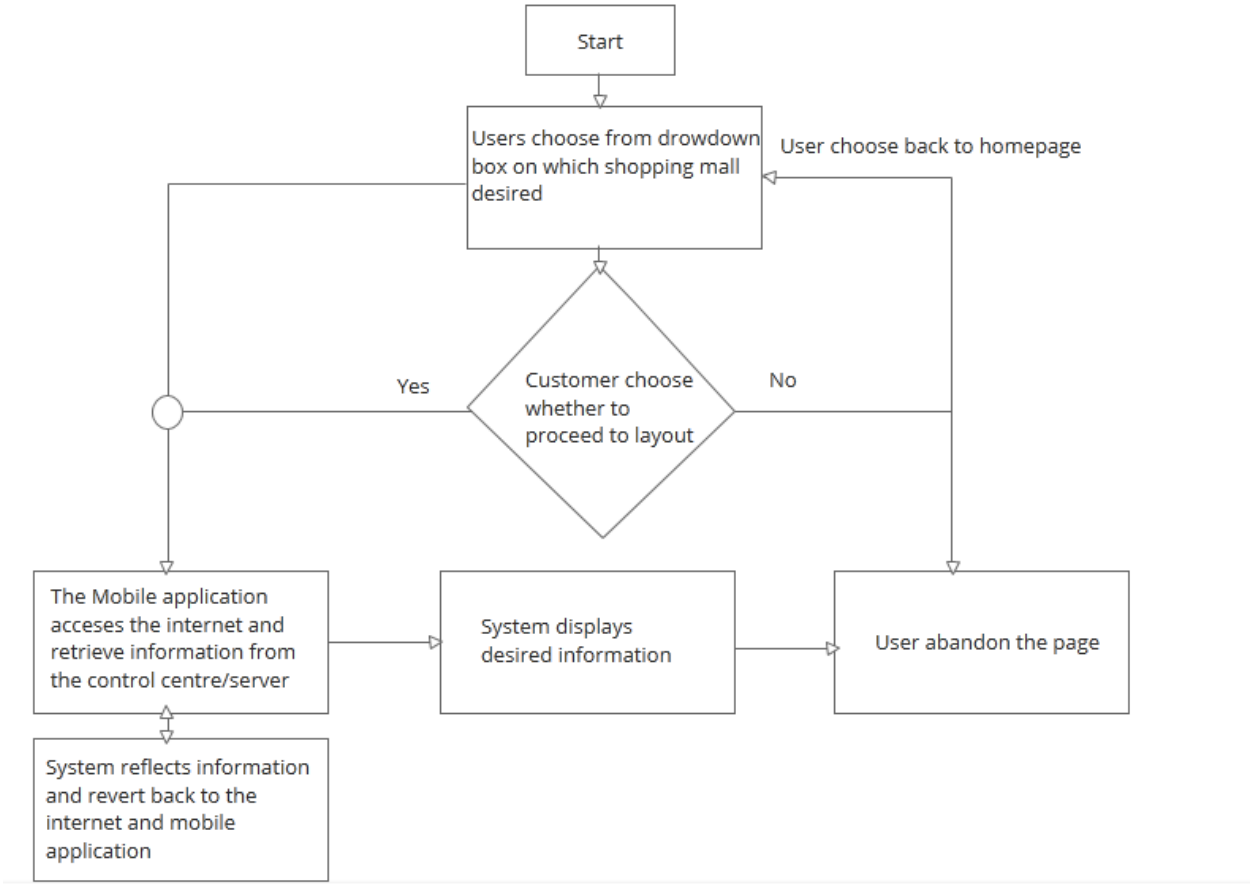


Figure 11: System Design

Through the activity diagram which is shown above, we can see that only simple steps are needed from the user and the interaction with the Parking Guidance System.

Firstly, users will be prompted to choose which shopping mall they would like to go to and the application will then access the internet and reflect the information on parking space availability count and level to the users after accessing the shopping mall's car park control centre or server.

If the user wishes to proceed on to view the layout of the designated shopping mall's car park, the user will then prompt the mobile application again to access the designated shopping mall's car park control centre or server and revert on the parking layout as well as availability of the car park spaces or the user can choose the back button to return to the homepage and re-pick the designated shopping mall and start over again.

4.3 Discussion on Findings/ Results

To survey on the acceptability of the concept of the PGS App as well as the parking problem existence, a questionnaire was drafted and distributed to friends and their peers who are familiar and within close vicinity to a shopping mall which implements the Parking Guidance system where in this case, people who usually shop in Sunway Pyramid are chosen to answer this questionnaire.

A total of 44 people responded to answering the questionnaire while another 3 have accepted to be interviewed to give their opinion on the current parking guidance system and the concept of PGS App. After the prototype is being developed, another set of questionnaires was drafted and distributed together with the apk file for user testing, 2 individuals were approached and interviewed on their opinion on the PGS App. The tables below show the responses from the individuals regarding the questionnaire.

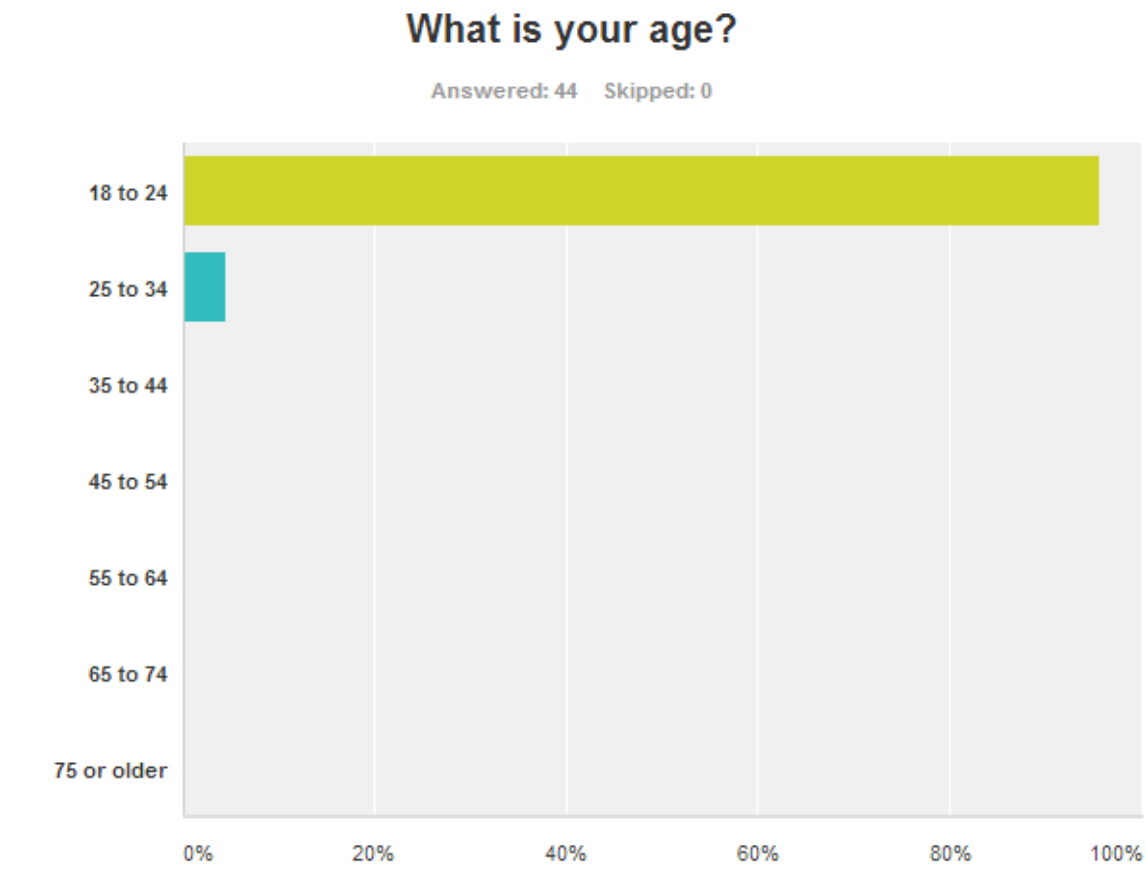
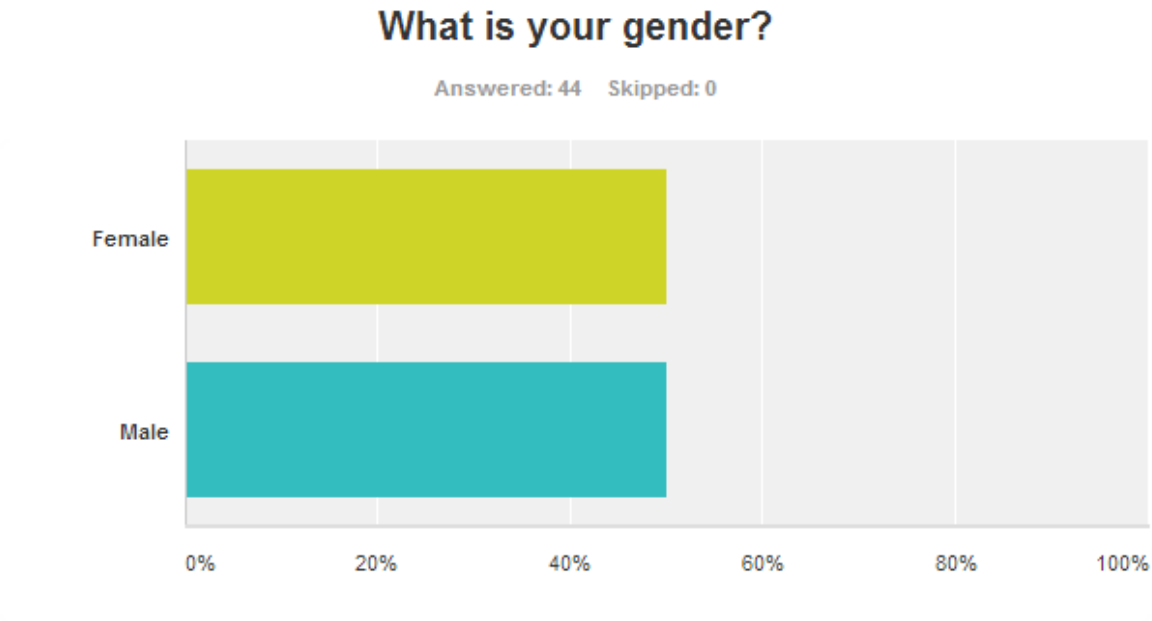


Figure 12: Age of respondents

Answer Choices	Responses	
18 to 24	95.45%	42
25 to 34	4.55%	2
35 to 44	0%	0
45 to 54	0%	0
55 to 64	0%	0
65 to 74	0%	0
75 or older	0%	0
Total		44
Comments (0)		

Figure 13: Age of respondents

It can be seen through Figure 12 and Figure 13 that the respondents are between the ages of 18 to 34. This is due to distribution of the questionnaire in the shopping mall and the relay of the questionnaire to peers who are in usually in the same age group. From the figures, we can see that most of the respondents are the younger generations who play around more with their smart phones with the age range between 18-25 years old with domination percentage of 95.45% while the other age group is 25-34 years old with a percentage of 4.55%. However please note that there is actually no limit to the age of people to answer this survey as it is open to people of all ages.



Answer Choices	Responses	
Female	50%	22
Male	50%	22
Total		44

Figure 14: Gender of the Respondents

It is found interestingly enough that the total numbers of male and female respondents are equal as shown from Figure 11. We can see that there are 22 males and 22 females who have responded to this survey. Again there is also no gender bias as in to who can answer in questionnaire as it is open to all the Malaysian public who usually shop in a shopping mall which implements the Parking Guidance System.

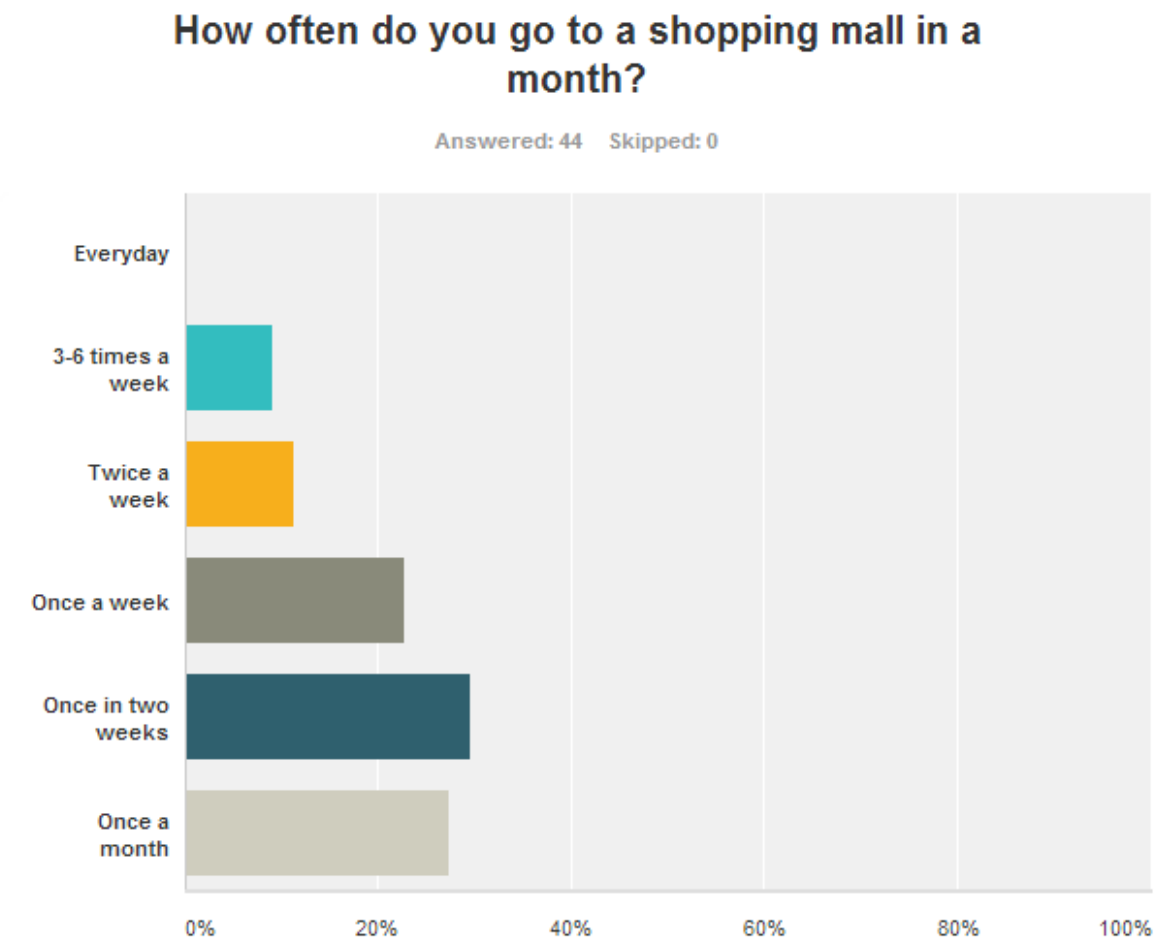


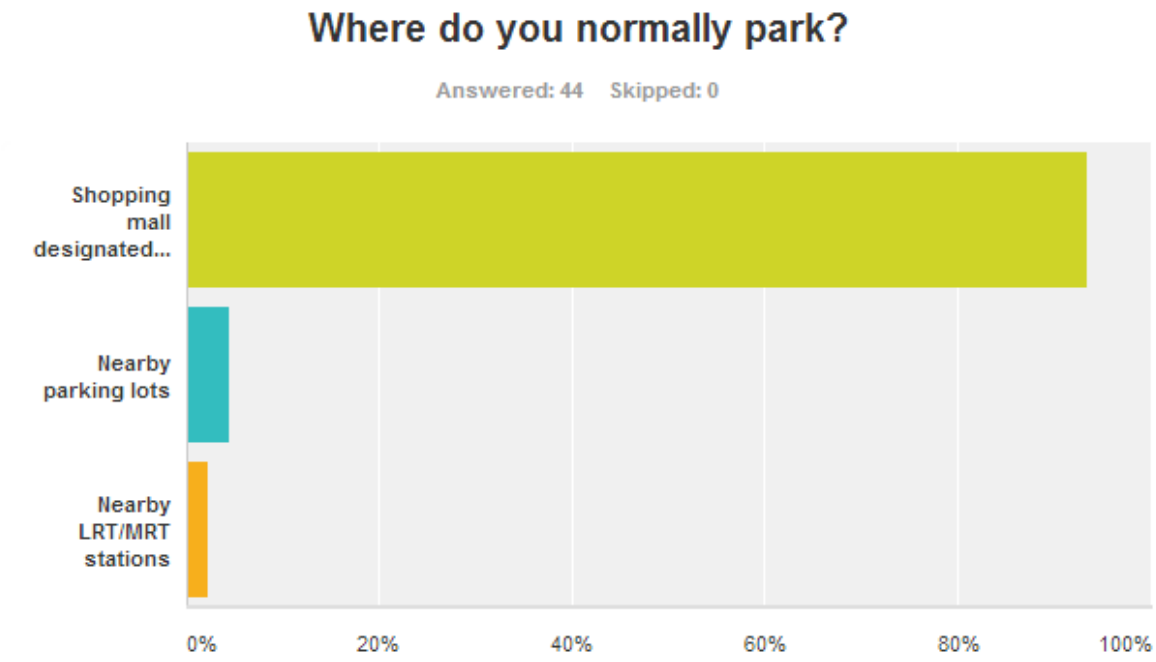
Figure 15: Frequency of respondents going to designated shopping mall

Answer Choices	Responses	
Everyday	0%	0
3-6 times a week	9.09%	4
Twice a week	11.36%	5
Once a week	22.73%	10
Once in two weeks	29.55%	13
Once a month	27.27%	12
Total		44

Figure 16: Frequency of respondents going to designated shopping mall

From Figure 12 and 13, we can see the frequency of the respondents visiting the designated shopping mall. It is found that among the respondents of the survey, no one goes to the

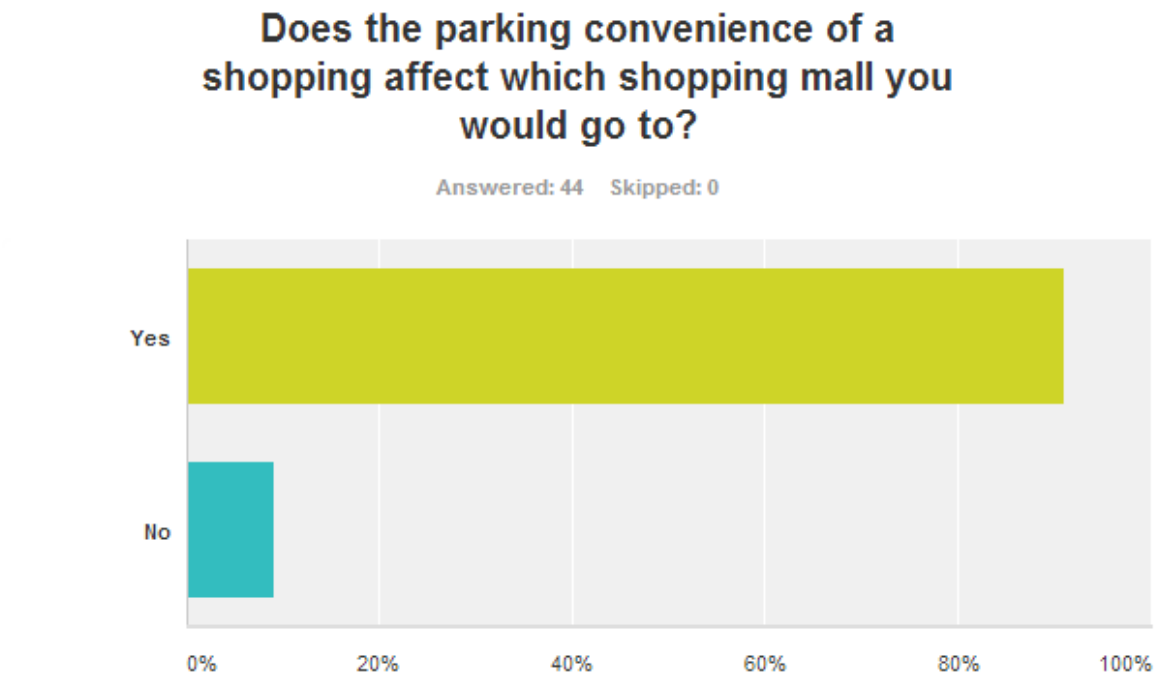
shopping mall every day. The highest percentage of frequency to designated shopping mall is 29.55% which is almost one third of the whole survey respondents where the frequency of them going to the designated shopping mall is once in two weeks. It is then followed by frequency of once a month with 27.27% of respondents answering to that and once a week with 22.73% of response. Only 11.36 % of the respondents visit twice a week while only 9.09% visit the designated shopping mall 3-6 times weekly.



Answer Choices	Responses	
Shopping mall designated car parks	93.18%	41
Nearby parking lots	4.55%	2
Nearby LRT/MRT stations	2.27%	1
Total		44

Figure 17: Preferred parking space

In figure 17, it can observe that majority of the respondents have a preference of parking in the shopping mall designated car parks with 93.13% dominating the chart. Only 4.55% respondents prefer to park at nearby parking lots and 2.27% prefer to park at nearby LRT/MRT stations. Factors such as convenience as well as safety are derived from this question to be the hypothetical factor which contributes to the result of the response.



Answer Choices	Responses	
Yes	**90.91%**	40
No	**9.09%**	4
Total		44

Figure 18: Affect of parking convenience

We can see from Figure 18 that parking convenience have a huge impact on the choice of shopping malls which the respondents will choose with 90.91% answering yes and 9.09% answering that the parking convenience does not bother them.

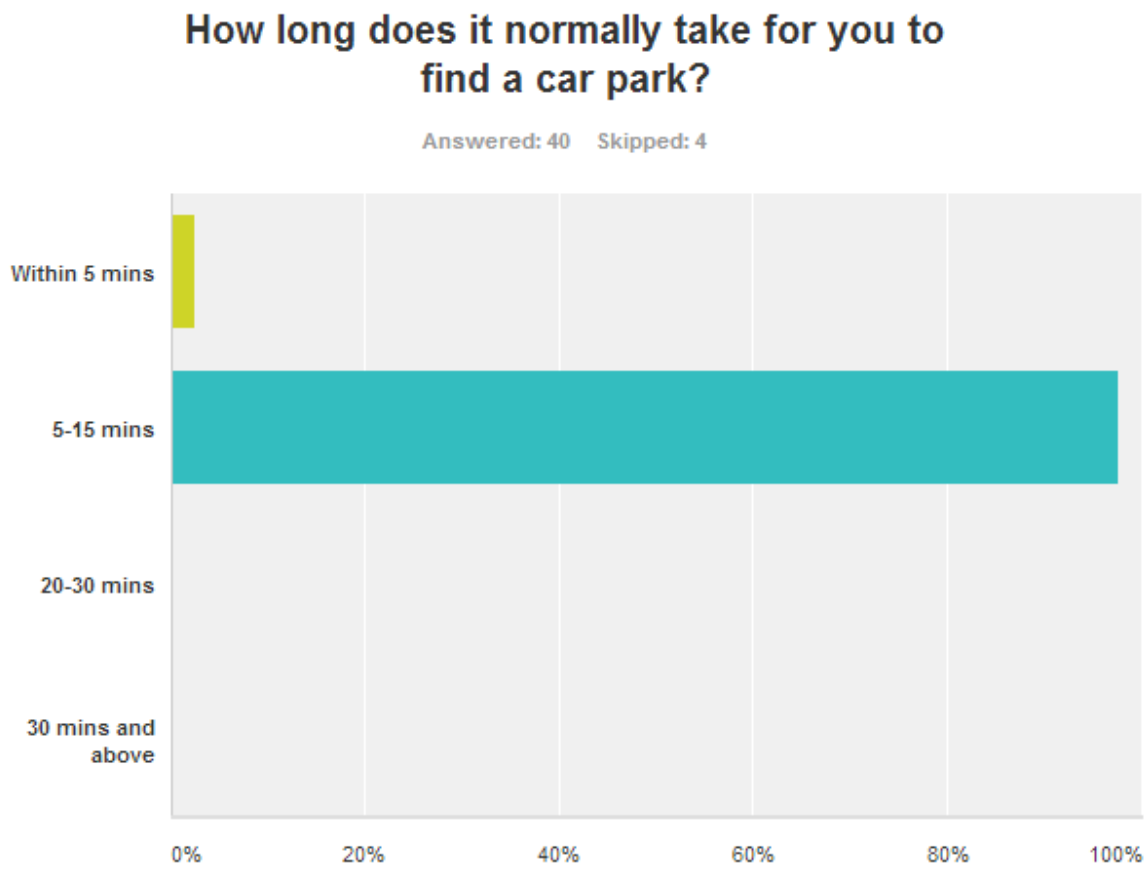
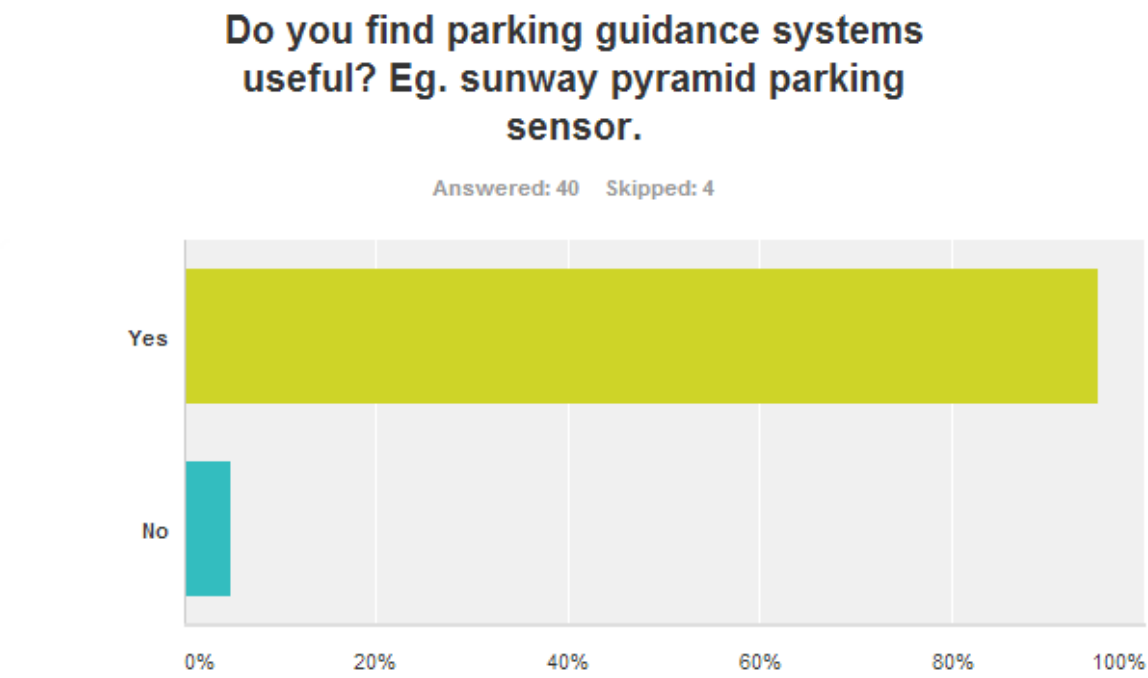


Figure 19: Average time taken to find a car park

Answer Choices	Responses	
Within 5 mins	2.50%	1
5-15 mins	97.50%	39
20-30 mins	0%	0
30 mins and above	0%	0
Total		40

Figure 20: Average time taken to find a car park

Through Figure 19 and 20, we can see the average time taken by the respondents to find a car park in designated shopping mall. The average time taken to find a car park through the survey is 5-15 minutes with 97.50% of the response while minority (2.5%) have lower average parking time of within 5 minutes.



Answer Choices	Responses	
Yes	95%	38
No	5%	2
Total		40

Figure 21: Usefulness of parking guidance system

In Figure 21, response on usefulness of parking guidance system is quantified. With 95% of the respondents agree that the PGS is useful but there are also 5% or respondents who view that the PGS is not useful at all. It can be seen that 4 respondents have opted not to answer this section of the questionnaire.

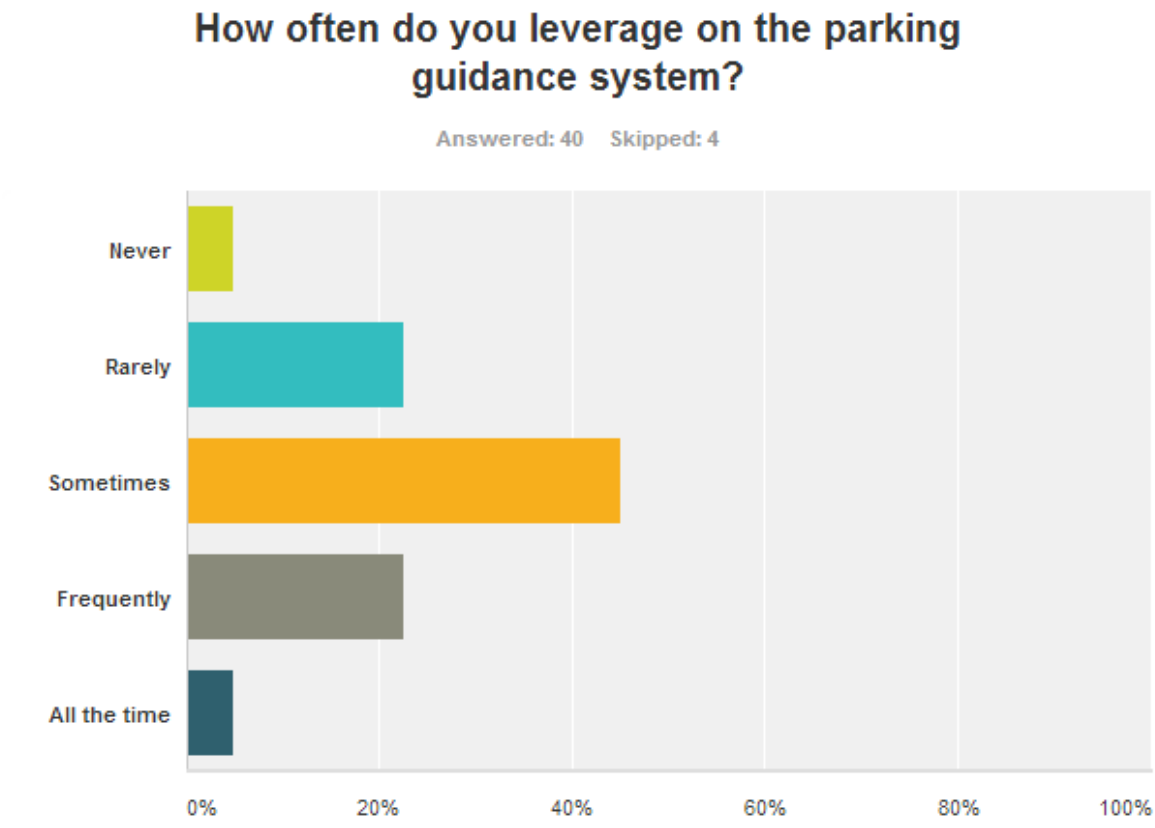


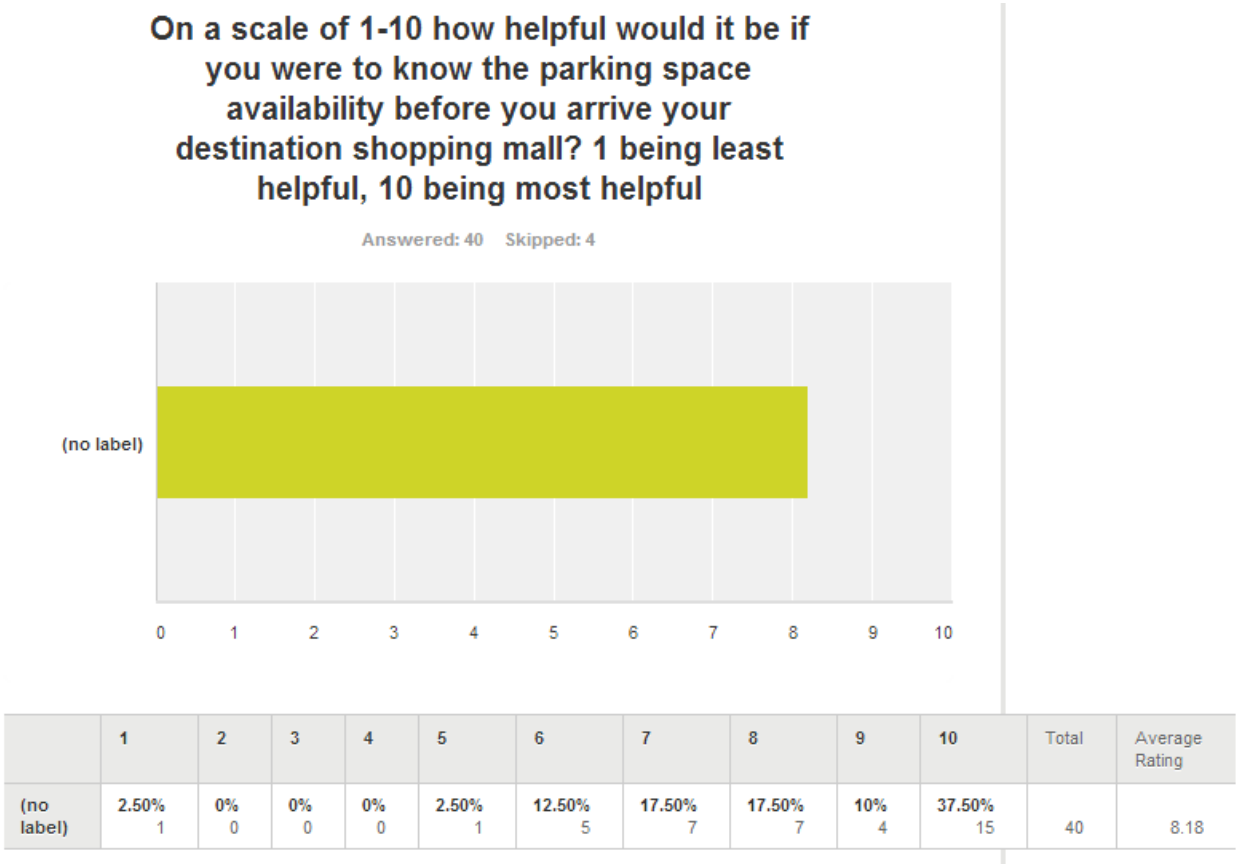
Figure 22: Frequency of leveraging on PGS

Answer Choices	Responses	
Never	5%	2
Rarely	22.50%	9
Sometimes	45%	18
Frequently	22.50%	9
All the time	5%	2
Total		40

Figure 23: Frequency of leveraging on PGS

It can be seen through Figure 22 and 23 that even though from the previous question that majority of the respondents agree that the PGS is useful but not all are fully utilizing the PGS with 5% of the respondents never bothered to use the PGS in shopping malls. The dominant percentage is 45% with users who rated to only sometimes using the PGS and

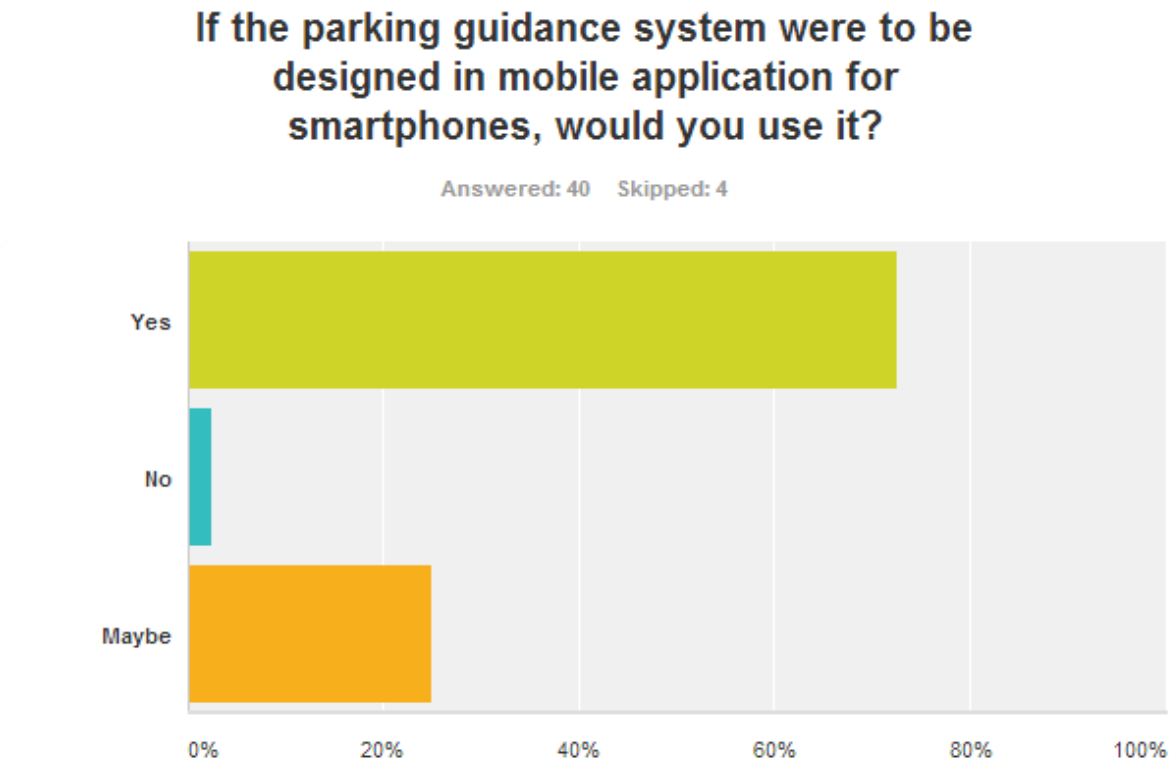
22.5% are tied by both rarely and frequently while another 5% responded in using the PGS all the time.



	1	2	3	4	5	6	7	8	9	10	Total	Average Rating
(no label)	2.50% 1	0% 0	0% 0	0% 0	2.50% 1	12.50% 5	17.50% 7	17.50% 7	10% 4	37.50% 15	40	8.18

Figure 24: Impact of earlier information reflecting chosen shopping malls

It can be seen in Figure 24 that there is a trend of the percentage growing higher in the rating scaling meaning most of the respondents agree that the earlier information gained will be useful to them in choosing designated shopping malls



Answer Choices	Responses	
Yes	72.50%	29
No	2.50%	1
Maybe	25%	10
Total		40

Figure 25: Acceptability of PGS App

For acceptability on the PGS App, 72.5% of the respondents have said that they will use the PGS App if it is available in mobile application market. Another 25% answered maybe and are not sure whether they will use the PGS App or not while a 2.5% answered they will not use the PGS App.

For qualitative aspect to the survey, several random shoppers were approached and interviewed on their satisfaction with the current parking guidance system and whether or not they utilize it. In the interview, they were also asked on their opinions of the concept of the PGS mobile App. Beside covering the basic questions on the drafted questionnaire, other questions were added in the interview for answering such as the longest time taken to find a car park as well views and comments on the PGS App. Among the questions added are listed below with answers from one of the interviewees:

Question: What is the longest time taken for you to find a car park and which shopping mall was that? Worst case scenario.

Answer: The longest taken for me to find a car park would be 45 minutes at One Utama Shopping Mall but they don't have the Parking Guidance System like Sunway Pyramid.

Question: Do you think the current Parking Guidance System is useful and fully utilized?

Answer: I think that the PGS is useful but it is definitely not fully utilized maybe due to habits of the public? And sometimes the system has problems and is not accurate.

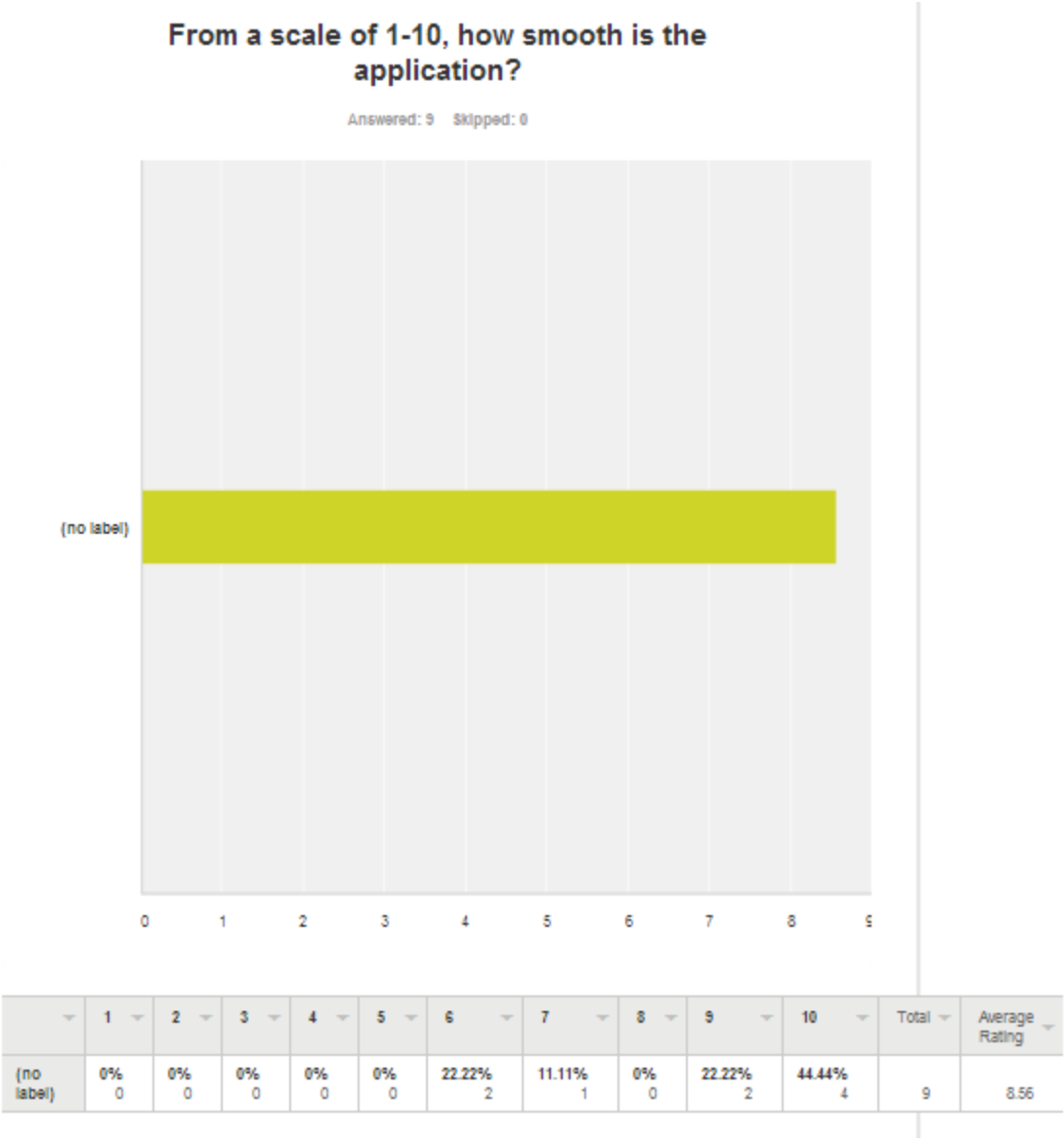
Question: In your opinion, how would you want the PGS App to be for you to use it more often?

Answer: I would have to say it must be kept simple. If the application is attractive, smooth and simple to be used, I will definitely use it more often.

Prototype testing

After the prototype has been developed, it was distributed to a few selected people through apk file to test and comment on the functionalities and practicality of the prototype. In total 9 people responded to the questionnaires in a period of 3 days. Below are the structure of questionnaires and interview questions for the "Prototype testing".

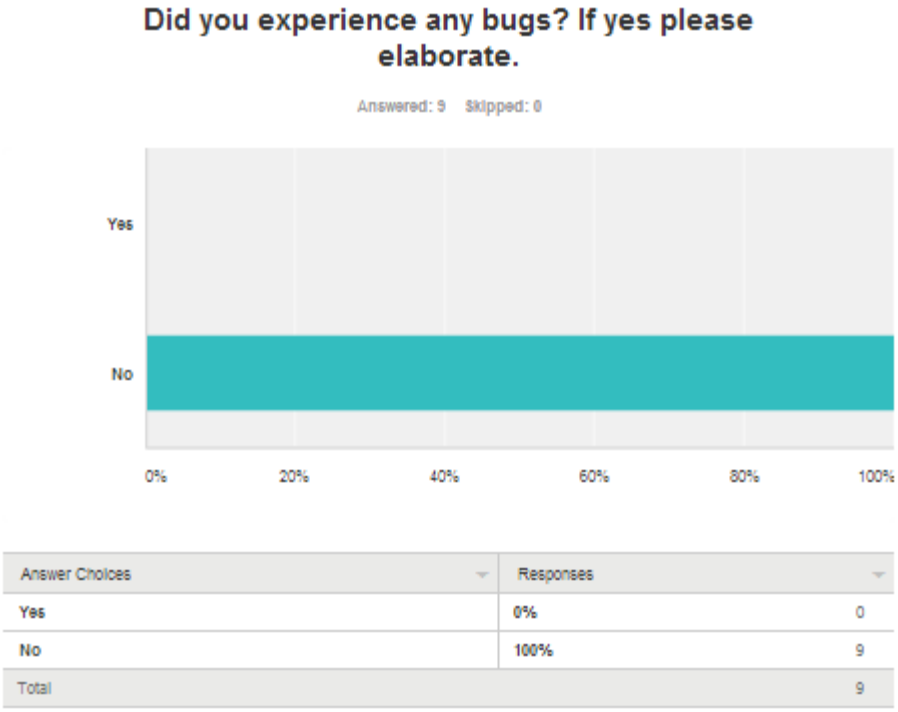
The questionnaire results are shown below.



	1	2	3	4	5	6	7	8	9	10	Total	Average Rating
(no label)	0% 0	0% 0	0% 0	0% 0	0% 0	22.22% 2	11.11% 1	0% 0	22.22% 2	44.44% 4	9	8.56

Figure 26: Smoothness of application

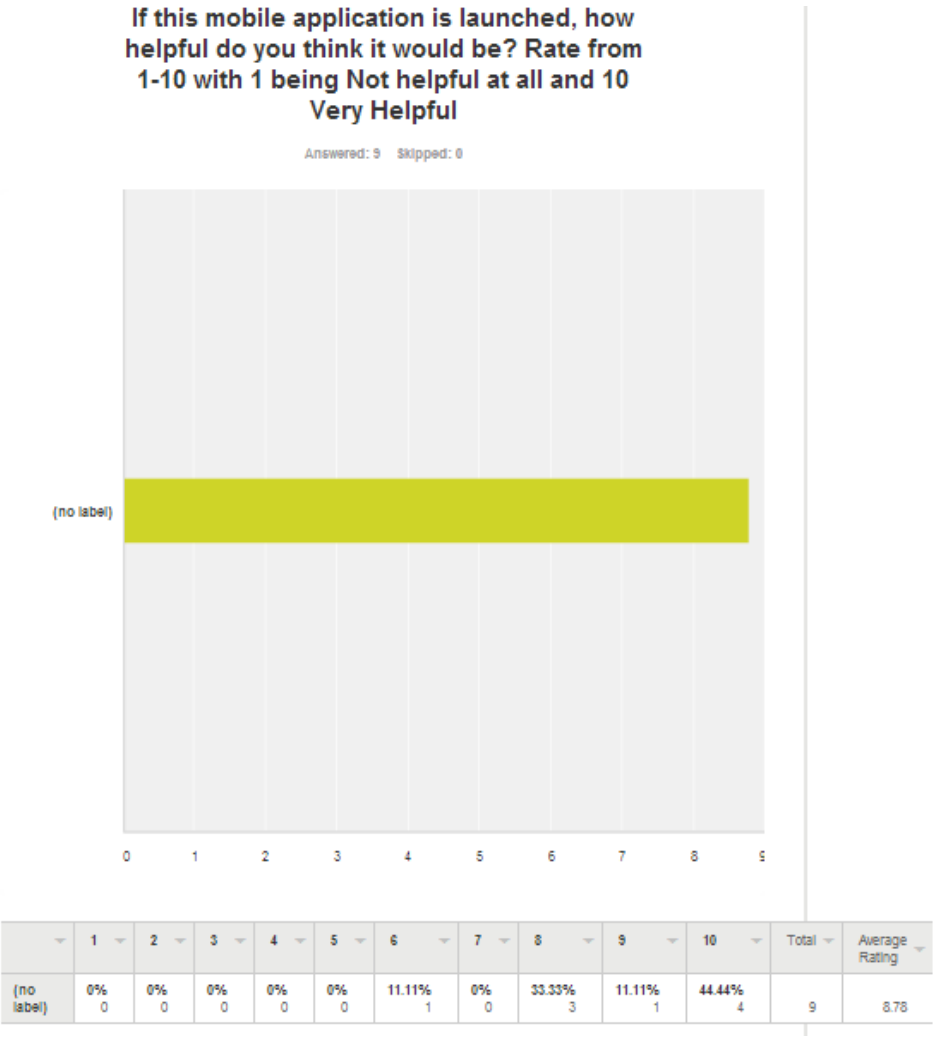
In figure 26, most respondents feel the application is smooth however there are 3 respondents who feel the application is not smooth enough for the home page where the loading of data from database is slightly slow



Answer Choices	Responses	
Yes	0%	0
No	100%	9
Total		9

Figure 27: Bugs on application

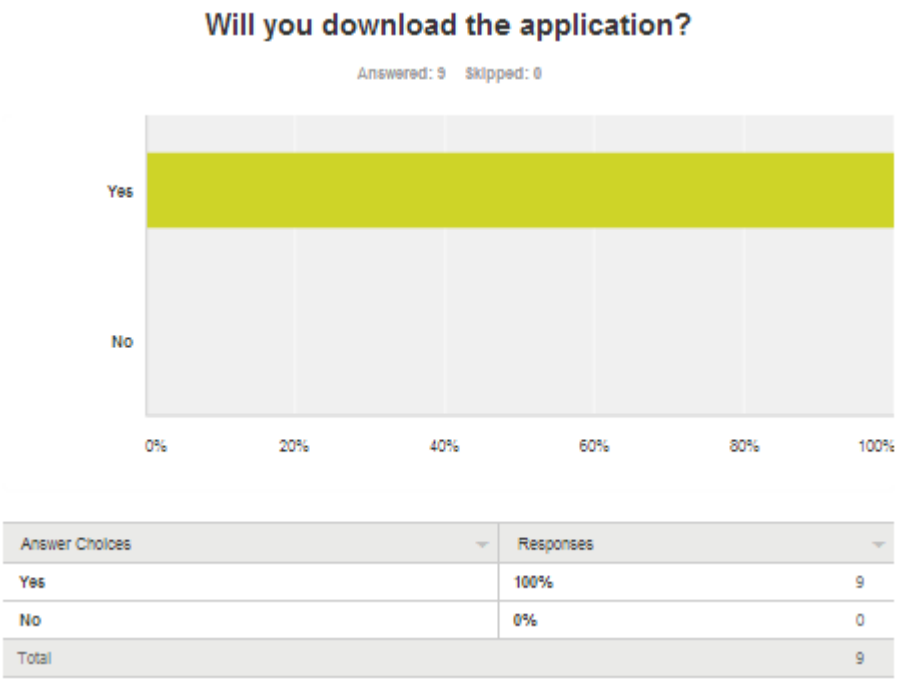
As shown above, the results from the questionnaires respondents show that there are no bugs which are found in this application.



	1	2	3	4	5	6	7	8	9	10	Total	Average Rating
(no label)	0% 0	0% 0	0% 0	0% 0	0% 0	11.11% 1	0% 0	33.33% 3	11.11% 1	44.44% 4	9	8.78

Figure 28: Helpfulness of the application

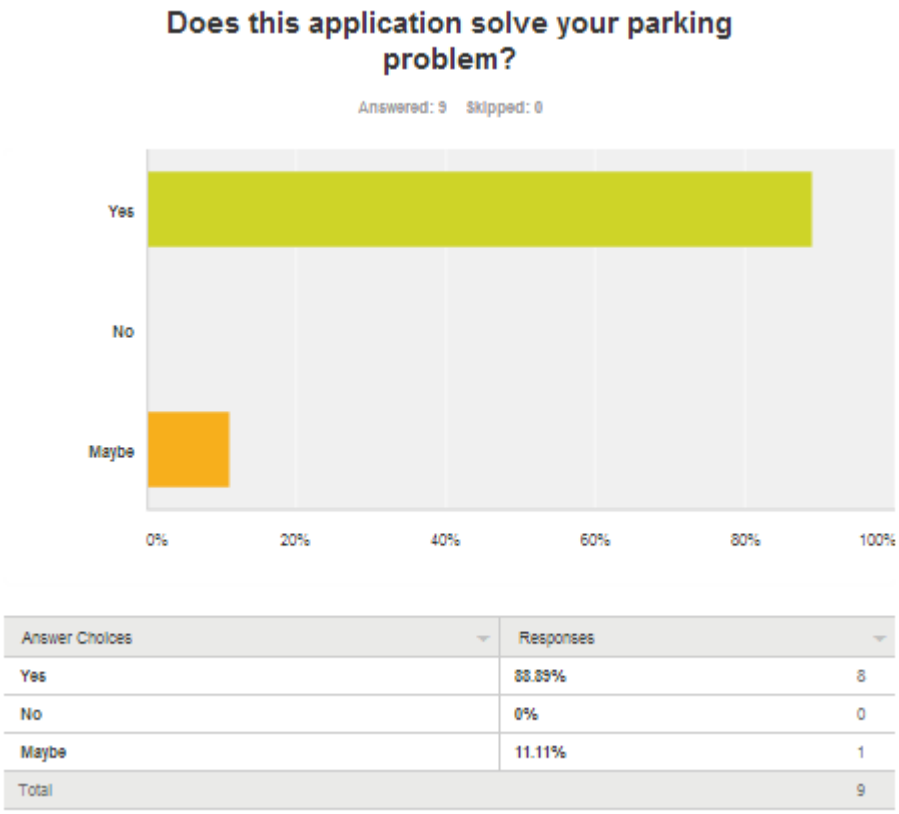
All the respondents view the app as helpful as all are rating above 5 rating out of 10 and that the highest percentage of respondents rated 10 out of 10 for helpfulness.



Answer Choices	Responses	
Yes	100%	9
No	0%	0
Total		9

Figure 29: Download rate

Apparently all users will download the Parking Guidance System Application if the application is available on android market.



Answer Choices	Responses	
Yes	88.89%	8
No	0%	0
Maybe	11.11%	1
Total		9

Figure 30: Problem solving

Out of the 9 respondents, 8 view the app as means of solving their parking problems while the other one view the app as only a possibility of solving his/her parking problem.

Figure 31: Additional comments and remarks.

For the interview, aside from answering the same questions in the questionnaire, more detailed questions are asked for qualitative purposes. The results of the interviews for both individual are shown below.

Question 1: From a scale of 1-10, how smooth is the application?

Answer 1: I would say about 9

Answer 2: 8 because the loading of the home page is slightly slow.

Question 2: Did you experience any bugs? If yes please elaborate.

Answer 1: No

Answer 2: Nope

Question 3: If this mobile application is launched, how helpful do you think it would be? Rate from 1-10 with 1 being not helpful at all and 10 being VERY helpful.

Answer 1: I think I will rate it about 7 because when we are driving alone or at somewhere where there is no internet connection, it's not really helpful

Answer 2: I will rate it at 7 as I do not really go out much and there only a limited number of buildings which are installed with PGS in Malaysia

Question 4: Will you download the application?

Answer 1: Yes

Answer 2: Maybe

Question 5: Does this application solve your parking problem? What are the other issues do you think arises with parking that this application can help or is lacking?

Answer 1: In terms of parking problems with shopping malls with PGS, yes but other places with parking issues will still be an issue for me.

Answer 2: Not really, as I have mentioned before I don't really go out much and only a few of the buildings I go to have the PGS system.

Question 6: How does it solve/ does not solve your parking problem?

Answer 1: For places which are equipped with PGS it serves its purpose, however for other places, this application does not solve my parking problem.

Answer 2: It does help a bit but it does not solve my parking problem as I rarely go to shopping malls especially during peak time and that normally I go to those places alone to do some shopping and I prefer not to use the mobile phone and drive at the same time. My parking problems are mainly at workplace and other places which does not have PGS.

Question 7: Are there any other comments or remarks you would like to add for the PGS App?

Answer 1: I love this idea of combining systems with mobile applications especially ones that can make people's life convenient like Waze and this PGS application.

Answer 2: I like this PGS app and the whole concept but I personally feel that it would be better if it is extended and further improved with having functions which can tell us where are available parking spaces in nearby vicinity.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

Through the research it can concluded that the public agree on the existence of parking problems in urban areas especially in shopping malls during the peak hours and that the PGS App is agreed to be of usefulness to them.

The objectives of the project are achieved. The application Parking Guidance System in mobile phones was attained through the project prototype. The Parking Guidance System Mobile application functions by capturing the availability of parking in designated shopping malls and reflect the information through mobile application in real time. A user perception study was carried out to segment and detect potential users who are younger aged regular shoppers who own android smart phones. Through this study it is found generally that Parking Guidance System in mobile application form is acceptable to users.

5.2 Recommendations

For future work of the application, the application should be expanded by adding in more buildings which use the Parking Guidance System and maybe even segment to areas and demographics. Ads can be added in the mobile application in the future to generate some income.

As continuation of the research project, the PGS App should be continued to be monitored to see if any significant improvements can be made. This will result in more satisfied users and promoting the use of Parking Guidance system will eventually lead to less consumption of petrol, wastage of time and decrease in stress level when finding a parking space.

Finally, the Parking Guidance System Mobile Application will be the first to be incorporating mobile application for Parking Guidance System.

Reference

1. A, A. P. (1993). Driver Response to Parking Guidance Information Systems. Traffic Engineering and Control,Vol.34,No.6.
2. A.Hester, E. a. (2002). Drivers' Parking Decisions: Advanced Parking Management Systems, Journal of Transportation Engineering,Vol.128, No.1.
3. Asakura Kashiwadani, K. a. (1995). Driver's Response to Parking Information System: Empirical Study in Matsuyama City, Steps Forward,Proceedings of the Second World Congress on ITS.Vol.IV,VERTIS,Yokohama.
4. Axhausen, J. P. (1990). Parking Search Behaviour: A Review of Current Research and Future Prospects.
5. B.J. Waterson, *. N. (n.d.). Quantifying the potential savings in travel time resulting from parking guidance systems – a simulation case study.
6. David, M. L. (2006). A PARKING MANAGEMENT SYSTEM : A CASE STUDY OF A GARDEN CITY COMPLEX.
7. Keng, W. T. (2006). Intelligent Parking Manager.
8. R. Arnott, T. R. (2005.). Alleviating Urban Traffic Congestion. MIT Press.

Appendix A

1. What is your age?

- 18 to 24
- 25 to 34
- 35 to 44
- 45 to 54
- 55 to 64
- 65 to 74
- 75 or older

Other (please specify)

2. What is your gender?

- Female
- Male

3. How often do you go to a shopping mall in a month?

- Everyday
- 3-6 times a week
- Twice a week
- Once a week
- Once in two weeks
- Once a month

4. Where do you normally park?

- Shopping mall designated car parks
- Nearby parking lots
- Nearby LRT/MRT stations

5. Does the parking convenience of a shopping affect which shopping mall you would go to?

- Yes
- No

6. How long does it normally take for you to find a car park?

- Within 5 mins
- 5-15 mins
- 20-30 mins
- 30 mins and above

7. Do you find parking guidance systems useful? Eg. sunway pyramid parking sensor.

- Yes
- No

8. How often do you leverage on the parking guidance system?

- Never
- Rarely
- Sometimes
- Frequently
- All the time

9. On a scale of 1-10 how helpful would it be if you were to know the parking space availability before you arrive your destination shopping mall? 1 being least helpful, 10 being most helpful

1	2	3	4	5	6	7	8	9
○	○	○	○	○	○	○	○	○

10. If the parking guidance system were to be designed in mobile application for smartphones, would you use it?

- Yes
- No
- Maybe