CAMPUS NAVIGATION AND INTERACTION MODULE IN MOBILE UNICAT SYSTEM

BY

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DECLARATION OF ORIGINALITY

I declare that this report entitled "**CAMPUS NAVIGATION AND INTERACTION MODULE IN MOBILE UNICAT SYSTEM**" is my own work except as cited in the references. The report has not been accepted for any degree and is not being submitted concurrently in candidature for any degree or other award.

Signature   :   _____

Name   :   _____

Date   :   _____

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ABSTRACT

University Cyber AgenT (UniCAT) is a graphical social network system surrounded by the multi-agent approach. The stimulated environment in the system is the picture of the real-life environment of Universiti Tunku Abdul Rahman (UTAR) Perak Campus and Kampar Westlake as well as Kampar Eastlake. UniCAT is able to analyse the users' preferences and behaviours by capturing their actions and reflecting them to the software agents. The system integrates the automated behaviour of agents to represent preferences of the users. The main purpose of this system is to study the behaviours of population in UTAR Perak Campus, Kampar Westlake and Kampar Eastlake in order to predict the future trend of some places.

This project seeks to further the course by re-engineering and adding native mobile support to one of its various modules, the campus mapping module. This project aims to develop campus navigation for the mobile platform that guide users within UTAR Perak Campus. Besides that, users are able to upload photos and contribute informations to UniCAT systems.

After studying the existing system, it has been noted by the author that existing system can be improved upon. Systems that are similar in nature are studied and compared. A solution is derived from the extensive research done. Prototypes will be made based on the solution and improved upon during different development phases.

In a nutshell, this project will enable the local population and visitors to be familiar with UTAR Perak Campus easily with mobile devices in their hand; whereas the UniCAT system can benefit from the increased collection of user data and photos of UTAR Perak Campus.

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LIST OF ABBREVIATION

API	Application Programming Interface
GPS	Global Positioning System
IDE	Integrated Development Environment
OS	Operating System
MBaaS	Mobile Backend as a service
POI	Point of Interest
UI	User Interface
UniCAT	University Cyber Agent

Chapter 1 : Introduction

1.1 Motivation and Problem Statement

By default, UniCAT system was run on **desktop-based and there is no mobile client for user to find out information regarding UTAR Perak Campus**. In this globalisation era, mobile devices such as access to cellular data and portability is the greatest benefit provided to smartphones users which cannot be found in a normal computer. According to research , most of the users use mobile devices to search information online rather than using a normal personal computer (MIGHTYminnow 2015). This shows that most of the users utilise mobile devices to discover information over the world, rather than using a personal computer.

Although Kampar, Perak is not a huge and bustling town as compared to any town located at Kuala Lumpur, but people are still able to **get lost or could not get the right direction in UTAR Perak Campus**. Hence, campus navigation is to be implemented in mobile version UniCAT system in order to help users to locate their current location in Universiti Tunku Abdul Rahman Perak Campus, Kampar Westlake and Kampar Eastlake by using global positioning system (GPS). Not only that, a photo gallery module will be implemented into the mobile UniCAT system as well. Most importantly, this module helps the visitors and freshmen to get familiar with the environment around UTAR Perak Campus.

Chapter 1 : Introduction

1.2 Project Scope

The project scope is about developing a mobile application module that provides campus navigation and useful information of Universiti Tunku Abdul Rahman Perak Campus in a mobile application.

1.3 Project Objectives

The objectives of the project are :-

- To develop an campus navigation module using mobile solution to guide users within UTAR Perak Campus.

- To allow user to retrieve information around UTAR Perak Campus using mobile UniCAT system through QR code mechanism.

- To enable lecturers to disseminate up-to-date information through push notification.

1.4 Proposed Approach

The proposed approach to overcome the problems stated is to build a mobile UniCAT client with a campus navigation module. With UniCAT campus navigation module, users are allowed to navigate, discover information, and view photo gallery of places around UTAR Perak Campus. Besides that, authorised users are able to upload and report images as well as to edit their profiles. The module makes use of the information provided by university and deliver them to the users. There are different points of interest that allow user to switch between buildings, departments, bus stop and etc. By selecting the point of interest, mobile UniCAT will suggest the nearest point of interest to the users, so that users do not need to find it by themselves. Furthermore, whenever users navigate to a selected building, mobile UniCAT will retrieve users' current location and calculate the nearest path to the user.

Chapter 1 : Introduction

1.5 Background information

University Cyber AgenT (UniCAT) is a graphical social network system which surrounded by the multi-agent approach. The environment in the system is the stimulation of the real life environment of Universiti Tunku Abdul Rahman (UTAR) Perak Campus (Shieh, YX 2014). UniCAT is an existing system developed by the previous author. It has the ability to analyse users' preferences by capturing their actions and reflect them to software agents. The system integrates the automated behaviour of agents to represent preferences of the users.

The main purpose of UniCAT system is to study the behaviour of population in UTAR Perak Campus by sharing and discovering information such as events, foods, and so on. This test is being run in order to predict the future trends of particular places. For instance, the change in population in some areas, popularity level of shops, the most favourable gathering place and so on.

UniCAT system is then extended to have campus navigation and photo sharing gallery. The functions are implemented for the ease of freshmen or visitors to familiar with the environment of UTAR Perak Campus. They are able to receive all the information of UTAR Perak Campus and get familiar with UTAR's environment easily. By using UniCAT system, they can adapt to the new environment in UTAR even before the semester begins and not much travelling is needed.

Chapter 1 : Introduction

1.6 Report Organisation

There are 6 chapters drawn up separately in this report. Besides project objectives, the motivations and problem statements of this project are outlined in the first chapter. Up next, five similar systems that are available in current market have been selected and reviewed in order to make comparison with the proposed solution. The functionalities and UI designs of each systems are investigated further.

In chapter three, the design of the proposed system is explained in details. In chapter four, the methodology implemented and the tools required as well as the timeline to be followed throughout the project are elaborated. Then, the implementation and testings conducted on the project are detailed in the next chapter, chapter five. Last but not least, the project is concluded and possible future improvements and research on the finished system are explained.

Chapter 2 : Literature Review

2.1 Review Description

The figures below portrait some systems available in the market with identical functionalities and usefulness to this project. The author has evaluated the strengths and weaknesses of these existing systems.

2.2 Review of Existing System

2.2.1 Purdue
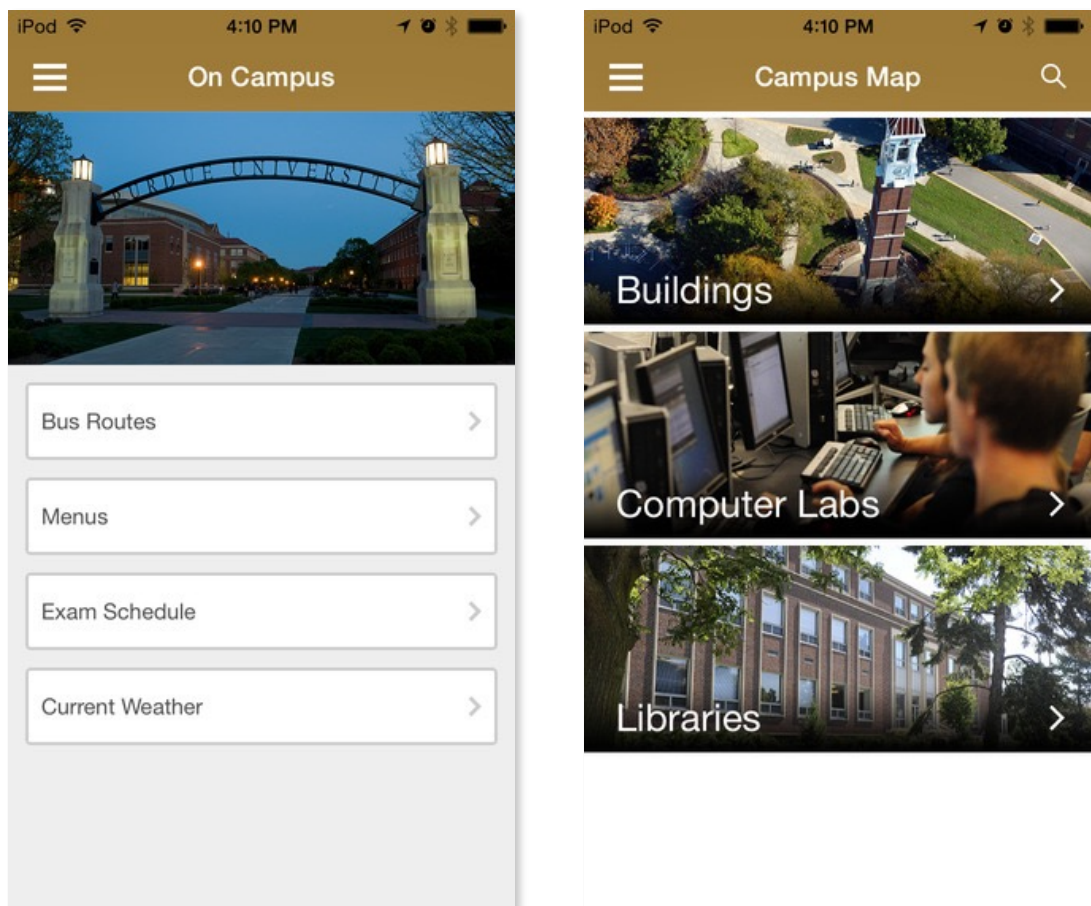
Figure 2.1 : Screenshots of Purdue

Purdue is a free online application that guides users with useful information and campus navigation for Purdue University (Purdue University 2011). The mobile application of Purdue works only for iOS platforms. Purdue provides informative details regarding

Chapter 2 : Literature Review

Purdue University such as buildings' information, computer labs rule and regulation, etc to the users. Bus routes, exam schedules and venues, the current weather around Purdue University and etc can be searched by the users using this mobile application, as shown in Figure 2.1.

Purdue allows the users to view all the building's location in Purdue University using their mobile devices. Besides that, it provides a point-to-point navigation using the build in Apple Map. With this function, users can easily get their correct path from their current location to the location they are heading to. Not only that, Purdue application also provides bus routes that allow users to check the estimated time for the next bus and the arrival time at their destination. However, there is a limitation of Purdue application whereby most of the functions such as bus routes and weather require internet connection to retrieve data from the database.
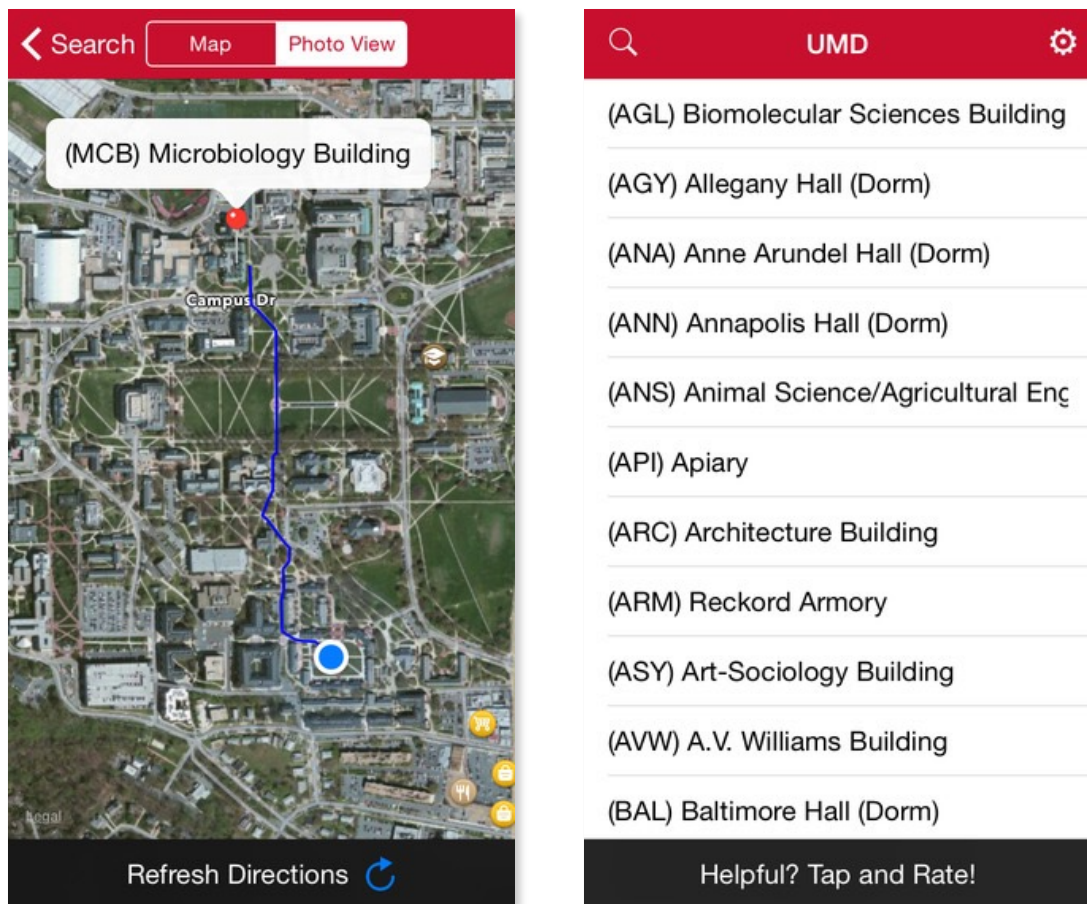
2.2.2 Campus Maps

Figure 2.2 : Screenshots of Campus Maps

Campus Maps is a free campus mapping and navigation application with more than 100++ campuses, as shown in Figure 2.2. Its mobile application works on both Android and iOS platforms (Vikram Bhandari 2015). It provides campus mapping and navigation for most of the universities but only available in overseas.

At the beginning of Campus Maps, users are prompted to select their campus before they are asked to select their building they heading to. After campus selection, Campus Maps provides all the building names for the selected campus and users are able to select any building in the list. Not only that, Campus Maps will automatically navigate user from their current location to buildings using the Apple Map API. With this feature, users are able to travel from one place to another with just few taps, as shown in **Figure 2.2**. Besides campus navigation, users are able to switch the map between normal map view

and photo view. However, Campus Maps application will crash when users try to switch between normal map view and photo view.

2.2.3 Lost On Campus
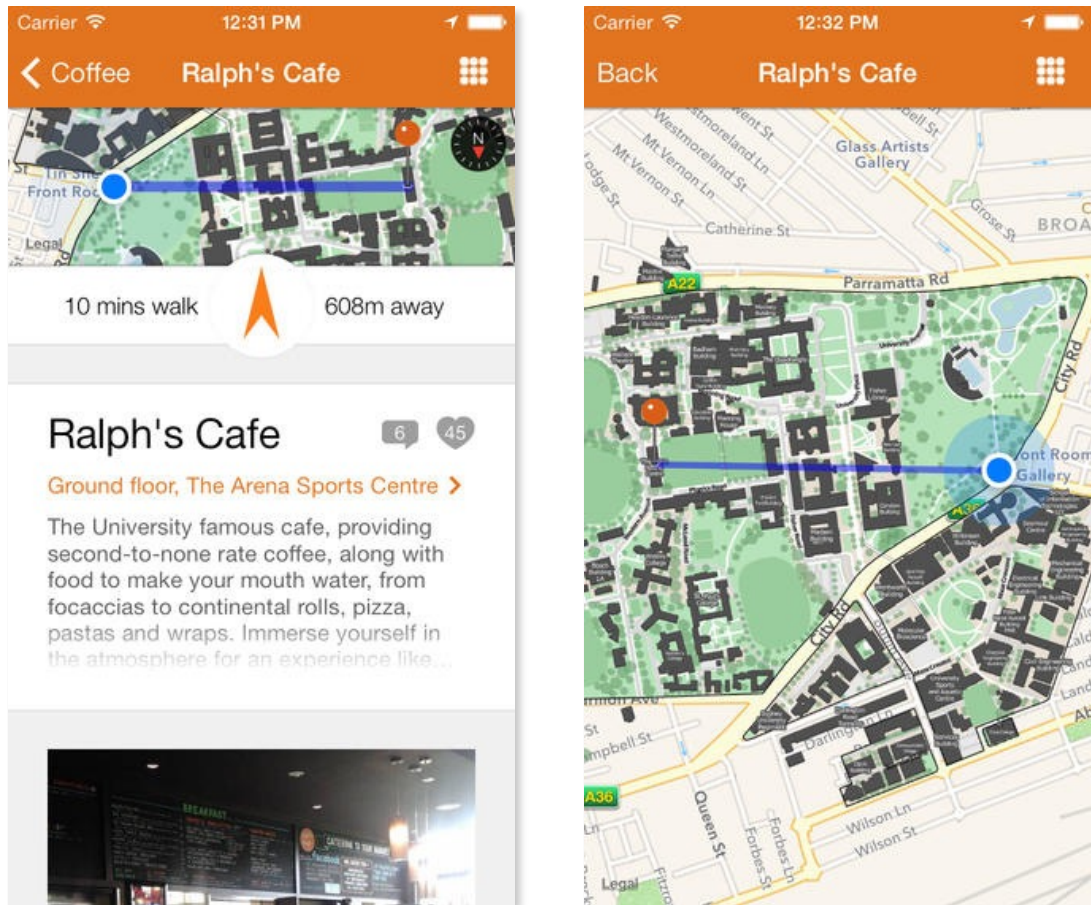
Figure 2.3 : Screenshots of Lost On Campus

Lost On Campus is a free campus mapping and navigation application for 57 Australian uni and tafe campus maps. More than 40,000 campus locations and about 52,000 photos were mapped on this application (Student Services Australia 2013). Users are prompted to register before they are allowed to use this mobile application and users are not allowed to skip the registration. This mobile application works on both Android and iOS platforms.

Chapter 2 : Literature Review

It allows the users to find every tutorial rooms, labs, lecture theatres, coffee shops, carparks and etc easily (Lost On Campus 2015). Not only that, the application provides the estimated time and the distance for a user to walk from their current location to the destination. A compass were implemented into the application and points the users in the right direction. Besides that, Lost On Campus provides point to point navigation which gather users' current location and navigate them to their destination, as shown in the **Figure 2.3**. In order to provide accurate and updated information, an internet connection is needed while using Lost On Campus.

2.2.4 UCLA Campus Map
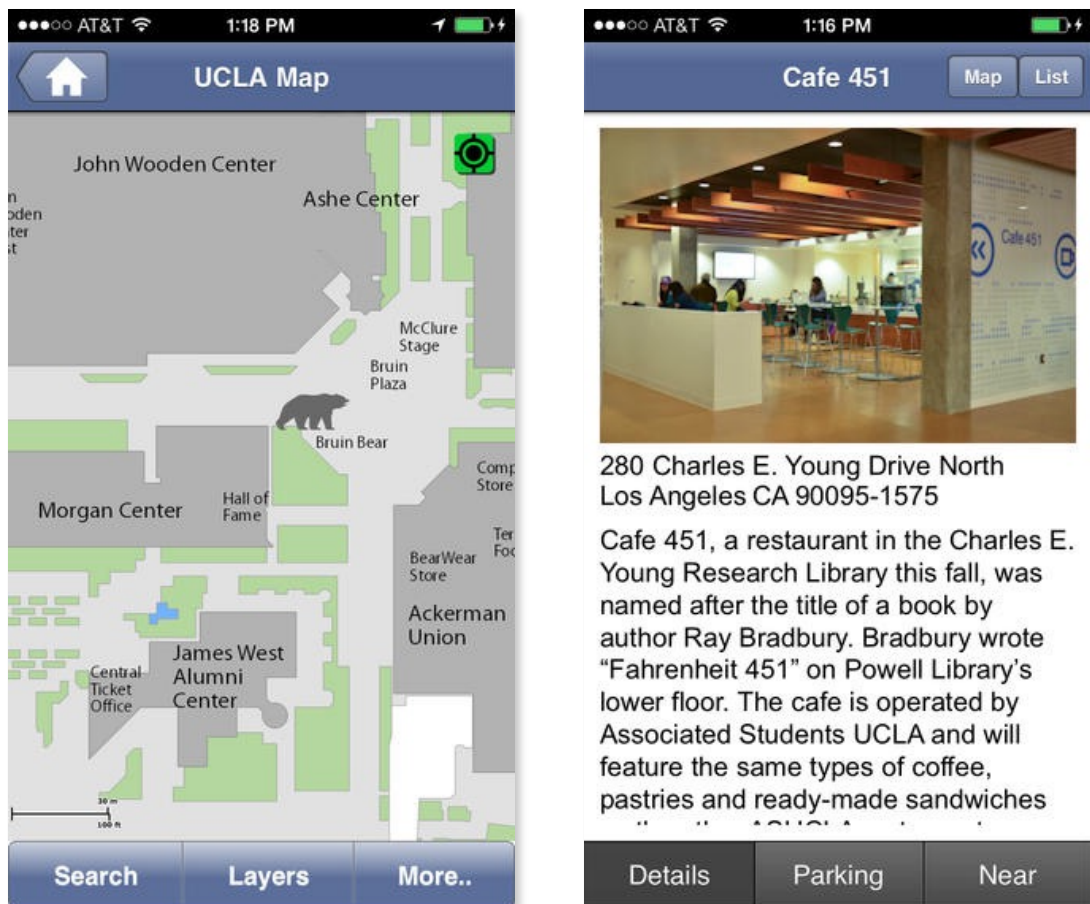
Figure 2.4 : Screenshots of UCLA Campus Map

The UCLA Campus Map application, was developed by University of California, Los Angeles Administration, and this is the official UCLA campus map application (UCLA Campus Map 2014). Unlike Lost On Campus, UCLA Campus Map does not require

preregistration before using it. However, there is similarity where UCLA Campus Map also has a mobile application that supports both Android and iOS platforms.

Users can switch among three layers which are Aerial, Accessibility and Media, as shown in **Figure 2.4**. Aerial layer shows the map to satellite view of University of California, Los Angeles, while the Accessibility layer provides all the details such as parking lot, washroom and etc. Meanwhile, Media layer shows the image of particular places from all angles, 360º. Besides that, the application enables users to find more than hundreds of locations in campus easily, including building, lecture halls, dining and etc. UCLA Campus Map provides all the information about University of California, Los Angeles. This application helps to find the available parking slots near by, as shown in **Figure 2.4**. It has the same limitation as Purdue, since it requires internet connection in order to view campus map.
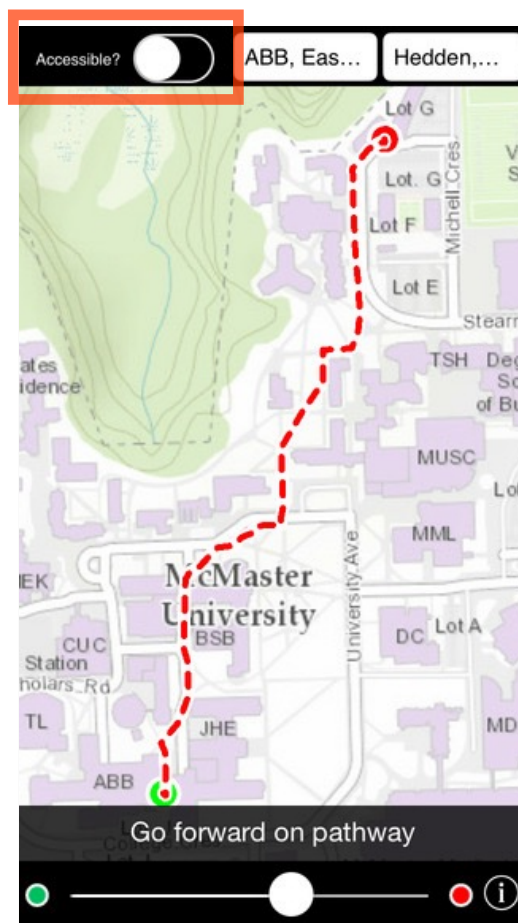
2.2.5 MacMap 2.0

Figure 2.5 : Screenshot of MacMap 2.0

MacMap 2.0 is a free online campus mapping and navigation application for McMaster University, developed by Esri Canada (Esri Canada Ltd 2014). With the interactive map, MacMap 2.0 has the ability to calculate the shortest walking path between building entrances and the selected location, as shown in **Figure 2.2.5**. It also allows the users to filter the accessible entrances for users route. However, MacMap 2.0 does not have users positioning function. Thus, users may not be able to know the estimated time and distance from their current location to the selected destination.

MacMap 2.0 shows 3 different layers to users, which are Esri Canada's Community base map, HSR bus stops and emergency phone locations. On top of that, users can switch off the map layers on the top right button, as shown in **Figure 2.2.5**. Nevertheless, there are some limitations appeared in MacMap 2.0 where it requires internet connection to view the campus map and it currently supports for the iOS platform only.

Chapter 2 : Literature Review

2.3 Critical Remarks

2.3.1 System Comparison

Criteria	Purdue	Campus Maps	Lost On Campus	UCLA Campus Map	MacMap 2.0	Mobile UniCAT
Location positioning	✔	✔	✔	✔		✔
Navigation	✔	✔	✔		✔	✔
Building information	✔		✔	✔		✔
Virtual world						✔
Rating system			✔			
Photo sharing system						✔

Table 2.3.1 : System Comparison Table

2.3.2 Criteria Explanation

Criteria	Elaboration
Location positioning	This application has the ability to collect users' current location.
Navigation	This application can guide users from point-to-point.
Building information	This application provides buildings information for specific campus.
Virtual world	This application does not relay on Google or Apple map.
Rating system	This application allow users rate contented displayed by provide rating system.
Photo sharing system	This application provide a photo sharing system that lets users share photos.

Table 2.3.2 : Criteria Explanation table

Chapter 2 : Literature Review

2.3.3 Compare Analysis

After studying all the similar systems available in the current market, we can conclude that Lost On Campus supports location positioning, navigation besides providing a lot of building information regarding the campus. It also allows the users to rate the particular building and comment about it. However, it does not provide routes for navigation. Lost On Campus only draws a line from starting point to the destination point. Thus, users may not be able to get the accurate navigation path to their destination. On the other hand, almost the similar functions go to Purdue, it navigates users from point-to-point, provides building information and so on, but Purdue does not provide rating system to the users.

Meanwhile, Campus Maps provides campus information up to 100++ campuses. It also supports location positioning and navigation. Nevertheless, it does not provide buildings' information throughout the campus. Not only that, Campus Maps usually crashes when users switch between Map View and Photo View.

UCLA Campus Map provides all the information about University of California, Los Angeles. Besides that, it allows users to change layers between aerial, accessibility and media. UCLA Campus Map also provides the information about nearby parking slot for the users. Nevertheless, there is no navigation provided by UCLA Campus Map. Users might get lost in the campus easily.

MacMap 2.0 only provides point-to-point navigation which means it only navigates users from staring point to ending point. After choosing the staring and ending point, MacMap 2.0 will calculate the shortest walking path between the two points. Although the navigation is useful for users, the functions are very limited.

Chapter 3: System Design

3.1 Requirement Specifications

3.1.1 Functional requirements

1. Users should be able to register and log in to the system.

2. User should be able to update his/her personal information.

3. Users should be able to view the map of UTAR Perak campus.

4. Users should be able to view his/her current location.

5. Users should be able to view or upload images to photo gallery.

6. Users should be able to switch layers between building and point of interest.

7. Users should be able to view the buildings' information.

8. User should be able to flag an images that is inappropriate or abusive to be reviewed by administrator.

9. User should be able to navigate from current location to any buildings.

10. Approved users should be able to create new group.

11. User shouldn't be allowed to join any group without the passphrase.

12. Group creator should be able to create any forums.

13. Group users should be able to join any forum discussion.

14. Administrator should be able to review flagged images.

15. Administrator should be able to unflag or remove a flagged images.

Chapter 3: System Design

3.1.2 Non-functional Requirement

1. User data changes should be synchronised with the server in real time.

2. All buildings' data should be stored in the database and not hard coded in the application source code.

3. All uploaded images should be stored on the server and retrieved on demand.

3.2 Design Specifications

3.2.1 Use-case Diagram
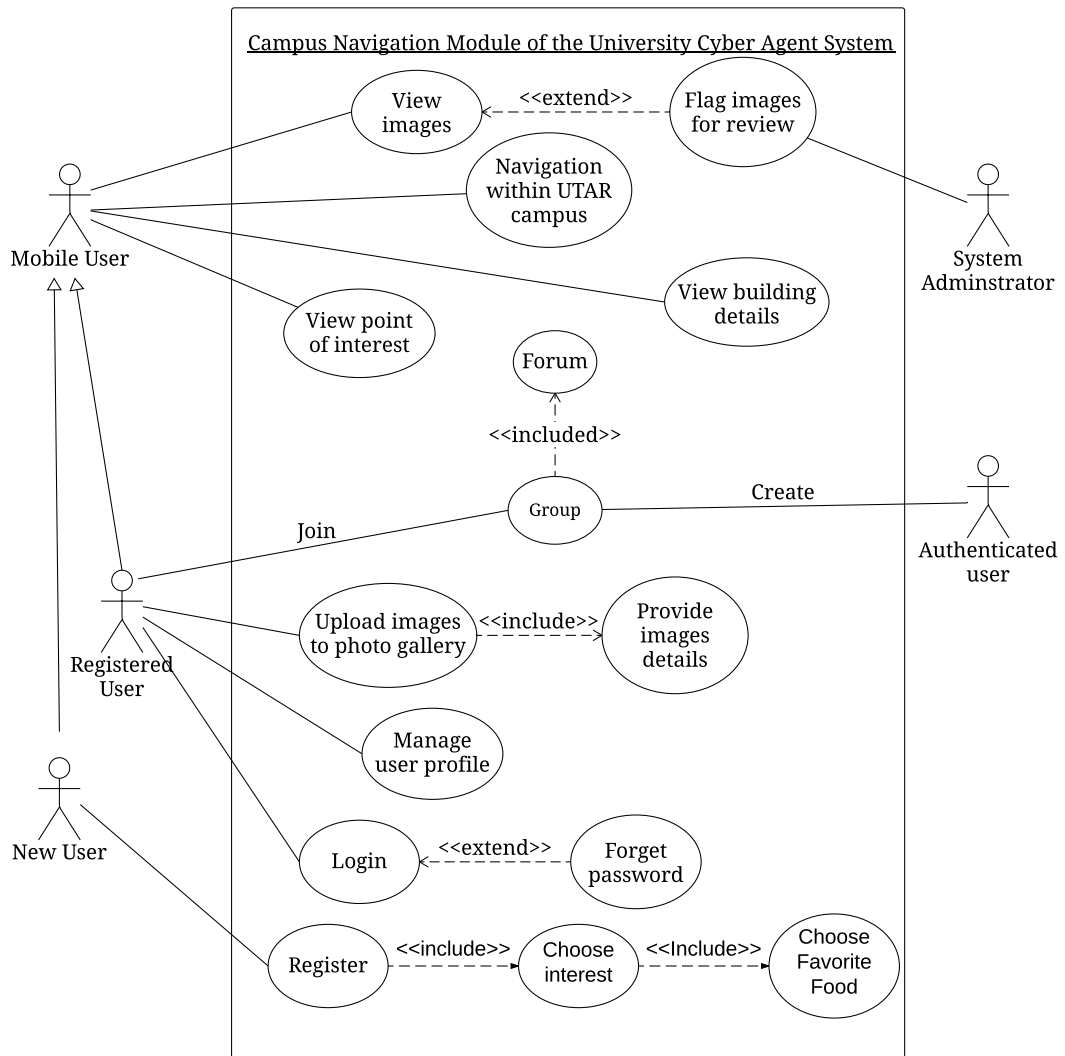
Figure 3.1 : Use case diagram of the Campus Navigation module of UniCAT

Figure above shows the use case diagram of the campus navigation module of UniCAT system. As shown in figure 3.1, new users will be prompted to register a new account before using the UniCAT system. However, users are allowed to skip the registration before using it but they are limited to some actions only, such as viewing images, details of buildings, and the point of interests as well as navigation within UTAR campus. On the other hand, authenticated user are allowed to create a new group with or without a passphrase. The reason of having a group is to allow users to have some discussions by

creating a forum. Besides that, registered users are allowed to upload images to the photo gallery, provide the image details, join a group and manage their user profile. System administrator is allowed to grant privilege to users such as allowing them to create new group. Not only that, system administrator is also allowed to review all the flagged images and unflag or remove flagged images.

3.2.2 System Flow
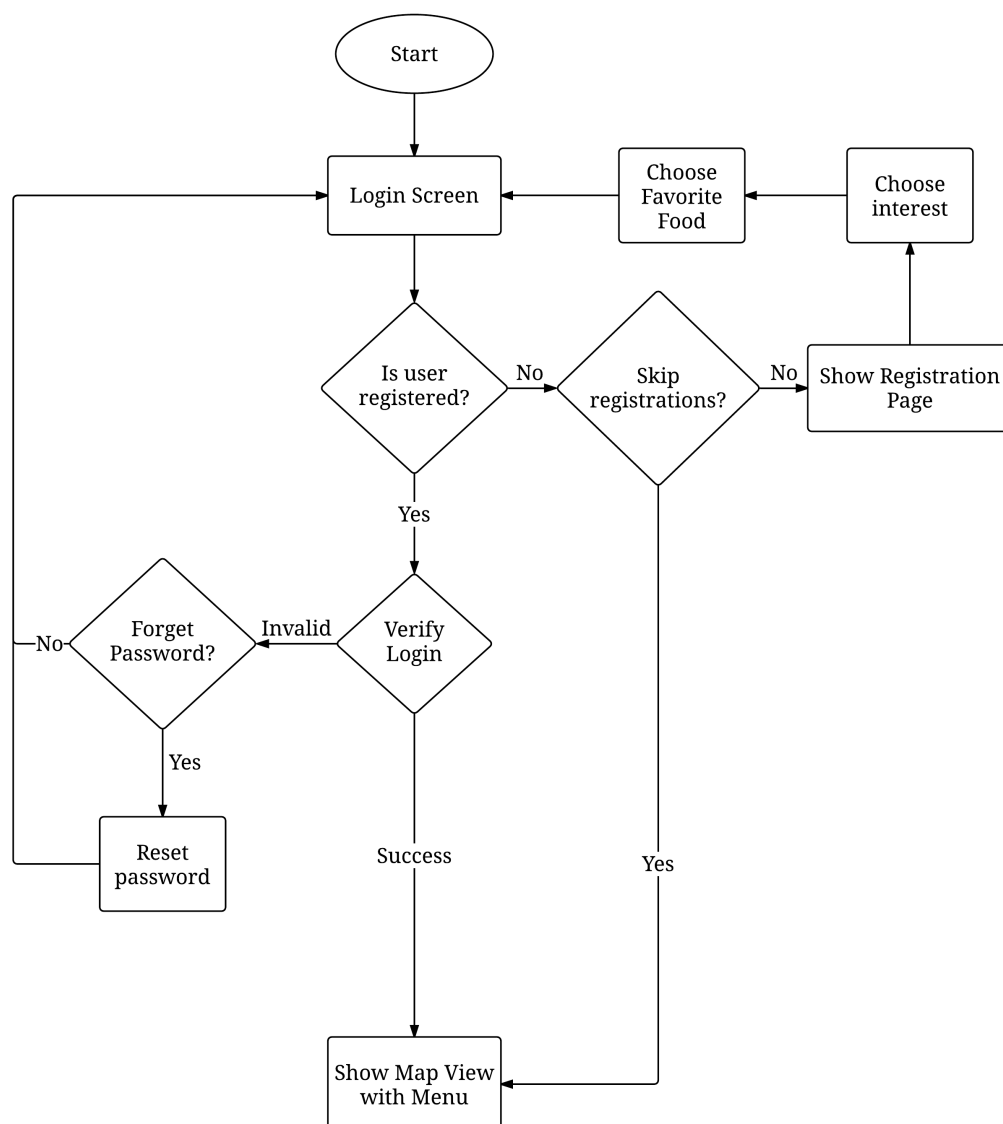
Figure 3.2 : System flowchart of the Campus Navigation and Interaction module of UniCAT (Part 1)
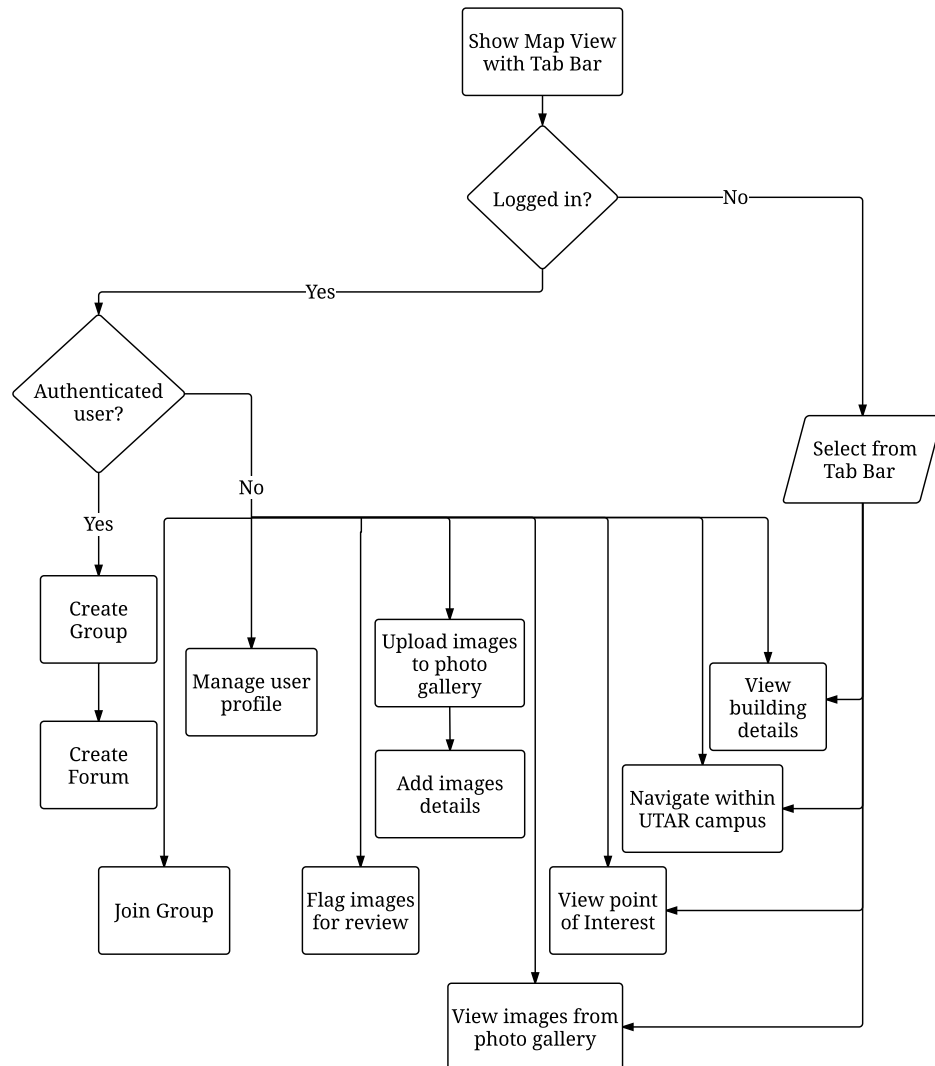
Figure 3.3 : System flowchart of the Campus Navigation and Interaction module of

UniCAT (Part 2)

3.2.2.1 System Flow Elaboration

Figure 3.2 and **Figure 3.3** as shown above are the system flowchart of the campus navigation and interaction module of mobile UniCAT system. When the users start using mobile UniCAT system, users are prompted to key in their username and password. After a login authentication being checked by the server, a main dashboard will be shown in mobile UniCAT system. Users are allowed to skip the login page but some actions will be restricted. For unregistered users, they are only allowed to view building details, point of interest in UTAR campus and images from photo gallery as well. Meanwhile, for registered users, they are allowed to manage their user profile such as changing their profile picture, username and so on. Besides that, they are also allowed to upload images to photo gallery and provide all the necessary information above the images. Not only that, they also have all the privileges that owned by unregistered users. For authenticated users, they are allowed to create any groups with or without a passphrase. Besides that, they are also allowed to create forum to allow registered user to join the discussion.

3.2.3 Sequence Diagram
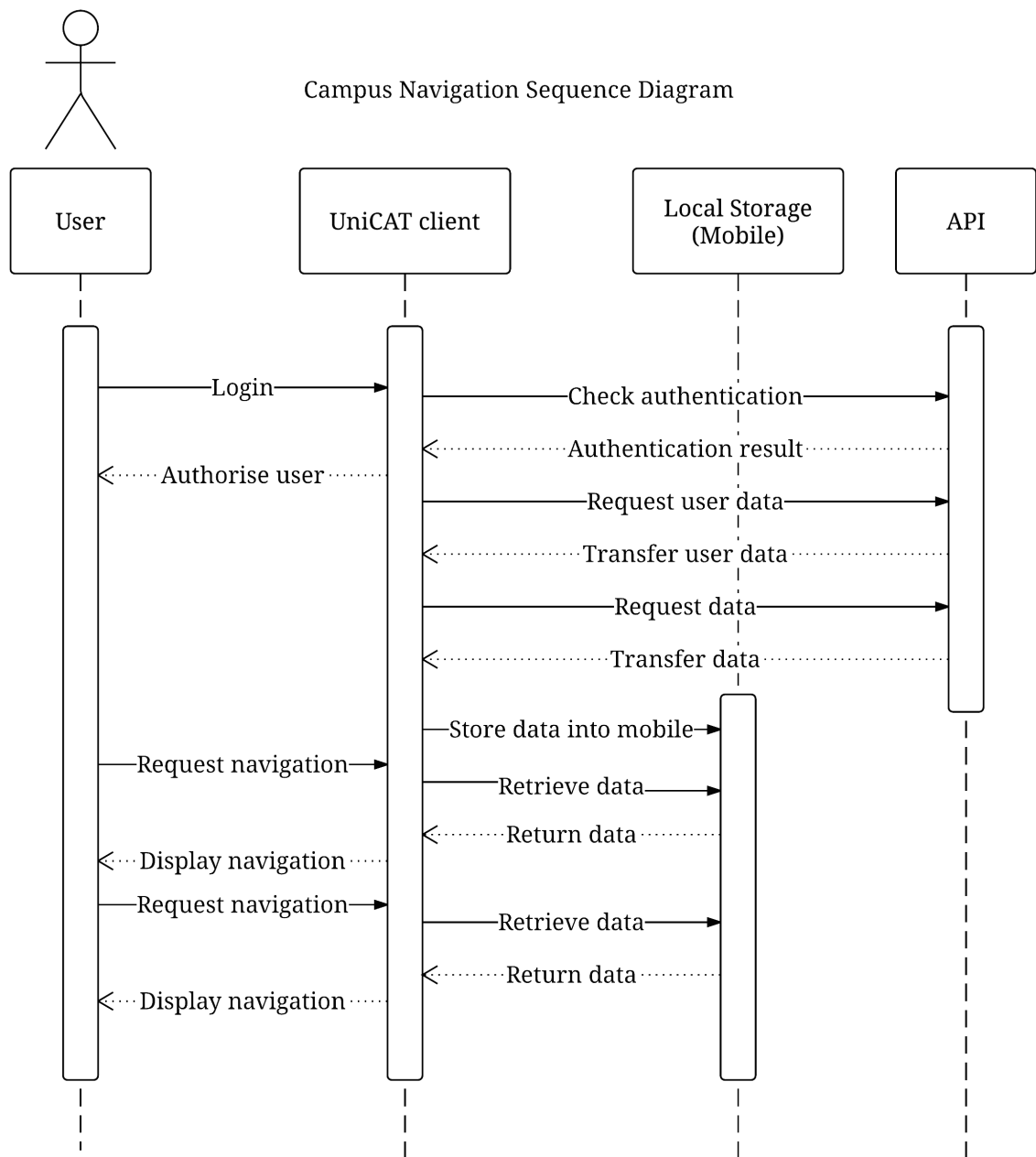
Figure 3.4 : Sequence Diagram of Campus Navigation of UniCAT
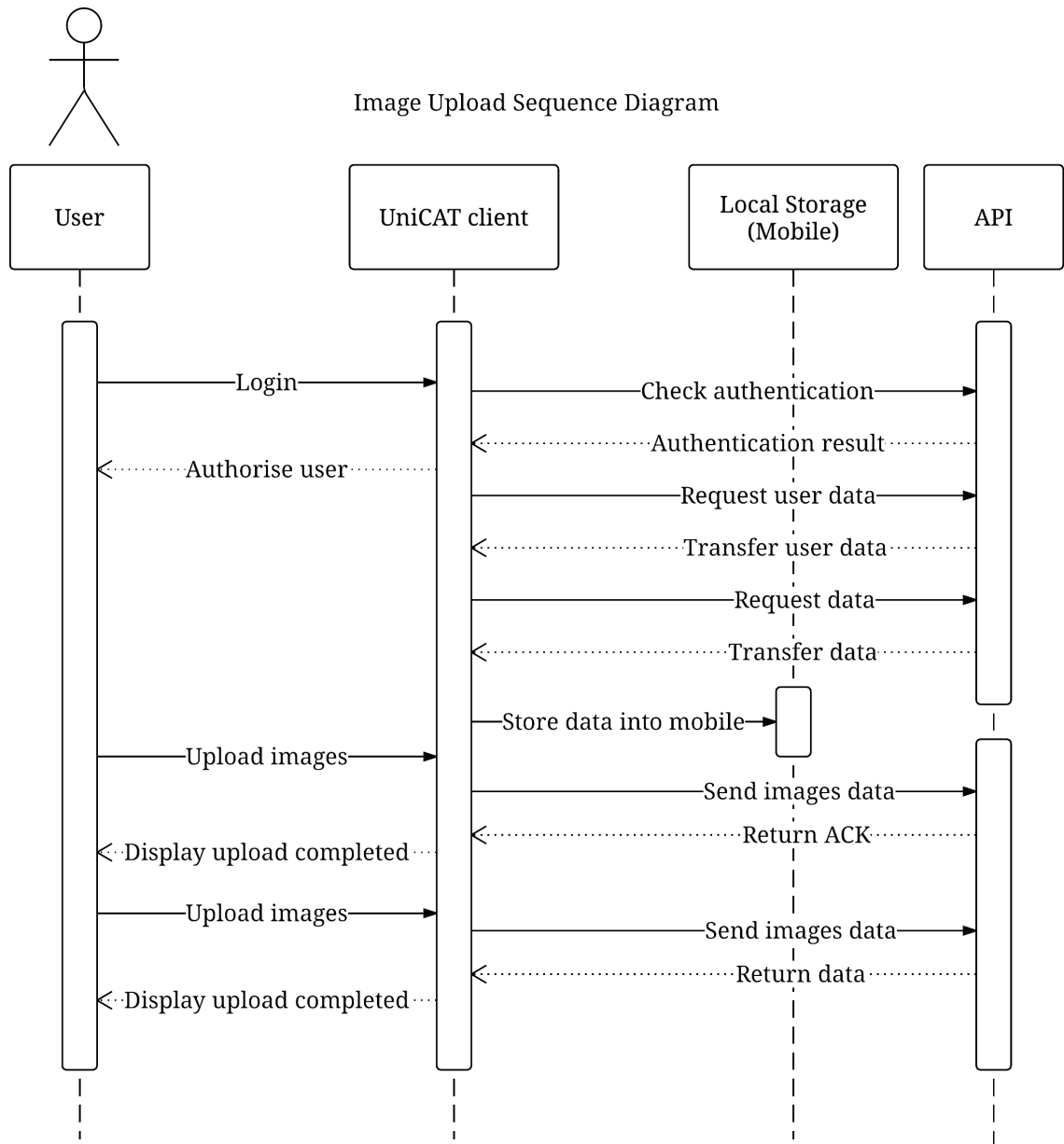
Figure 3.5 : Sequence Diagram of Image Upload of UniCAT

3.2.3.1 Sequence Diagram Elaboration

In order to login to UniCAT system, users are prompt to key in their email and password to gain authentication result from the server as show in **Figure 3.4**. User information such as display image, username and etc. will be requested from the server after the system receive the authentication result and store into local storage. This allow mobile UniCAT system to provide a better performance. When users request for navigation, UniCAT system will start retrieve data from mobile devices and receive all the return data from mobile storage. After UniCAT system receive the return data, it will display the navigation to the users. While in **Figure 3.5**, when registered user upload an image to photo gallery, it will send image's data and the details data to server and data will store into the database. Once the image finish uploaded, the server will send an acknowledgement message to UniCAT system and notify to the user that the image has been successfully uploaded.

3.2.4 Entity-Relationship Diagram
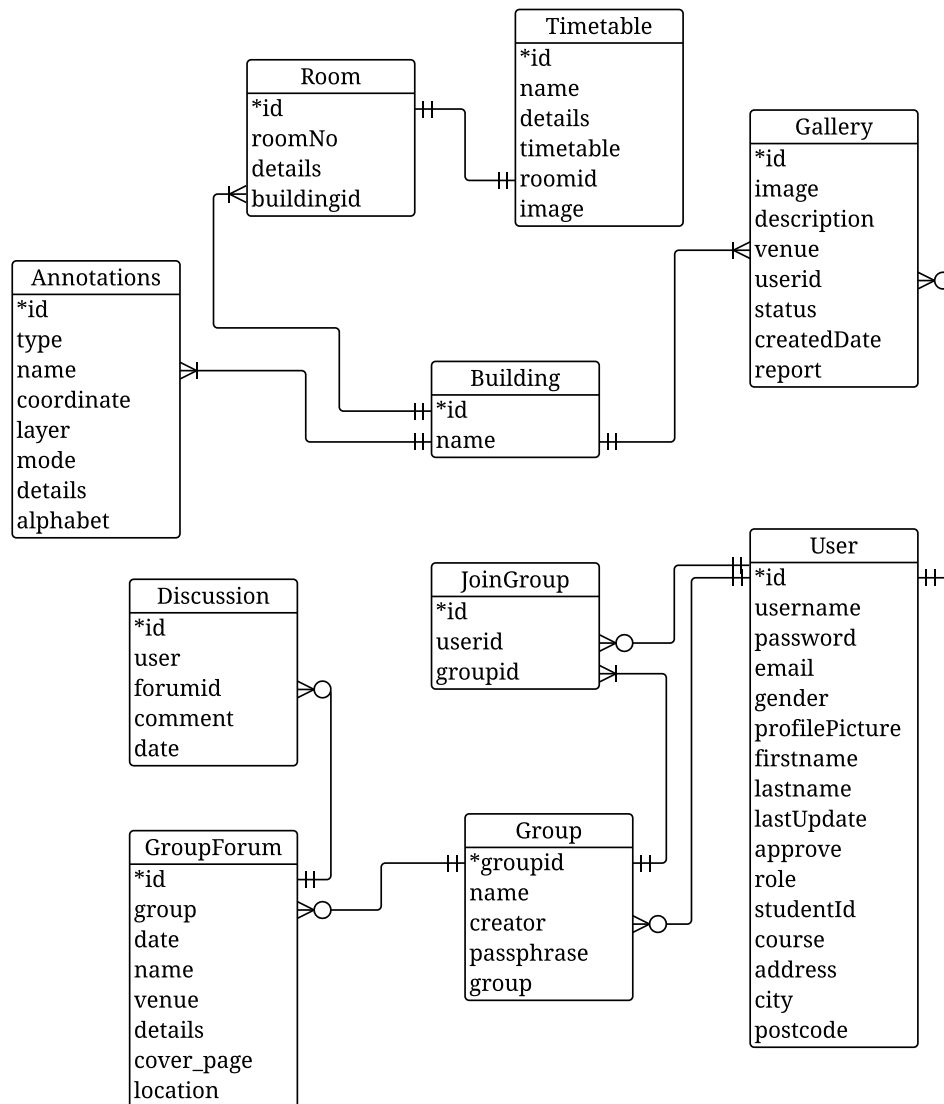
Figure 3.6 : Entity-Relationship Diagram

Chapter 3: System Design

3.3 User Interface Design

All UI designs are to be adhered to the iOS HIG, which is a requirement for iOS apps to be accepted in the App Store as stated in the App Store Review Guidelines (Apple, 2016)

3.3.1 Map Module

(a) Map View   (b) Point of interests   (c) Building Details View
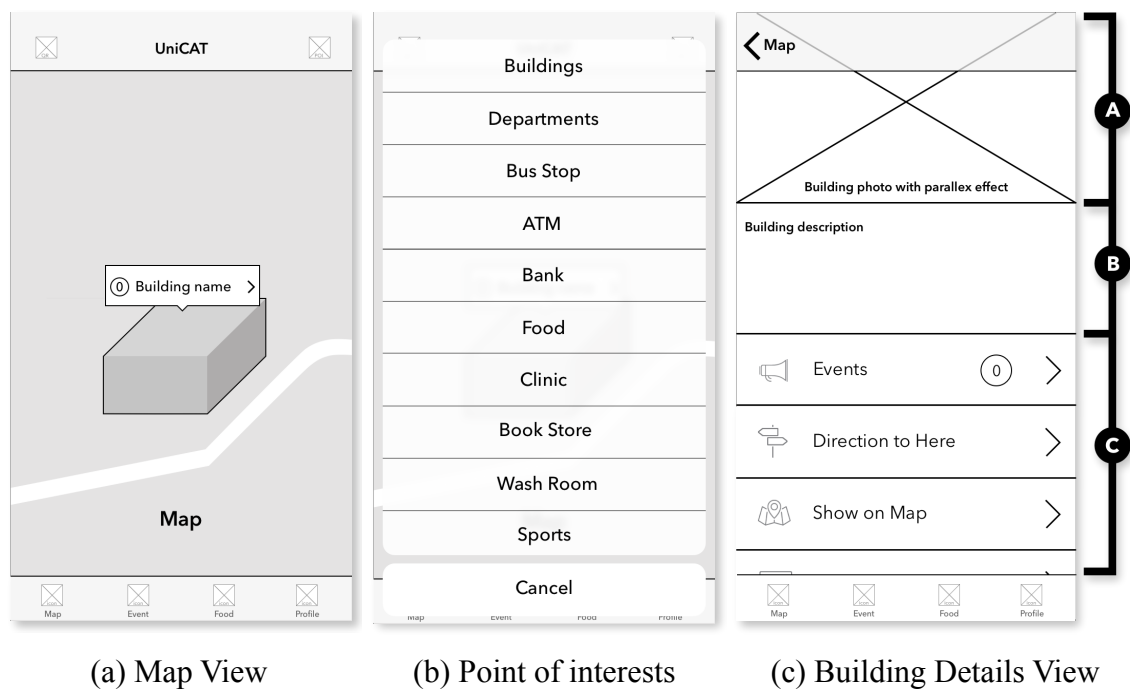
Figure 3.7 : User interface design of main dashboard

Figure 3.7 illustrates the actual design of the mobile UniCAT system. In Figure 3.7 (a), there will be only 2 buttons set on the navigation bar. On the top left, there is a button navigating to QR code module. This module allows the users to scan and retrieve information from any QR code that are attached with UniCAT logo. On the other hand, the top right button allows users to switch between all point of interests such as Bus Stop, Sports, location of ATM machines and etc that are available in UTAR Campus, as shown in figure 3.7 (b). By pressing any point of interest, mobile UniCAT will calculate and suggest the nearest point of interest to the users. Therefore, users do not need to travel for a long distance in order to reach their destination. Besides that, a tab bar will be implemented into mobile UniCAT module. The advantage of this tab bar controller is that

it helps to manage independent set of view controllers. By implementing tab bar controller into mobile UniCAT, it enables major focus on the map and allows users to switch between campus navigation modules and different modules of the UniCAT system. This design has well improvement in consolidating all the standalone and sluggish user interface as compared to the current client program of UniCAT. Map annotations are labeled with all the buildings' name and the number beside building name indicating the number of events that are happening at the particular venue. Users are allowed to pan and zoom into the map. While users interacting with the map, map annotation shows and hides to avoid overlapping and confusing the users. Users will be navigated to building details view if they tap on any of the map annotations, as shown in figure 3.7 (c).

Figure 3.7 (c) illustrates the design of building detail view. The building details view has been separated into 3 sections where the section A is the buildings' image, section B is the details of the building and section C is the options that are selected by the users. The image and the details of the building will be shown in section A after users tapping on map annotation in the map view. Buildings' details such as the history of the building and some mega event held before will be listed out in section B. While in section C, there are a few buttons such as "Events", "Direction to Here", "Show on Map", "Photo Gallery" and etc available to be selected by the users. By tapping "Direction to Here", it will navigate users from their current location to the building they selected. Meanwhile, "Show on Map" button allows the building to be shown or displayed in map view of the users and the "Photo Gallery" option allows users to display or add photo in the photo gallery of the specific building.

3.3.2 Navigation Module
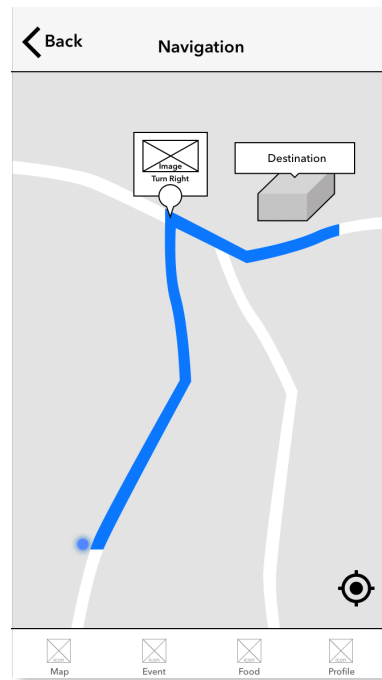
Figure 3.8 : User interface design of Navigation module

Figure 3.8 shows the navigation module of mobile UniCAT system. When users tap on the button "Direction to Here" in Figure 3.7 (c), mobile UniCAT system will pass the location of the users and the location of the end point to the api and calculate the shortest path to reach the destination. Mobile UniCAT navigation module provides the same feature that provided by most of the navigation applications such as user current location, the path of the route, and etc. However, UniCAT navigation module provides a pop-up windows dialog where it will show all the important turning points by providing images and some instruction (Turn Left, Turn Right and etc.). The reason of providing image and instruction at each turning point is to lower down the probability of users turn at the wrong turning point.

3.3.3 Group Module

(a) Group view   (b) Join group
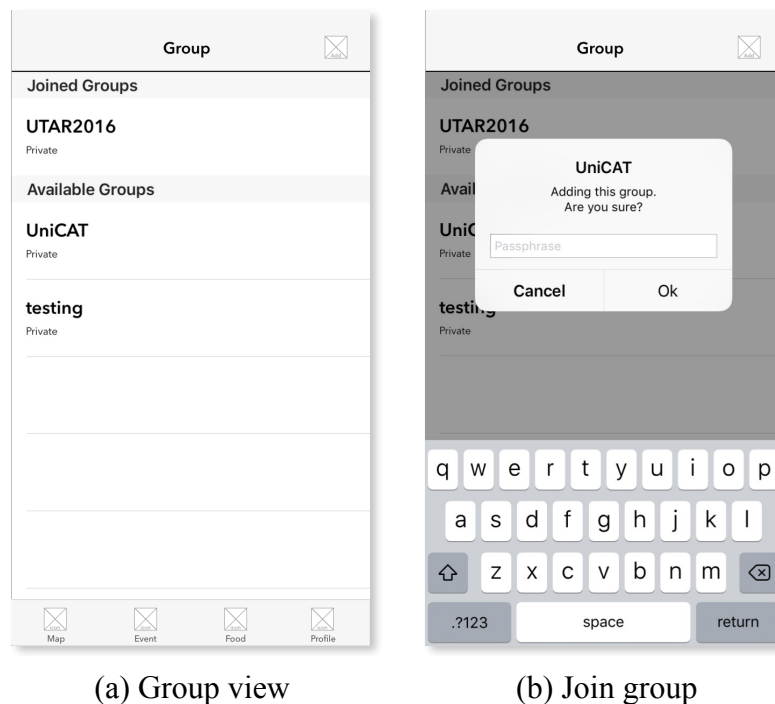
Figure 3.9 : User interface design of Group module

Figure 3.9 shows the user interface design of group module in mobile UniCAT system. When users tap on the 3rd item in the tab bar, all the available groups and joined groups will be shown in the mobile UniCAT, as shown in Figure 3.9 (a). The groups are created by administrator or authenticated users such as lecturers or event planners. While creating new group, users are prompted to key in the group name and a passphrase. The passphrase is used to avoid some unwanted users to join the group without permission. The group are categorised into 2 types, which are public and private group. A public group is created when the users leave the passphrase empty and a private group is created when the passphrase is filled. When users wish to join any private group, mobile UniCAT system will prompt users to key in the passphrase as shown in Figure 3.9 (b). If the passphrase is incorrect, UniCAT system will prompt a error message to inform users that the passphrase is incorrect and thus, they are unable to join the particular group.

3.3.4 Forum Module

(a) Forum in map view   (b) Details of the forum   (c) Discussion for specific forum
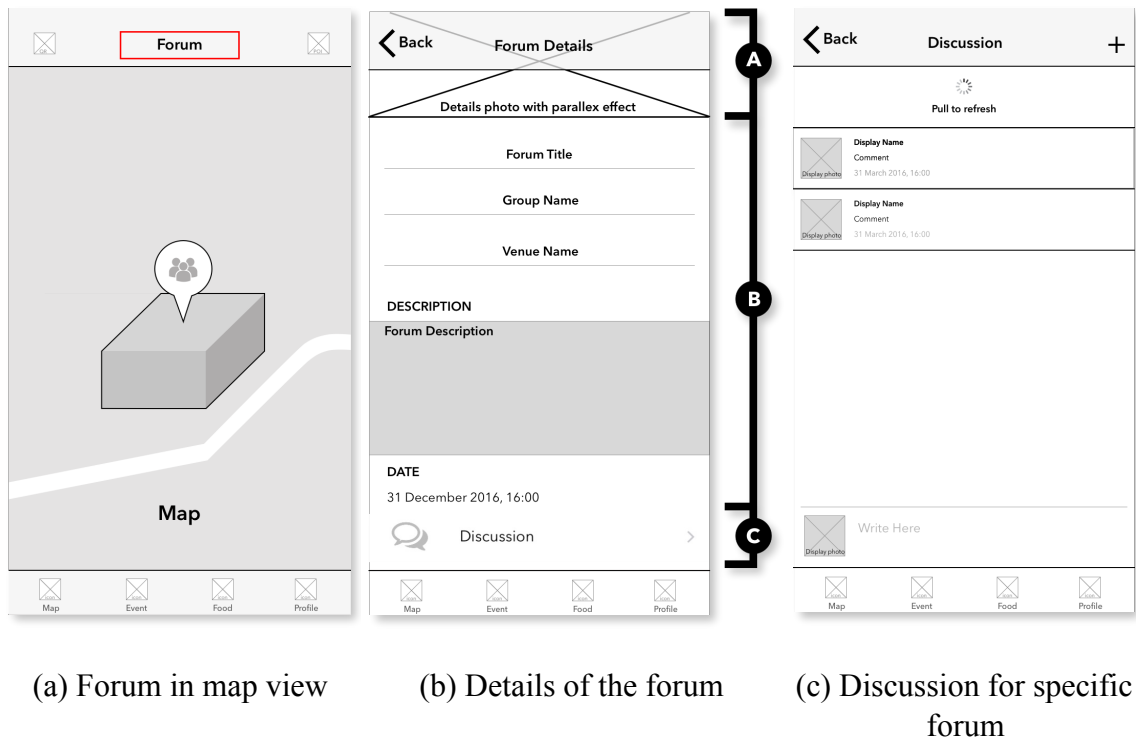
Figure 3.10 : User interface design of Forum module

There are a number of different modes exist in UniCAT system, such as a normal UniCAT mode, a Forum mode and a Convocation mode. In Figure 3.10 (a), when users tap on the highlighted area, they are able to switch to the mode mentioned above and all the available forums will be displayed in UniCAT system. Users are allowed to press in any annotations shown on the map and mobile UniCAT system will display a list a forums that are available on each of the building. Figure 3.10 (b) shows the details of a forum. The forum details view is separated into 3 sections where section A is the forum's image, section B is the details of the forum, and section C navigates user to a discussion view. The creator is given the option to include a forum cover photo to be displayed at the top of the forum detail view. The basic details such as forum title, group name, venue name, description, and the date are displayed on section B. When user presses on the "Discussion" button, mobile UniCAT system will navigate user to the next view, which is the discussion view for the forum, as shown in Figure 3.10 (c). In discussion view, user profile picture will be displayed on the left bottom and users are allowed to write down their comments. When a new comment is added, their profile picture, display name,

comment, and the date of the comment will be shown in the discussion view. In order to retrieve all the latest information, users are advised to pull down to refresh, as shown in Figure 3.10 (c).

3.3.5 Photo Gallery Module

(a) Photo Gallery View   (b) View of selected image   (c) Action Sheet
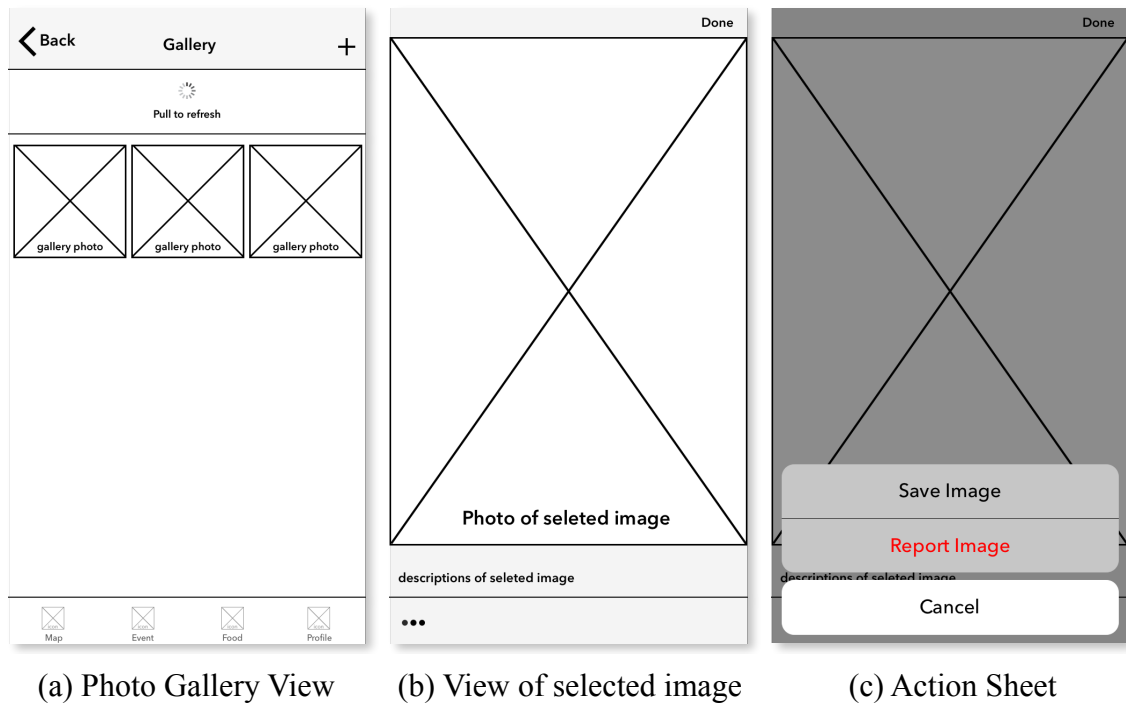
Figure 3.11 : User interface design of Photo Gallery module

Figure 3.11 shows the user interface design of photo gallery. When users select the "Photo Gallery" in Figure 3.7 (c), all the images that belong to the specific building will be displayed on mobile UniCAT system. Registered users are allowed to add in new image by pressing the "+" button on the top right. A view will be displayed and it prompts users to insert an image and the details of that particular image. When a new image is uploaded to the server, users are advised to pull down to refresh all the images for the specific building, as shown in Figure 3.11 (a). A full image and the description of the image selected in photo gallery view is shown in Figure 3.11 (b). Users are able to swipe between images in the photo gallery. Also, users can exit the full screen view by pressing on the button "Done" on the top right whereas the button on the bottom left

allows users to save or report the image if the users find the image is offensive, as shown in Figure 3.11 (c).

3.3.6 QR code Scanner module
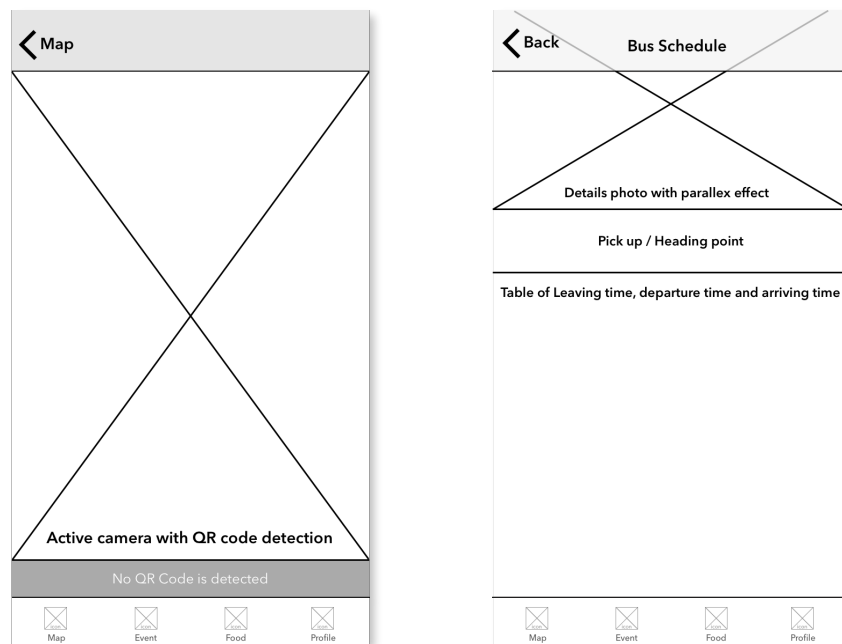
(a) QR code scanner view   (b) Timetable / Bus schedule view

Figure 3.12 : User interface of QR code scanner module

Figure 3.12 shows the user interface of QR code scanner module. When users press on the button shown on the top left in Figure 3.7 (a), UniCAT system will navigate user to QR code scanner view, as shown in Figure 3.12 (a). In this view, users' phone camera is activated and a QR code detection library is added to detect any UniCAT QR code placed around UTAR. When the QR code scanner detects that the QR code is belong to UniCAT system, image and details of timetable for a specific classroom or bus schedule will be retrieved from server. Once the images and details are retrieved successfully from server, the timetable or bus schedule details will be displayed to the users, as shown in Figure 3.12 (b). Besides timetable and bus schedule, QR code scanner is also able to detect the events that have been registered using mobile UniCAT system.

3.4 Parse Core Setup
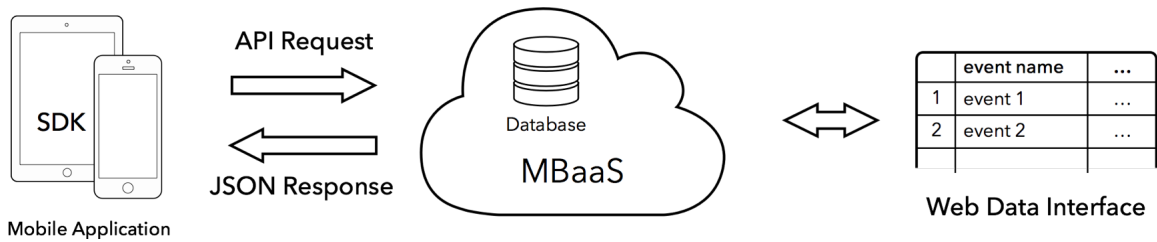
Figure 3.13 : System Architecture diagram

Figure 3.13 shows an overview of the system architecture diagram and the relationship between each component of this project. Parse Core acts as the backend server to support this project. Parse Core is the database component of Parse, a Mobile Backend as a service (MBaaS), a model of cloud computing, owned by Facebook, Inc (Cutler and Constine, 2013). Parse Core provides services such as store and handles basic data types, which includes files and images in the cloud server.

In order to use the Parse Core services, a Parse app has to be created in the Parse web-based dashboard. A set of application and client keys will be generated after creating of the Parse app. The usage of the keys is to allow the application to store and retrieve data from the correct Parse app. The aforementioned keys have to be added into the project file in order to connect to the Parse Core.

```
Parse.setApplicationId("7UFsHzCG5NRgycDbxVDDU0RZHhK81jWVWcBZHMOB",
    clientKey: "WpQjPL4eKx7SVhb097Tr8uAJZDqF6FS7z0Rjyw3k")
```

Open the "AppDelegate.swift" in Xcode project and add the both keys with the line of code as shown in above to the "application:didFinishLauchingWithOptions" function. Mobile UniCAT system is now able to connect with UniCAT Parse app by adding this line of code.

Chapter 4 : Methodology and Tools

4.1 Project Methodology

In this project development, Evolutionary Prototyping will be implemented as its software development methodology. Due to the limited screen size of a mobile, the design of the user interface is an important factor towards its usability. By using prototyping methodology, error can be detected earlier with user intervention. As users work with the system, they may give request to the developers. Besides that, by using this methodology, developers can focus on parts of the system that they are familiar with instead of working on developing a whole system.
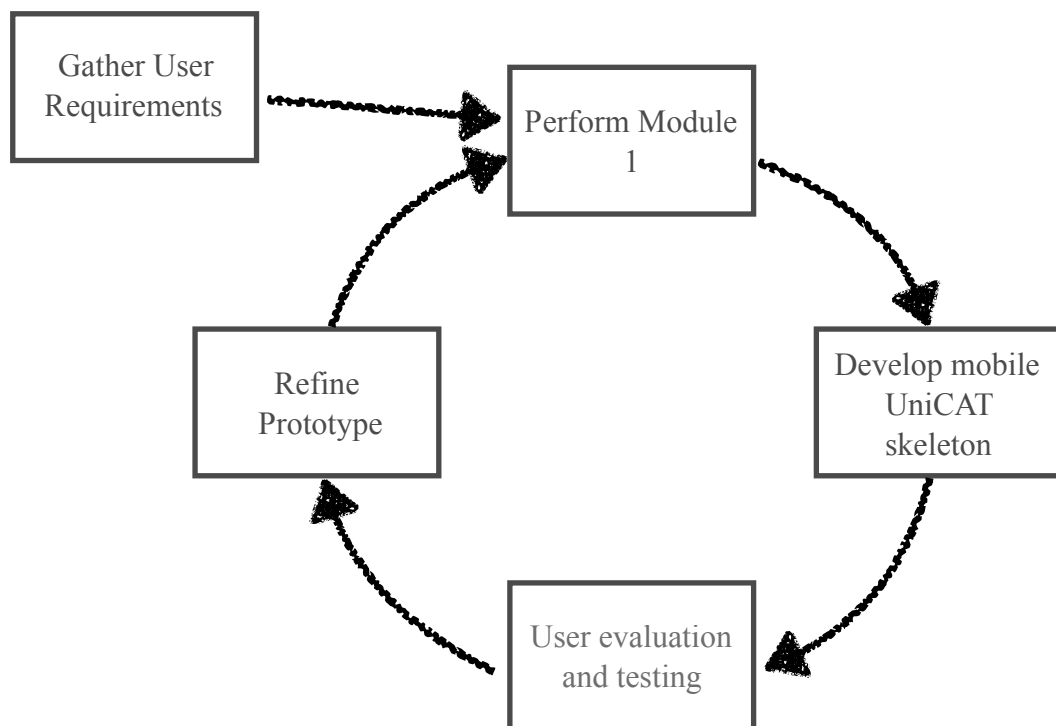
Figure 4.1: Flow chart of the Evolutionary Prototyping in Module 1
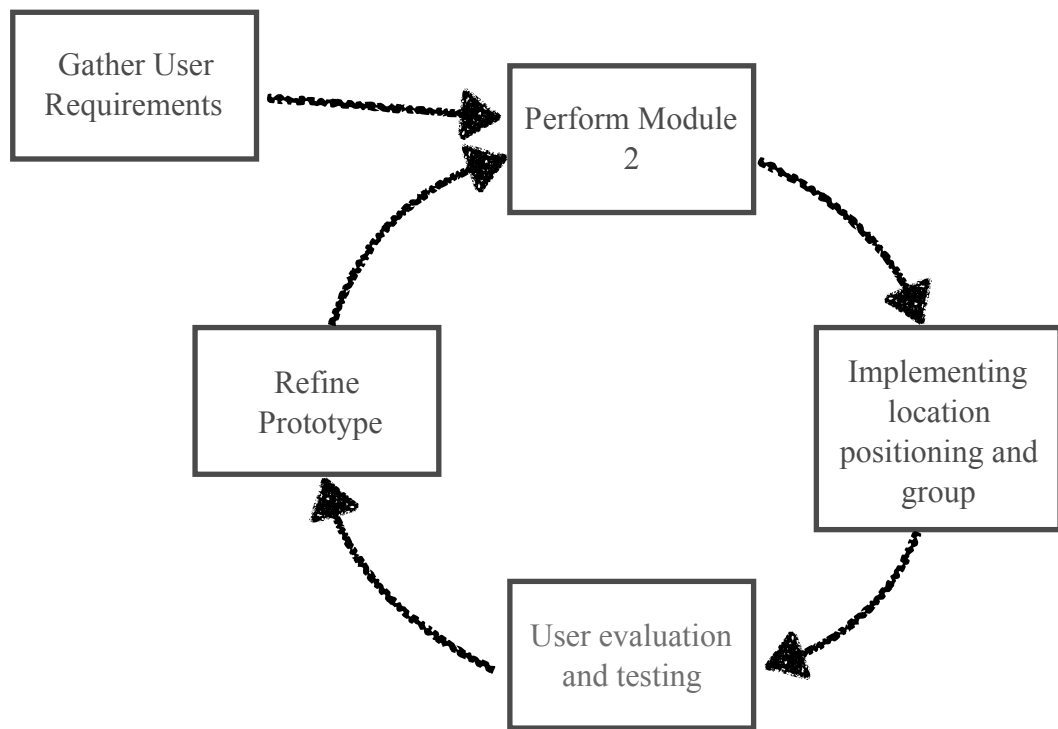
Figure 4.2: Flow chart of the Evolutionary Prototyping in Module 2
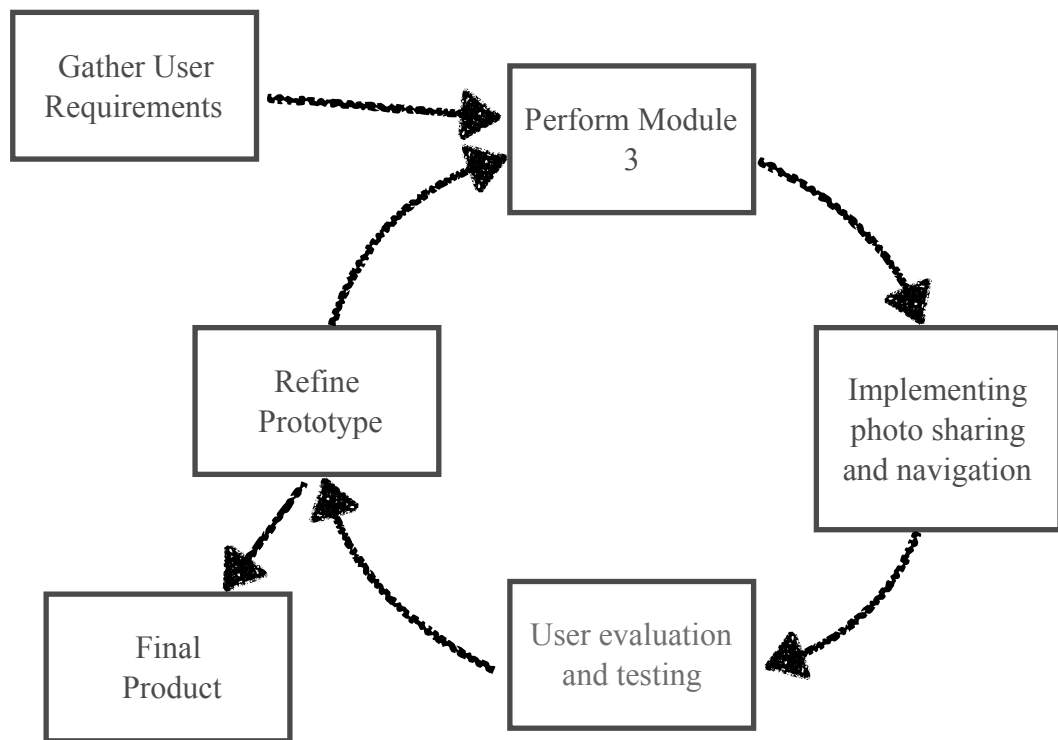
Figure 4.3: Flow chart of the Evolutionary Prototyping in Module 2

4.1.1 General Work Procedures

Study on Global Positioning System and UniCAT system
- Study and analyze the architecture of GPS.
- Study and understand the purpose of UniCAT system.
- Determine how to convert UniCAT system into a mobile version.

Scope and objectives planning
- Gather the project user requirements.
- Determine the project scope.
- Set objectives for the project.
- Set project workflow and milestone.

Application analysis and Solution proposed
- Analyze the requirements.
- Refer to similar system to determine a better solution.

Development phase 3 (Photo Sharing module and Navigation module)
- Implement photo sharing system into the mobile UniCAT system.
- Implement campus navigation into mobile UniCAT system

Development phase 2 (GPS and Mapping module)
- Location positioning and guiding will be implement into mobile UniCAT application.

Development phase 1 (UI module)
- Develop a mobile UniCAT system UI skeleton.

User evaluation and testing
- User evaluate the prototype and give some feedback.

System deployment
- Initiate the service on the server.
- Publish the mobile UniCAT and allow others user to download it.

Figure 4.4: Work flow diagram of the Evolutionary Prototyping methodology

Chapter 4 : Methodology and Tools

4.1.2 Work Procedure Elaboration

In Figure 4.4, it shows the workflow of this project. Before developing a mobile UniCAT application, the author needs to understand the functions and purposes of the current UniCAT system being run on desktop-based. Besides that, studies on how GPS work is necessary because location coordinating will be implemented into the mobile UniCAT application.

In the planning stage, the problems faced by the visitors and freshmen have been discovered and the problem statements were constructed. The project scope had been identified after some research and findings. With that, we have come out with the main scope of this project is to develop a mobile UniCAT application and to provide a campus guide to them whenever and wherever they are in UTAR Perak Campus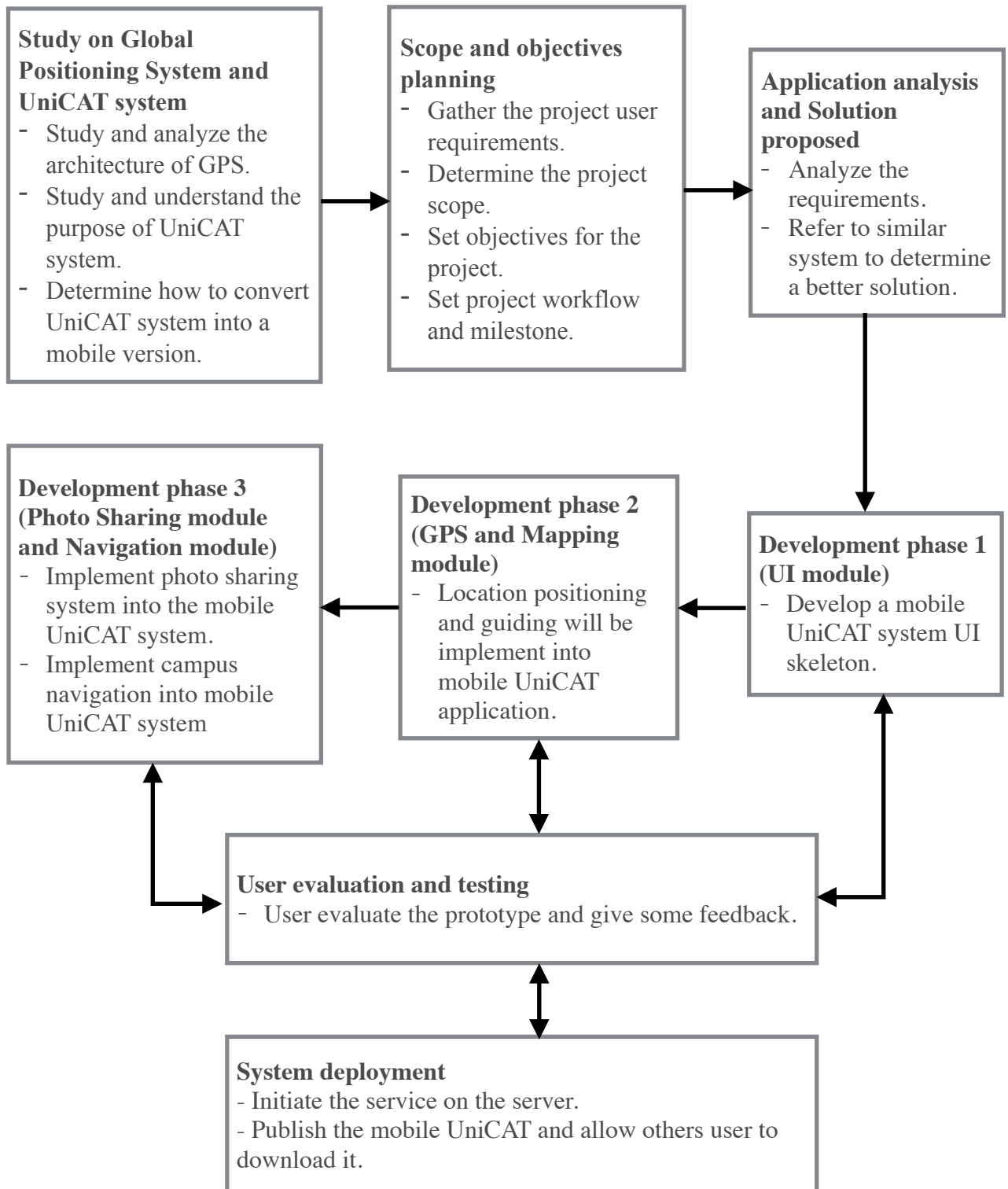 by providing some images, history about UTAR and etc. This could help users to build out the image of the UTAR. In addition, the scope also includes the photo sharing gallery function.

In the analysis phase, several existing system available in the market have been chosen for review purpose and a comparison table had ben constructed. The strengths and weaknesses of every system are recorded and analyzed in the reviewing process. A new solution was then proposed to solve the current situation met by visitors and freshmen.

In the development stage, it is separated into 3 phases. Developing a mobile version of UniCAT system is the first phase. The second phase is the user location positioning and mapping module. This is a new function that can detect users' current location and help users to familiar with UTAR environment. The third stage is to implement the photo sharing module into mobile UniCAT application. This is another new function to allow users sharing and viewing some of the photos taken in UTAR. Photo sharing module will help to increase users' experience and mobile UniCAT application in term of having a better view of UTAR surroundings.

A prototype is delivered to the user to evaluate and acquire feedback, at the end of every development phase. If a further refinement is requested by the user, then the prototype will be returned back to the previous phase and some necessary changes will be made. There will be a continuous loop until the end of the third stage.

Chapter 4 : Methodology and Tools

A client installer is built and ready for users to install in the system deployment stage. In order to get feedbacks from the users and record them for maintenance purposes, a service of server is initiated.

4.2 Tools Used

4.2.1 Software

Xcode IDE

Xcode is the tools used to develop and debug iOS mobile application.

Parse Core

Parse serves as back-end server which solve all the database for the users.

Lucid chart

An online software used to sort ideas of this project.

Adobe Illustrator

A design software used to enhance the interface of the project.

Sketch

A vector drawing to sketch the graphical content such as icons and images of this project.

OS X v10.11 El Capitan

OS X is the operating system that will be used during the project.

GitHub Desktop

Source code management and distributed revision control of the project.

Chapter 4 : Methodology and Tools

QR Snipp

An online QR code generator to generate QR code required in this project.

4.2.2 Hardware

Computer

System type : Laptop

Processor : 1.6 GHz Intel Core i5

Installed memory : 8 GB 1600 MHz DDR3

Smartphone

A 16 GB of iPhone 4S, iPhone 5C, iPhone 5S and iPhone 6 running on iOS version 9.2 is used to test the application functionality and actual performance.

Chapter 4 : Methodology and Tools

4.3 Timeline

4.3.1 Gantt Chart

ID	Task Name	Start	Fisish	Duration		Q3 15			Q4 15			Q1 16		
					Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1	Study existing system	28-May-15	11-Jun-15	2w										
2	Planning	11-Jun-15	25-Jun-15	2w										
3	Requirement analysis	25-Jun-15	2-Jul-15	1w										
4	System design	2-Jul-15	16-Jul-15	2w										
5	**System development**	16-Jul-15	31-Dec-15	24w										
6	Phase 1	16-Jul-15	13-Aug-15	4w										
7	Phase 2	13-Aug-15	22-Oct-15	10w										
8	Phase 3	22-Oct-15	31-Dec-15	10w										
9	System Deployment	31-Dec-15	28-Jan-16	4w										
10	Report 1	28-May-15	9-Jul-15	7w										
11	Report 2	11-Jan-16	28-Mar-16	12w										

Figure 4.3 : Gantt Chart

Figure 4.3 shows the gantt chart of this project. There are 8 tasks in total being assigned throughout this project and the starting date of this project is on 28 May 2015. The first task of this project is to study the existing system in order to understand the concepts and ideas of this project. This task will take approximate two weeks to complete. This is an important stage because the author can understand the purpose of the current UniCAT system. Planning is the next step of this project. This includes gathering the requirements of the project, determining the scope and objectives of the project. This task will be accomplished within 2 weeks.

The next step of this project is requirement analysis whereby the author will analyze the requirement and refer to some projects similar to UniCAT system. Requirement analysis will take about 1 week to finish. The main purpose of this step is to compare the strengths and weaknesses of the similar projects. System design is the process of defining

the architecture, components, modules, interfaces, and data for a system to satisfy specified requirements. Therefore it will take about 2 weeks to finish this task.

In system development, it is sub-divided into 3 phases, whereby the first phase is development of user interface module, second phase is development of GPS and mapping module, and the third phase is development of photo sharing and campus navigation module. The development of phase 1, phase 2 and phase 3 will take about 24 weeks to finish. After the system development, UniCAT system will be published to the public and this take about 1 month time.

Two reports regarding the project will be submitted, where report 1 will take about 7 weeks and project 2 will take about 12 weeks to complete. The end date of this project is on 28 March 2016.

Chapter 5 : Implementation and Testing

5.1 Implementation

5.1.1 Map Module

(a) Map view   (b) Mode switching picker
view
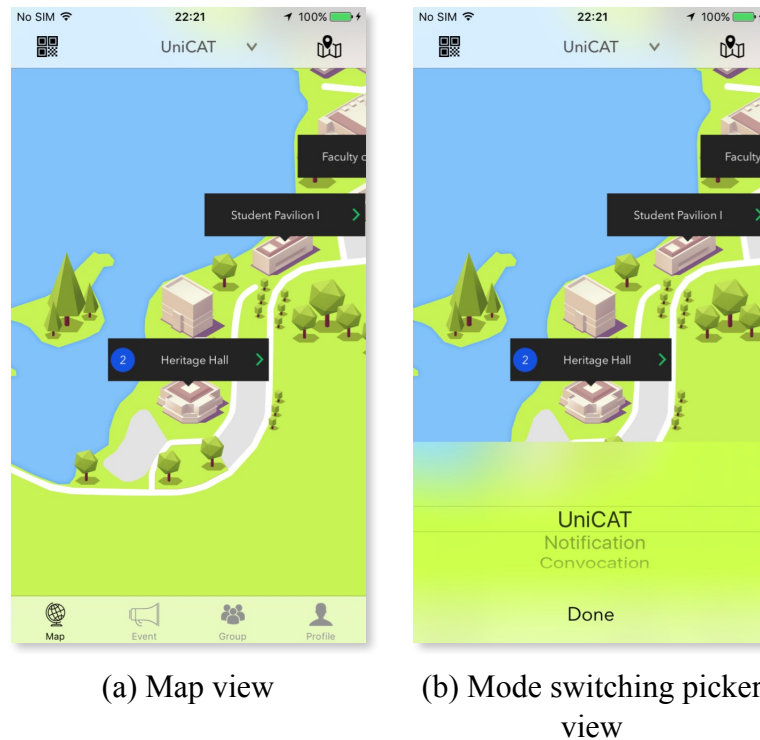
Figure 5.1 : Screenshot of the map module

JCTiledScrollView library was used to develop the map view for UniCAT system. This library was developed by Jesse Collis and contain a number of classes wrapping CATitledLayer library and UIScrollView component to enable a scrollable map. CATitledLayer library is used to improve the loading speed of the map. The map annotations are programmatically added to each building using UIImageView and UIButton. The total number of event count for each building is shown inside each map annotation, as shown in Figure 5.1 (a).

Users can switch between modes, from current mode to other mode such as Notification mode or Convocation mode by pressing on the "UniCAT" button. The notification mode shows all the available forums, while convocation mode shows the details during

convocation. Once the users press the "UnICAT" button, a picker view will overlay on top of the map view to allow users to choose their preference, as shown in Figure 5.1 (b).

(a) Point of interest view   (b) Selection of POI
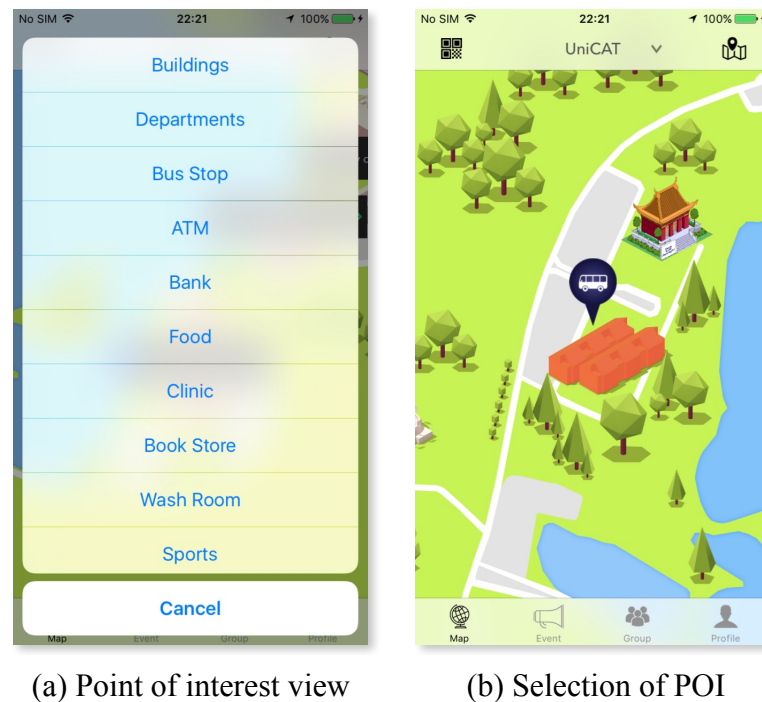
Figure 5.2 : Screenshot of the map module (cont)

When users press on the point of interest button on the top right of the map view, the list of the point of interest will be displayed, as shown in Figure 5.1 (a). Due to the limited screen size of mobile, an action sheet is used to display all the point of interest available, as shown in Figure 5.2 (a). After users selecting a point of interest, the point of interest will be shown on the map view. For example, when users select "Bus Stop" point of interest, all the bus stop POI will be shown, as shown in Figure 5.2 (b). Not only that, mobile UniCAT system will calculate the nearest point of interest and display it on the middle of the mobile device. Users do not need to find the available point of interest by scrolling through the whole map view.
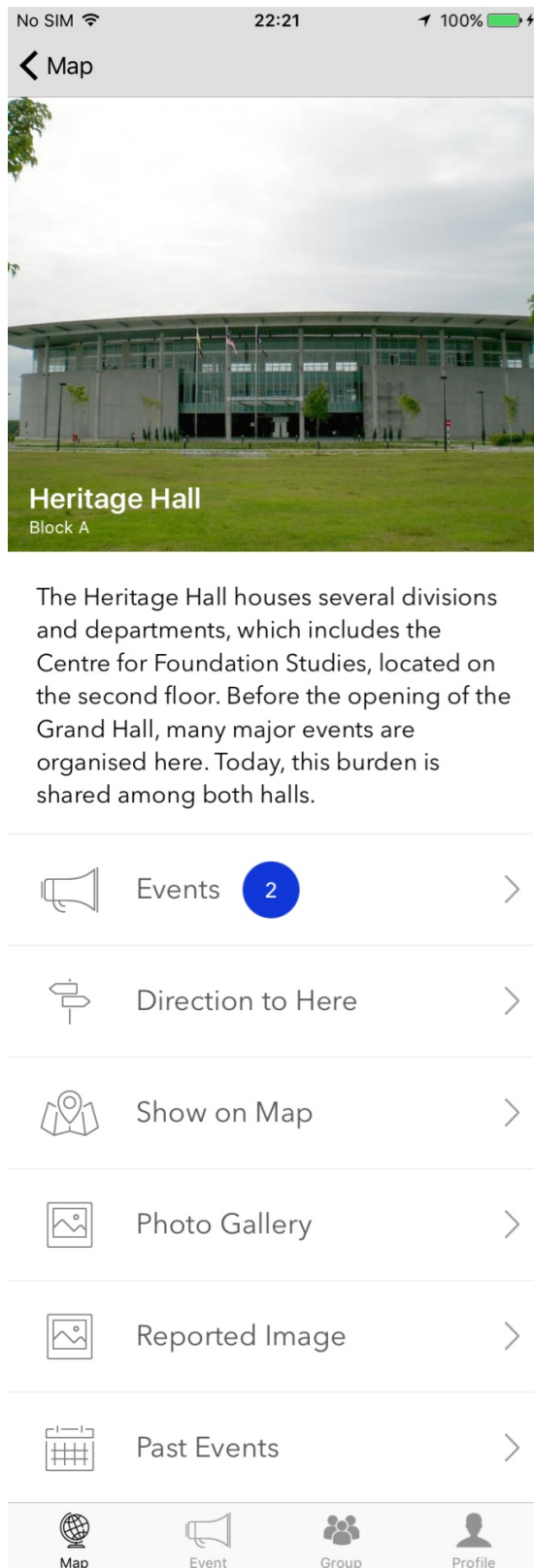
Parallax blur library is used while implementing the building view. This library was created by Software for Good. It wraps the UITableViewController component with a parallax image as the header. The parallax header is blurred with dynamically with the PXBlurView library, as shown in Figure 5.3. The events tab is shown if there is upcoming event held in the building selected, else the events tab will be hidden. When users press on the show on map tab, mobile UniCAT will navigate user back to the previous view which is the map view. Reported image tab bar is visible to authenticated users only. Authenticated users can remove any image that were reported by other users.

Figure 5.3 : Screenshot of the map module (cont)

5.1.2 Navigation Module
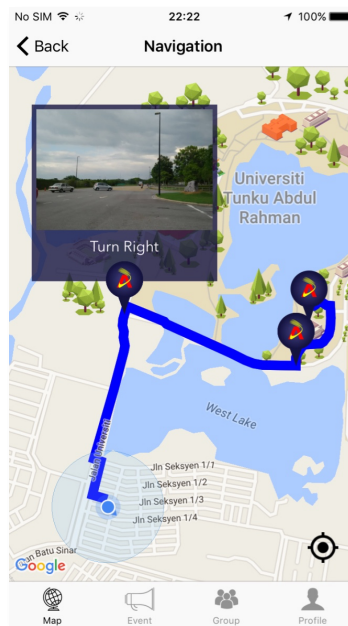
Figure 5.4 : Screenshot of navigation module

The navigation view is implemented using Google Map library, developed by Google. The library is a set of classes wrapping the Google Map view components, the annotations, and information windows. When users press the button "Navigation to Here" from Figure 5.3, mobile UniCAT system will collect user current location and pass the parameters such as the point of current location and the point of the targeted point to Google Map API. The shortest path is calculated and returned in JSON format and the n the route is displayed to the users. Google Map annotations are pinned on every important turning point to alert users to make a turn on that particular point. Google Map information windows is overridden using a custom information windows. The custom information windows is created using UIView, UIImageView and UILabel, where UIView holds the background, UIImageView holds the image and UILabel holds the details of the information window, as shown in Figure 5.4.

5.1.3 Group Module

(a) Create group view   (b) Join group view
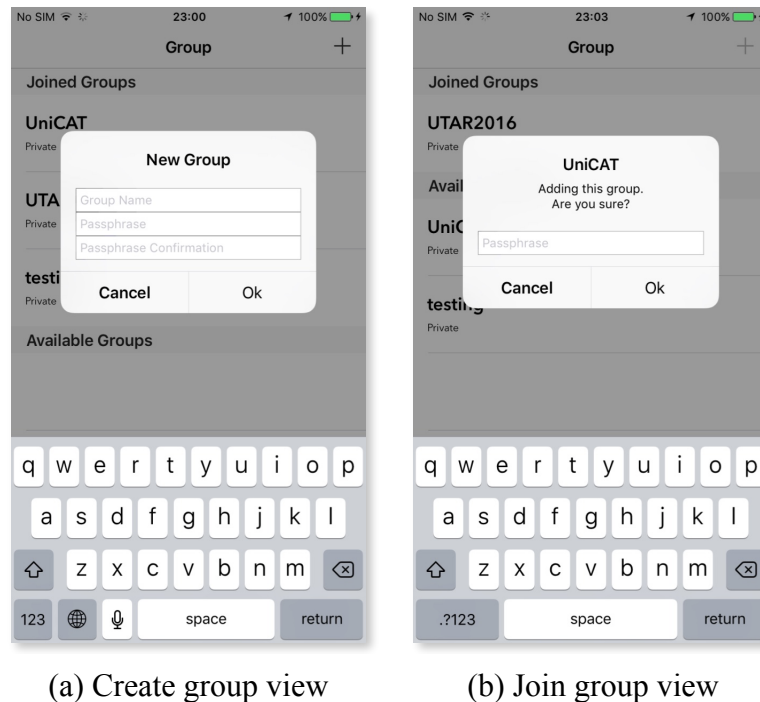
Figure 5.5 : Screenshot of group module

The group view is implemented using UITableViewController to show all the available and joined groups. When authenticated users press on the button "+", UIAlertView is called and it prompts the users to key in the group name and the passphrase in order to create a new group, as shown in Figure 5.5 (a). If the particular user leaves the group name blank or unfilled, UIAlertView will show that there is no valid group name being inserted. However, the passphrase is optional. For registered users, they are allowed to join any public groups without the passphrase, or private group with a correct passphrase. If the passphrase is incorrect, UIAlertView will indicate that invalid passphrase has been inserted.

5.1.4 Photo Gallery Module

| (a) Photo gallery view | (b) Image display view | (c) Report image view |
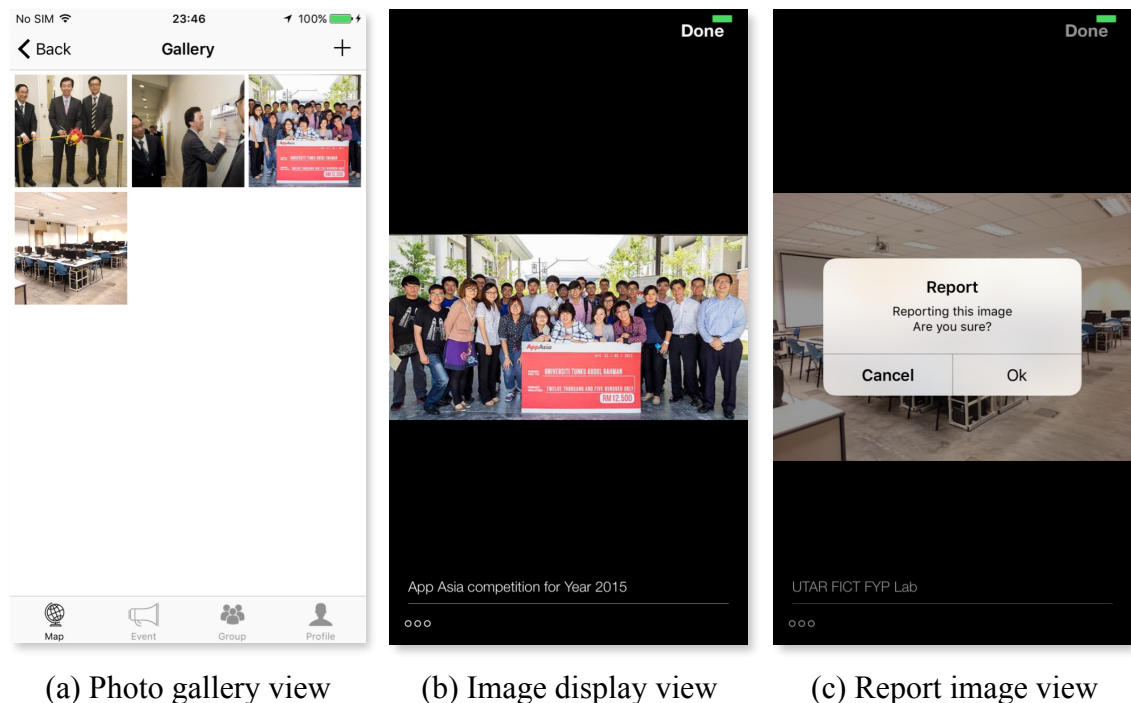
Figure 5.6 : Screenshot of photo gallery module

The photo gallery view is implemented using UICollectionViewController. With this, registered users are able to upload any image related to the buildings to the server. They are suggested to fill in the image details each time before saving the image to the server. Meanwhile, the image display view is implemented using EBPhotoPages library which was developed by Eddy Borja. EBPhotoPages library allows users to display pages of photos and their meta data in a scrollview (Borja, 2014), as shown in Figure 5.6 (b). Moreover, users are able to pinch to zoom in and out, save images to mobile devices and report abusive photos that violate certain terms or policies. When a user reports an abusive photo, an UIAlertView is prompted for confirmation of reporting. If the user presses "Ok" button, the selected image will subsequently be marked as flagged image while awaiting for the review results from administrator.

5.1.5 QR code Scanner Module

(a) QR scanner view   (b) Timetable details view   (c) Bus schedule view
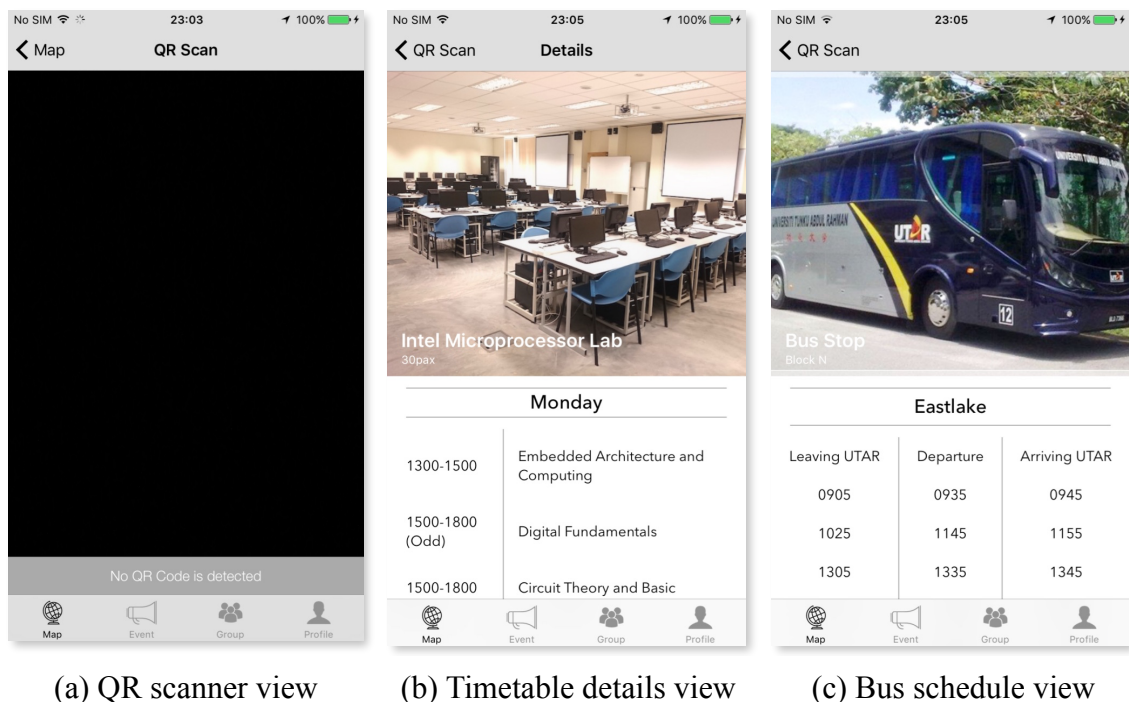
Figure 5.7 : Screenshot of QR code scanner module

The QR code scanner view is implemented using AVFoundation framework, the framework is developed by Apple. QR scanner view contain a UIView where the UIView is the container to preview video captured by the mobile device later, and a UILabel shows the text detected by QR scanner. At the bottom of the UIView, UILabel presents the status of the QR code reader. When a QR code is detected, mobile UniCAT will check for validation. If the QR code is valid, timetable / bus schedule view will appear, as shown in Figure 5.7 (b) and Figure 5.7 (c).

Chapter 5 : Implementation and Testing

5.2 Black Box Testing

5.2.1 Map Module

Table 5.2.1 : Map Module Test Case

Map Module			
Case	**Test Action**	**Test Result**	**Status**
1	Tap on a building annotation.	Building details view appeared.	Pass
2	Tap on point of interest button.	List of point of interest appeared.	Pass
3	Tap on "UniCAT" title.	Modes appeared.	Pass
4	Tap on QR code button.	QR code scanner view appeared.	Pass
5	Tap on "Direction to Here" in building details view.	Navigation view appeared.	Pass
6	Tap on "Show on Map" in building details view.	Navigate back to map view.	Pass
7	Tap on "Photo Gallery" in building details view.	Gallery view appeared.	Pass
8	Tap on "Pass Events" in building details view.	Pass event view appeared.	Pass

5.2.2 Navigation Module

Table 5.2.2 : Navigation Module Test Case

Navigation Module			
Case	**Test Action**	**Test Result**	**Status**
1	Tap on current location button	User current location pointed at centre of view	Pass
2	Tap on a annotation in navigation view	A window info with image and detail appeared.	Pass
3	Tap on destination annotation	A window info with "Destination" appeared.	Pass

5.2.3 Group Module

Table 5.2.3 : Group Module Test Case

Group Module			
Case	**Test Action**	**Test Result**	**Status**
1	Tap on group option in tab bar.	Group view appeared.	Pass
2	Tap on a available group in group view.	An alert view prompt user for the passphrase.	Pass
3	After case 2, passphrase accepted.	The selected available group should changed to joined group.	Pass

4	Tap on a joined group in group view.	An alert view to prompt for user conformation.	Pass
5	Tap on "+" button on top right.	An alert view prompt user for group name, passphrase and passphrase confirmation.	Pass

5.2.4 Forum Module

Table 5.2.4 : Forum Module Test Case

Forum Module			
Case	**Test Action**	**Test Result**	**Status**
1	Long press on map view.	Forum create view appeared.	Pass
2	After case 1, tap on the annotation of forum appear in the map view.	A list a forum appeared.	Pass
3	After case 2, tap on any forum in the list.	Details of the forum appeared.	Pass
4	Tap on "Dissuasion" button in forum details.	Discussion view appeared.	Pass
5	Tap on "Send" button in discussion details.	User comment should appear in discussion table view.	Pass

5.2.5 Photo Gallery Module

Table 5.2.5 : Photo Gallery Module Test Case

Forum Module			
Case	**Test Action**	**Test Result**	**Status**
1	Tap on "+" button on gallery view.	Add new photo view appeared.	Pass
2	Tap on Save button with no image.	Warning alert is shown as empty data.	Pass
3	Tap on Save button with all data fill in.	Data successfully stored and add photo view dismissed.	Pass
4	Tap on Save button with only image.	Data successfully store and add photo view dismissed.	Pass
5	Tap on only image in gallery view.	Image shown in full size with detail is appeared.	Pass
6	After case 6, long tap on image view.	Action sheet with "Save Image", "Report Image" and "Cancel" appear	Pass
7	After case 6, tap on button "Save Image".	Image saved into user device.	Pass

5.2.6 QR code Scanner Module

Table 5.2.6 : QR code Scanner Module Test Case

Forum Module			
Case	Test Action	Test Result	Status
1	An invalid QR code detected.	Warning alert is shown as not found.	Pass
2	A valid room QR code detected.	Image with timetable details appeared.	Pass
3	A valid bus QR code detected.	Image with bus schedule appeared.	Pass
4	A valid event QR code detected.	The details of event is appeared.	Pass

Chapter 6 : Conclusion

6.1 Project Review

This project strives to provide UTAR students and visitors useful information and navigation of UTAR Perak campus. The campus navigation module of the UniCAT clients for mobile, in the form of a mobile application, will allow the target users to get familiar with environment around the campus with just using the device in the palm of their hands. UniCAT system is not only providing campus navigation to the users, but also providing all the necessary information about UTAR Perak Campus to them. In addition, UniCAT system provides a photo gallery to allow users to provide images for each building. By viewing the images inside the photo gallery, the visitors and students are able to be more familiar with UTAR environment. Most importantly, the lecturers can disseminate up-to-date information easily and quickly to the group members by sending them a push notification. It then enables the group members to receive the latest information faster.

Through this project, UniCAT is not only being granted the chance to first enter into mobile platform, but also manage to find new ways to interact more with users and ease the access by users at anytime and anywhere.

Chapter 6 : Conclusion

6.2 Future Work

Firstly, the most important module is the map module which consists of the base of the whole UniCAT project. The map in mobile UniCAT should support areas outside UTAR such as Westlake, Eastlake, Kampar West City and other more. When the map in mobile UniCAT expands, users are allowed to create community groups on area basis which then enable them to share and discuss the concurrent issues happening in their areas.

Secondly, UniCAT system can be expanded to indoor navigation by using the existing function in UniCAT system which is the mobile navigation using WiFi signal strength ,also known as received signal strength indicator (RSSI) and QR code around UTAR. To be specific, indoor navigation detects user current location using WiFi RSSI. However, the signal strength may be interrupted by internal walls, varying signals and etc. Therefore, by using QR code, mobile UniCAT can make sure users are in the correct coordination.

Thirdly, UniCAT system can be expanded to food advisory system by using the existing users' informations. However, the food advisory system is different from existing application such as hungry go where and etc. Due to the dilemma having by most of the users in selecting a particular restaurant in order to have their meal, UniCAT system provides an algorithm that will suggest a restaurant to the users. Before that, users are being presented a list, showing all the categories of food and they can select any categories based on their favour as they wish to. Then, they may select their friends nearby, within 50m away from their current location. UniCAT system will then analyse the same categories selected by them and suggest a restaurant using UniCAT system algorithm.

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Appendix

Promotional Poster

Appendix A-1: Promotional Poster for UniCAT Campus Navigation

CAMPUS NAVIGATION AND INTERACTION MODULE IN MOBILE UNICAT SYSTEM

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