UNIVERSITI TEKNOLOGI PETRONAS

DEVELOPMENT OF INTERACTIVE MAPS APPLICATION FOR EE DEPARTMENT ON ANDROID SMARTPHONE DEVICES

by

MOHD SHARIR B MOHAMAD SAYUTI

Dissertation Report submitted in partial fulfillment

of the requirement for the

Bachelor of Engineering (Hons) Electrical and Electronics

DECEMBER 2011

Universiti Teknologi PETRONAS

Bandar Seri Iskandar

31750 Tronoh

Perak Darul Ridzuan

CERTIFICATION OF APPROVAL

DEVELOPMENT OF INTERACTIVE MAPS APPLICATION FOR EE DEPARTMENT
ON ANDROID SMARTPHONE DEVICES

by

MOHD SHARIR B MOHAMAD SAYUTI

Dissertation report submitted to the

Electrical and Electronics Engineering Programme

Universiti Teknologi PETRONAS

In partial fulfillment of the requirement for the

BACHELOR OF ENGINEERING (Hons)

(ELECTRICAL AND ELECTRONICS ENGINEERING)

Approved by,
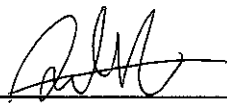
_____

(Dr Aamir Saeed Malik)

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

DECEMBER 2011

ii

CERTIFICATION OF ORIGINALITY

This is to testify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and the original work contained here have not undertaken or done by unspecified sources or persons.

(Mohd Sharir B Mohamad Sayuti)

ABSTRACT

Android platform has become a leading mobile operating system since it first appearance on November 2007. Latest statistic based on July market data in U.S shown that Android smartphone has gain 40% of market share compare to iOS and Blackberry which hold only 28% and 7% respectively. While Android operating system is only maturing with just about 3 years old, it already exceeds their close competitor. This growth is driven by the availability of many high-end products and the variety of applications in Android Market.

Android smartphone gives the advantage of touchscreen display with multi-touch, internet access, efficient storage system and many other Application Programming Interfaces (APIs) depending on the software versions. In this project, an offline maps application will be develop for Android platform using android Software Development Kit (SDK) and Integrated Development Environment (IDE) software. The maps are design for the usage of Electrical and Electronic (EE) students where it will show maps for EE department, search lecturer information and provide direction to the desired destination. The process of developing the maps includes designing an interactive User Interface (UI), programming the structure of the application, creating and connecting databases of lecturer information such as room number and location, office phone number, and email address. The application will not only help student searching lecturer's details and location, but also can be used by lecturers and visitors.

ACKNOWLEDGEMENTS

I would like to express my utmost gratitude to Allah Almighty for giving me the strength and knowledge to face the challenges in completing this Final Year Project.

I also would like to extend a special thank you to my project supervisor, Dr Aamir Saeed Malik from Electrical and Electronics Department whose has given me this project and guidance on the subject of image processing. My deepest appreciation also goes to staff at Android developer team for their constant support and help throughout this project.

I also would like to thank my parent and friends for supporting and helping me with testing throughout the project. Their concern and compassion for me during this project are greatly appreciated as I could not have endured this very challenging moment without them.

Thank you.

Mohd Sharir B Mohamad Sayuti

EE10781

Electrical and Electronics Engineering Programme

TABLE OF CONTENT

LIST OF FIGURES

CHAPTER 1: INTRODUCTION

1.1 BACKGROUND OF STUDY

Smartphone started to gain popularity with the increase of internet connectivity especially when the 3G network was introduced. The range of smartphone user increased over time from only professional and business man to teenager, students and women. This is driven by the flexibility and usability of the operation system as well as the affordability of the smartphone itself.

As a result, Google, a multinational internet search company has taken a giant leap by investing in the smartphone operating system. Google bought Android operating system from Android Inc. and then founded the Open Handset Alliance. This alliance is a business joint venture of 83 firms with an objective to develop open standards for mobile devices. Member firms include Google, HTC, Sony, Dell, Intel, Motorola, Qualcomm, Texas Instruments, Samsung, LG, T-Mobile, NVidia, and Wind River Systems.

Android mobile operating system has emerged from the underdog to the top operating system due to the rapid hardware development and fast software update. Many high end smartphone nowadays are packed with Android. Not only that, Android operating system is also compatible with tablet and there is an Android version specifically optimize for tablet.

The usage of smartphone and tablet has varies from not only to make call and SMS, but also as a personal organizer, internet browser, map viewer, media player and many more. The best part of Android operating system is the flexibility and intuitive option provided to the developer to develop an application. Because the program will be based on widely used programming language which is Java, programmer has a lot of option to manipulate the given APIs to develop a creative and innovative application.

1.2 PROBLEM STATEMENT

Locating lecturer's office and classroom have always been difficult especially for new students. Moreover, the information maps provided by UTP are only available at certain places. Without this information, a lot of student's times are wasted just for searching lecture's office and classroom. Not only student, visitors are also having trouble touring around campus without proper maps. With a portable interactive maps application that runs on Android smartphone, student, lecturer and visitor can get quick access for lecturer's information and direction to the desired location.

1.3 OBJECTIVE

This project is developed to achieve these objectives:

1. To provide a portable interactive and informative map layout to guide users to the desired location.
2. To provide complete database of lecturer for EE department that includes lecturer's title, room number, office phone number and email address.
3. To reduce time (especially new student) to search for classroom, lab and lecturer's office.

1.4 SCOPE OF THE STUDY

1. Understanding Android OS architecture.
2. Designing UI using .xml format and android APIs.
3. Java programming.
4. Understanding mobile internet communication protocol
5. Designing map layout using Microsoft Visio.
6. Basic knowledge of image processing for optimal image display.
7. Database management using SQLite.
8. Develop flash video using Adobe Flash.

1.5 RELEVANCY AND FEASIBILITY OF THE PROJECT

Mobile system is growing rapidly with new gadget and technology every day and this will become the trend in the future. It is relevant to proceed with this project to gain the basic knowledge of mobile operating system that will be useful to develop something new in the future. Furthermore the completed application can be featured in UTP website and be used all EE student. The project can be completed within the given time because it did not required physical resources and constructions.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter we are going to discuss about the basic concept and theory behind the application. We are also going to review some application that already available on the market to that meet the same objective as our project. The reviewed sample can be used as a references material for both its functionality and interface to improve the quality of this project.

2.2 BASIC THEORY AND CONCEPT

2.2.1 Android Architecture

Android is a software stack for mobile device that contains elements such as operating system, handler and key application [1]. It is built on top of optimized Linux kernel version 2.6 as the core system service that handles security, memory management, process management, network stack, and driver module. Figure 1 below explains the architecture of android operating system.
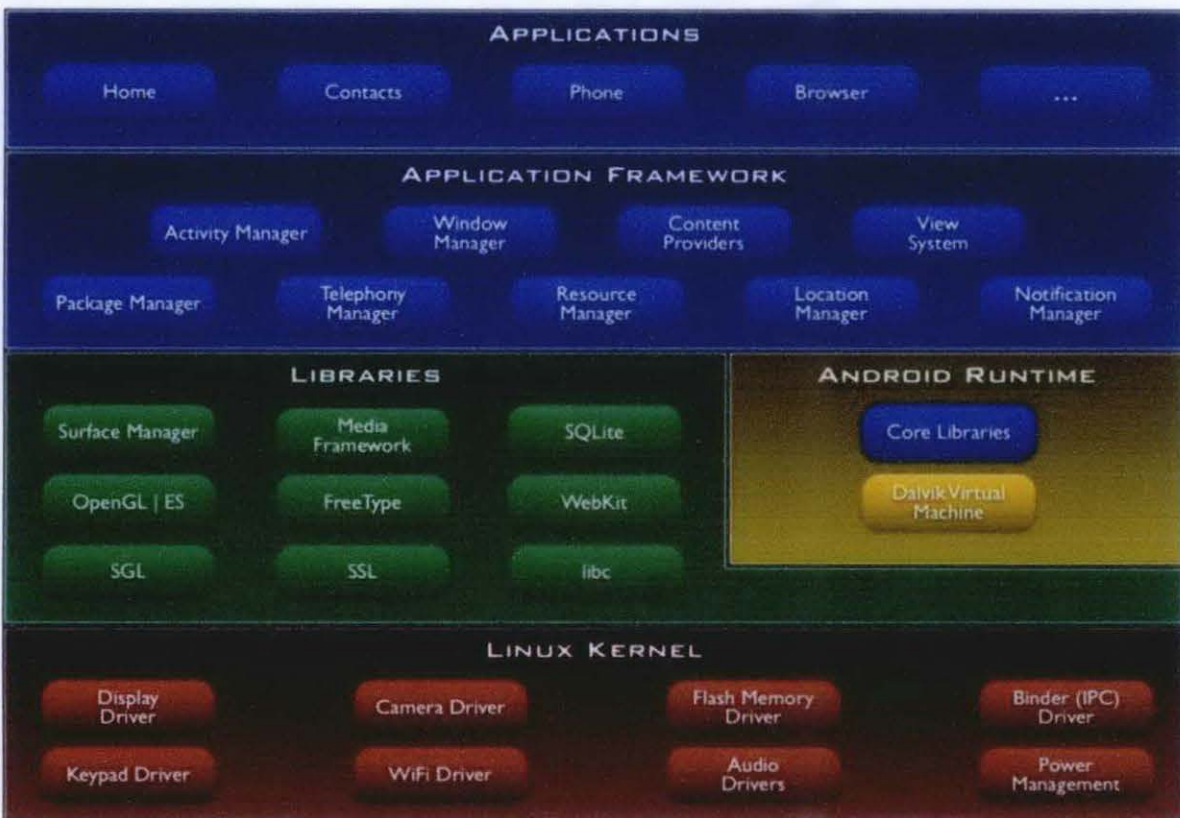
Figure 1: Android operating system architecture. Green items is written in C/C++, blue items is written in java and run in Dalvik Virtual Machine(VM). Image taken from [2].

The first layer of android stack is Linux Kernel that acts as the system management, the second layer is android native libraries. It's written in C/C++ that contains surface manager, 2D and 3D graphic, databases, media coder and native web browser engine. This entire libraries file will provide resources to the application. Next is the android runtime that includes Dalvik virtual machine and java core libraries. All android application run in their own sandboxed Dalvik VM in dalvik executable (.dex) format which is the compact and efficient version of java class file. The main purpose of Dalvik VM to optimized memory usage since android will run on a phone that will have limited memory. The next layer in android stack is the application framework that includes APIs provide by Google. The most important component of the framework is the Activity Manager, which manages the life cycle of applications and a common "back-stack" for user navigation. The final part of android structure is the applications layer which will contain the application program written in java.
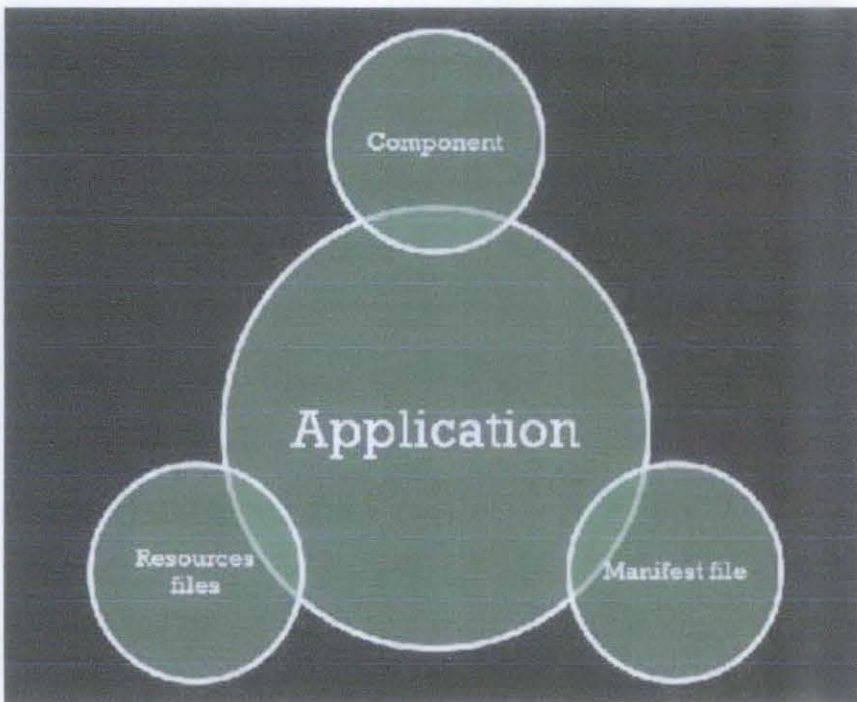
Figure 2: Android application layer consist of three parts; Component, manifest file and resources files

Android application layer includes application components, manifest files and application resources. Android application can consists of one or more application components which are activities, services, content providers, and broadcast receivers. These components act as a building block for the application and have to be declared in the manifest file. An activity is a single screen with a user interface elements that have specified function and life cycle. For example a messaging application might have one activity that show list of messages, another activity to compose messages and option activity to adjust the setting. The combination of activities creates an application although each activity acts independently. A service is a component that runs in the background of the system. It does not have user interface and can be bind with an activity for example in music player application. The music will be select in the player activity and after it has been set, the activity can be ended and the service will run in the background allowing the music stay playing while the system can run another activity. The next component is content provider, it allows another application to excess and modified our application SQLite databases or storage link by enabling data sharing from our application to another. The last component is broadcast receivers, it responsible to make system-wide broadcast announcement for example when battery is low, when receive incoming call and others. This component usually uses to make application execute using external condition as an input. All these components are activated by an asynchronous message called intent. Intents bind individual components to each other at runtime whether the component belongs to your application or another.

Activities, services and other permission required in the application need to be declared in the manifest file because Android system will read the manifest file first when executing the application. The last component of application layer is application resources. This component will store all resources for the application such as images, sound, theme and color code, and others.

2.2.2 Development Platform

Android applications are usually developed in the Java programming language using the Android Software Development Kit (SDK), but other development tools are also available. Methods that available are using multi-language Integrated Development Environment (IDE) software such as Eclipse or NetBeans and write the application in Java or use App Inventor from Google. Most

commonly use method is using IDE together with android developer tool (ADT) plugin because it's more structured and easy to deploy to the device [3]. In this project we are going to use Eclipse Helios 3.6 with ADT 10.0.1. The setup tools will support all features that available in Android 2.3.3 and below.

2.3 SIMILAR APPLICATION

There are several similar applications which already available in the Android Market that has the same function and purpose as this project. The similarity such as the ability to view and manipulate displayed map, provide route direction and search lecturer's information. These applications will be used as example and reference to this project.

2.3.1 Tube Maps

This application is free on the Android Market [4] that will provide a scrollable and zoomable tube map of London train route. From figure 4 we can see that the application can suggest route to take and provide live information. The maps and route database are stored in the application but internet access still required for the live information.

Figure 3: Map's main screen

Figure 4: Route direction screen

2.3.2 University of Alabama

This is an official University of Alabama application [5] that's developed to lets the student stay connected even while on the go. The application provides instant access to the campus directory, map, news, library catalogs, class schedule and more. Because this application was developed as an official media for mobile access, it has a privilege to get information from university database server. All the information and database for this application are stored in server, therefore users required to have internet connection to access this information.

Figure 5: Main screen

Figure 6: Participant information directory

Based on these applications, lots of features and function can be taken as example that will be implemented on our project. For example on how to manage the image files and add zooming function, also assigning function to the menu button. The user interface design can also be adapted in this project to make it more appealing to the users. Although these application use online database as storage but the method can still be refer for our project.

By all mean these applications only available in a package form that cannot be reverse engineer, therefore it's impossible for me to refer to their source code directly. But the ideas and the design can be taken as based to develop our application.

8

2.4 PROBLEM WITH UTP CURRENT MAP

To achieve the objective of this project, a small survey has been conducted to identify the problem with the current UTP maps and what causes student to come late to class. 20 random participants have been selected and the result of the survey is as below:
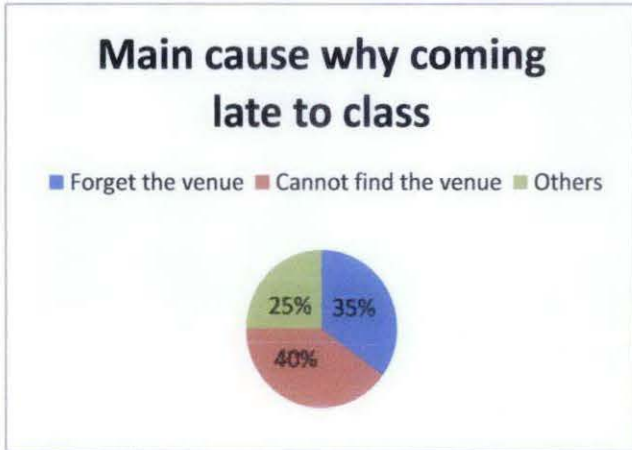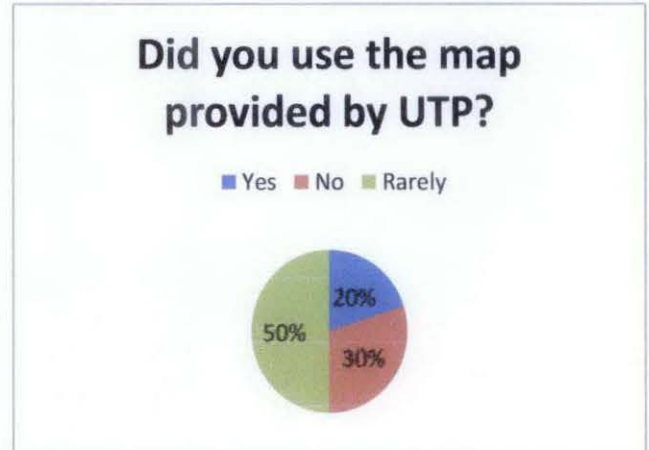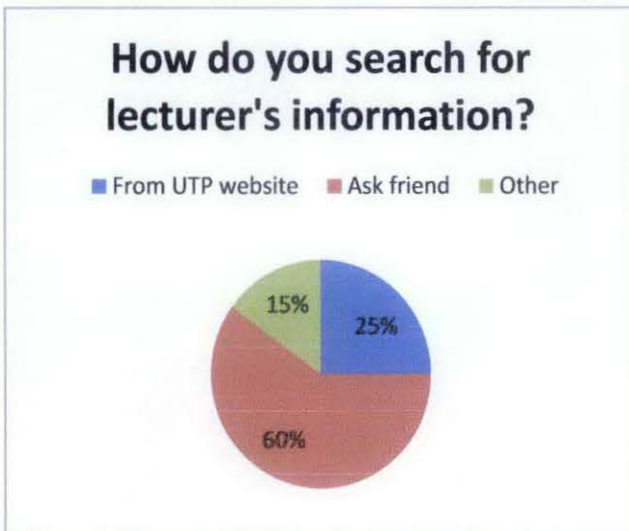

Figure 7(a)

Figure 7(b)

Figure 7(c)
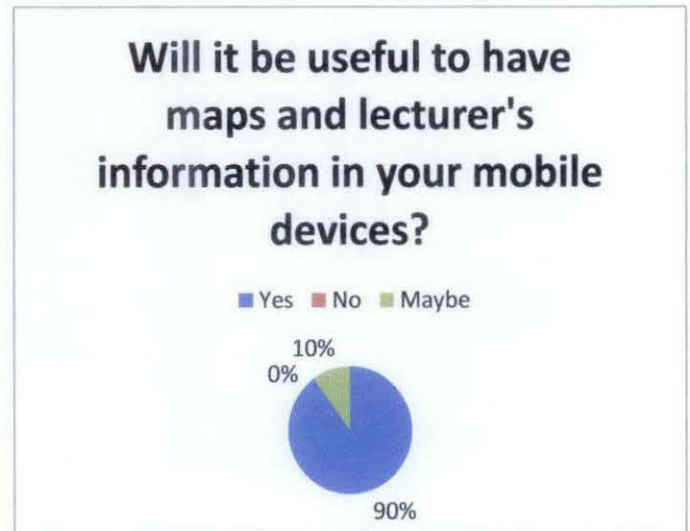
Figure 7(d)

To get the basic idea of the problems that student faced due to current UTP maps, four survey questions has been asked. First question is to identify the main cause of late comer in class. Then second question is to get opinion on the current maps provided by UTP. Third question ask the methods for student to get lecturer's information. Then the last question asks about opinion on the concept of this application.

As shown in figure 7(a), we can see that 40% of students coming late to class because they cannot find the classroom. They give reason because the class venue is not always on the EE department. For the second question, the result in figure 7(b) shown that over half of the participant did not use maps provided by UTP. This is because the maps only available at certain places in the building.

Searching for lecturer's information from UTP website is also not very preferable among student as shown in figure 7(c). They prefer to get the information such as lecturer's room number and phone number from friends rather that from UTP website. Lastly, 90% of students like the idea of having maps and lecturer's database in their mobile devices.

From the data gather during the survey, we can conclude that problem of late comer in class can be minimize by having a more structured and flexible maps and lecturer's information database.

CHAPTER 3: METHODOLOGY

3.1 PROCEDURE

For this project, the processes are divided into 4 stages:

Stage 1: Gathering resources

In this stage, all the information will be gather including the layout of block 22 and 23 from ground floor to the lecturer office, numbers and information for each room and lastly the lecturer's details including title, room number, office phone number and email address. The map layouts are based on floor blueprint provided by UTP. The lecturer's details are based on list of UTP staff.

As shown in figure 8, the floor layouts are drawn using Visio based on office template. Once the map is finished, it will be edited using Adobe Photoshop for optimizing the quality and adding some visual effect. The databases of lecturer also have to be constructed using SQLite editor before it can be added in the application.
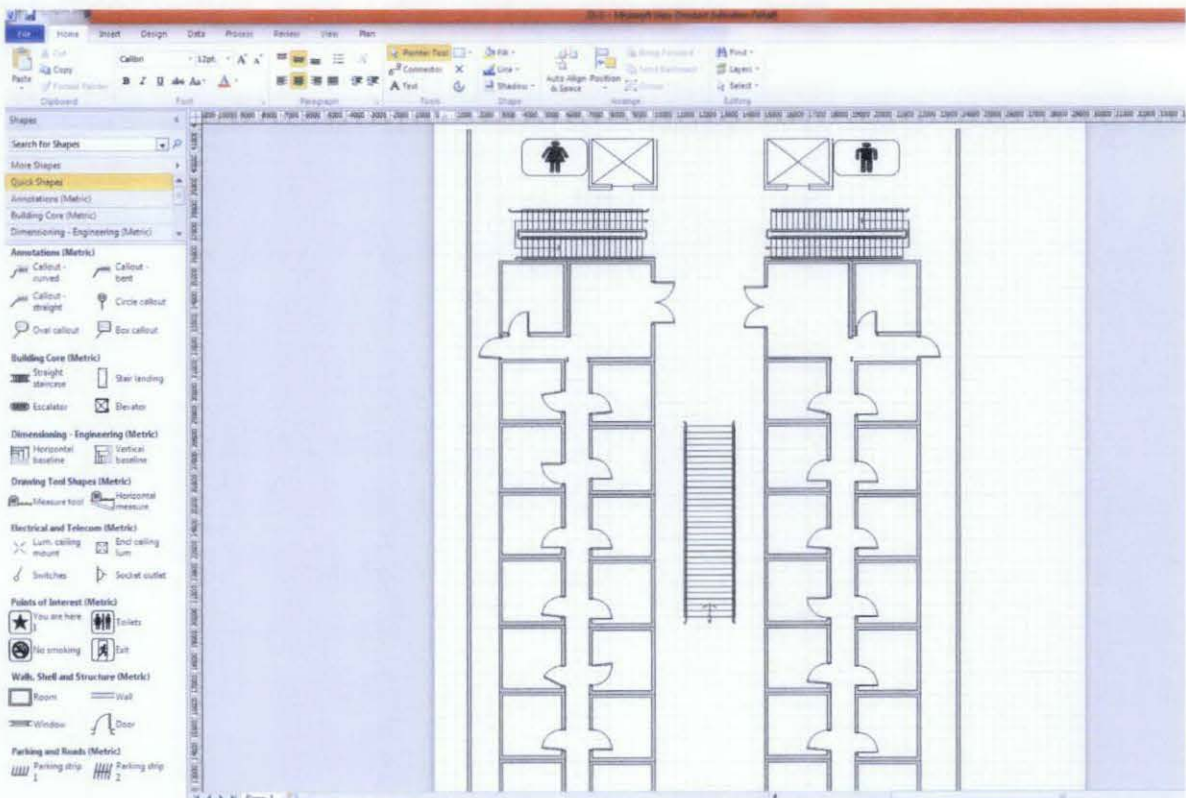
Figure 8: Microsoft Visio design screen for drawing the map.

Stage 2: Defining functionality

The second stage involve in defining all the function that will be included in the application. Basic ideas and design will be drafted and plan for programming will be made. Some of the basic functions that will be added on the application are:

- Viewing maps and toggle for different floor
- Searching lecturer base on querying the name
- Directly call or send email to the lecturer
- Flash video showing direction to the desired location
- Voice narrative for direction

After several revisions and testing, these are the final user interface design that will be used in the application:

User Interface Design

Figure 9.1

Figure 9.2

Figure 9.3

Figure 9.4

12

13

Figure 9.5

14

15

16

Figure 9.6

17

18

Figure 9.4

Figure 9.5

Figure 9.6

Legend:

Figure 9.1: Main menu screen

Figure 9.2: Block 22 & 23 screen

Figure 9.3: Search screen

Figure 9.4: Lecturer information screen

Figure 9.5: Lecturer location screen

Figure 9.6: UTP maps

1: Link to figure 9.2

2: Link to figure 9.2

3: Link to figure 9.3

4,12: Link to figure 9.5

5: Link to figure 9.6

6: Unassigned

7: Maps display

8: Toggle between floor

9: Input lecturer name

10: Search button

11: List of search result

13: Lecturer information

14: Details lecturer information

15: Display direction animation button

16: Turn to turn direction details

17: Toggle between point of interest

18: UTP maps using Google Maps

Stage 3: Programming

In this stage, programming and coding will be conducted including designing the UI and programming the desired function. The programming will be done using my personal computer with Eclipse as a main IDE.

Figure 10 below shown the main layout of Eclipse software which will be use during the whole programming process.
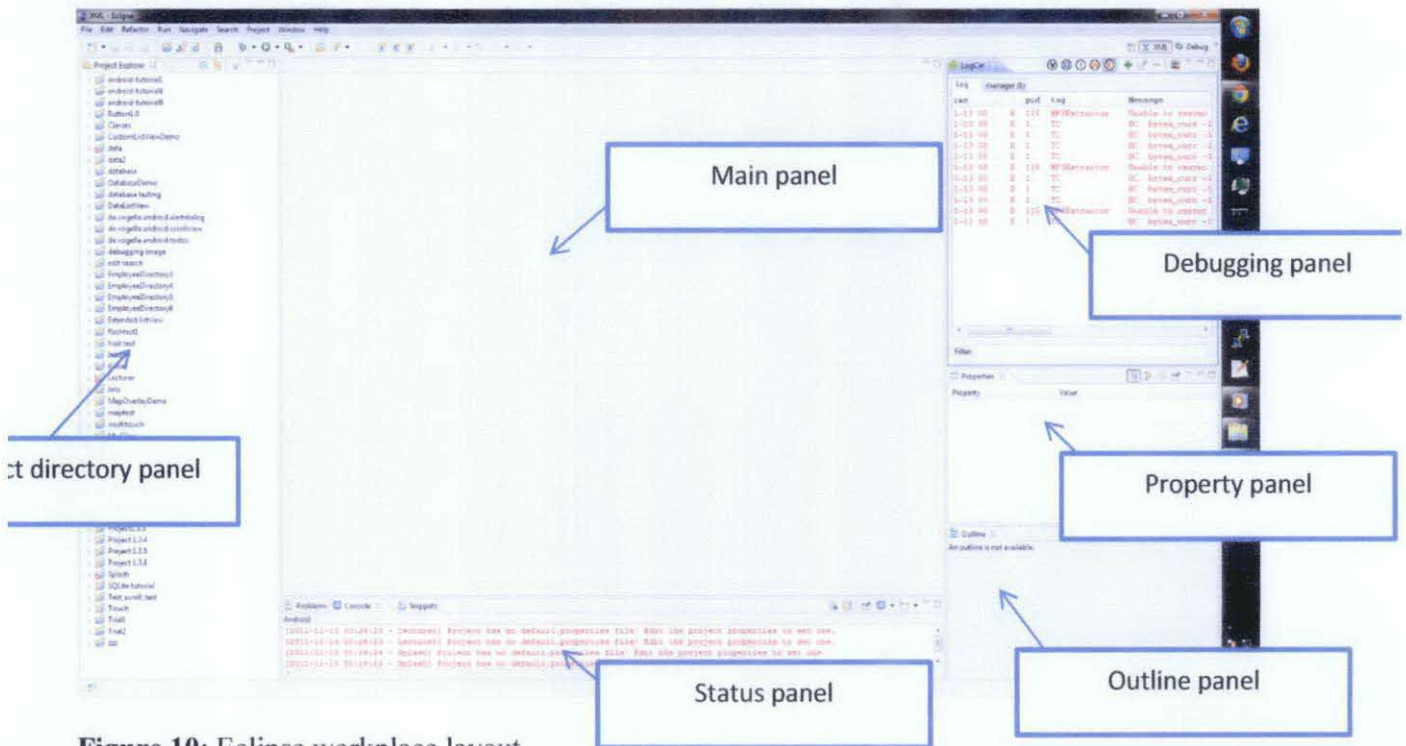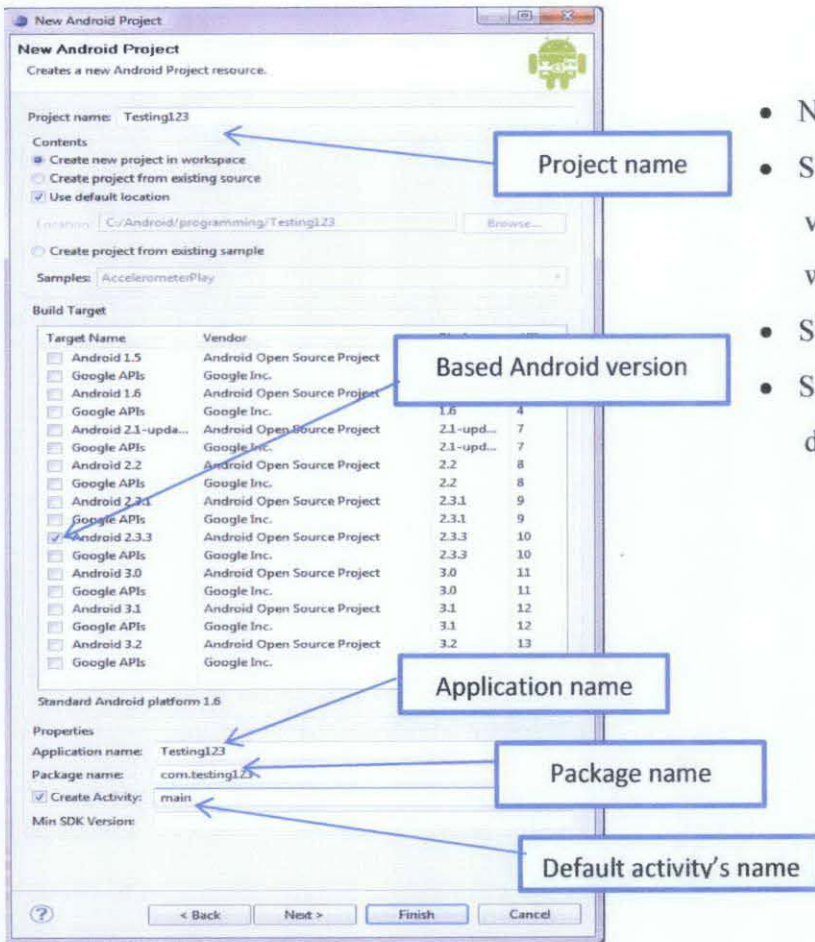

Figure 10: Eclipse workplace layout

Below is the procedure to create new Android project in Eclipse:

Figure 11: New project wizard windows.

- Select Android Project and proceed

New Android Project
Creates a new Android Project resource.

Project name: Testing123

Contents
- Create new project in workspace
- Create project from existing source
- Use default location

Location: C:/Android/programming/Testing123   Browse...

- Create project from existing sample

Samples: AccelerometerPlay

Build Target

Target Name	Vendor	Platform	API
Android 1.5	Android Open Source Project		
Google APIs	Google Inc.		
Android 1.6	Android Open Source Project		
Google APIs	Google Inc.	1.6	4
Android 2.1-upda...	Android Open Source Project	2.1-upd...	7
Google APIs	Google Inc.	2.1-upd...	7
Android 2.2	Android Open Source Project	2.2	8
Google APIs	Google Inc.	2.2	8
Android 2.3.1	Android Open Source Project	2.3.1	9
Google APIs	Google Inc.	2.3.1	9
Android 2.3.3	Android Open Source Project	2.3.3	10
Google APIs	Google Inc.	2.3.3	10
Android 3.0	Android Open Source Project	3.0	11
Google APIs	Google Inc.	3.0	11
Android 3.1	Android Open Source Project	3.1	12
Google APIs	Google Inc.	3.1	12
Android 3.2	Android Open Source Project	3.2	13
Google APIs	Google Inc.		

Standard Android platform 1.6

Properties
Application name: Testing123
Package name: com.testing123
Create Activity: main
Min SDK Version:

< Back   Next >   Finish   Cancel

Labels: Project name, Based Android version, Application name, Package name, Default activity's name

- Name the project
- Select maximum Android version that will be compatible with the project
- Set the application name
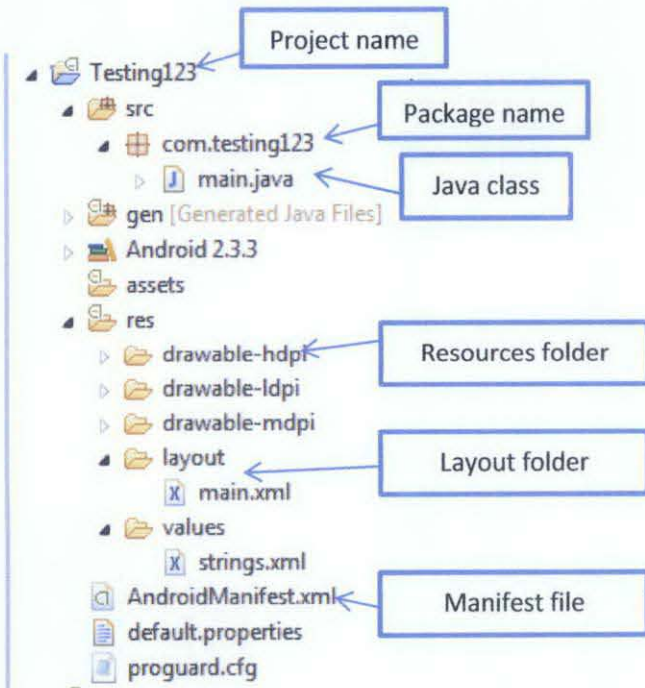- Set the package name and default java class name

Figure 12: Project information

Testing123 — Project name
  src
    com.testing123 — Package name
      main.java — Java class
  gen [Generated Java Files]
  Android 2.3.3
  assets
  res
    drawable-hdpi — Resources folder
    drawable-ldpi
    drawable-mdpi
    layout — Layout folder
      main.xml
    values
      strings.xml
  AndroidManifest.xml — Manifest file
  default.properties
  proguard.cfg

Figure 13: Project directory

15

```
 J main.java  X    d main.xml

 1  package com.testing123;
 2
 3⊕ import android.app.Activity;☐
 5
 6  public class main extends Activity {
 7      /** Called when the activity is first created. */
 8⊖     @Override
▲9      public void onCreate(Bundle savedInstanceState) {
10          super.onCreate(savedInstanceState);
11          setContentView(R.layout.main);
12      }
13  }
```

- Set main.java class as an activity by adding extends identifier
- Create subclass onCreate() to set the default condition on the start of the activity [6]
- Using setContentView to assign main.xml to load as the layout on the start of the activity.
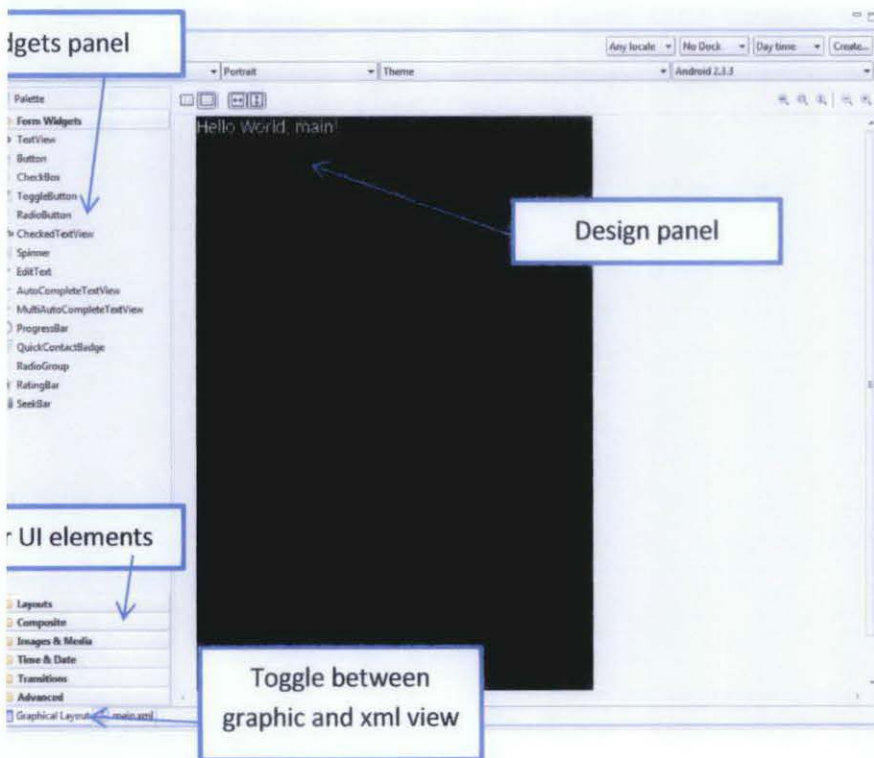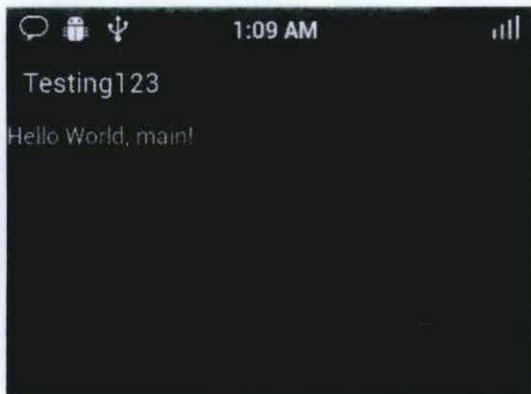
Figure 14: main.java class

Figure 15: main.xml graphical layout

16

```
J main.java    d main.xml  ⊠

1  <?xml version="1.0" encoding="utf-8"?>
2  <LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
3      android:orientation="vertical"
4      android:layout_width="fill_parent"
5      android:layout_height="fill_parent"
6      >
7  <TextView
8      android:layout_width="fill_parent"
9      android:layout_height="wrap_content"
10     android:text="@string/hello"
11     />
12 </LinearLayout>
13
```

Figure 16: main.xml

● After compiling and run the project, the activity
will start by displaying the main.xml layout.

Figure 17: Output display

Stage 4: Testing and survey

The last stage is testing the application in different devices and collects opinion from users to improve the application. This procedure will conduct in two phase, the first phase is after the completion of the beta version and to be tested by my course mate which already been done last semester. The testing was done with different Android smartphone that have different screen resolution. The second phase of the testing will be conducted during the pre-edx presentation which will give larger group of participant to test the application.

3.2 KEY MILESTONE

All of the features and function that has been defined was programmed in the application and it's already completed most of the objective of this project. These are the main key milestone in this project timeline:

- Understanding basic Android programming (week 3 FYP1)
- First design layout with button and intent function (week 4 FYP1)
- Completed lecturer database and first map design (week 5 FYP1)
- First working prototype that includes pinch to zoom for map images, lecturer information search query, voice call and email to selected lecturer. (week 7 FYP1)
- Added UTP map based on Google Maps API (week 9 FYP1)
- Redesign the application layout to more user friendly interface (week 14 FYP1)
- Added flash player function to the application (week 3 FYP2)
- Complete the get direction function (week 5 FYP2)
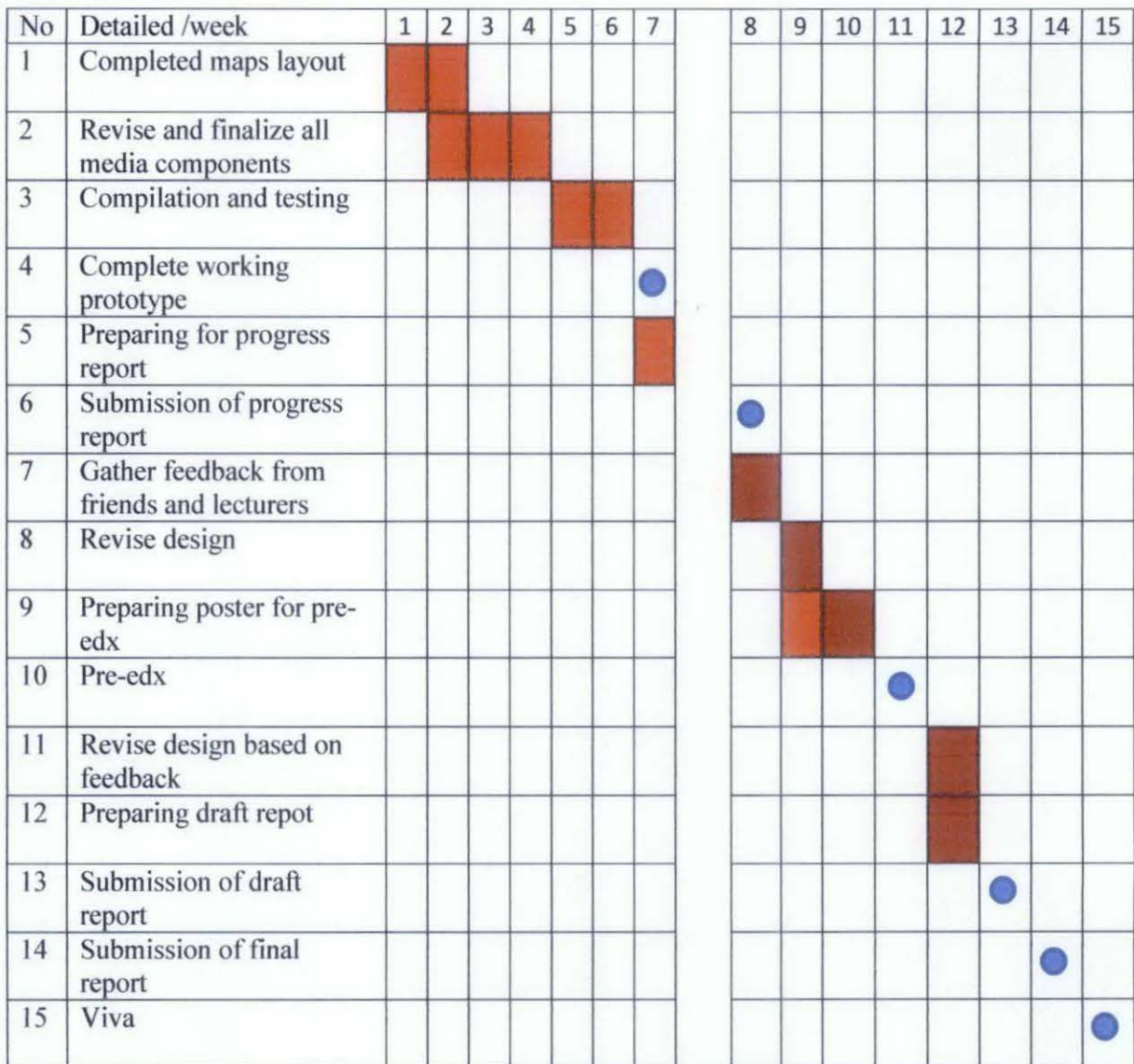- Added route navigation with direction icon (week 7 FYP2)

3.3 GANTT CHART

No	Detailed /week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Completed maps layout	■	■													
2	Revise and finalize all media components		■	■	■											
3	Compilation and testing					■	■									
4	Complete working prototype							●								
5	Preparing for progress report							■								
6	Submission of progress report								●							
7	Gather feedback from friends and lecturers								■							
8	Revise design									■						
9	Preparing poster for pre-edx									■	■					
10	Pre-edx											●				
11	Revise design based on feedback												■			
12	Preparing draft repot												■			
13	Submission of draft report													●		
14	Submission of final report														●	
15	Viva															●

Figure 18: Gantt chart

3.4 TOOLS

- Eclipse IDE for Java Developers
- Android SDK (version 1.5 to 2.3.3)
- Android Development Tool plugin for Eclipse
- Java Development Tool plugin for Eclipse
- Android debugging bridge utilities for testing with real device
- Microsoft Visio
- Android device (version 1.5 and above)

CHAPTER4: RESULT AND DISCUSSION

4.1 INTRODUCTION

In this part, we are going to discuss into details on the design and functions of the application. As stated in the objective, the application should be able to:

- Display map of each floor of Block 22 and 23
- Store information on lecturer
- End to end direction guide

Here the flowchart of the process:
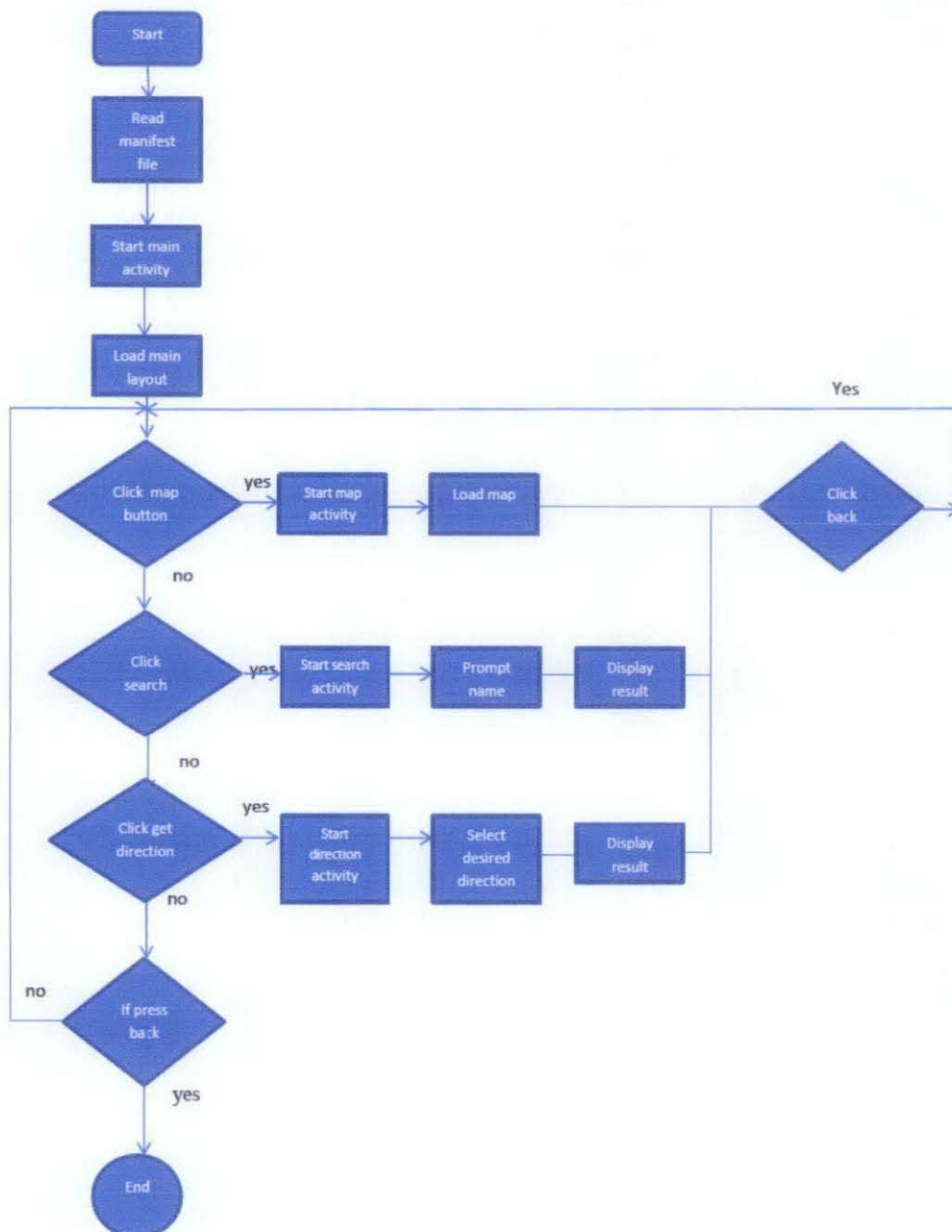
4.2 DESIGN DESCRIPTION

4.2.1 Start screen

The first screen that user will encounter once they start the application is the start screen as shown in figure 19. In this activity user will be given options to proceed to the main menu where all the main functions are located, or go through the tutorial session where user can get quick overview on how to navigate in the application. There are also help desk button and about button that will show related information about UTP and credits to the author respectively.
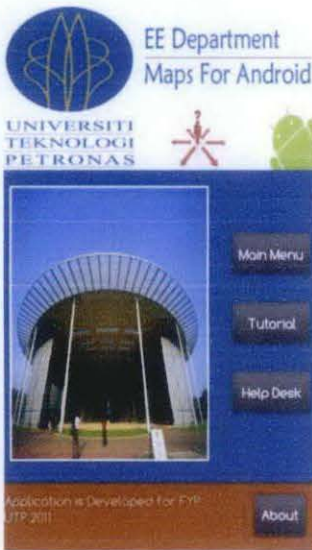
Figure 19: Home screen display
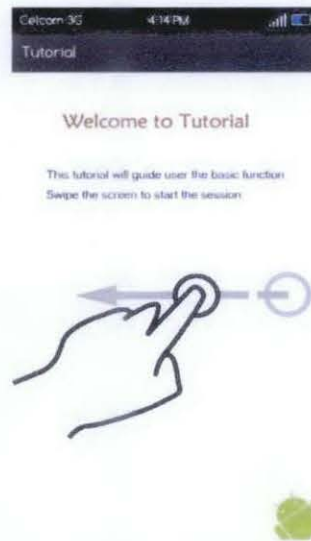
Figure 20: Tutorial Screen

Figure 21: Help Desk

Figure 22: About

21
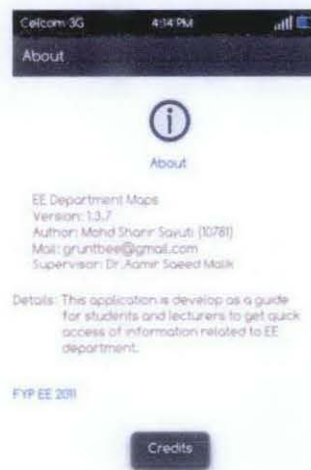
4.2.2 Main menu

Once the user click on the main menu button, the main menu activity will start and the layout will be loaded. In this screen, user will be presented with five icons which is EE maps, UTP maps, Search lecturer, Get direction and Search Lab. Each of these icons will redirect user to their respective activity. As shown below in figure 23, the design was made to be minimalistic to avoid confusion to the users.
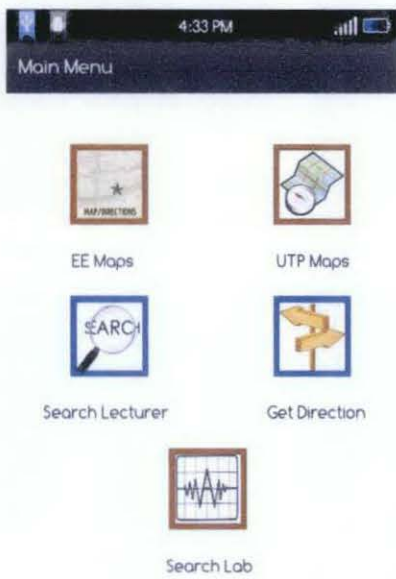

Figure 23: Main menu screen

4.2.3 EE Maps

As stated in the objective of the project, the application should be able to display maps layout of EE department which consist of Block 22 and Block 23. Once the users click on the EE maps icon, new layout as shown in figure 24 will load that allow users to select either to view maps of Block 22 or 23.

After choosing the building that they want to view, the map will load to a ground floor as the default floor. Figure 24 describe that users can change the floor by clicking the menu button on their phone. The size of the map can also be change by using pinch to zoom gesture.
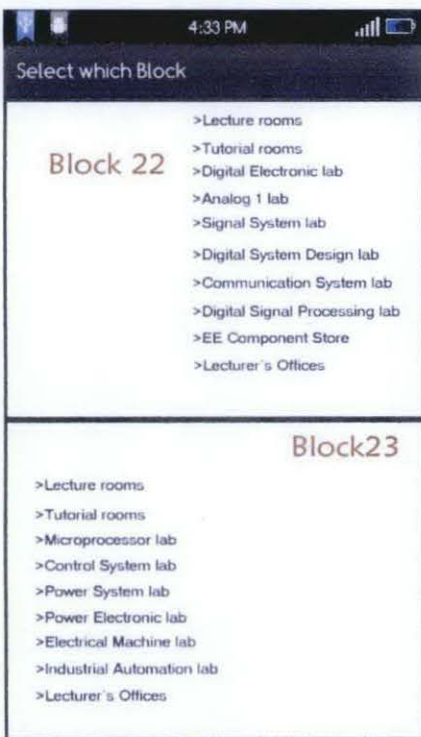
Figure 24: Maps selection screen
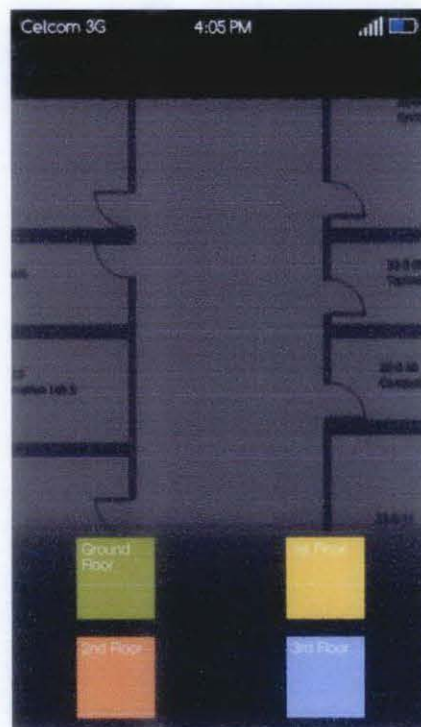
Figure 25: Maps for Block 22

4.2.4 Search Lecturer

Another function that was predefined in the objective is the ability to search for lecturer's information. In the search lecturer activity, users can search for lecturer information such as name, title, office phone number, email address, room number and also photo. By typing either lecturer's name or related field of studies, the list of relevant result will be displayed in the result panel as shown in figure 26.

Users also can get more info by clicking on the respective result. From the details page as shown in figure 27, users can directly call the lecturer or send an email by tapping their number and email address. User also can get the direction to the lecturer's office just by clicking on the get direction button.
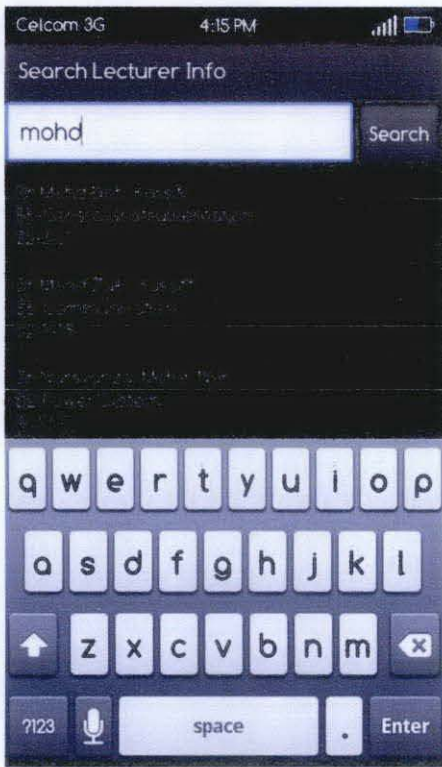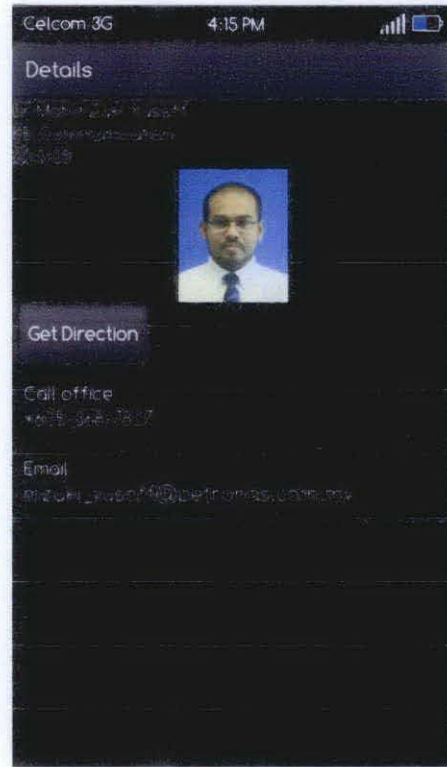

Figure 26: Search lecturer screen

Figure 27: Lecturer's details

4.2.5 Get Direction

The last function that should available in this application is the end to end direction guide to the selected location. From the main menu, users can click on the get direction icon to start the activity. Similar to EE maps activity, users can either get direction to Block 22 or 23 by click the respective panel.

Once in the correct block, users can scroll down from the list and select which lecturer they want to view as shown in figure 28. The direction details will provide office room number and the turn by turn direction the room from the ground floor. There is also flash animation that will help user to navigate to the location.

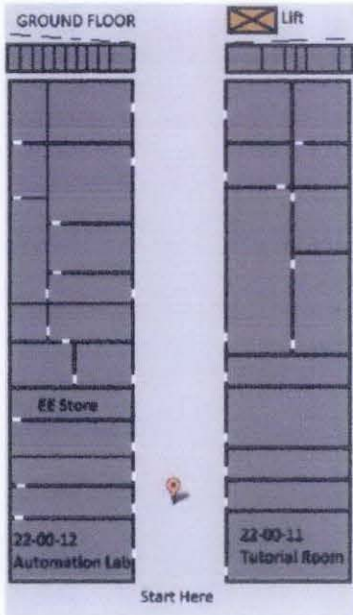This activity also can be access from the lecturer details in the search activity.

Figure 28: Lists of lecturer
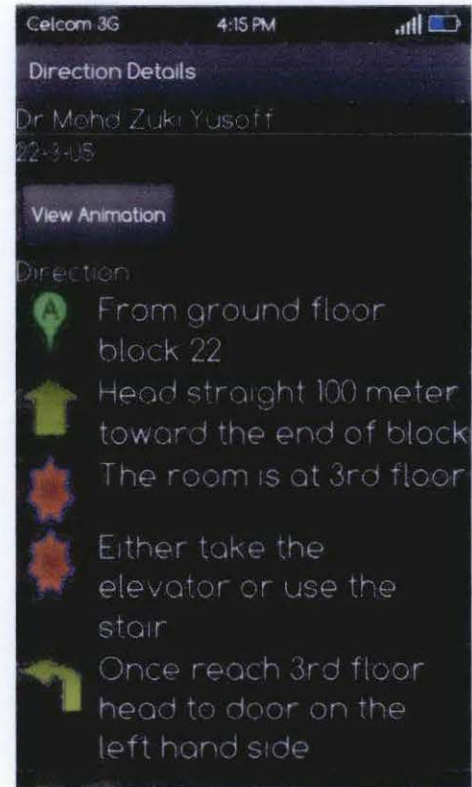
**Figure 29:** Direction details

Figure 30: Flash animation

4.2.6 Search Lab

Based on the initial survey result as shown in the literature review, most of student came late to class because of they cannot find the correct venue. This is due to lack of information in the maps provided by UTP. Therefore in this application, database of labs in EE department has been collected and compiled to help students locating their classroom correctly.

The search lab option is available in the main menu screen and once users click on that, the layout will be loaded as shown in figure 31. Here users can key in name of labs that they are looking for and the relevant search result will be displayed in the result panel. Users can click the result to view more details information about the lab.

Figure 31: Search lab screen
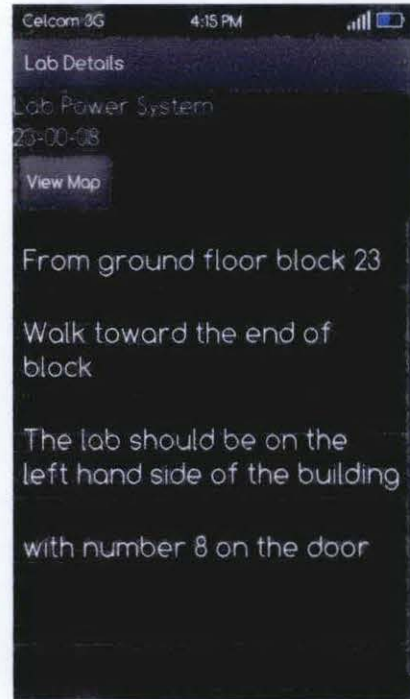
Figure 32: Lab details

4.2.7 UTP Maps

From the main menu, users also have the option to view UTP maps based on data from Google maps. Unfortunately this function required users to have internet connections. The function was intended for visitors that came to UTP so that they can view the location of EE department which is Block 22 and 23 and also others important location.

Figure 33: View of Block EE from

UTP maps

4.3 USERS SURVEY

During the Electrex exhibition I have the opportunity to present this project to my fellow EE student and lecturer. From this event, I have gather survey from 20 participants that has tested this application.
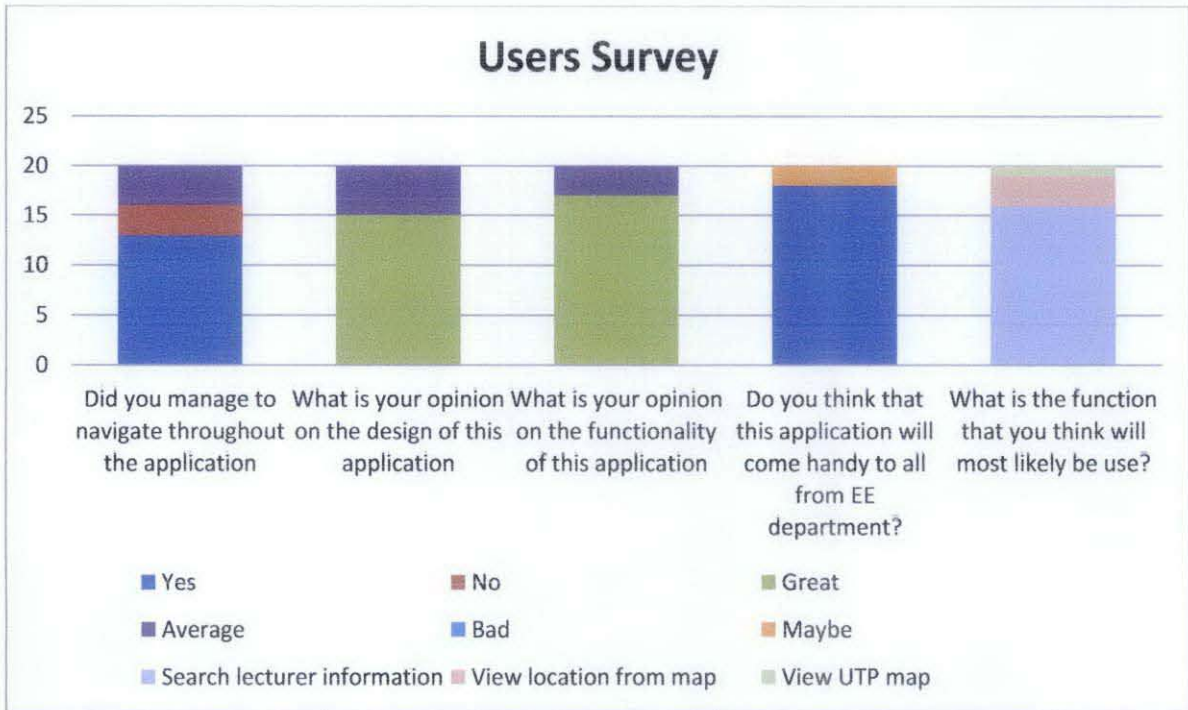
Figure 34: Survey result

From the data in figure 34, we can conclude that most of the users manage to navigate within the application. Although there are 7 people cannot play around in the application means that the interface is not user friendly. Majority of the users satisfied with the design and the functionality of the application. 90% of the participant also found that this application is practical to be used in real life situation. Lastly, the most used function in this application is the search lecturer information.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

The contribution of this project is to help users to get the relevant information related to EE department remotely without need to access to UTP website. This information is vital especially to new student that still lack of experience and knowledge about the lecturers and venue information in EE department.

The main objective of this project had been successfully achieved. Once this project has been finalize and reviewed by EE department community, it will be made available on the UTP website to be download and install to all student.

Some improvement can be made to make the application more interactive and user friendly such as to include elearning forum in the application and access to grades and financial statement. But these features will only be possible if there are internet connections in the academic block.

REFERENCES

[1] Stefan Br¨ahler, Analysis of the Android Architecture

[2] What is Android,
http://developer.android.com/guide/basics/what-is-android.html?

[3] Installing Android SDK by Android Developer,
http://developer.android.com/sdk/installing.html

[4] Tube Maps for Android, http://www.mxdata.co.uk/products/tube_map.aspx

[5] University of Alabama Application for Android, http://m.ua.edu/app/

[6] Tutorial on Hello World by Android Developer,
http://developer.android.com/resources/tutorials/hello-world.html

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

[8] Tutorial on Database by Christophe Coenraets,
http://coenraets.org/blog/android-samples/androidtutorial/

[9] Lars Vogel article 2011,http://www.vogella.de/articles/AndroidSQLite/article.html
Using the Android SQLite Database

[10] Stefan Br¨ahler, Analysis of the Android Architecture

[11] Xianhua Shu, Zhenjun Du, Rong Chen.
Research on Mobile Location Service Design Based On Android

[12] Google Code 2008,http://code.google.com/android/add-ons/google-
apis/reference/index.html   Google APIs add-on: Package com.google.android.maps

[13] Working with image in Android, http://www.higherpass.com/Android/Tutorials/Working-
With-Images-In-Android/