MOBILE CAMPUS BUILDING GUIDE APPLICATION

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CERTIFICATION OF APPROVAL

Mobile Campus Building Guide Application

By

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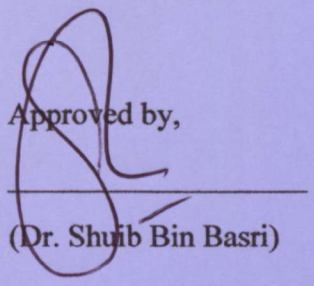

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ABSTRACT

Map is an effective and useful tool to help navigate towards a location because it provides a visual representation of the area of interest. Nowadays, navigation and map are usually associated with GPS (Global Positioning System) which are accessible through mobile Smartphone. However, there are usage limitations; one in particular is that it is not feasible to use indoor (inside a building) due to its signal being blocked by bricks and mortar. In this case, the common workaround is to look for the building directory, ask around or look for signboards but there are cases where the direction instruction given were wrong or confusing and; the signboard is nowhere to be found. The project goal is to develop an Android mobile application that provides interactive map of floor plans to mobile users albeit without the GPS features and the study of perception of distance that discusses the usability of the mobile application. Another study is focussed on the challenges and best practice of mobile application; in order to develop the application up to a certain standard and quality. Included is also the study where we will look into market trend of mobile phone as supporting addition to the overall project.

Keywords: interactive map, mobile application, floor plans, perception of distance, challenges and best practices, market trend.

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INTRODUCTION

1.1 BACKGROUND

Map is a visual representation on usually a flat surface of an area [1]. Its function is to describe the places reside inside an area together with other elements such as roads, buildings and geographical properties like rivers and greenery. People uses map to help finding ways toward certain location that is of interest to them. It is very helpful because visual representation is an effective for people to actually know how to get somewhere. Many maps exist as a two-dimensional, approximately accurate representation of real world space although there are three-dimensional and virtual spaces maps. Nowadays, when talking about map, people would likely associate it with navigation and the GPS (Global Positioning System).

Navigation refers to the method for people to get information on how to get where they wanted to be. In this day of technological advancement, the most prominent navigation technology option is GPS. It uses satellites that are positioned around the world in space to lock on a user location and then provides them the relevant information needed to help them navigate towards a specific location [2]. The information is presented in various forms such as graphical map or direction instruction.

Before the existence of GPS, directory and sign board was the de-factor ways of navigation. The ways of navigating indoor has always has been possible with the help of building directory which locations information. It is an important tool for visitor to navigate themselves to a location inside a building. This statement is especially true for a new visitor that found themselves inside a building for the very first time. The relevant information needed to walk towards specific locations indoor is located in a building directory. Often associated with directory are the floor plans, walkways, lifts and stairs available inside the building. These are useful by giving information on which way to get to a location.

GPS features has evolves since its early days as it is now available on Smartphone in the form of mobile applications or also known as apps. The features are available at the cost of small internet charges. Most people today have GPS application on their Smartphone and can use its features anywhere as they please [4]. Despite that, GPS has not made its way into indoor environment i.e. inside buildings. It is not feasible to be use indoor or inside building for navigation purposes due to poor signal retentiveness [3]. The GPS signal cannot maintain the connection with Smartphone because there are many interferences indoor compare to outdoor where there is less to none interferences.

Furthermore, because there are many buildings exist and to generalize these buildings directory is rather ambiguous. It touches the topic of confidentiality, privacy, and not feasibly cost-effective and manageable. However, there is a promising technology called WiFiSLAM [34] that uses nearby Wi-Fi network "fingerprint" to act like an indoor GPS. The downside of this system is that reference data of every room inside the building needs to be collected beforehand a few times. Although that maybe the case, imagine the potential benefit it could bring if a directory of a building is easily accessible like the GPS i.e. a floor plans available on mobile applications. It would be an interesting and a useful alternative because the floor plans or the building map can be accessible from the Smartphone which support mobility in the design. Moreover, mobile applications are gaining more attention more now than ever before.

A recent report by Flurry [33] shows that daily time spent on mobile apps surpasses desktop and mobile web consumption for the U.S based users as depicted in Figure 1. The report compares how daily interactive consumption has changed over the last 12 months between the web (both desktop and mobile web) and mobile native apps. It shows that mobile apps are gaining interest from the Smartphone users.

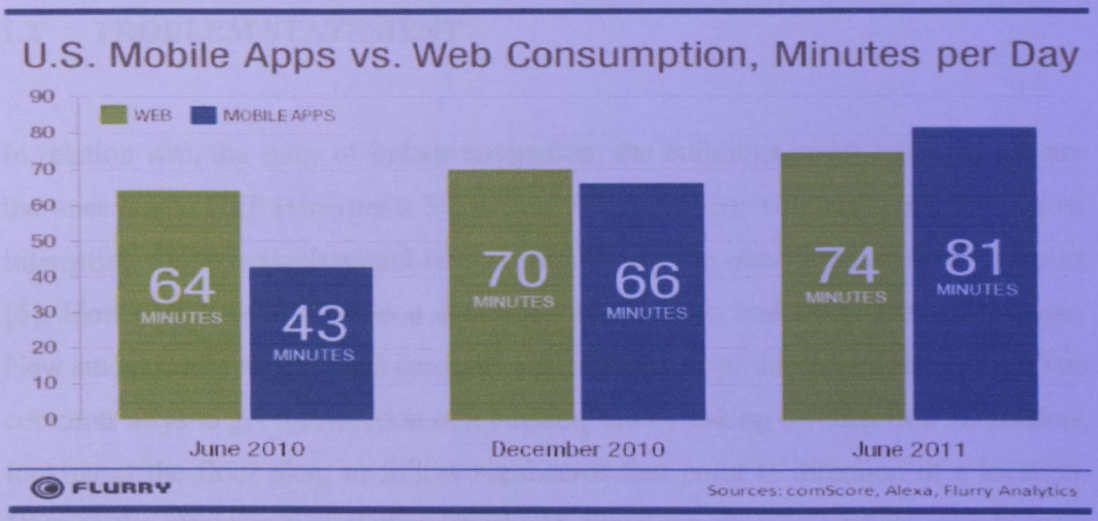


Figure 1: U.S Mobile Apps vs. Web Consumption

The project focuses on exploiting mobile applications current and potential market including its interesting technology. Among the many OS available on Smartphone, Android OS is chosen because it is a popular open source platform and has many resourceful, active developer communities [7]. Moreover, as depicted in Table 1, there is positive prediction on the future of Android OS as the chosen mobile OS of many in the near future.

Worldwide Mobile Communications Device Open OS Sales to End Users by OS (Thousands of Units)

OS	2010	2011	2012	2015
Symbian	111,577	89,930	32,666	661
Market Share (%)	37.6	19.2	5.2	0.1
Android	67,225	179,873	310,088	539,318
Market Share (%)	22.7	38.5	49.2	48.8
Research In Motion	47,452	62,600	79,335	122,864
Market Share (%)	16.0	13.4	12.6	11.1
iOS	46,598	90,560	118,848	189,924
Market Share (%)	15.7	19.4	18.9	17.2
Microsoft	12,378	26,346	68,156	215,998
Market Share (%)	4.2	5.6	10.8	19.5
Other Operating Systems	11,417.4	18,392.3	21,383.7	36,133.9
Market Share (%)	3.8	3.9	3.4	3.3
Total Market	**296,647**	**467,701**	**630,476**	**1,104,898**

Table 1: Worldwide Mobile Phone OS Prediction; Source: Gartner (April 2011)

1.2 PROBLEM STATEMENT

In relation with the issue of indoor navigation, the buildings under investigation are the ones inside UTP (Universiti Teknologi PETRONAS). The buildings here are of interesting modern architectural design particularly the ones at Academic Complex [5]. However, it is in a sense a collection of complex and complicated buildings. New students and staffs could perceive said impression of the campus buildings. The common ways to get information of a building are by asking for direction instruction, looking at the floor plan, or follow signboards that point to direction of a location. Despite the effectiveness of these methods, there are situations where people were given the wrong information and confusing, unreadable building map and floor-plan (as depicted in Figure 2), and the signboards are nowhere to be found. Moreover, these common methods are usually repetitive and would require further effort and time to accomplish. As the consequence of these less than favourable situations, the victim would feel frustrated, tired and lost [6]. On the other hand, if it were to happen to new student or staff, they could be late for class or to important meeting. Therefore an alternative would be helpful in such situations.

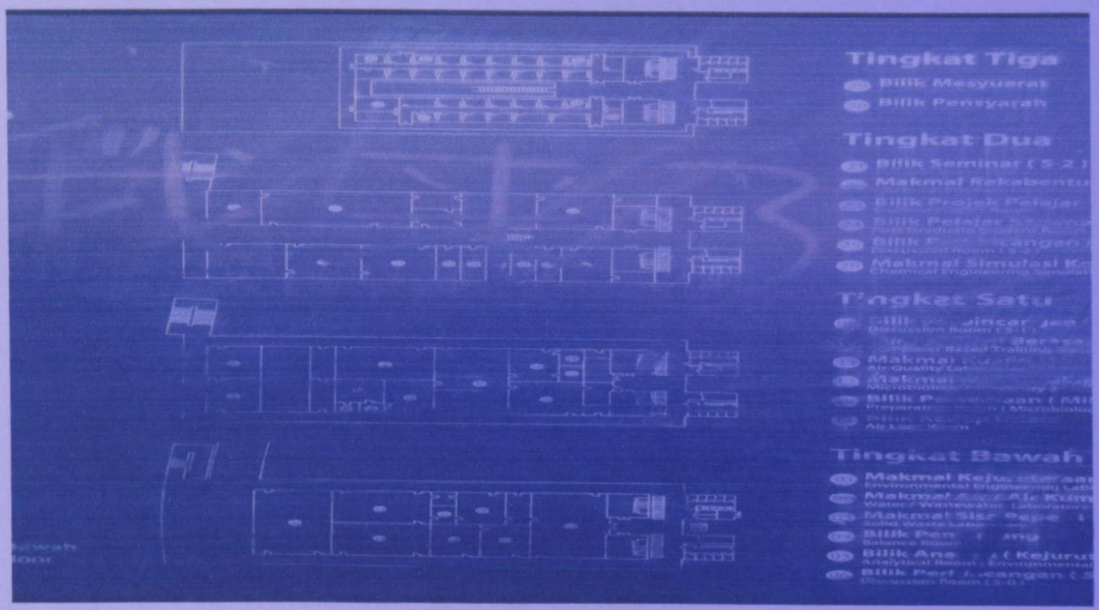


Figure 2: Discoloured floor plan

1.3 OBJECTIVES

1) To study on the properties of interactive map in navigation-context mobile applications, the discussion of distance perception, and the challenges and best practice of mobile applications.

2) To design the user interface and the wire-frame of the proposed mobile application, and to design concise interactive indoor floor plans of the campus buildings.

3) To develop the mobile campus building guide application that provide user with interactive map and relevant information of the campus buildings that will guide them to locations.

1.4 SCOPE OF THE STUDY

The study revolves around interactive map, distance perception and mobile application development. The study on interactive map will include its properties and practicality context. In order to make use of the map, the study also discuss on the perception of distance to compensate the lack of GPS position-lock feature in the mobile application. Adding to the study is mobile application development that includes the challenges and best practices in mobile applications. The result and discussion would focus on the mobile application developed in the context of the study.

CHAPTER 2.0

LITERATURE REVIEW

2.1 MARKET TREND OF MOBILE PHONE

The global market segments for mobile applications are growing [8] in-line with the increase of Smartphone sales worldwide. Mobile applications or also known as apps consist of software that runs on mobile devices and has capabilities to perform user-context tasks. It is common to have mobile applications on most Smartphone nowadays that uses OS (operating system) as its core platform. The wide reach of Smartphone are contributed by its basic and interactive features including the basic telephony and messaging services, as well as more advanced features such as games, video player, music player, navigation application and mobile internet browser. Mobile applications have gained the attention of users from all-age bracket because there are many varieties of application available for download to their Smartphone and one Smartphone can have more than one mobile application installed. Based on the statistic in Table 2, Android OS tops other mobile OS developed by other companies. Corresponding to the number of Smartphone sales, there will also be an exponential increase in the number and sales of mobile applications.

Worldwide Smartphone Sales to End Users by Operating System in 1Q11 (Thousands of Units)

Company	1Q11 Units	1Q11 Market Share (%)	1Q10 Units	1Q10 Market Share (%)
Android	36,267.8	36.0	5,226.6	9.6
Symbian	27,598.5	27.4	24,067.7	44.2
iOS	16,883.2	16.8	8,359.7	15.3
Research In Motion	13,004.0	12.9	10,752.5	19.7
Microsoft	3,658.7	3.6	3,696.2	6.8
Other OS	3,357.2	3.3	2,402.9	4.4
Total	**100,769.3**	**100.0**	**54,505.5**	**100.0**

Table 2: Worldwide Smartphone Sales by OS in 1Q11; Source: Gartner (May 2011)

2.2 MAPS APPLICATIONS

There are a lot of available mobile applications or apps that is build for navigation purposes. One of the most used is the Google Maps app because to it is a bundled together with the Android based mobile phone right out of the box [11]. Google Maps application uses the Google Maps database to perform functions such as voice-guided GPS navigation, finding places and recommendation and; see friends on the map and check in at places [12]. The features of Google Maps that are of interest here are the 'offline reliability', 'layers', 'my location', 'directions' and 'places'. 'Offline reliability' is the feature to see and interact with the map even if user lose connection temporality; 'layers' are overlay layers that display location's information on the map interactively; 'my location' enable user to see their location without GPS service; 'direction' provide instructional direction to follow and; 'places' that help user search nearby point of interest (POI).

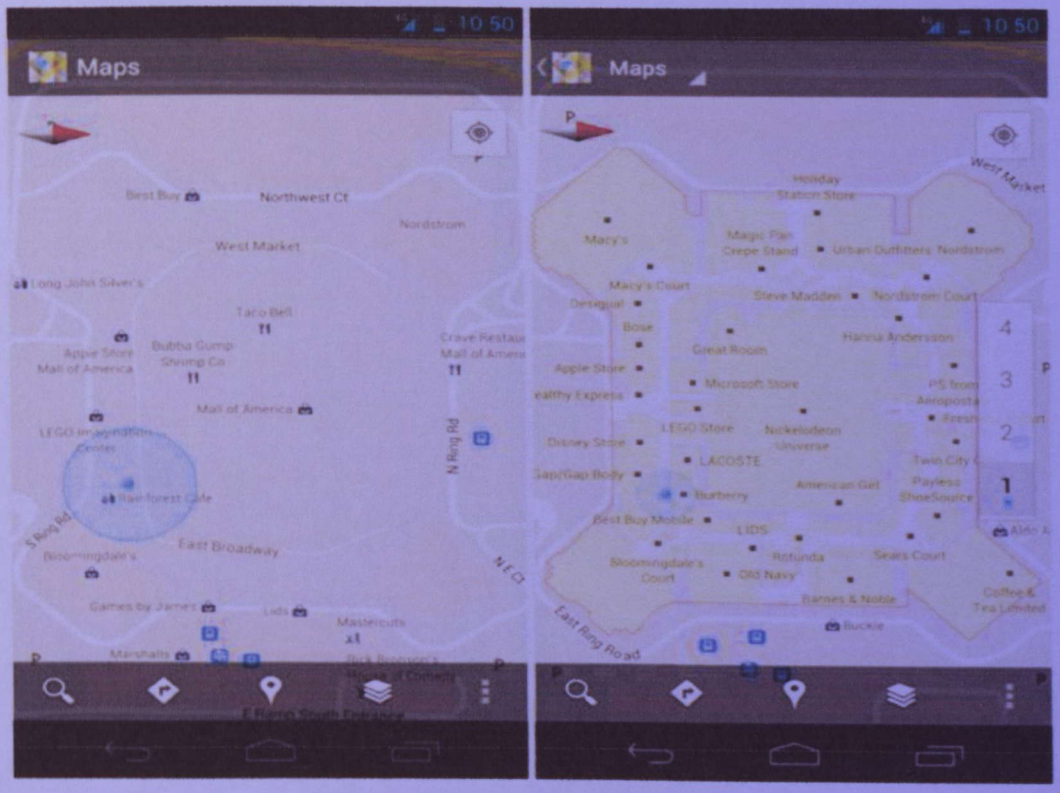


Figure 3: Google Maps App - Indoor

On 29th November 2011, Google release the feature for indoor navigation to its Google Maps 6.0 app. This latest version of the application features floor plans of venues of major airports, transit stations and retails stores around US and Japan [30]. "*This opens a new mapping frontier for mobile users: indoor public spaces*," said Steve Lee, a Google director of product management [31]. In view of his statement, this project is an effort to be part of the frontier and realising indoor spaces potentials in providing values to user. Figure 3 above depicted an example of the indoor feature from the Google Maps app.

2.3 INTERACTIVE MAP

When most people thinking of maps on the internet, Google Maps, MapQuest and Yahoo! Maps might come to mind. They are the common providers of maps as a service [9]. The purposes that maps can serve in today's environment have evolved from the earlier days of static and dull-looking maps. The areas that represent maps capabilities now are navigation, direction and point of interest; interactively. Interactive maps on the Internet present data effectively because they invite action from the user [10]. The display of relationship between map data is easier when the user has the control to change the visuals over conventional static maps. If a static map has no clear indication, a person can do very little to understand it but for interactive maps, an action of moving sliders around, zooming in and out; can show the map information and its content relationship easily.

The fundamental of interactive map are the action of panning and zooming. These actions allow the user to focus their display area (browser) on information they needed and in a visual view of information that they are comfortable with [10]. Figure 4 shows the interactive map features from the Google Maps of KLCC areas.

Figure 4: Google Maps

This type of maps is now available on mobile devices. With so many mobile navigation applications on mobile phone, interactive maps are accessible to the average person to use and experience the innovation. The implementation of interactive map is essential to these applications because it gives value to the application that no static map can offer to user. As a result, interactive maps is becoming a standard, a feature that user expected to get of navigation or guiding mobile application.

2.4 DISTANCE PERCEPTION

Distance perception is cues to determine how far away an object are from a point or from where the user currently is. In the context of the proposed application, the question posed is: Given a two dimensional visual image with several points, how one perceive the distance between oneself and these points, or between two points? The question points will be referring to where the user is and their destinations in the floor plan.

A way to perceive is to consider surrounding environment and bodily context in which the floor plan is referring to [36]. People can perceive the visual information from a map and derive on where they ought to walk in order to get to a destination by comparing their environment surroundings to the visual image i.e. the floor plan. Below figures are an example of a floor plan and its corresponding visual environment.

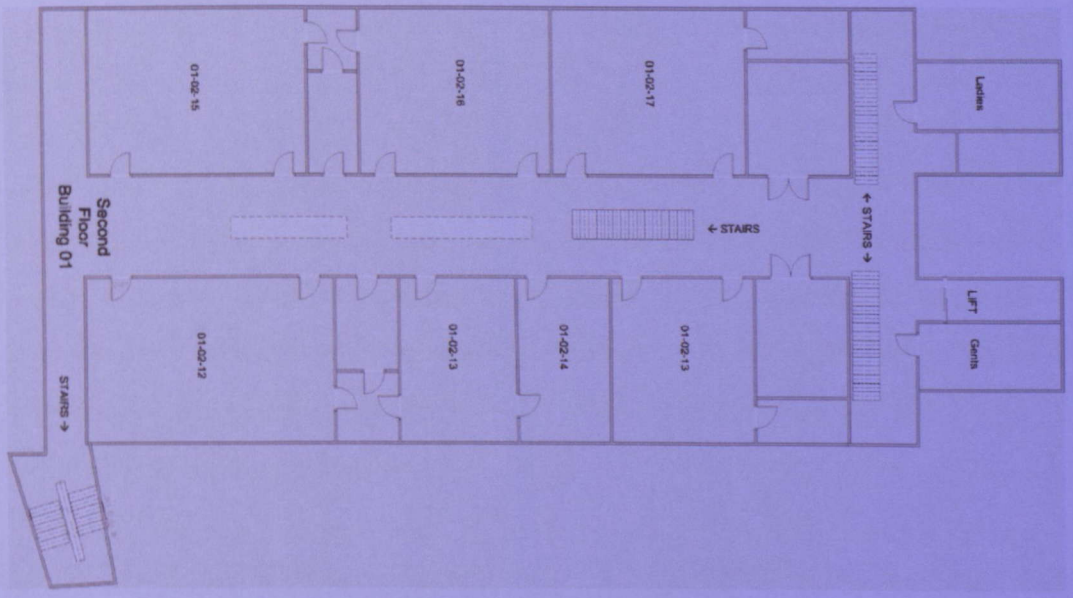


Figure 5: Example of floor plan

Figure 6: The corresponding visual environment of floor plan

2.5 CHALLENGES OF MOBILE APPLICATION

The development of mobile application encompasses the context of hardware, software and user interaction; and these poses many constraints and challenges peculiar to mobile application. Prof. Dr. Birgitta König-Ries stated in her article, to address this context, *among others, there are the questions of software architecture for mobile applications, approaches to the software design for mobile applications and how the consequences of being mobile, e.g. changing location, changing context, changing connectivity, heterogeneous software and platforms influence the software development process and what design approaches do reflect the specialities of mobile applications and system appropriately* [16].

Software developments for mobile devices are challenging because they have limited capabilities and are highly heterogeneous. The result of these often raises the need for customization towards individual device types which is a costly and time consuming approach. It might require similar building blocks for example determining user's location followed by manipulating the application's behaviour; or different context source integration. Then there is requirement to specify what data to store on mobile device, how to locally store the data or keeping it synchronized with central server if any. These decisions are dependent on the context of what the user usage and what the mobile application is for (task). Often, the user content will directly influence the application and its behaviour. Thus it conveys the important of correctly modelled, stored, and efficiently handled context. On the other hand, mobile application adoption is by far driven by user experience more than other type of software.

User of mobile devices such as mobile phone and tablets would experience different user experiences when interacting with these devices. The differences are significant when comparing to a desktop or laptop computers that have larger screens, full keyboards and pointing device (mouse). These mobile devices are usually smaller in size, with limited display areas (screen) and restricted input methods that limit user's retentiveness after a short period of time. Moreover, user most probably uses these devices with one hand while standing and in a crowded space, trying to accomplish a

context-specific task such as getting directions information. These tasks could be important to the user and added that mobile users are impatient; the slightest problem with the mobile application performance or usability would results in user frustration [14]. The common challenges includes, among others [14] [15]:

1) Limited screen size made it more difficult to maintain user's retention within the application task.

2) Variation of screen sizes, resolutions and orientation (portrait, landscape) available based on manufacturer.

3) Limited input method but a number of possible interaction method such as keypad and touch screen.

4) Limited battery life means that application activities have to be accordingly managed especially for power-hungry application.

5) Limited processing power restricts the complexity of an application.

6) Usage environment challenges including running in multitasking mobile phone environment, outdoor external factors.

Mobile applications developers face the challenge of overcoming these constraints while making an effort to build a highly usable application in wide range of demanding user contexts. In light of these challenges, developers have to take advantages of the lesson learned and best practices developed by others from their experience developing mobile application [15]. Best practice is the best guide towards building a quality mobile application.

2.6 BEST PRACTICES

There are two categories of best practices for mobile application which are design for usability and; right architecture and design. Designing for mobile applications is different compare to designing software for desktop computer and laptop because mobile application has limited resources and hardware constraints as discussed earlier. When developing a mobile application, compared to the much complex main application of desktop or laptop computer; consider mobile application as a child of a main application rather than a miniature version of it [13].

In designing for usability, a thorough understanding of the user's context and objectives is paramount [13]. It is necessary to think about the user as a good set of features does not equal to successful application. First and foremost is identifying the user experience and expectation [17]. There is a difference of experienced user who has handled mobile application before and first-time user. It is complicated to design an application that can shape toward these two types of user but it is not impossible to archive. On the other hand, user's context of use also needs to be considered. The question of where and how the users interact with the application is essential because it could change the approach taken for the user interaction design [17].

Another factor of design for usability is the weighing of the application simplicity. A mobile application need to be simple but not too simple that it lacks of essentials features. Developing an application that is intuitive can be done by organize functionality and content into intuitive flows and structures, breaking it down into small digestible chunks that creates a robust application [17]. Next to be considered is the platform the application is developed for such as iOS or Android. Each platform has its advantages that if utilized can change how the application's interaction would be on that platform towards a more successful application.

Best practice for mobile application also includes right architecture and design. In view of this, mobile application performance and usability are interrelated. To

archive high level of both properties while working with many device-related constraints, some considerations need to take into accounts which are [15] [13]:

1) Use prototyping methodology and continuous testing to come up with the best possible end product that has high level of performance and usability.

2) Consider the limitation and different hardware of mobile devices into the design and structure.

3) Conserve the memory by defining a proper data structure and using predefined tools or objects.

4) Manage content intelligently by implementing deep application structure instead of wide structure that is typical on normal computer software.

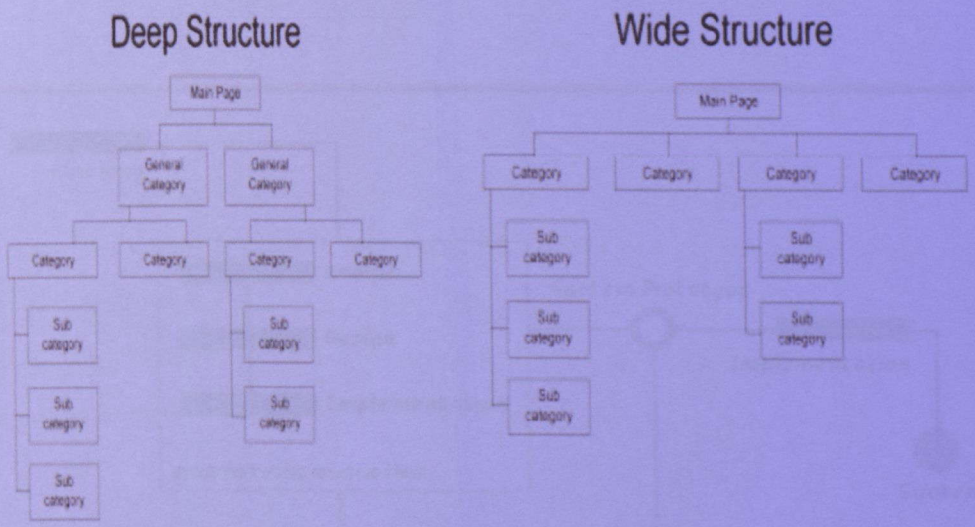


Figure 7: Deep Structure and Wide Structure [13]

CHAPTER 3

METHODOLOGY

3.1 PROJECT METHODOLOGY AND ACTIVITIES

The methodology that will be use for this project is the RAD (Rapid application development) that focuses on rapid prototyping and less planning [15]. Prototyping works through phases of SDLC (System Development Life-Cycle) to make faster software delivery. In short, RAD process enables the development of quality product faster by avoiding extensive pre-planning; allowing software to be written faster thus making it easier in adapting to changing requirements. Effective delivery of the mobile application is achievable through RAD's Throwaway Prototyping as shown in the Figure 8 below. This methodology is useful to help visualizing how the requirement may be implemented, reveals gaps in the requirements and let user judge whether the requirement will enable necessary application process [18].

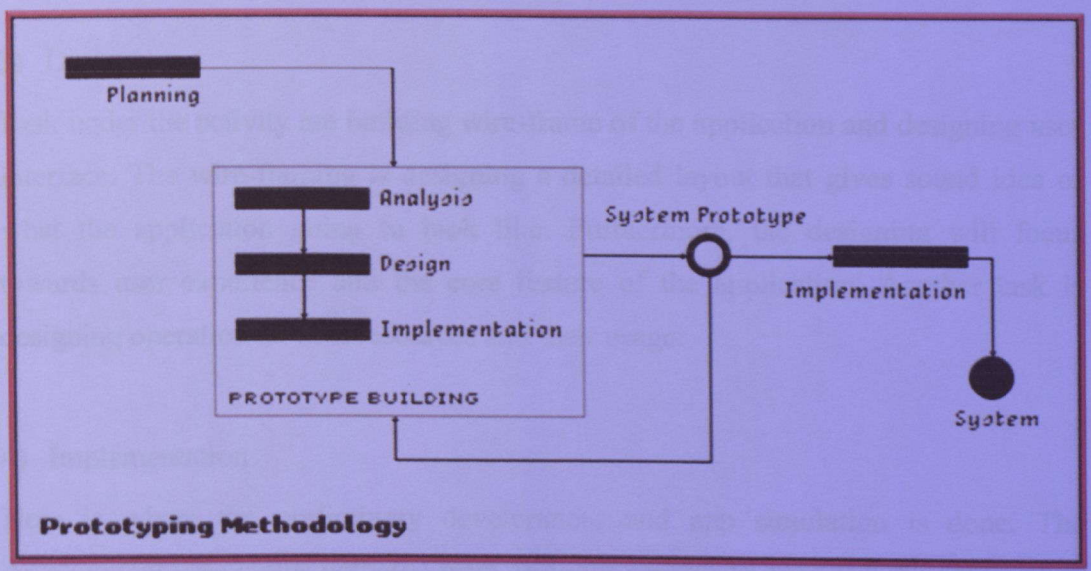


Figure 8: Throwaway Prototyping

The phases and its corresponding activities in the methodology are as explained in the following:

1) Planning

This activity covers defining the overall processes of the project. It underlines the important points of the development projects. This is where the requirements and functionality are identified. Further into the stage is producing initial sketch of the application and getting into key components and architecture that will be used for the development.

2) Analysis

In this activity, the functionality of the application is defined. It covers storyboarding the application workflow and deciding how it will function. Next is to determine the interface and; other structural characteristics and framework. Near the end of this activity, more requirements might appear although after having done the planning activity. Therefore, it is an iterative activity.

3) Designing

Task under the activity are building wire-frame of the application and designing user interface. The wire-framing is designing a detailed layout that gives sound idea of what the application going to look like. Furthermore, the designing will focus towards user experience and the core feature of the application. Another task is designing operation on data resources and their usage.

4) Implementation

Here is where the preliminary development and app simulation is done. The development uses inputs gathered from previous activity to construct the application. Once completed, the prototype will be tested on the simulator. Next is porting it to a physical device for usability and user experience testing.

3.2 TOOLS AND TECHNOLOGY

The mobile application is developed for the Android OS platform. Android is a software stack for mobile devices that include an operating system, middleware and key application [19]. The operating system is an open source platform developed by Google that is freely distributed for device manufactures to use with their product commonly mobile phones. To develop Android mobile application, common tools needed are Android SDK (software development kit), Eclipse IDE (integrated development environment) and SQLite Database.

The Android SDK consists of several groups of tools and APIs (application programming interface) necessary in developing applications on the Android platform [20]. Figure 9 depicted the major component of Android OS architecture [35]. Android application is developed using Java programming language. The Eclipse IDE provides the Java environment needed to access the Android SDK tools and write application codes. The SDK also provides simulator to simulate the application created before transferring for testing on devices. On the other hand, SQLite Database provides software library that implement a self-contained, server-less, zero-configuration, transactional SQL database engine [22].

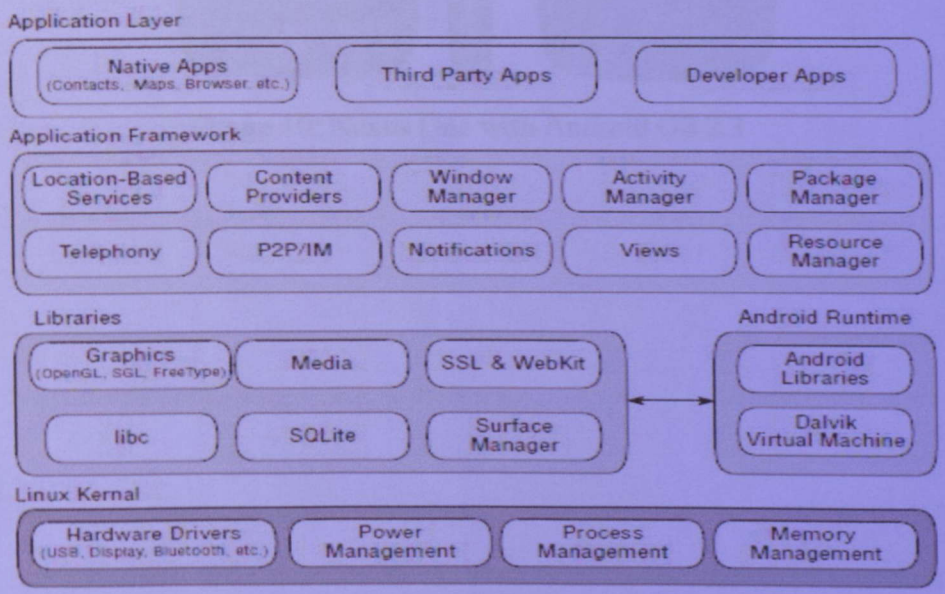


Figure 9: Android Architecture

The indoor floor plans are designed and created using Microsoft Visio [21] software. The features of interactive maps can be implemented using SDK's tools. These technology described here are capable to integrate and work together to develop the mobile application.

For testing and usage purposed, an Android based device is required. Google Nexus One is the mobile phone that is chosen for testing and usage purposes [23]. The phone provides Google experience, which means the phone, is running on stock Android OS without any customization from manufacturer. It is SIM-unlocked and hardware-unlocked that is designed with developers in mind for tweaking and testing application. Despite the purposes, the mobile phone is capable of normal telephony, messaging and other typical phone functions.

Figure 10: Nexus One with Android OS 2.3

3.3 GANTT CHART AND MILESTONES

Figure 11 below shows the project's corresponding Gantt chart and milestones of deliverable for FYP1 and FYP2.

Task	Milestone	W1	W2	W3	W4	W5	W6	W7		W8	W9	W10	W11	W12	W13	W14
STAGE 1 - Planning																
1.1 - Topic selection and proposal preparation																
1.2 - Submission of proposal	5/10		x													
1.3 - Identifying the requirements of project																
1.4 - Identifying the methodology of the project																
1.5 - Submission of extended proposal	2/11						x									
STAGE 2 - Analysis																
2.1 - Gathering the requirement for the project																
2.2 - Obtaining information and resources																
2.3 - Proposal defense – Oral presentation	23/11										x					
2.4 - Feedback amendments on project																
2.5 - Submission of interim report	7/12												x			
2.6 - Identifying the functions of the system																
2.7 - Designing the interface of the system																
2.8 - Submission of technical report	21/12														x	

Legend	
	Task Duration
x	Milestone

Task	Milestone	W1	W2	W3	W4	W5	W6	W7		W8	W9	W10	W11	W12	W13	W14
STAGE 3 - Design																
3.1 - Developing the system interface																
3.2 - Developing the function of the system																
3.3 - Submission of progress report 1	7/3							x								
3.4 - Configuring database for the system																
3.5 - Connecting system with the database																
3.6 – Further work on the system																
STAGE 4 - Testing																
4.1 - Pre-testing the system function																
4.3 - Poster exhibition	4/4												x			
4.2 - Further work on the system																
4.4 - Submission of dissertation report (soft bound)	12/4													x		
4.5 - Oral presentation	x															x
4.6 - Submission of dissertation report (hard bound)	x															x

MID-SEMESTER BREAK

Legend	
	Task Duration
x	Milestone

Figure 11: Gantt chart and milestones

CHAPTER 4

RESULT AND DISCUSSION

4.1 MOBILE APPLICATION COMMON DEVELOPMENT

A small survey focusing on mobile developers was conducted by Agrawal, S. and A.I. Wasserman [32], through available mobile developer forums to solicit respondents with the goal to gain a better understanding of development practices for mobile applications. The conclusion included the following results:

1) Most applications were relatively small, averaging several thousand lines of source code, with one or two developers responsible for conceiving, designing, and implementing the application;
2) there was a sharp divide between "native" applications, those that run entirely on the mobile device, and web applications, which have a small device-based client with execution occurring on a remote server;
3) developers adhered quite well to recommended sets of "best practices" but rarely used any formal development processes, and;
4) developers did very little to organize the tracking of their development efforts and gathered few metrics.

Mobile applications are smaller when compare to full blown software for desktop computer or laptop. Typically these applications are uploaded into online market for other user to buy and download; and these markets restrict the size of your application. For example in Android Market the maximum size of .apk (the compiled application) is 50mb [34]. Despite that, a locally develop application can be more than 50mb such as running or testing for internal purposes and not upload it to the Android Market. Although most developers would follow the restriction because the main reason they develop an application is to gain some profit from it.

"Native" applications as stated in the conclusion refer to stand-alone application that do most of its processes locally and run entirely on the mobile device. These applications are designed for disconnected or occasionally connected context which is different from web applications that mostly need to be connected to a network to function. Both have their own advantage and disadvantage. Among others, a native application wins in situation where there are no network connections or if using so cost money but loses in feature department. On the other hand, a web application is useful when it is necessary to be connected in order to update status or get real-time news such as Facebook apps or mail apps but the downsize is it does not function like it should when there are no network connections available.

"Best practices" as discussed in earlier chapter are there to help build a quality mobile application that will work and sell well. Despite that, it takes considerable time and effort to actually adhere to the recommended best practice thus the rarity in using formal development processes. Moreover, best practice is there as a set of guide but it is up to the developer to choose whether to practice it or not. They can also 'miss and match' the best practices to what they think will be good for the application being develop. For a well organized company or a group of people they would follow formal development processes because it is business for them but for individual, following it or not would pose no harm to them.

As mention before, it require a little more effort and time to actually adhere to best practice. Thus conveys that most developer as said in the survey conclusion, did very little to organize the tracking of their development efforts.

4.2 SYSTEM ARCHITECTURE

The desired audience or users of the proposed application are among students, staffs and visitors. As for the requirement, maps of campus buildings does not physically change drastically which meant data on the application do not need frequent update. Meanwhile, user experience feature expected is of interactive context.

Based on the desired audience, application requirements, technology constraints and type of user experience, the application type implemented is the rich client application. Application of this type usually developed as stand-alone applications with a user interface that displays data using a range of control and can be designed for disconnected and occasionally connected scenarios if needed to access remote data or functionality [24][25]. The application can function and be useful to user without the need to be connected to a network.

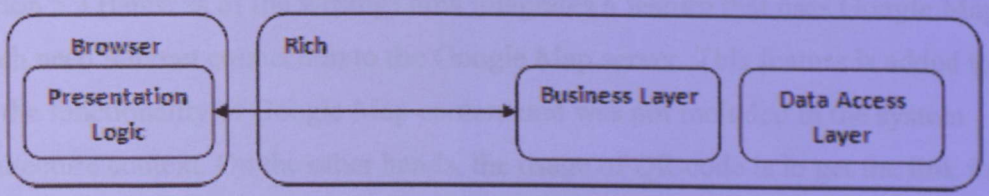


Figure 12: Rich Client Architecture

Based on Figure 12, a Rich Client Architecture consists of Data Access layer which holds the application data and Business Layer that have operation that control and manipulate the data. The Browser side which has Presentation Logic component will interact with Business Layer to initiate operations and processes on the Data Access Layer. As depicted, the system architecture is stand-alone client without any remote component. This shows the offline feature of the application.

4.2.1 APPLICATION ARCHITECTURE

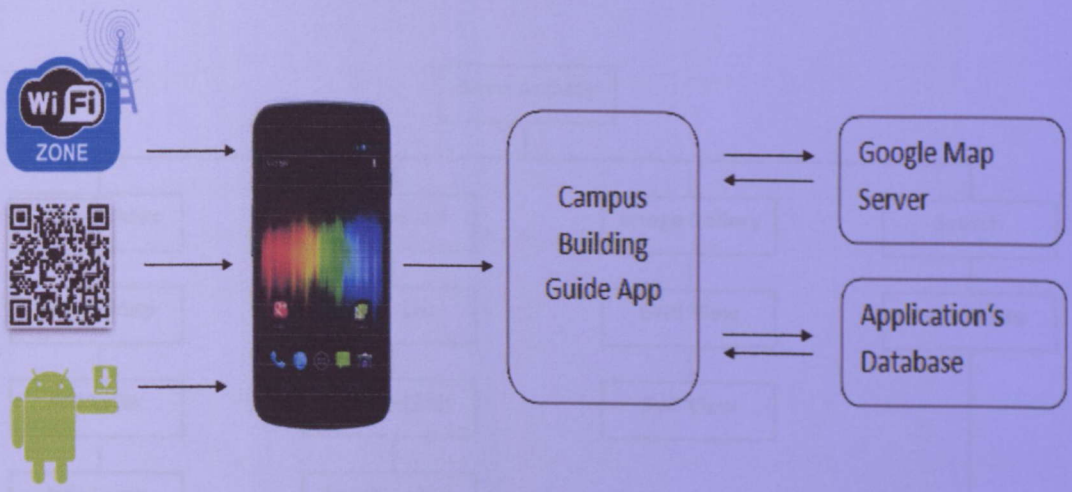


Figure 13: Application architecture

As depicted in Figure 13 above, the campus building guide application will interact mainly with the application's local database for floor plan layouts. The prototype version 5.3 (latest as of the writing) now integrates a feature that uses Google Map which need internet connection to the Google Map server. This feature is added to test the functionality of Google Map content and was not included in the system architecture context. On the other hands, the usage of QR code is to get the link for downloading the mobile application. QR code is simple, easy to display and to distribute so that user can easily get the mobile application.

How to get the mobile application:

1. Connect to mobile internet service or open WIFI.
2. Scan the QR code below for download link.
3. Download and install the Campus Building Guide Application (.apk file)

Figure 14: QR code for link to download the prototype [37]

4.2.2 APPLICATION STRUCTURE

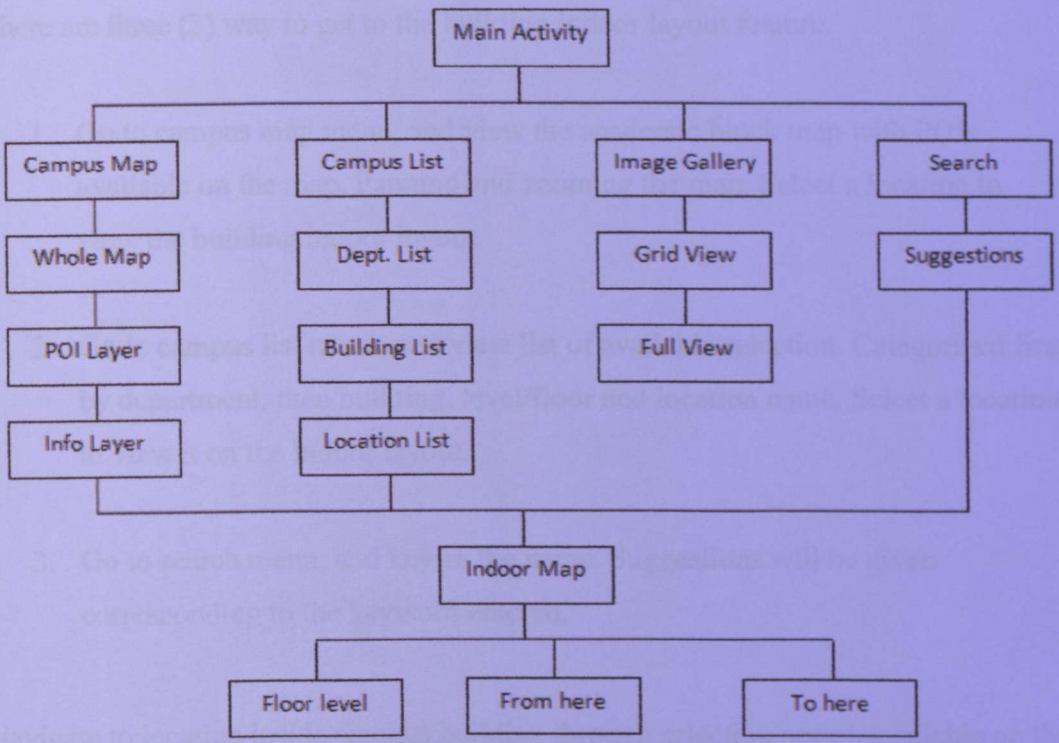


Figure 15: Structure of the mobile application

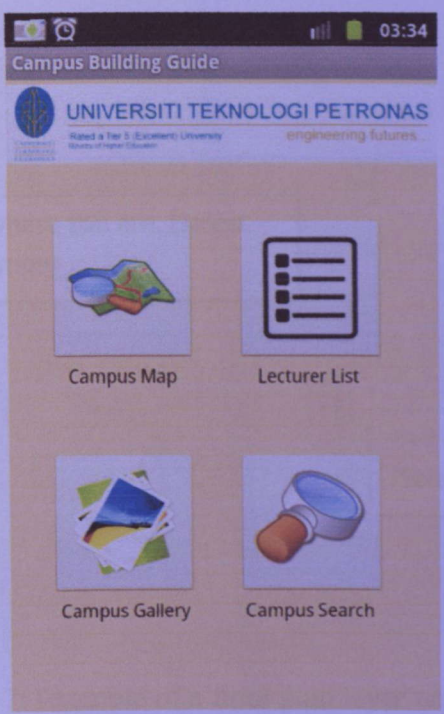


Figure 16: Home screen of the mobile application

4.3 APPLICATION STORYBOARD

There are three (3) way to get to the building indoor layout feature.

1. Go to campus map menu, and view the academic block map with POIs available on the map. Panning and zooming the map. Select a location to view the building indoor layout.

2. Go to campus list menu, and view list of available selection. Categorized first by department, then building, level/floor and location name. Select a location to view it on the indoor layout.

3. Go to search menu, and key-in the name. Suggestions will be given corresponding to the keyword entered.

Navigate to location inside campus building through selection option available on the layout view. User perceives the distance based on the layout and move towards the location.

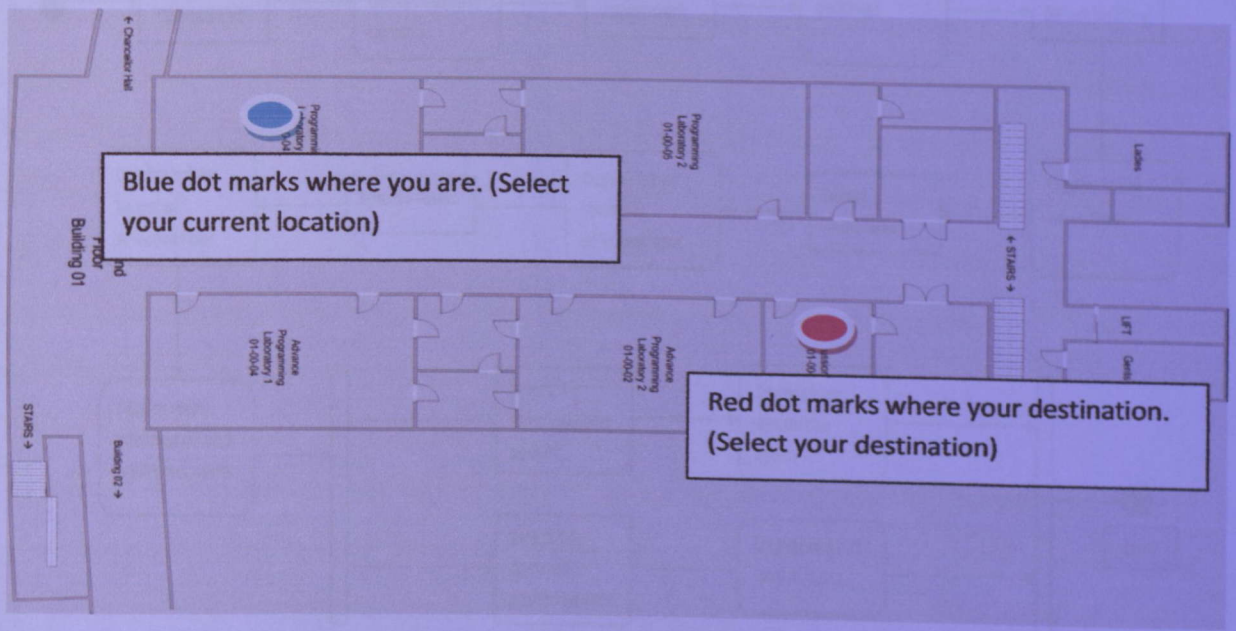


Figure 17: Example of a floor plan layer with marks

4.4 APPLICATION USE-CASE DIAGRAMS

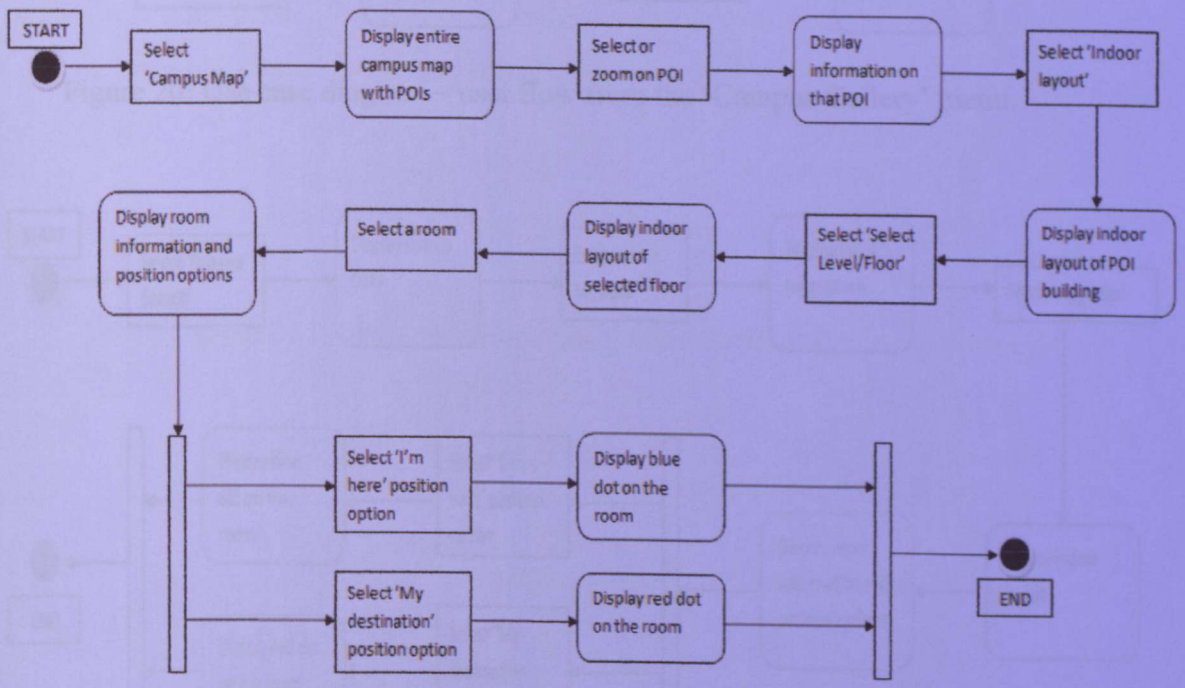


Figure 18: Use case diagram – user flow from the 'Campus Map' menu.

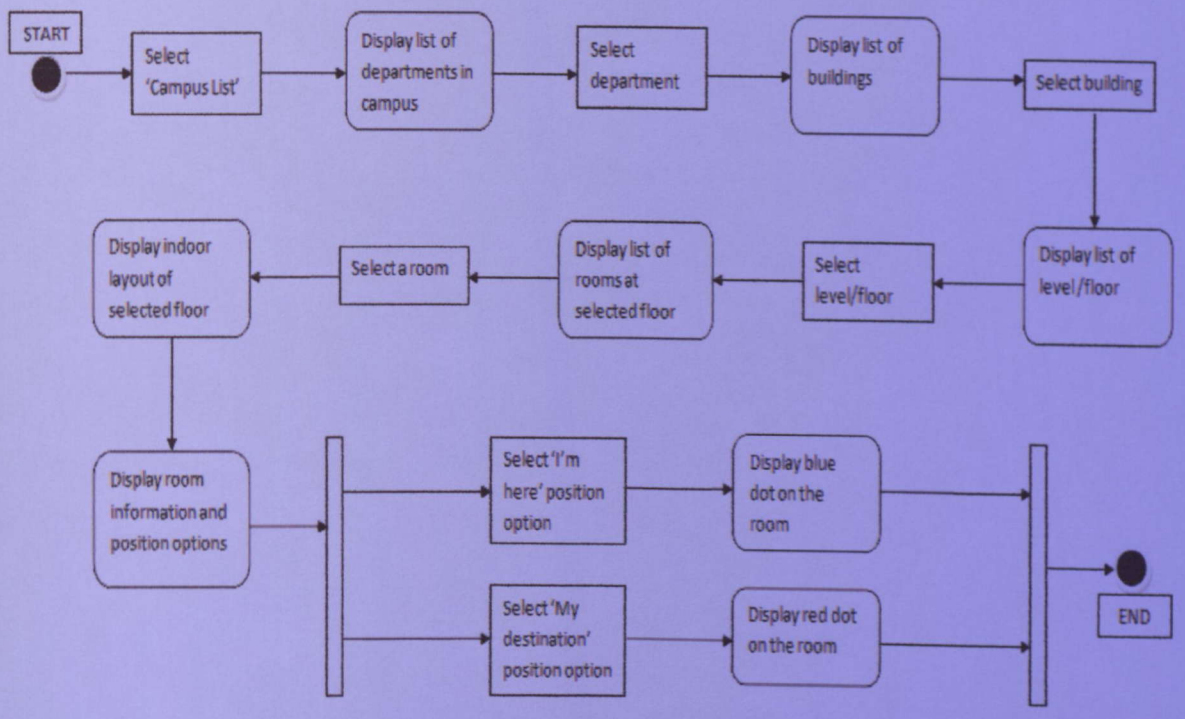


Figure 19: Use case diagram – user flow from the 'Campus List' menu.

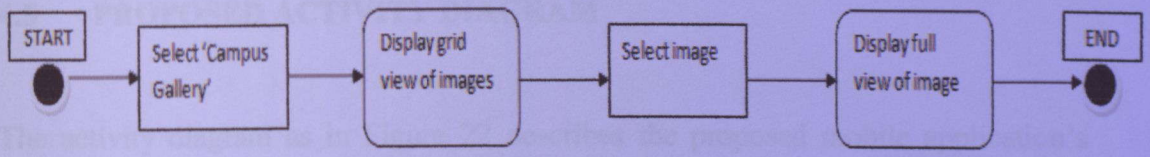


Figure 20: Use case diagram – user flow from the 'Campus Gallery' menu.

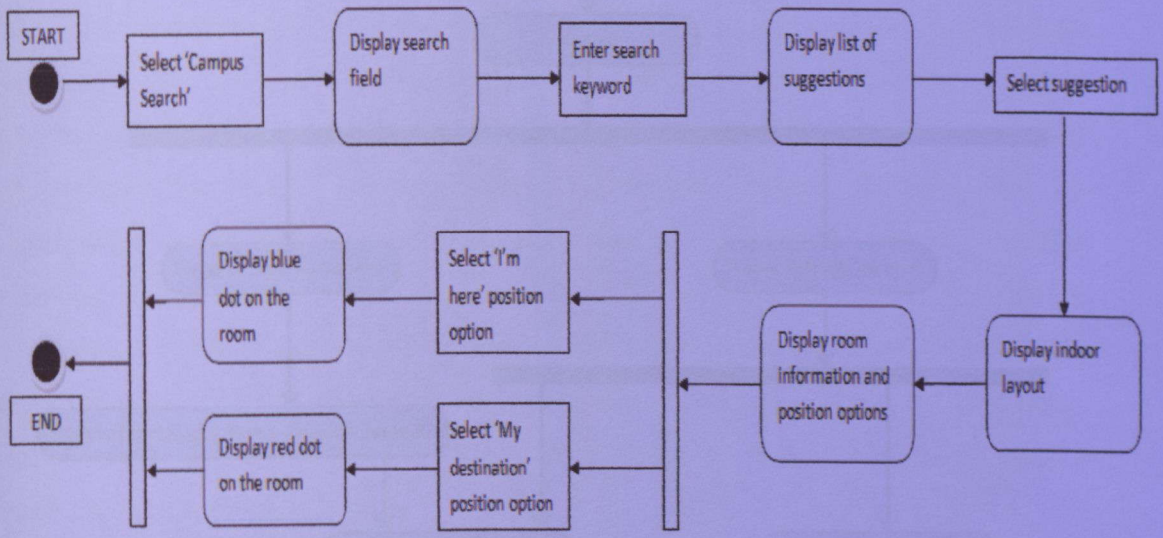


Figure 21: Use case diagram – user flow from the 'Campus Search' menu.

4.5 PROPOSED ACTIVITY DIAGRAM

The activity diagram as in Figure 22 describes the proposed mobile application's functionalities and workflows of stepwise activities.

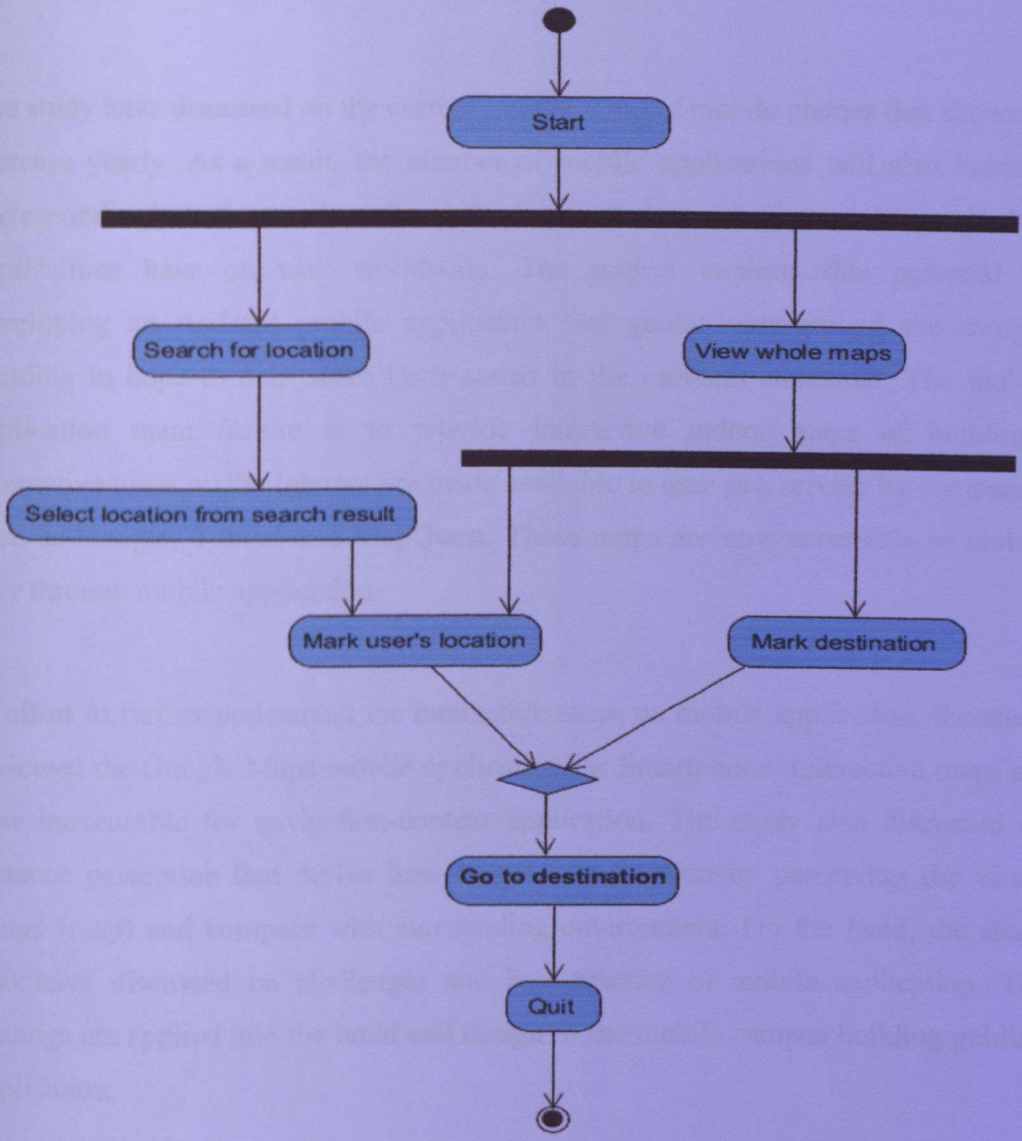


Figure 22: Proposed Activity Diagram

CHAPTER 5

CONCLUSION AND RECOMENDATION

5.1 CONCLUSION

The study have discussed on the current market trend of mobile phones that shows an increase yearly. As a result, the number of mobile applications will also increase correspondingly to the number of mobile phones. It shows the potential reach mobile applications have on user worldwide. The project exploits this potential by developing an Android mobile application that guides user around the campus building in hope to help solve issue stated in the problem statement. The mobile application main feature is to provide interactive indoor maps of buildings. Interactive maps on the Internet are made available to user as a service by companies such as Google, Yahoo! and MapQuest. These maps are now accessible to mobile user through mobile application.

In effort to further understand the interactive maps on mobile application, the study reviewed the Google Maps mobile application for Smartphone. Interactive maps are now inexcusable for navigation-context application. The study also discussed on distance perception that derive how to get to a location by perceiving the visual image (map) and compare with surrounding environment. On the hand, the study also have discussed on challenges and best practice of mobile application. The findings are applied into the build and design of the mobile campus building guiding application.

5.2 RECOMMENDATION

In light of this study, several recommendations were devised to help in developing mobile application. Developer need to take into account the challenges persist in mobile application that is much different from normal software application. It is recommended to follow a set of best practice that would be useful and important to an application's usability and user experience. At the very least, the application is guarantee to achieve some standard because the best practices help in distinguishing the standard and quality of the mobile application.

Further continuation of the prototype would be to integrate server-side architecture like what Google Map server provides for map context mobile applications. By doing so, the burden of the Smartphone processing will be halved as the server will handle request from user and push the requested map to the mobile applications. The prototype can also be further enhance with more interactive and informative features, and cover more buildings in the campus. I believe if further work is done on the prototype, it could be an official application for the university to distribute under its name for visitor and new student in particular.

REFERENCES

[1] Mappings, Denis E. Cosgrove, Reaktion Books, 1999

[2] What is GPS? http://www8.garmin.com/aboutGPS/

[3] Toward the indoor use of location-based augmented reality, Study Tour Pixel 2010 – University of Twente

[4] GPS and Mobile Handsets - 4th edition, BERGINSIGHT

[5] University of Technology PETRONAS, On Site Review Report, Hanif Kara, 2007

[6] Lost on the Road; Mihret Aschalew; 23 July 2011; http://www.thereporterethiopia.com/Society/lost-on-the-road.html

[7] Android Community; http://source.android.com/community/index.html

[8] Gartner Says 428 Million Mobile Communication Devices Sold Worldwide in First Quarter 2011, a 19 Percent Increase Year-on-Year; http://www.gartner.com/it/page.jsp?id=1689814

[9] The Web's Best Mapping Sites; Steve Bass; 21 August 2007; http://www.pcworld.com/article/136018/the_webs_best_mapping_sites.html

[10] Maps in Modern Web Design: Showcase and Examples; Zach Dunn; 6 April 2010; http://www.smashingmagazine.com/2010/04/06/maps-in-modern-web-design/

[11] Google Maps is the most popular mobile application; Alice; http://www.justsearchseo.co.uk/news/google/google-maps-is-most-popular-mobile-application.html

[12] Google Maps for mobile; http://www.google.com/mobile/maps/

[13] Tips for Designing Mobile Applications; Ray; January 12, 2009; http://www.clickbrand.com/blog/web-design/tips-for-designing-mobile-applications/

[14] Challenges of Mobile Application Development, Bright Software Pty. Ltd, Australia 2007

[15] Mobile Application Development: Challenges and Best Practices, bitHead, January 28 2009

[16] Challenges in Mobile Application Development, Birgitta König-Ries, Friedrich-Schiller-Universität Jena, 2009

[17] Best Practices for Designing Mobile Touch Screen Applications; 15 June 2011; http://www.usercentric.com/news/2011/06/15/best-practices-designing-mobile-touch-screen-applications

[18] Karl E. Wiegers, *Software Requirements (2nd Edition), Microsoft Press, 2003*

[19] What is Android; http://developer.android.com/guide/basics/what-is-android.html

[20] Introduction; http://developer.android.com/guide/developing/index.html

[21] Create a floor plan; http://office.microsoft.com/en-us/visio-help/create-a-floor-plan-HP001208559.aspx

[22] About SQLite; http://www.sqlite.org/about.html

[23] Using Hardware Devices; http://developer.android.com/guide/developing/device.html

[24] Rich Internet Application, Manikavelu Velayutham, December 13, 2010

[25] Mobile Application Architecture Guide, Microsoft 2008

[30] Google Maps 6.0 hits Android, adds indoor navigation for retail and transit; Joseph Volpe; 29 November 2011; http://www.engadget.com/2011/11/29/google-maps-6-0-hits-android-adds-indoor-navigation-for-retail/

[31] Google Maps app for Android adds indoor floorplans; Juan Carlos Perez; 29 November 2011; http://www.computerworld.com/s/article/9222237/Google_Maps_app_for_Android_adds_indoor_floorplans

[32] Agrawal, S. and A.I. Wasserman, "Mobile Application Development: A Developer Survey", 2010

[33] Mobile Apps Put the Web in Their Rear-view Mirror; Charles Newark-French; 20 Jun 2011; http://blog.flurry.com/bid/63907/Mobile-Apps-Put-the-Web-in-Their-Rear-view-Mirror

[34] Uploading application; http://www.google.com/support/androidmarket/developer/bin/answer.py?hl=en&answer=113469

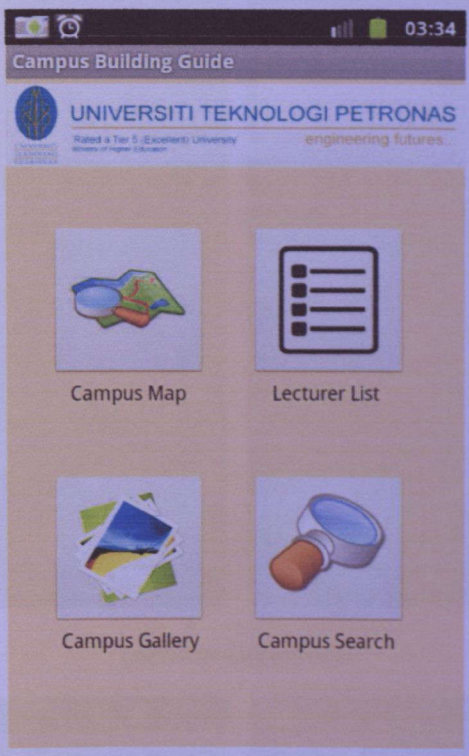
[34] New Wi-Fi Technology Keeps You from Getting Lost in the Mall; http://gizmodo.com/5809530/new-wifi-technology-keeps-you-from-getting-lost-in-the-mall

[35] Hello Android: Introducing Google's Mobile Development Platform; Ed Burnette; 2009, pg.14

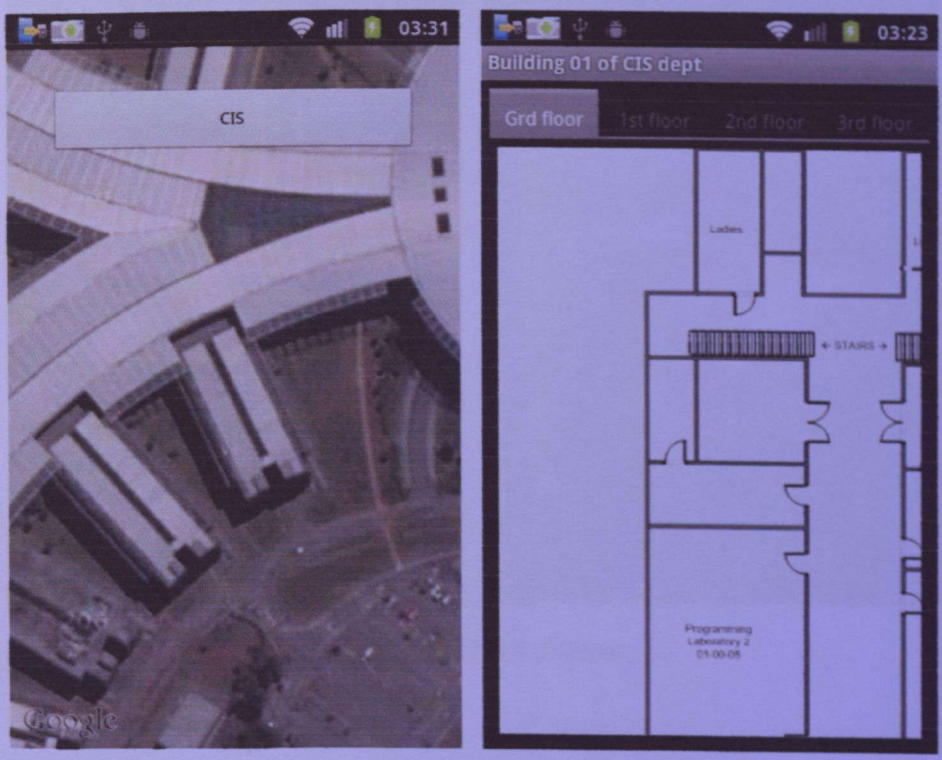
[36] Distance Perception, Dennis R. Proffitt, University of Virginia, 2006

[37] QR Code Generator; http://www.qurify.com/en/

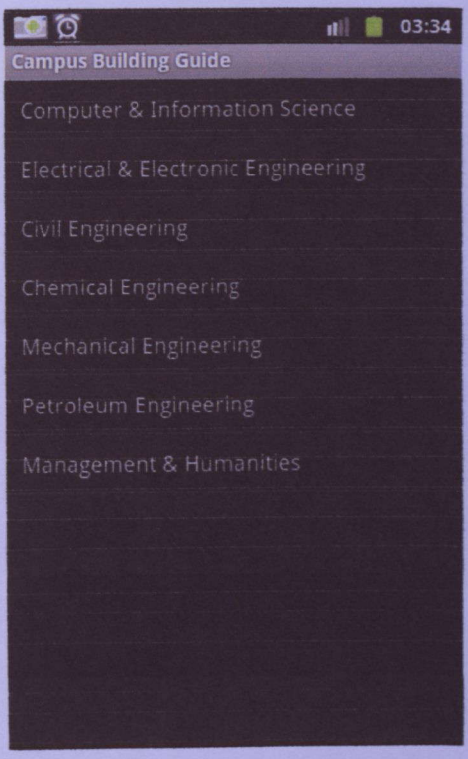
APPENDICES

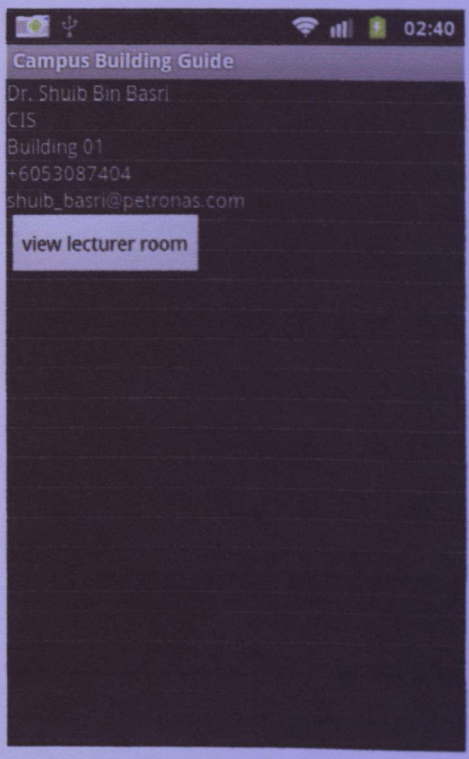


Home screen

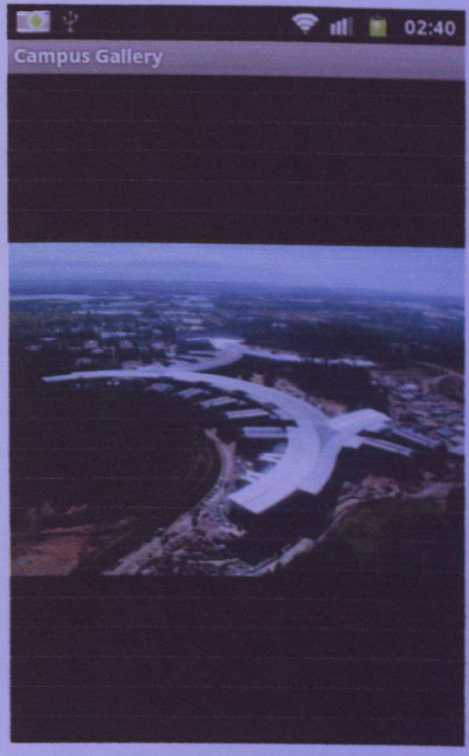


Campus Map screen

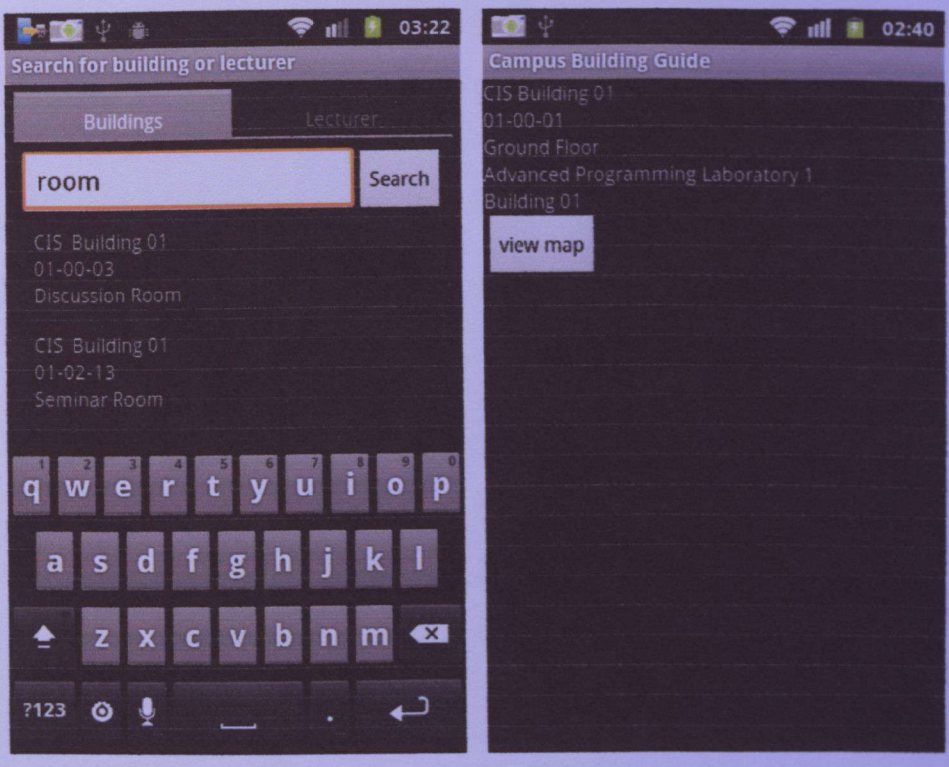




Lecturer List screen



Campus Gallery Screen



Campus Search screen