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Department of Electronic Engineering

FINAL YEAR PROJECT REPORT

Project Title

Virtual Campus Navigation of Android Smart Phone Application

Student Name: TseHiuYeung
Student ID:
Supervisor: Dr Ray Cheung
Assessor: Prof. Hong Yan

Bachelor of Engineering (Honours) in Computer Engineering
Student Final Year Project Declaration

I have read the student handbook and I understand the meaning of academic dishonesty, in particular plagiarism and collusion. I declare that the work submitted for the final year project does not involve academic dishonesty. I give permission for my final year project work to be electronically scanned and if found to involve academic dishonesty, I am aware of the consequences as stated in the Student Handbook.

Project Title: Virtual Campus Navigation of Android Smart Phone Application

____________________________
Student Name: TseHiuYeung

____________________________
Signature

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Date: 6/4/2011
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1. Project Introduction

1.1 Introduction of Year Project Title

The title of my Final Year Project is called the Virtual Campus Navigation of Android Smart Phone Application. Its purpose is to design a campus guiding application of the City University of Hong Kong in a portable device. The aim of design instantly navigates users to find the own way by a short period of time, no matter they are inside and outside campus.

To sum up, the purpose of this year project can be categorized by the following points:

i. Design a navigating application which can be used inside and outside the campus of City University of Hong Kong

ii. Study the background of Android OS and basic functions of Java language in Eclipse software

iii. Design the project algorithm and write a Java program to read user command, display the routes which guide to the destinations

iv. Locate the Wi-Fi hotspots and learn the Wi-Fi distribution pattern to design Augmented Reality with the help of camera display

v. Create a database of Wi-Fi information and eliminate the memory space of the project

Figure 1.1.1: The target Smart Phone of project
1.2 Title Explanation of my Development

Every one of us should have the experience of getting lost and missing way from an unfamiliar region and unknown place, let alone the enormous indoors. Unfortunately, some new outcomes are encountering the same situation when they enter our campus of City University, as it is always commented to be a super big mall or market. In order to make convenience for those visitors and freshmen, my application is to provide a simple platform for navigating locations prior to or subsequent to entering City University.

According to my first general idea of the project, the designing application should provide a typical location selection input with corresponding output. User can properly choose the entrance from our campus or particular location of different floor, and the most suitable way will be shown on display steps by steps with the use of panorama images (360 photo view) on each part of route. The main reason of designing in this aspect is to let user be prepared of the destination whether they are required to go in home or on the way before coming to our campus.

As a matter of fact, least of website, if not all, would not provide a good navigation to students and visitors on the Internet. More badly, visitors may not be able to get into the connection of Internet when they are moving on vehicles and the signal is shielded, although there are many hotspots of Wi-Fi and service of GPS provided in Hong Kong. It will make users be convenient when they have a first glimpse of the route by disconnecting the browser.

However, despite of the advantage provided by the designed application, visitors, or even freshmen, may have their possibility to lose after they get into a new place they have never met before, and the only navigation function has its own insufficiency which is required to guide a person in the area of campus.

In order to provide with a clearer view when they are getting lost in our campus, a Wi-Fi location function is required to show their proper location on the map of campus. GPS function will not be considered as
main function of navigation, since a precise distance changed cannot be detected, and, more importantly, the location may not be scanned under the environment of indoors. After my deep considerations of feasibility and reference from other navigation applications, this function is changed by using a camera to show a virtual reality when they are on-field.

When they are using the application by this on-scanning function, all the nearest facilities, lecture rooms and tutorial rooms can be scanned and located on the camera display. Information will be updated after user moved their orientation to look around and move forward to change distance between the mobile and hotspot of Wi-Fi. Visitor will only be required a rough scan by camera, he/she then will know the place where he/she is facing.

To summarize, my developed application will be a navigation tool which helps both students and non-students in City University by using this installed application in Android phone.
2. Background of Android Platform

2.1 Brief Explanation of Android

Android is a kernel based (Linux) open source platform which was firstly developed by Google and other companies, like Motorola and HTC, at the end of 2007. It is a free development platform to both manufacturer and developer in mobile phone market.

The design concept of Android platform, from now on, is to popularize the use of this operation system by manufacturers in market. It will not limit manufacturers which can be enabled to add particular functions or new components when they have own resources to do.

On the side of developer, Android SDK is an advanced operation system as it is capable of all mobile devices which runs Android platform, and it supports all networks, graphics, drawings and 3D development. Developers can share or sell their designed application around the world through the Android Market which was provided by Google.

On the side of user, the application designed by Android SDK is friendly used on Android Market, and the downloaded applications can be shared to different models of mobiles when they have registered one’s account on Google.

Nowadays, the major usage of mobile operation platform is Android in European markets. The demand of customers still arises, and more companies would like to use Android OS platform to be the main system of mobile device.

Indeed, the development of Android will soon be as popular as other software programming in coming future.
2.2 History of Android Development

On 5th, November, 2008, the Open Handset Alliance (OHA), a consortium of 33 companies which include Texas Instruments, Broadcom Corporation, Google, HTC, Intel, LG, Motorola, Samsung Electronics were unveiled the first product, called Android, with the goal to develop open standardsof Android OS Platform for mobile devices.

A week later, Google unveiled the Software Development Kit (SDK) could be downloaded and used in Windows, Mac OS X and Linux system, so that everyone will have a chance to change and design their desired application in mobile.

The Android operating system software stack includes Java applications running on a Java based object oriented application framework. The Android operating system consists of 12 million lines of code including 3 million lines of XML, 2.8 million lines of C, 2.1 million lines of Java, and 1.75 million lines of C++.

On 24th, September, 2008, the first Android Smart Phone G1 has been released by T-Mobile, and Android SDK version 1.0 has been also released on the same day. It reveals that the developers can firstly have a target device to place the designed applications.

On 9th, December, 2008, OHA was announced that 14 new members would be joining the Android Project, including PacketVideo, ARM Holdings, Atheros Communications, Asustek Computer Inc, Garmin Ltd, Softbank, Sony Ericsson etc.

The development of portable device using Android platform excluding mobiles has been started in February, 2009. A group of more than 25 companies, called Open Embedded Software Foundation (OESF), started to build a new Android platform which could be used in variable types of device in Japan, which includes the works of VoIP, network security, survey and control, system kernel, application and service, sales and
education etc. Later, all the developed application in OESF will also be release in OHA at the same time.

The following picture shows all the types of organization included in OHA:

![Organization Diagram]

Figure 2.2.1: The organization of Open Handset Alliance

On 27th April, 2009, Google released the Android SDK version 1.5 and Android Development Kit (ADT 0.9), which supported multiple languages, new soft-keyboard and input methods.

From the time to the release of new version of Android SDK, HTC, Sony Ericsson and Motorola started to build and announce their new User Interface like Moto Blur UI, Rachael UI, etc. In June, 2009, Android has been released the first version of Android Native Development Kit (NDK 1.5) which provides developers to achieve a high computation work by using C language and converted to the application of Android SDK. However, it cannot be used alone by developing application.

On 28th October, 2009, Google released the Android SDK version 2.0 and Android Development Kit (ADT 0.9.4) by supporting Bluetooth, Multi-Touch and virtual button functions to provide a better interaction. Other functions included Exchange, Account Management, Synchronization Tools, Brower Support, and better revolution gives developers more flexibility to design their application.
Few days later, Google released their Google Navigation on Android 2.0. It utilized Google map and sound recognizing functions to have navigation by using mobiles, like the Motorola Droid which using WVGA technology.

The following figures give a brief summary of history on the development of Android Operation system within these two years.

**Android 1.5: Cup Cake**

- Released Date: 2009/4/27
- Main Function Updates: Support Bluetooth, text prediction of software keyboard, animation screen supported

**Android 1.6: Donut**

- Released Date: 2009/9/16
- Main Function Updates: Integration of camera, camcorder and gallery interface, supported voice search, WVGA screen, and the technology of CDMA/VPNs
Android 2.1: Éclair
Released Date: 2010/1/20
Main Function Updates: Multi-touch support, optimized speed of hardware, support several screen size and resolutions

Android 2.2: Froyo
Released Date: 2010/5/20
Main Function Updates: Adobe flash support, 3G hotspots function support, apps supported in SD card

Android 2.3: Ginger Bread
Released Date: 2010/12/6
Main Function Updates: Updated design of user interface, Audio, graphical and input enhancement.
From now on, the new version of Android SDK keeps updating continuously, and supporting functions of the advanced technology and improving components implemented in the Android Smart Phone.

Here is the summary of the release date of all versions:

<table>
<thead>
<tr>
<th>Android SDK Version</th>
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<tr>
<td>Android SDK 2.3</td>
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</tr>
<tr>
<td>Android SDK 2.2.1</td>
<td>2010/5/20</td>
</tr>
<tr>
<td>Android SDK 2.1.1</td>
<td>2010/1/20</td>
</tr>
<tr>
<td>Android SDK 2.0.1</td>
<td>2009/12/04</td>
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<tr>
<td>Android SDK 2.0</td>
<td>2009/10/28</td>
</tr>
<tr>
<td>Android SDK 1.6</td>
<td>2009/9/16</td>
</tr>
<tr>
<td>Android SDK 1.5</td>
<td>2009/4/27</td>
</tr>
<tr>
<td>Android SDK 1.1</td>
<td>2009/2/10</td>
</tr>
<tr>
<td>Android SDK 1.0</td>
<td>2008/9/23</td>
</tr>
</tbody>
</table>

Table 2.2.3: Summary of Android SDK releasing date
2.3 System requirement of Android ADT and SDK Tools

Prior to build up the new project, we need to first getting familiar with the requirements and installation procedures of all Android SDK files.

Android SDK Tools support the following operation systems:
- Window XP, Vista or Widow 7
- Mac OS X 10.4.8 or later version (Only suitable for x86 Intel Mac)
- Linux (Linux includes several components like Fedora, Debian, OpenSUSE, and the official file is Ubuntu)

We are required to install the software suitable for the environment of Android Development. The following materials are free of charge from the Internet:

i. JDK 5 or JDK 6
   All platforms of JDK can be downloaded from “http://java.sun.com”

   Under Window’s environment, we need to install the Java Development Kit. Installing JRE is not sufficient to provide the developing environment. Instead, JDK should be required. You can check the version of Java software by typing “java-version” in cmd.

   If developers would like to develop applications on MAC system, JDK is already pre-installed on MAC OS.

   The user of Linux platform should be aware of the poor compatibility between Android and Java Gnu Convertor (GCJ). Suggested that using official documents of JDK.

ii. Eclipse IDE

   We should install Galileo version 3.5 or Eclipse version 3.4 to be the development platform. It should be reminded that the files should include Java Development Tool Plugin. All Eclipse IDE installing packages are already included JDK. If users do not get familiar with the Eclipse platform, they are suggested choosing the “for Java Developer” version to install. It should be reminded that Android ADT is based on the Eclipse developing environment.
while Android SDK is Software Development Kit includes the Android Virtual Device.

iii. Other Development Tools

On Linux and Mac system environment, if users require the automate conversion. They can install the Apache Ant 1.6.5 or later version. Apache Ant 1.7 is required on the Window environment. NetBeans and IDEA software also have their own Android development tools.

Supposing that developers have been installed the JDK 5 and JDK 6, the installation procedures has been separated into several steps:
1. Download Eclipse
2. Installation of Eclipse
3. Installation of Android ADT
4. Installation Android SDK
5. Setting of Android ADK

1. Download Eclipse
Firstly, we are required to install the Eclipse software to integrate Android Development application. From now on, we can only use the supported Java language to write Android application, so we must install the Java Development Kit before developing application. After the installation of JDK, we can go to the website http://www.eclipse.org/downloads/ download Eclipse to integrate the environment. We are required to choose “Eclipse IDE for Java Developers” or “Eclipse IDE for Java EE Developers” in these two versions, as these versions will only pre-install Eclipse JDK.
2. Installation of Eclipse

Eclipse IDE can be run without installation of documents. We only required confirming the installation of JDK, and unzipping the files to the suitable directory.

After that, we can run the Eclipse software by clicking the Eclipse icon in the unzipped file. If developer starts the Eclipse in first time, there will be a dialog requesting the working place directory.

3. Installation of Android ADT

After running the Eclipse software, we need to install the Android Development Tools (ADT), which is a plug-in for the Eclipse IDE that
is designed to provide a powerful, integrated environment in which to build Android applications.

First of all, we should select Help>Install New Software. It will come out a new dialog afterwards.

In the Input box with “Work With” field, enter the web link http://dl-ssl.google.com/android/eclipse/site.xml and press the “Add” button. The “Add Site” dialog will come out. Add the web link in the input box with “Location:” field and add “ADT” in the input box with “Name” field. Subsequent to the addition of web link, choose the “Developer Tools”, and press the “Next” button. Press the “Finish” button after the next dialog, and Eclipse will start to install the ADT components.

4. Installation of Android SDK
   We are required to the Android Software Development Kit from the Android official web site http://developer.android.com/sdk/index.html. After that, unzip the download files and put them into a document in which we can call it “android_sdk”.

5. Setting of Android ADK
   Click the “Preference” on the list item, the Eclipse will open a dialog. We should choose the Android item from the left hand side. Press the “Browse” button with the “SDK Location” field. The entire process will be finished by putting the directory of unzip files “android_sdk” in the input dialog.

After all the installation process has been done, we can create our project files for the development of application.
2.4 Create Project Files

After the installation of Android ADT and Android SDK components, we can have a complete environment for developing application. We could start a new project by selecting “File> New> Project”, a “New Project” dialog will then come out.

Eclipse is a common environment of editing codes, and it can support various types of files by installing the suitable development tools. We can see the “Android” folder by the correct installation of ADT documents, and appear a “New Project Dialog” after selecting the Android Project under the Android folder. The following picture will show the result:

Figure 2.4.1: The window dialog of New Project
In the “New Android Project” dialog, we can choose either creating new project files or opening the files existing in the work place. The setting will be different in these two purposes.

If we are required to open a new project file, we can either set the folder directory for the data of the project or just use the workplace folder pre-set in Eclipse.

However, we have to choose the file property including Project and Package Name, and select the suitable target device to run the project files.

If we are required to open an existing project file that has been changed before, we can only choose the target device to open the project file. The following are the setting of “New Android Project” dialog:

![New Android Project dialog](image)

**Figure 2.4.2: Setting properties of a new project**
3. Introduction of Navigation Apps in Mobile Market

3.1 Introduction of Navigation Application

Navigation is defined as controlling or monitoring the movement of objects from one place to another. It always gives a signal to person who gets lost in an unknown area when he or she is using website or mobile navigation applications. Thanks to the advanced network technology, most of users guarantee navigation application could be used at any time.

Generally, all navigation apps could be separated into two main operation systems, which are in Apple iOS and Android OS.

Apple iOS is Apple’s mobile operation system, which does not license in third party hardware, while the Android OS is a free mobile operation system collaborated by Open Handset Alliance, including Google, HTC, Motorola, Intel, and other companies.

3.2 Navigation Application Characteristics

In the design of Navigation Apps, there are several methods to create guiding platforms, which consist of different navigation features.

First of all, applications must be designed with the use of assisted GPS signals. Since GPS is a massive positioning system which covers most places in planet, the system must be implemented in large public area of foreign countries. More important, the application must use network resources as helping tool.

Owing to the maturity of 3G networks in mobile, almost none of applications never require or share resources between Internet networks. Other than this, navigation application has been developed in different representing formats, not just merely shows routes on map.
Developers tried to design such kinds of applications with the use of hardware resources on mobiles, like the electronic compass and gravity sensors, in order to locate users’ position accurately. Moreover, applications are always integrated by 3D computer graphics to achieve a better solution.

To sum up, the features of all navigation application in mobile software market can be grouped by the following points:

1. Designed with assisted GPS to integrate positioning system function.
2. Allocate and share network resources on Internet.
3. Presenting in different platforms with the use of hardware device.
4. Integrated by 3-Dimensional computer graphics.
3.3 Overview Examples of Navigation Apps

One of the most famous navigation applications is the product of Google. The Google Map Navigation Apps not only gives the GPS features to people, it provides the information of traffic, latitude, street views, walking directions, as well as driving and transit directions. Google has built up a large information database on Internet, which shares to users for the sake of providing convenience and saving application memory.

![Google Map Navigation Application](image)

Figure 3.3.1: Example function of Google Map Navigation Application

Other than the traditional road navigation function, there is new trend to the development of one navigation technology, which is called Augmented Reality. Augmented Reality (A.R.) is a combination of live view in physical environment and graphic elements generated by computers, which modifies the view of reality. It is a variation of Virtual Environments, and the technology evolutes from Virtual Reality.

A.R. system is supplement of reality view, instead of covering the real world. Developers designed to use the camera focus in mobile, and display the direction of nearby objects in the real situation.

This technology has firstly been introduced in Android Application called Layar. It combines Android’s camera, GPS, and compass features for
displaying real-time info of the establishments. All objects could be seen around us, and it provides a feeling in which user is been located by the system.

Figure 3.3.2: Application of Augmented Reality in Android Phone

In Hong Kong, several navigation apps also implemented this technology to have navigation. One example is the navigation function of MTR mobile applications.

Figure 3.3.3: Navigation function of MTR mobile application
4.1 Definition of Augmented Reality

Augmented Reality (A.R.) is a combination of live view in physical environment and graphic elements generated by computers, which modifies the view of reality. It is a variation of Virtual Environments, and the technology evolves from Virtual Reality.

The concept of Virtual Reality was appeared since ten years ago, and the term has been coined in 1990 by Thomas Caudell[18], an employee of Boeing at the time. In the case of Virtual Environment technology, it provides a virtual world system according to the virtual computer-generated sensory input such as sound or graphics. It completely immerses user in an enclosure environment, so that they cannot actually see the real situation surrounding them when using the system.

![Figure 4.1.1: Application of VR system and 3-D computer graphics](image)

However, owing to the limitation of the advanced technology, it can merely be achieved by wearing the Head-Mounted Displays (HMDs), 3-D mouse or gloves sensor devices, which makes the high cost of system and inconvenience of using.
Augmented Reality technology is the evolution of VR technology system, which shows the similarity between these two systems. It is the supplement of reality view, instead of covering the real world. User can see the objects in the physical environment by using AR equipment like monitor-based interfaces, monocular systems and see-through HMDs.

Thanks to the Smart Phone development in iOS and Android, A.R. technology application becomes renowned. The virtual image could be projected on the screen of Smart Phone in the real life according to the camera display, which makes the coexistence between the real and virtual world.

![Figure 4.1.2: The application of Augmented Reality in Android Phone](image)

A.R. technology was firstly used in Android application called Layar. It combines Android’s camera, GPS, and compass features for displaying real-time info of the establishments, so that all objects can be seen around us.

In general, there are several definitions of Augmented Reality. Since the A.R. technology was defined to the use of Head-Mounted Displays by researchers, so the definition is redefined by Ronald Azuma to avoid limitation of HMDs in 1997.[16]
The survey redefines the Augmented Reality as the following three characteristics:
- Combines real and virtual
- It is interactive in real time
- It is registered in 3-D

Indeed, there are several classes of applications which have been already explored in recent years, such as medical visualization, maintenance and repair, annotation, robot path planning, entertainment, and military aircraft navigation and targeting. It proves the popularization of Augment Reality.
4.2 Application of Augment Reality technology

The technology has been used in the recent ten years, and the application is still increasing. The following describes the area of potential A.R. technology.

4.2.1 Military Aircraft Navigation

After the invention of military jet crafts and helicopters, A.R. technology has been used for a long time in Head-Up Displays (HUDs) and Helmet-Mounted Sights (HMS) for the sake of echoing the targeting and providing basic navigation on the displays. Other than navigation, it can also accurately aim the weapons to destroy the target.

![Figure 4.2.1.1: The application of aiming aircraft weapons][23]

As the figure shows, the pilot tried to aim the target by using the technology applied on the MUDs, so that the graphics are sometimes registered with targets in the environment.
4.2.2 Medical Visualization

Augmented Reality technology could be used in the task of medical visualization and training purpose. It develops several functions which help surgeon to detect some characteristics or features could be seen by their naked eyes. For instance, it helps to develop a virtual image of fetus on a pregnant woman, with the use of scanning data by ultrasound sensor. Surgeon could see the image display on the see-through Helmet-Mounted Display (HMD). The technology could also have a virtual visualization in a breast operation, which identifies the location of an inside object and the steps of handling the target.

Figure 4.2.2.1: Visualization of virtual fetus set up on pregnant woman

Figure 4.2.2.2: Mockup on a breast surgery
4.2.3 Maintenance and Repair Objects

In maintenance, repair and assembly the operation or complexity machinery stage, A.R. technology could also help workers to do maintenance work. It will be more convenient to understand rather than read the guidelines on the paper. It superimposes a 3D object on the actual equipment and show steps by steps. The following figure shows the example of repairing printer.

Figure 4.2.2.3: Example of repairing painter
5. Principle of Project Design

5.1 Target Device of Project
Since my designing application is dealing with the upper layer system in the Android phone, and different components, existing in different models of mobile phones, may have various sorts of criteria settings to control applications in upper layer, the application may not be apply on other Android phones or Android devices when the project is first finished. So, my designing application will made a target device to run in the first step, and the model of target device is called Motorola Milestone.

![Motorola Milestone](image)

Figure 5.1.1: The appearance of Motorola Milestone

5.2 Structure of Project Design
The project is mainly constructed by two different parts, which are called on field and off field modules. All the logics and user interface will be run by the Java software called Eclipse, accompanying with Android SDK tools.
In the first layout of project, it will show the topic of this application with a background picture of City University of Hong Kong. It will be likely in this manner:

![City University of Hong Kong](image)

After showing the picture, it will automatically load into another user interface will six different functions, which are called Navigation, Introduction, Wi-Fi guiding, Setting, Map Preview, and Exit functions. The layout will be designed after the two main functions have been finished.

5.2.1 User Interface Introduction

CampusVR is a virtual navigation reality in campus of City University. The application includes two main functions with six different buttons. The following shows the first layout of the user interface:

![User Interface on simulator and Android Smart Phone](image)

Figure 5.2.1.1: User Interface on simulator and Android Smart Phone
Different image button will have one special function:

1. Navigation Function: It creates a simple navigation platform by providing some texts and map images to guild user in any time when calling the apps

2. Wi-Fi positioning function: It scans the available Wi-Fi signals in campus, calculate the visitor’s coordinate and show the nearby objects on camera.

3. Setting: It sets the properties of apps like ask visitor to read tutorial parts every time when calling the apps

4. Tutorial: It provides tutorial sessions in text format, which shows the guideline of using each application function
5. **Map**: It shows the view plan of each floor map, and provides panorama view of certain entries in different floor of campus

6. **About**: It reveals the information of the CampusVR, including the developer and cooperate organization

5.2.2 **First Offline Function of Navigation Function**

In Off Field module (called Navigation in application menu), it will provide several inputs to assign the starting location of user. Then they will select their appropriate location as the destination. After all inputs has been set, the computer will generate the fastest route and show it with helps of texts and maps. The following reference shows the similar functions which is provided by our Career and Development Office in City University of Hong Kong [7]:


When visitor use this function, it requires the input of user’s destination and his or her current location. Visitor needs to choose the location provided by the system. If user do not know the floor of location or destination, he could tap “All” command to show all entries provided by system.
After the input has been confirmed, it will show an intermediate path between visitor’s location and destination in text formats. The upper photo shows the real environment of destination, while the below text will guide user to the place.
User could also view the routes on map if he or she still does not understand the words.
5.2.3 Second Offline Function of Map Function

In Second Offline function, it will include a particular function to view our campus by 360 degrees by using panoramic images. Here is the example of a panoramic image:

![Panorama View example in Map View function](image)

In the original idea, I would like to view the panoramic image by adapting Adobe Flash software in the phone, so that an entire 720 degree of a target location can be shown on the screen but not only a 360 degree view.

Typically, a lot of 720 panoramic images can be browsed on the Internet, and those websites usually require the browser to install Quick-time player or Adobe Flash as a helping tool. Unfortunately, there is no application to view objects by using Quick-time under Android OS system, and the following website is the reference of viewing a 720 panoramic image.[8]

http://for360view.webs.com/

I have done a lot of researches about viewing the .fla files under the Android platform, but most of developers have not done these kinds of works, and it seems that we need to modify or change the source code of the Android OS system. This will violate the project concept, and it is difficult to get the job done by a student, so I only can give up this concept and replacing by this route.

The method to generate a 360 view photo is to use the software called Microsoft ICE, which is developed on July, 2010.
This will be easier by producing a jpg file and loaded into the Android phone, and the result showed on the screen is fairly good.

In this function, visitor could choose a 2D plan view or panorama view provided by the database system. The system will provide several fixed entry points in panorama view function. The following figures show the example of one panorama view:

![Microsoft Image Composite Editor](image1.png)

![Figure 5.2.3.2:Microsoft Image Composite Editor](image2.png)

![Panorama View of Map Function](image3.png)

Figure 5.2.3.3 Panorama View of Map Function
Figure 5.2.3.4 Panorama View of Map Function
5.2.4 Second Offline Function of Map Function

In Online Module (called Wi-Fi guiding in application menu), it will be the larger part which requires more calculation and logic functions than the first one. The module is separated into two design flows, which are called Wi-Fi Test and Camera with E-Compass.

The Wireless network of City University is established by the infrastructure mode, which gives hundreds of Access Points connected by the wired network. Each Access Point owned by a unique Media Access Control address (MAC address) and one Base Service Set Identifier. We first require all the locations of Assess Point in campus Wireless network. The accuracy of positioning system depends on the number of Assess Point in the target area. The more number the Assess Point, the high location accuracy results obtained.

After we got the information, we could assign a simple coordinate system in grid format. In system, we allocate each tutorial and Lecture room by a unique coordinate. Moreover, we have to assign the position of all useful Assess Points in the system.

The follow figure shows the general design flow of this module:

![Diagram showing the design flow of Online Module Function]

Figure 5.2.4.1: The design flow of Online Module Function
Since there are a lot of Wi-Fi signals in the campus area, the application should require a part of function to filter all the Wi-Fi signals out excluding our campus Wi-Fi signals which are called WLAN CityU. After finding out all the Wi-Fi signals around user, the application will calculate user location by coordination method and applying circle equations. Then we will display the results on the camera, to be controlled by another part of function.

Calculating the coordinate of user will not be the only data the application requires, but also the orientation of the location determined by the electronic compass.
The following tree diagram shows the entire construction of the On-field module:

![Tree Diagram](image)

**Figure 5.2.4.2: The tree diagram of Online Module Function**

On the calculation function part, the project is required a theory to explain how the condition of Wi-Fi signals be distributed and location be determined by applying circle equation.

As we all know that, Wi-Fi signals will be emitted in all directions and distribute like a circle. The signal strength will be affected by the materials in between the Wi-Fi emitting source and user location. In other words, if the material between is mere air, user can detect the particular emitting source through a long distance. As a result, the distribution pattern between different sources will not be the same as the conditions will also be totally different.

After the application knows the distance between source and user, it can calculate the exact coordinates of a user by applying circle equation formulas.

The following figure shows all the Assess Point locations of forth floor in campus, in which the locations represent by yellow spots, while another figure shows how the coordinate system apply on the real floor plan.
Figure 5.2.4.3: Assess Point locations of forth floor in campus

Figure 5.2.4.4: Coordinate system applied on forth floor in campus
We take one small zone area on forth floor as the research example. Subsequent to assigning the location of Assess Point (A.P.), we have to find out the Wi-Fi signals distribution pattern in each A.P. 3G and Wi-Fi networks is always represented by a cellular system conceptually. However, the complexity of a hexagon equation will be much more complicated than a circle equation. The concept of Wi-Fi Positioning System will be totally different than cellular network, as CampusVR does not require the connectivity of other routers or network device.

According to the research results on Wi-Fi signal distribution, it apparently shows that the Wi-Fi signal strength deteriorates in proportional to the inverse of distance square between visitor and A.P. location. We could obtain the estimated distance by the signals strength. The below figure shows Wi-Fi signal range of one Assess Point:

![Wi-Fi distribution pattern of one Assess Point](image)

Figure 5.2.4.5: Wi-Fi distribution pattern of one Assess Point

Although we assume the Wi-Fi signals emit in a circle range, the result may be totally different in the real environment. The Wi-Fi signals may be reflected, shadowed or blocked by obstacles, and we have to estimate the signal change in different directions. In real situation, we may have not only one scanning result, which means that we may get several Wi-Fi signals from different Wi-Fi Assess Point at the same time. If we got two or more results from at least two Wi-Fi Assess Points, we could simply
apply the circle equation to find the location of visitor. We take two different pattern distributions as two circles which intercepting each other. A normal will be formed by the two intercept points. These two coordinates will be calculated by applying the following equations and figures:

\[(a_1 - x)^2 + (b_1 - y)^2 = r^2\]

where \((a_1, b_1)\) are the target coordinate, and \((x, y)\) are different source coordinates.

Figure 5.2.4.6: Theory of circle equation
After this logic function has been finished, we can see the following results:
Figure 5.2.4.7: Real situation of Purple Zone

Figure 5.2.4.8: Temporary result from scanning
After the location of user has been calculated, we have to calculate the angle between the direction of North Pole and the direction of that object.
As we could see, we are required to calculate the red angle to represent the direction of object. We could imagine our reality is just like a continuous image, when we change our vision angle, we could move the objects relatively to achieve the result.
6.1 Database Structure of Navigation Function

In navigation function, we have to build an information database to store all the entries provided by visitors. Since there are many possibilities of making a location in campus, the application has grouped into one entry from those similar points. For instance, Lecture one to Lecture four belong to the area of Yellow zone, so it is made as one entry point. We may notice that all the lectures and tutorial rooms mainly locate on the fourth floor and fifth floor. The following shows the list of all entries:

<table>
<thead>
<tr>
<th>2F</th>
<th>3F</th>
<th>4F</th>
<th>4F</th>
<th>5F</th>
<th>5F</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSC A-K</td>
<td>Main Entry</td>
<td>U Circle</td>
<td>Y4701 – 4702</td>
<td>G5128 – 5217</td>
<td>Winling GYM</td>
</tr>
<tr>
<td>CSC P-Q</td>
<td>Library</td>
<td>LT1 – 4</td>
<td>P4801 – 03</td>
<td>G5314 – 5432</td>
<td>ARRO</td>
</tr>
<tr>
<td>ELC</td>
<td>Book Shop</td>
<td>LT5 – 10</td>
<td>P4901 – 10</td>
<td>B5114 – 5132</td>
<td></td>
</tr>
<tr>
<td>S.I. Lab</td>
<td>CY301 – 306</td>
<td>LT11 – 14</td>
<td>Covered Terrace A, B</td>
<td>B5307 – B5427</td>
<td></td>
</tr>
<tr>
<td>BCH Lab</td>
<td>CY311 – 316</td>
<td>LT15 – 18</td>
<td>Conference Rm</td>
<td>Y5101 – 5206</td>
<td></td>
</tr>
<tr>
<td>IT Lab</td>
<td>FY301 – 305</td>
<td>LT401</td>
<td>Multi purpose Rm ABC</td>
<td>Y5302 – 5412</td>
<td></td>
</tr>
<tr>
<td>B2625 – 2525</td>
<td>Heng Sang Bank</td>
<td>G4701 – 4702</td>
<td>Student Career Centre</td>
<td>City Express</td>
<td></td>
</tr>
<tr>
<td>SCM Screening Rm</td>
<td>B4701 – 4702</td>
<td>Sport Centre</td>
<td>Chan Tai Ho Multi purpose hall</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6.1.1: Table View of all entries in navigation function
All the information has been stored in a 2D array in order to make convenience of searching data.

Figure 6.1.2: Database information stored in 2D array

The database will be massive. Since the application will provide 41 entry points for either current location or destination of visitors, there are totally about 1600 routes and text formats required by showing the information.

Moreover, it will be a problem if the application reads information from XML file of my designed database. It is because there is difficult to design a XML file and read the texts from file, which makes the protocol more complicated. Other than this, it is no method to store the images in different positions.

For the sake of making convenience of database, it just hardcoded the database and tried all the possibilities of input. It tried to search the information like a tree structure, and build the database starting by different inputs.
The application will not use different texts to show each type of sentences travelling from current location to destination. Instead, we would like to reuse the sentences when visitors require going from different floors. For example, when we travel from one of the locations in second floor to one of locations in fourth floor, the texts will be reused as following figures show:

Figure 6.1.4: Database format of navigation database
As we could see the information in red block, the second sentence is the same either user goes from CSC to University Circle or user goes from BCH laboratory to University Circle.

The same method also applies on the map view function. Since there are so many ways showing the dedicate path between location and destination, CampusVR has reused the routes if the direction of routes are the same. For example, when we required going from LT5 – LT10 to LT11 – 14, the route will be the same but shifted the position.

Figure 6.1.4: Routes could be reused in database
As a result of elimination, the types of texts have been reduced to more than a half number, which makes less complexity.

6.2 Database Structure of Wi-Fi Positioning Function

In Wi-Fi Positioning Function, we have to locate all possible locations of Assess Point within campus, and we have to store all the BSSID address inside the programming parts.

It stored all the information in an array in order to make convenience of searching.

Since it relies on the signal strength to calculate user position by estimating the distance between Assess Point and visitor, the distance estimation is vital. The signal strength should be proportional to the inverse of distance square in value.

However, although we assume that the signals emitted are of circle range, the signal may also drop at different direction in respective of each Wi-Fi
hotspot. The signals will be reflected, shadowed or refracted by the obstacles around the signal source, which cause the frustration of reading. More important, if we required having distance assumption, as we need to calculate the location by two sets of circles, which means the two different Wi-Fi sources, the estimating distance representing by the same signal will be totally different.

In the design of database, we are required to set up different function by a pair of Assess Points. First, it will scan and filter other Wi-Fi signals, which are not belonging to City University Wireless LAN network. After that, it starts to find out the distance by the available Wi-Fi scanning results.

```c
//LT-10 graph
if(LT10){
    if(filter_level[i] > -80){
        inside_LT10 = true;
    }
    if(filter_level[i] <= -60 && filter_level[i] > -70){
        LT10_distance = 5.0 - ((filter_level[i] + 60.0) * 5.0/10.0);}
    else if(filter_level[i] <= -70 && filter_level[i] > -80){
        LT10_distance = 6.0 - ((filter_level[i] + 70.0) * 5.0/10.0);}
    else if(filter_level[i] <= -80 && filter_level[i] > -90){
        LT10_distance = 13.0 - ((filter_level[i] + 80.0) * 5.0/10.0);}
    else if(filter_level[i] <= -90 && filter_level[i] > -100){
        LT10_distance = 19.0 - ((filter_level[i] + 95.0) * 3.0/5.0);}
    //LT10 = false;
c1_LT10 = true;
c2_LT10 = true;
c3_LT10 = true;
c4_LT10 = true;
c5_LT10 = true;
}
//End LT-10 graph
//LT-17 graph
```

Figure 6.2.2: Wi-Fi distribution database in programming

This shows one of the examples which is about the distribution pattern in Wi-Fi source of LT18. The following figure shows the graph of Wi-Fi signal strength again distance:
The trend in graph proves that the signal strength is proportional to the inverse of distance square.

Figure 6.2.2: The graph of signal distribution against distance
6.3 System accuracy of Wi-Fi positioning system

In Wi-Fi positioning system, we have used one set data scanned from one point in Purple zone. The blue cross represents the calculated position while the red point represents the original position of the point:

![Figure 6.3.1: Location calculation on test point](image)

By calculation, visitor average location point = (31, 18)

The original position = (28, 20)

Each grid area = 1.5m x 1.5m = 2.25m²

In the test, we could see that the tolerance is within 5 metres in latitude and longitude.

The tolerance of latitude = \((31 - 28)/120 \times 100\% = 2.5\%\)

The tolerance of longitude = \((20 - 18)/75 = 2.667\%\)

We could see that the system accuracy only have not more than 5% for the position system with 120 grids long, and 75 grids wide.
We have to calculate the angle between the North Pole and object direction in order to show the direction on camera display. We could notice that the angle of $a_1$ and $a_2$, representing the angle of original position and calculated position, are almost the same.

To conclude, the Wi-Fi positioning system is successful to locate one’s position, and it will not be a problem if there are tolerances on the calculation part.
7.1 Different Screen Size of Android Smart Phone

When we talk about the screen size of phone, it means the length of diagonal and physical size. In general, Android Operation System has provided four different screen sizes, including small, normal, large, and extra large. However, all the android phones only support the first three screen sizes. The following figures show the relationship of the size configuration and the types of screen size in different densities.

![Figure 7.1.1: The relationship of screen sizes and density in Android Smart Phone](image)

Different Android Phones own their screen sizes, and the layout settings will totally be different when a small screen size has installed an application with large screen size. Design of layout will be an important issue to apply the application on all Android Phone with different screen sizes.

In my application, it only supports the screen size of 480 x 854. There will be further improvement in which the application will be able to install in different Android mobiles.
7.2 Signal Accuracy between the Wi-Fi signals and assisted-GPS

Wi-Fi is short form of Wireless Fidelity. It could create a wireless communication network within certain areas, with use of air to be the connection media.

Assisted Global Positioning System used the signals of satellites and base station around us to build up a connection and form a network. It is always to be the system to locate people’s position on planet.

When we need to concern the signal accuracy between these two systems, we have to know the situation of navigation apps will be applied. Since Wi-Fi system only supports a short range area, like 10 – 20metres, to provide services, comparing to the entire global positioning system, it will be difficult to provide network service in a relatively large area. That’s also the reason why most navigation apps always use aGPS signals in a large area.

However, several users claimed that aGPS signals are not accurate enough in Hong Kong. It is because of the spaces of public area. Since dozens of buildings erect on streets, aGPS signals will be blocked or reflected by buildings. More important, we could not use GPS signals inside the building. That would be a problem when the navigation apps would like to update user position inside a building.

Instead, Wi-Fi positioning system could solve this problem. Although the signals emitted by Wi-Fi sources will have interface or fading effects by nearby Wi-Fi signals, it still works if we could have more Assess Points within an area. That will be reason why the application is designed to use Wi-Fi signals rather than aGPS signals.

In the research of this new positioning system, it only applies when there are enough Assess Points on the target area. Otherwise, the system could not provide an accurate position to user.

Indeed, it depends on how accuracy the position we require in the design of navigation apps. Generally, it will be acceptable if user does not really
rely on the readings or the navigation apps could provide other information to locate one’s position.

7.3 Photo Size of Panorama View in Map Function
In the Map View function, the photo size of one panorama photo is around 1Mbytes. It will be a problem if we required providing lots of panorama photos in the application.

The photos are stored in JPEG format. The memory size of photos could be improved if we tried to suppress the photo before putting them in to the application.

Other than this method, we could use the program to compress the size of photos. It could save more memory when the application tried to load the photo and give a smooth action on the program.

7.4 User Interface Design of Application
When we talk about the design of User Interface, it will be a software design pattern which needs to concern dozens of problems.

There are totally five design patterns, which are about the Dashboard, Action Bar, Search Bar, Quick Action, and also Companion Widget. My application only concerns about the Quick Action and the design of widget.

In the Quick Action function, it should be reminded that all the quick functions should be fast and fun, and the function should be straightforward. And the icon of quick action should also not be disruptive to the content. The example is the white arrow on the top-right corner of my application design, which only performs go back function and makes it simple.
Moreover, all the quick action function will only present most important and obvious action.

In widget design, we are recommended that it must be space efficient, which make the natural feeling. We should not provide a large application launcher. So we could see that the User Interface design of my project only shows six Image buttons.
8. Working Schedule

Working Progress
According to my work schedule, there are totally 25 items required to be finished during the period from 1\textsuperscript{st} June, 2010 to 7\textsuperscript{th} April, 2011.

In the summer semester of last year, my schedule is planned to build up a new API of Map View function, which started to develop several basic function in viewing the floor plan view of campus. There are totally 9 items finished, including designing the User Interface of application.

In semester A, it started to work on the development of Wi-Fi positioning system, which requires to do a lot of researches on the location of existing Wi-Fi hotspots in campus, and also the theory to calculate visitor’s location. There will be a half work of developing Online Module and 10 items required to be finished.

In semester B, another half work of Online Module is finished by developing the function of displaying object directions. The schedule is planned to build the Offline Module after the work of Online Module is finished. The entire application is finished on 1\textsuperscript{st} April, 2010.
Figure 8: Working schedule of FYP Report

1. Starting of FYP
2. Starting of Semester
3. Project Title Organization
4. Getting Familiar with Eclipse Platform
5. Start building example of Project
6. Develop Photo Dragging Function
7. Develop Photo Zooming Function
8. Simple Layout of design application
9. Research on Wi-Fi scanning function
10. Title Reorganization
11. Starting of Semester A
12. On field module
13. Record all possible hotspots in campus
14. Data entry in programming
15. Study Signal Distribution Curve
16. Calculate distance on real map for the curve
17. Summary of the function
18. Start of Sam Brule
19. Repeat the steps and finish the co-ordination in Hour 4 of campus
20. Start of Semester B
21. Design Camera Layout
22. Compare Function research
23. Offline field module
24. Demonstration
25. Project Presentation and Documentary Work
Although the majority of applications in Android is not large enough than the applications of Apple, Android Operation System is a very strong tool, no matter it is either used on mobile or other electronic devices. It provides a good platform for developing not only navigation applications, but also other meaning and fun applications.

According to the project, we could have conclusion of the all navigation apps design patterns. The navigation application could be separated to one type, which only searches information from built in database. The format of displaying data will always be simple, and it need not connect other device to provide any-time using service.

Another design pattern of navigation application will be designed to allocate or share the resources on Internet by connecting with other networks or devices. It will show the information by downloading the data or receiving the signals from satellites or Wi-Fi hotspots, in order to build up connections or locate user position.

Indeed, there will be a new trend of using new technology, which is Augmented Reality to build a navigation platform. Owing to the insignificant accuracy of GPS signals in a small area, Wi-Fi positioning system will be the substitution of assisted GPS system in the future development.
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4. Basic description of Android Programming Design, 
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