

## **AIRPORT ASSISTANT APPLICATION**

### **Project No. 20**

Sorranant Thamnajit, Team, 55070503448, silverpenguinz@gmail.com

Apinut Saepong, Nut, 55070503455, ha2elnut.pong@gmail.com

Advisor: Asst.Prof.Dr. Marong Phadoongsidhi

Date: 24 May 2016

---

I have read this report and approve its content.

## **Abstract (English)**

Among the highly increasing rate of passengers that using air transportation around the world, the need of airport service is also high as well. Bangkok which is one of the most popular city for tourism in the world, Suvarnabhumi Airport and Don Mueang International Airport are first places that receive passengers from around the world. With the large amount of passengers, airport officers might not be able to assist or give a suggestion to all passengers that need help in the limited time.

iBeacon technology is a technology that uses Bluetooth to communicate with others devices and can indicate the indoor location. So, we are interested in implementing an application and integrate it with the iBeacon technology. It could make the airport management to be more efficient.

Our Application will be a good assistant for passengers. They can use this application to check-in and receive the boarding pass with all flight important information will be saved on their phone. The application will notify passenger if the time to board is coming or there are some change of their flight like boarding gate is changed or flight time is delayed. It also provides airport's indoor map to passenger with a direction from where the passenger is. So passenger can go anywhere they want without asking staffs.

## Abstract (Thai)

ท่ามกลางการเพิ่มสูงขึ้นของอัตรานักท่องเที่ยวทั่วโลกที่ใช้บริการการเดินทางทางอากาศ ความต้องการของการบริการในสนามบินก็เพิ่มขึ้นเช่นเดียวกัน กรุงเทพมหานคร ซึ่งถือเป็นหนึ่งในเมืองที่มีชื่อเสียงมากที่สุดในโลกสำหรับนักท่องเที่ยว สนามบินสุวรรณภูมิและสนามบินดอนเมือง ถือเป็นสถานที่แรกที่จะรับนักท่องเที่ยวจากทั่วโลกเข้ามา เนื่องด้วยจำนวนผู้โดยสารที่มีมากมาย อาจทำให้ทางเจ้าหน้าที่ของสนามบินไม่สามารถให้ความช่วยเหลือ หรือคำแนะนำแก่ผู้โดยสารได้อย่างทั่วถึงในเวลาอันจำกัด

เทคโนโลยีไอปีคอน เป็นเทคโนโลยีที่ใช้สัญญาณบลูทูธในการสื่อสารกับอุปกรณ์อื่นๆ และสามารถระบุตำแหน่งภายในอาคารได้ ดังนั้นผู้พัฒนาจึงมีความสนใจที่จะสร้างและพัฒนาแอปพลิเคชันที่ทำงานร่วมกับไอปีคอน โครงการชิ้นนี้อาจทำให้การบริหารงานภายในสนามบินมีประสิทธิภาพมากขึ้น

แอปพลิเคชันนี้จะเป็นผู้ช่วยที่ดีสำหรับผู้โดยสาร ผู้โดยสารสามารถใช้แอปพลิเคชันเพื่อเช็คอินและรับข้อมูลของบอร์ดดิ้งพาส รวมถึงข้อมูลที่จำเป็นของไฟล์ท์บินมาเก็บไว้ในโทรศัพท์ได้ แอปพลิเคชันจะแจ้งเตือนผู้โดยสารหากเวลาขึ้นเครื่องใกล้เข้ามา หรือไฟล์ท์มีการเปลี่ยนแปลงบางอย่างเช่นการเปลี่ยนเลขที่เกต หรือการเปลี่ยนแปลงของไฟล์ท์บิน แอปพลิเคชันนี้ยังสามารถแสดงแผนที่ภายในให้กับผู้โดยสาร และเส้นทางต่างๆจากตำแหน่งของผู้โดยสาร ซึ่งทำให้ผู้โดยสารสามารถเดินไปยังสถานที่ต่างๆได้ โดยไม่ต้องสอบถามเจ้าหน้าที่สนามบิน

## **Acknowledgements**

First of all, we would like to say that this project wouldn't be completed without our project advisor, Asst.Prof.Dr. Marong Phadoongsidhi, and our project committees. They spend their precious time for our project consultations and give us many useful suggestions. We really appreciated that.

Not only our kind advisor and co-advisor, but there are also many people who has been contributed in this project - Our seniors who gave us suggestions about Swift programming and iBeacon knowledge.

Moreover, this project wouldn't be done if there is no encouragement and support from our beloved parents. There are many friends who really help us to complete this project too.

Finally, we would like to thank airport officers at Suvarnabhumi Airport and Don Mueang International Airport who also spend their precious time gave us many important information. This project will not reach its goal if we didn't get these information from them.

# Table of Contents

## Contents

Chapter 1: Introduction.....	1
1.1 Problem Statement and Approach.....	1
1.2 Objectives .....	1
1.3 Scope .....	2
1.3.1 Application Scope .....	2
1.3.2 Acceptance Criteria .....	2
1.4 Tasks and Schedule .....	3
1.4.1 Tasks for First Semester .....	3
1.4.2 Tasks for Second Semester.....	3
1.4.3 Gantt chart for First Semester.....	4
1.4.4 Gantt chart for Second Semester .....	5
Chapter 2: Background, Theory and Related Research .....	6
2.1 Previous Project.....	6
2.2 iBeacon .....	6
2.3 Beacon .....	7
2.4 Parse .....	7
2.5 Estimote Cloud .....	7
2.6 Swift Language.....	7
2.7 Project with real world stakeholders .....	7
Chapter 3: Design and Methodology.....	10
3.1 Software requirements list.....	10
3.2 Database Requirement list.....	10
3.3 Feature list .....	10
3.4 System Architecture .....	11
3.5 Use Cases Diagram .....	12
3.6 Sequence Diagram.....	13
3.7 Architectural Context Diagram .....	15
3.8 Database Design .....	16
3.9 User Satisfaction Evaluation .....	18

Chapter 4: Results and Discussion .....	19
4.1 Screenshots .....	19
4.2 Application and Beacon Performance.....	27
4.2.1 Check-in Function .....	27
4.2.2 Navigate Function .....	27
4.2.3 Notifications .....	28
4.2.4 Beacon .....	28
4.2.5 Parse database.....	29
4.3 Summarizing .....	31
4.3.1 Project's benefits, new knowledge, system or software.....	31
4.3.2 How our project can solve problems stated in Chapter 1? .....	31
4.4 Evaluation.....	32
Chapter 5: Conclusion .....	36
5.1 Completion Status .....	36
5.2 Problem we have faced while doing the project .....	37
5.3 How the project could be extended? .....	37
References .....	38
Appendices .....	39

## List of Figures

Figure 1.1 Gantt Chart for First Semester.....	4
Figure 1.2 Gantt Chart for Second Semester.....	5
Figure 2.1 How iBeacon works.....	6
Figure 2.2 Chart for Passengers' result.....	8
Figure 2.3 Chart for Airport Officers' result.....	9
Figure 3.1 System Architecture.....	11
Figure 3.2 Application Use cases diagram.....	12
Figure 3.3 User Sequence Diagram.....	13
Figure 3.4 Architectural Context Diagram.....	15
Figure 4.1 Beacon setting screen 1.....	19
Figure 4.2 Beacon setting screen 2.....	19
Figure 4.3 Welcome screen.....	20
Figure 4.4 Main menu screen.....	20
Figure 4.5 Check-in screen 1.....	21
Figure 4.6 Check-in screen 2.....	21
Figure 4.7 Check-in screen 3.....	22
Figure 4.8 Flight Information Screen.....	22
Figure 4.9 Flight information screen 2.....	23
Figure 4.10 More information screen.....	23
Figure 4.11 Navigate feature screen 1.....	24
Figure 4.12 Navigate feature screen 2.....	24
Figure 4.13 About us screen.....	25
Figure 4.14 Notification screen.....	26
Figure 4.15 Notification screen 2.....	26
Figure 4.16 Installation Table.....	29
Figure 4.17 Booking Table.....	29
Figure 4.18 Check-in Counter Table.....	30
Figure 4.19 Flight Information Table.....	30
Figure 4.20 Participants' gender Chart.....	32
Figure 4.21 Participants' Age Range Chart.....	32
Figure 4.22 Easiness of user interface to be understood Chart.....	33
Figure 4.23 Participants' satisfaction with check-in function Chart .....	33
Figure 4.24 Participants' satisfaction with notification function Chart.....	34
Figure 4.25 Participants' satisfaction with flight transit function Chart.....	34
Figure 4.26 Participants' satisfaction with location and direction function Chart.....	35

# **Chapter 1: Introduction**

## **1.1 Problem Statement and Approach**

Nowadays, air transportation is the most popular way to go to somewhere. A lots of people are heading to the airport but some of them are new or might not be familiar with the airport's system and direction. For example, new passengers might not know how to check-in or where is their check-in counter. Walking inside each airport can be a problem for passenger too since each airport has the complicated direction.

So our project which we are going to do will solve problems which are listed above. Our application will be developed to work as an assistant for passengers. It will provide an airport map for passenger and help them to know where they are and are there any nearby places. Moreover, it will also show the estimated time for walking and distance for flight transit.

Lastly, we would state that our project belongs to 'Project with real world stakeholders' category. Because when it's completed then it will mainly help passengers when they're in airports and reduce workload of airport officers.

## **1.2 Objectives**

1. To assist or help passengers in airport - Sometimes it quite hard for passengers to know the working system or procedures of each airport. So our application will make it easier for procedures that passenger need to complete such as check-in, go to a gate, wait for on board, or even transit a flight.

2. To work as a reminder - The application can notify passengers when they need to go to a gate or when a flight is delayed. So passengers can spend their time in an airport without worrying that they will miss something.

3. To provide map and information for everyone in airport - Each airport has a complicated direction and it can cause problems for everyone who comes to the airport. We decided to use iBeacon technology to integrate with this application in order to provide the indoor location map of each airport and specify a position to let people know where they are now. Moreover, this application will also let user know about their nearby places and estimated distance for each places.

4. To learn more about iBeacon technology - iBeacon technology is a bluetooth technology which consumes low energy and can be used in many ways.

5. To learn about Swift language - Swift is a new programming language which is used for apple devices' application development. It's established to



replace Objective-C. It's stated to be more powerful and has more flexibility than Objective-C.

## **1.3 Scope**

### **1.3.1 Application Scope**

1. A mobile application which will be working on iOS platform.
2. Backend of this application will be managed by using Parse.
3. We don't have any plan to develop an application on Android platform right now.
4. Our application need to work with Beacons which are set up by us.
5. Internet connection is required for some features.

### **1.3.2 Acceptance Criteria**

1. Functionality of check-in feature.
2. Functionality of flight information feature.
3. Functionality of navigation feature.
4. Functionality of notifications system.
5. Functionality of backend system.
6. User satisfaction evaluation.
7. Overall application performance
8. Signal transmission between beacons and device.

## **1.4 Tasks and Schedule**

### **1.4.1 Tasks for First Semester**

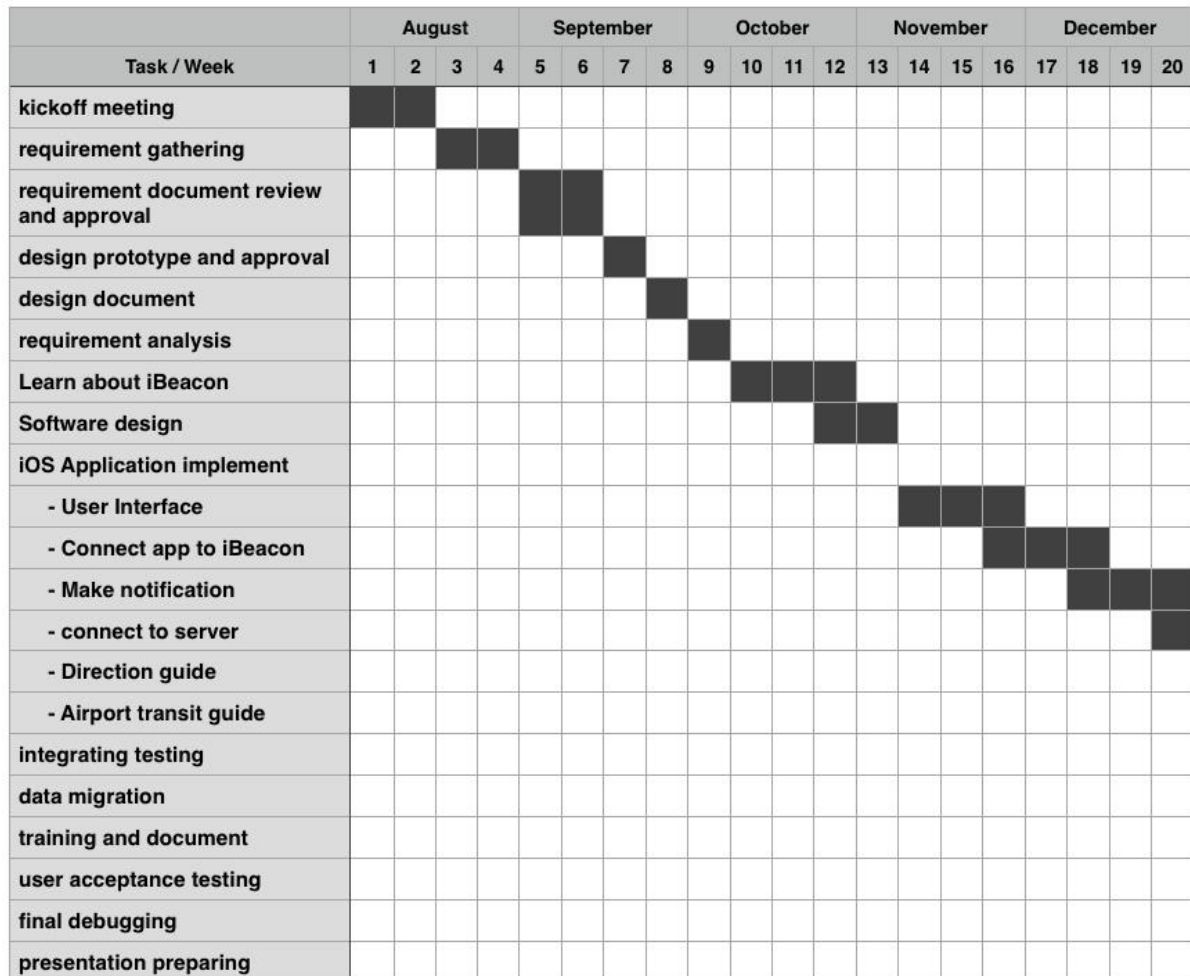
1. Backend application managing by using Parse.
  - 1.1 Parse setup.
  - 1.2 Adding information.
  - 1.3 Connect beacon, Parse, and device together.
2. An airport map which can be used in a completed application.
  - 2.1 Identify location in map by using beacon.
  - 2.2 Name of each place in airport map
3. Filling in information about distance and walking time.
  - 3.1 Estimated time for walking to each place.
  - 3.2 Estimated distance for walking to each place.
4. Mockups for each user interface screen.
  - 4.1 Mockup of main menu screen.
  - 4.2 Mockup of check-in screen.
  - 4.3 Mockup of flight information screen after check-in.
  - 4.4 Mockup of more information screen in flight information feature.
  - 4.5 Mockup of navigation feature screen.
  - 4.6 Mockup of average distance and time show to transit flight.
  - 4.7 Mockup of a screen when receives notifications.
5. Make a beacon to be able to communicate with an iOS device.
  - 5.1 Make a beacon to detect devices within proximity range.
  - 5.2 Make a beacon and a device to send and receive identifiers and information correctly.

### **1.4.2 Tasks for Second Semester**

1. Completed iOS application which can interact with Beacon efficiently.
  - 1.1 Check-function works precisely.
  - 1.2 Flight information must be saved in device.
  - 1.3 Indoor airport map and nearby places' name are shown precisely.
  - 1.4 Flight transit information must be sent to user precisely.
  - 1.5 Estimated remaining time and distance are shown precisely.
  - 1.6 If there are any changes, user must receive notifications precisely.
2. An airport information which can be used in reality.
  - 2.1 An airport map which will be used for navigate feature.
  - 2.2 Name of each place.
  - 2.3 Estimated time for walking to each place.

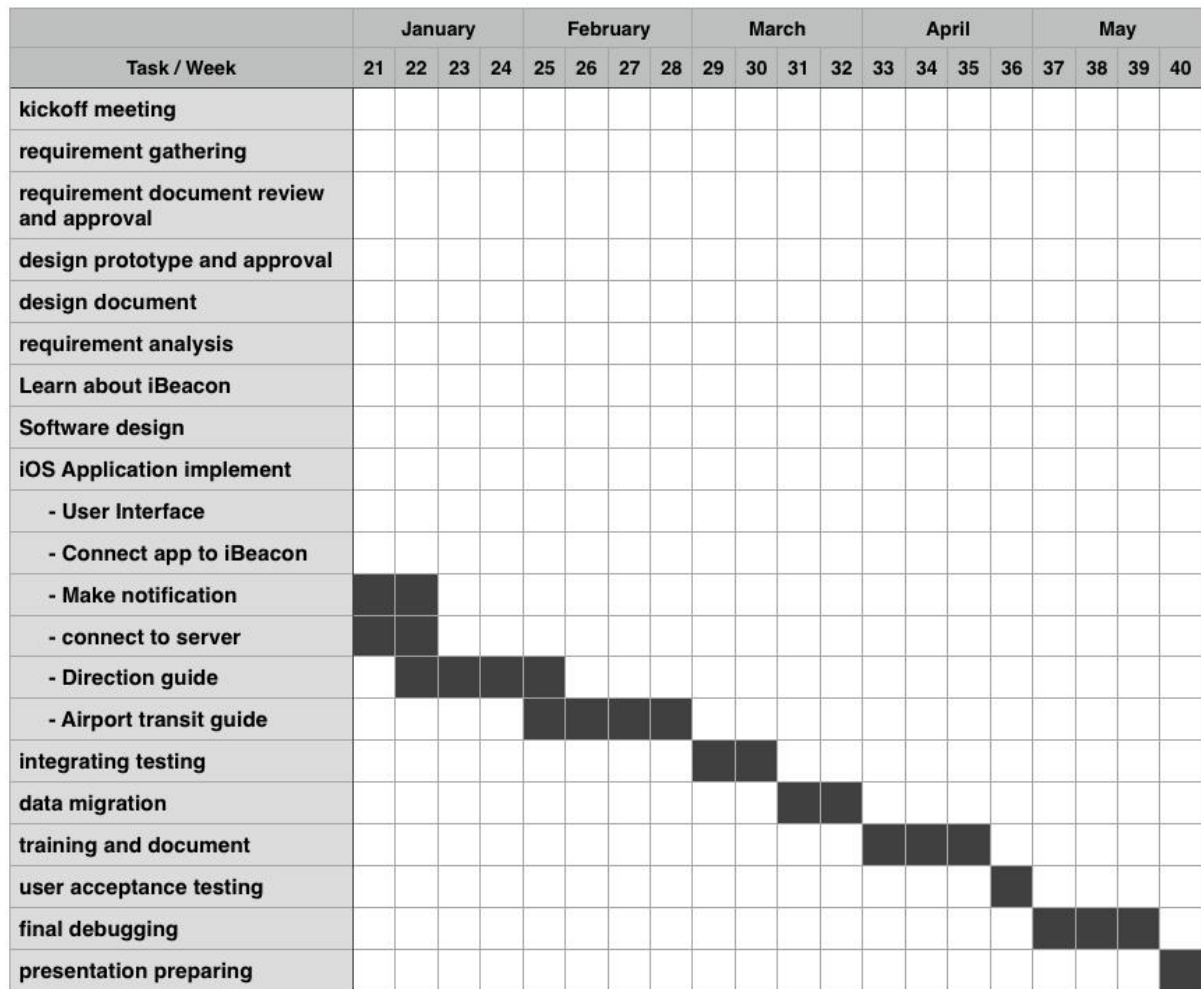
- 2.4 Estimated distance for walking to each place.
- 2.5 Flight transit procedures
- 3. Final report.
  - 3.1 Final report contains overall information needed.

### 1.4.3 Gantt chart for First Semester



*Figure 1.1 Gantt Chart for First Semester*

## 1.4.4 Gantt chart for Second Semester



*Figure 1.2 Gantt Chart for Second Semester*

## Chapter 2: Background, Theory and Related Research

This chapter contains many background information. It's composed of technologies which are used for application development, previous project information which has the same goal as our application, and results that we got by doing surveys with passengers and airport officers at the Suvarnabhumi Airport.

### 2.1 Previous Project

There is a previous project developed by SITA which also uses iBeacon technology. Their application is mainly used for tracking passengers' location to use for further action and might give passengers some relevant information. But our application which will be developed, contains those functions already. Moreover, we will add many features into this application. First, user will be able to check-in to the flight via our application. Second, user can open the indoor map location and find where they are or where they want to go. Last, user will get flight transit steps and information if any including with average remaining time and distance.

### 2.2 iBeacon

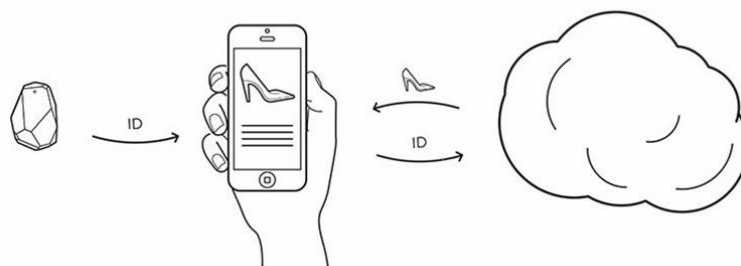
iBeacon is a technology that enable a location awareness for application. It uses bluetooth low energy for transmitting signal that contain an identifier which will be picked up by a supported application.

The identifier signal will contain 3 main pieces of information

2.1.1 UUID - A 16 byte string used to differentiate large group of beacons.

2.1.2 Major - A 2 byte string used to differentiate a smaller group but in the subset of UUID.

2.1.3 Minor - A 2 byte string used to identify individual beacon.



**Figure 2.1** How iBeacon works

[Source: <http://developer.estimote.com/ibeacon/>]

From Figure 2.1, it shows how iBeacon and beacon works. When users come close to the beacon device, it will send the identifier signal to a device and then a device will pass the identifier to a cloud. Then a cloud will send the real information back to a device.

## **2.3 Beacon**

Beacon is a device which is created to attract attention to a specific location. It's contained of bluetooth module, temperature, and motion sensor. Signals in each beacon can be broadcasted using built-in antennas.

Our group chose Estimote Beacon which its battery can last more than 3 year. A beacon is not always broadcasting but it's blinking instead. The signal detection reliability will be proportional to the times beacon blinks.

## **2.4 Parse**

Parse is a backend service provider. It provides user with an application development using platform in the cloud.

Parse offers a backend service to store data in database which can be created online. It also allows to push notifications directly from its service to an application.

## **2.5 Estimote Cloud**

Estimote Cloud is a kind of tool used for managing beacon. It works as a web-based platform. This tool allows us to remotely access beacons setting.

Estimote Cloud also contains many tools that allow user to manage their beacons easier.

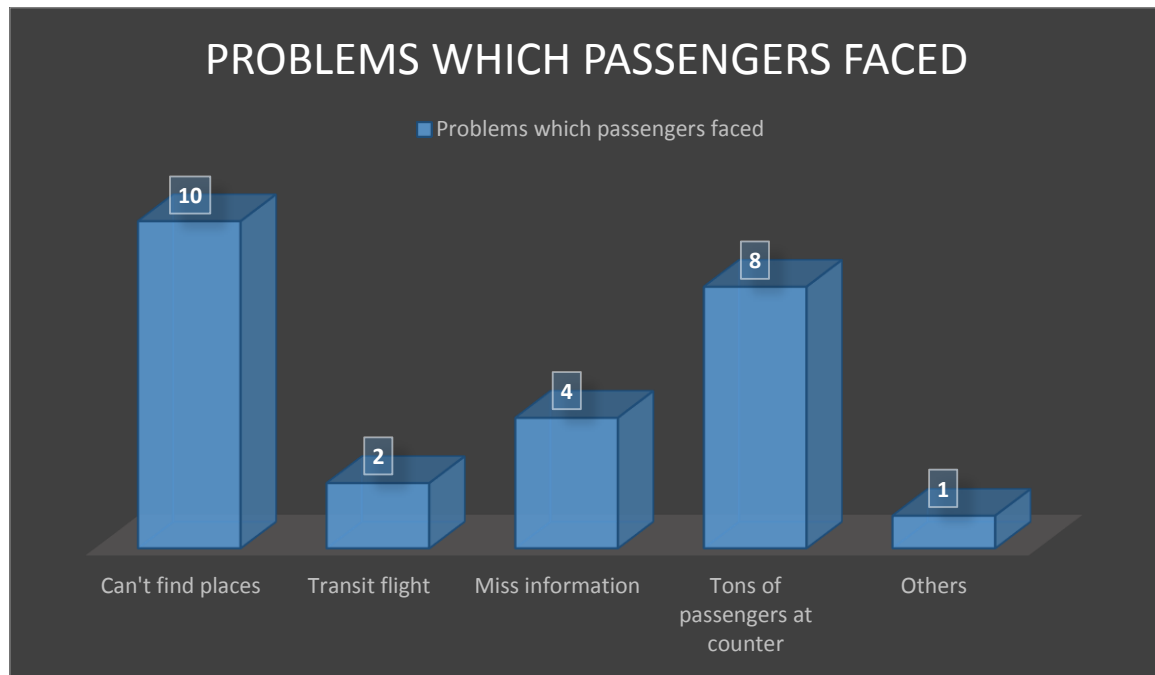
## **2.6 Swift Language**

Swift is a new programming language created by Apple Inc. It can be used for iOS, OS X, watchOS, and tvOS development. Swift is available on Xcode6 and later. It's stated to be more efficient and easier to implement than Objective-C which is a former programming language for iOS, OS X, watchOS, and tvOS development.

## **2.7 Project with real world stakeholders**

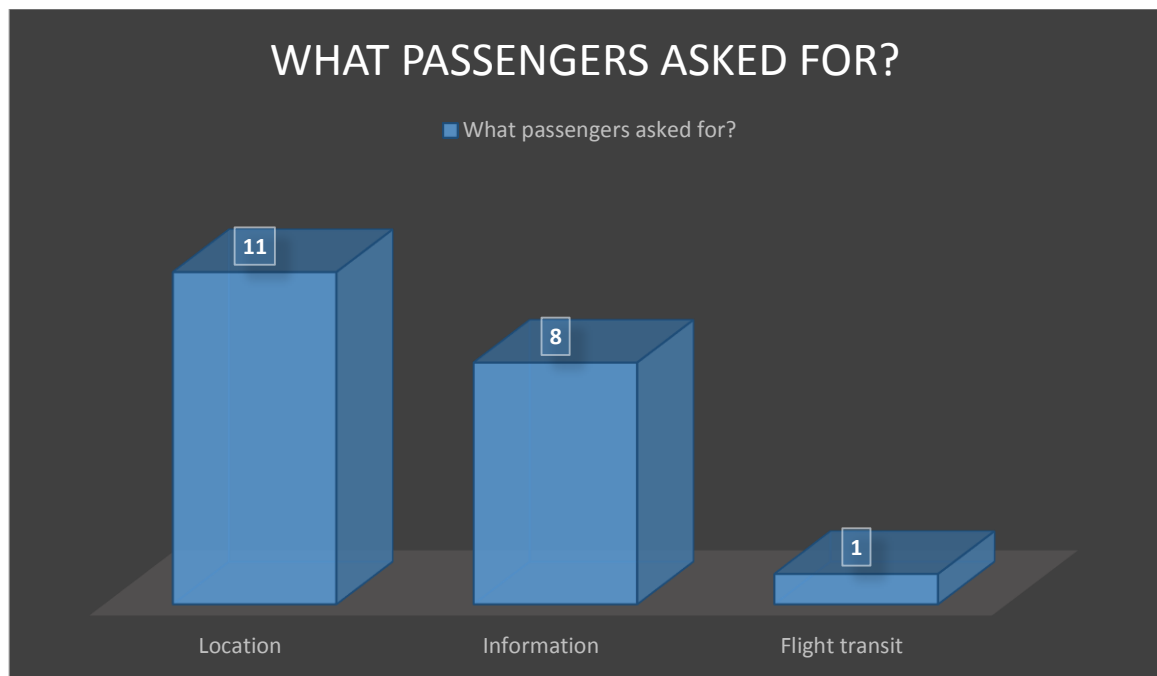
Stakeholders of this project are passengers and airport officers. Because passengers will be more convenient travelling in airport with our application. So when passengers have less problems, this can reduce workload of airport officers too. We will determine results and information which we retrieved from our surveys. These part will be separated into 2 parts, the first one is passengers'

feedback and another is airport officers' feedback. The survey took place at Suvarnabhumi Airport.



***Figure 2.2 Chart for Passengers' result***

From the chart above, we gathered the result from 25 passengers. We asked them what their main problem is while using an airport. You will see that 10 out of 25 select can't find places in an airport is their main problem. Our indoor location map feature will solve this problem effectively. Tons of passengers at the check-in counter came up in the second place, so this problem will be solved by checking-in feature via our application to avoid crowded passengers at the check-in counter.



***Figure 2.3 Chart for Airport Officers' result***

From the second chart, we did a survey with 20 airport officers and gathered response from them. We asked them that in their daily work, what is the most thing that passengers ask them about. Their response are passengers ask about each place in an airport the most. Next is passengers sometimes ask them about flight information, or whether the flight is delay or cancelled or not. The thing that passengers ask the least is flight transit steps and information.



## **Chapter 3: Design and Methodology**

This chapter contains each component requirements, feature of the complete application. Moreover, overall design, many kinds of diagram which are used for describing application concept. User interface design of each screen will also be included in this chapter.

### **3.1 Software requirements list**

1. This application is designed to be compatible with iPhone.
2. This application will be implemented using Swift language.
3. Parse will take the responsibility of application's backend.
4. This application must be able to communicate with our beacons.
5. Menu will be shown in English.
6. This application need an internet in order to work.
7. User authentication is required in check-in feature.
8. Only administrator can add, remove or change flight transit information.
9. Only administrator can change or edit navigation map.
10. Only administrator can push notifications from Parse database to devices.

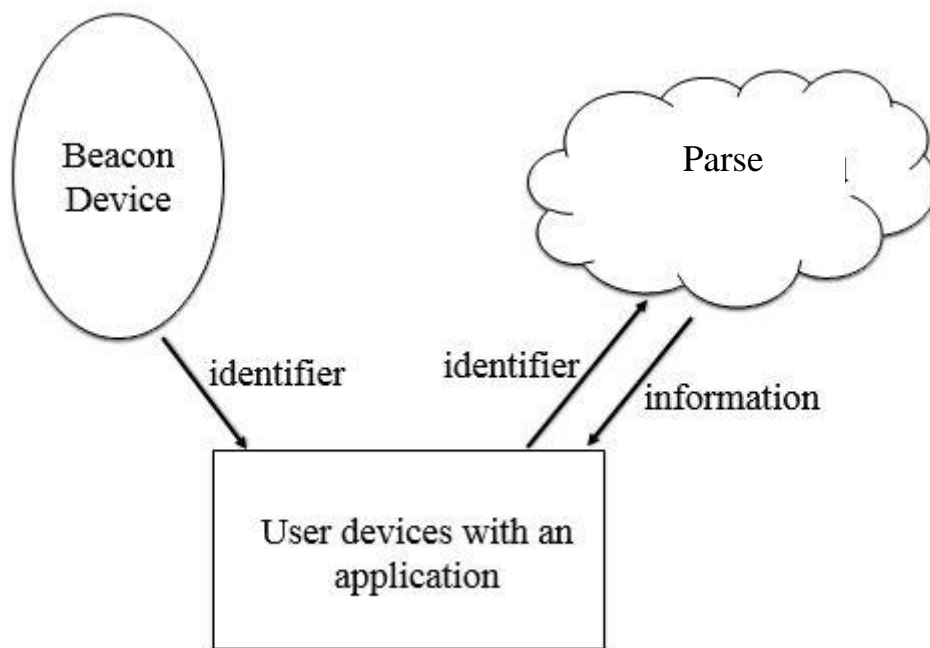
### **3.2 Database Requirement list**

1. Database must contain the flight transit information.
2. Database must contain the flight information.
3. Database must contain distance and time for walking to each place.
4. Database must contain passenger booking information.

### **3.3 Feature list**

1. Navigation feature will show the overall map and user's position.
2. Check-in function will provide list of airlines for user and allow them to enter booking number and their identification (passport number or id card number).
3. After checking in, flight information will be saved on user's device.
4. User can press more information button in flight information screen to view some information in details.
5. Notifications will be sent to user device automatically if the boarding time is coming.
6. Flight transit steps will be sent to user device automatically.
7. Estimated remaining time or walking time will also be shown.
8. If flights have some changes, notifications will be sent to user device automatically to notify user.

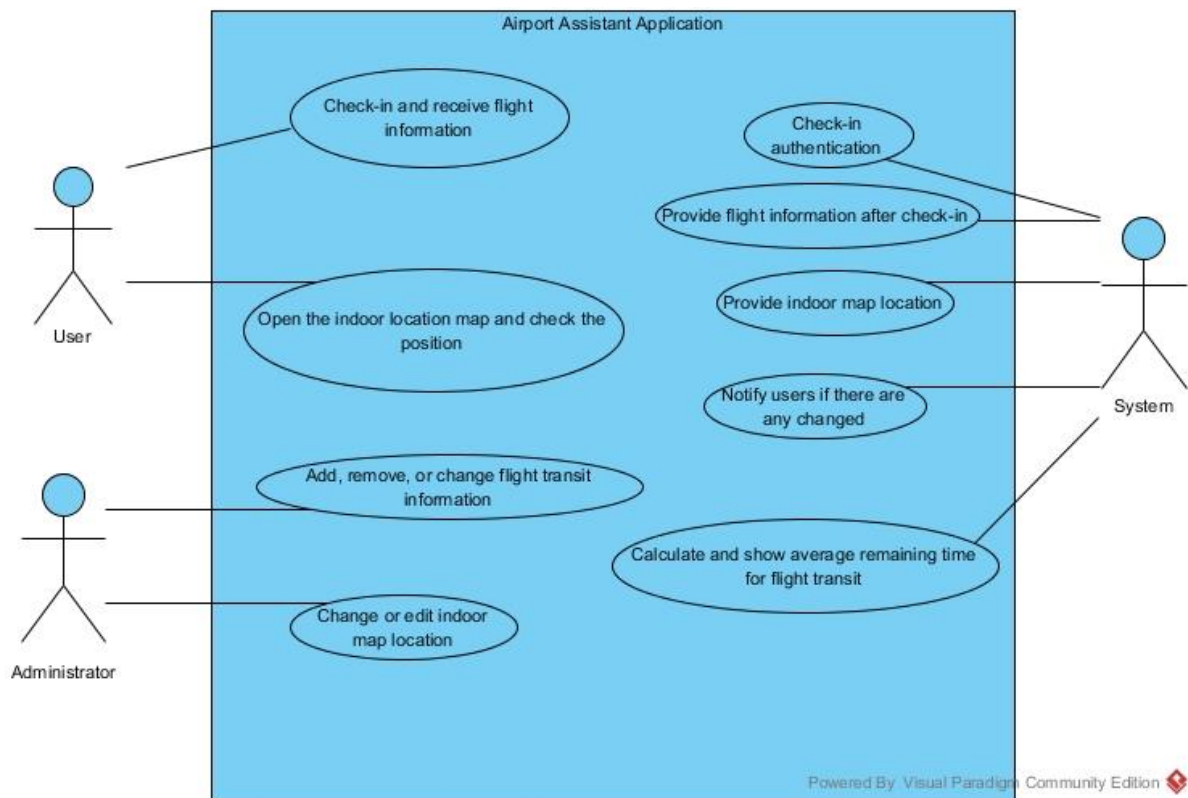
### 3.4 System Architecture



*Figure 3.1 System Architecture*

From Figure 3.1, this diagram show that there 3 main components in this project. First, it's beacon device which will send identifiers to user device. Second, user devices which already installed our application to receive identifiers from beacon and pass them to Parse then receive the real information back. Last, it's a system backend management tool called 'Parse'. It will contain the useful information and send it to user device after receive the identifier from them.

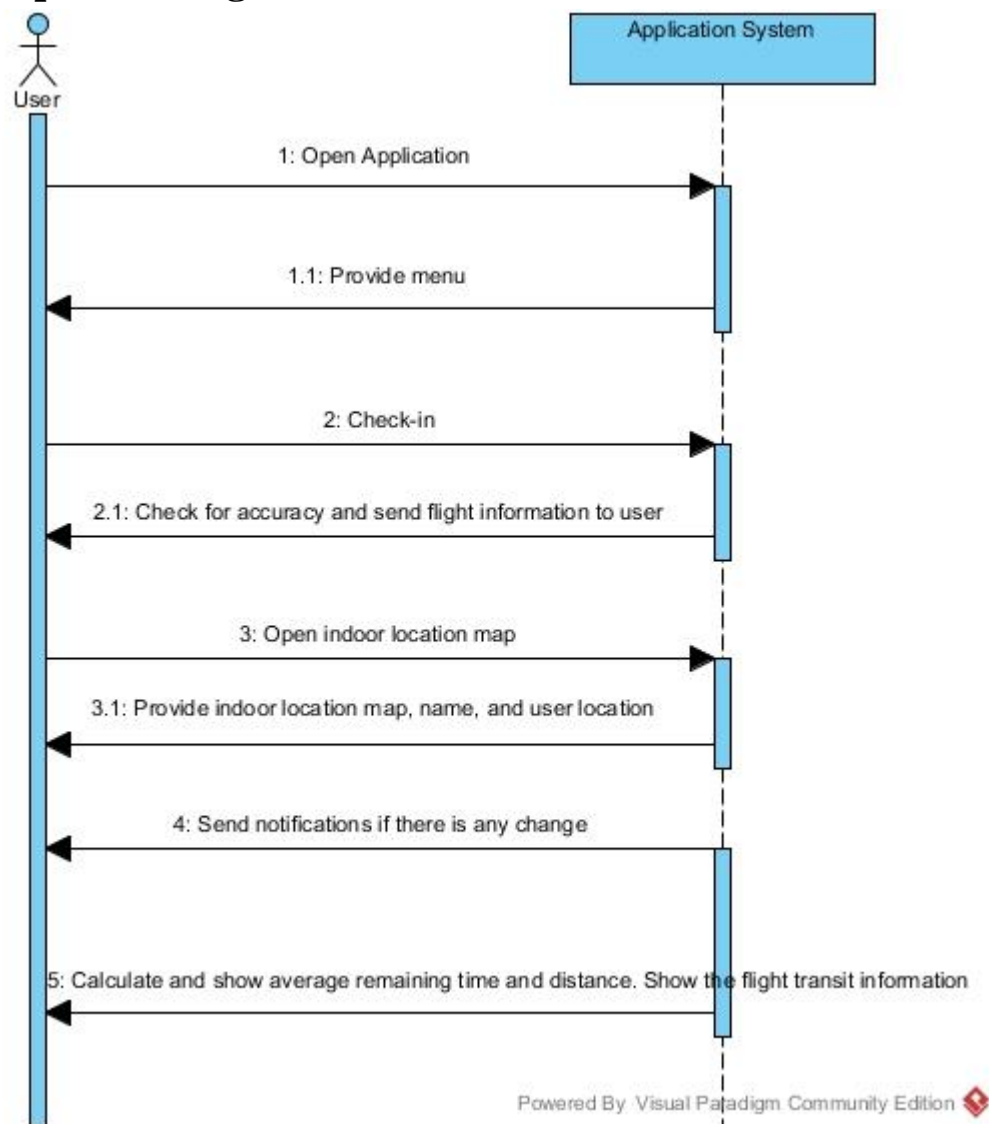
### 3.5 Use Cases Diagram



**Figure 3.2** Application Use cases diagram

From Figure 3.2, users will be able to log-in, check-in, receive flight information, and check their position using indoor map location function. An administrator can edit or modify flight transit information and indoor map location. Lastly, the system will do user authentication, provide flight information after user check-in successfully, provide indoor map location, send notifications to users if there is any change, calculate then show the average remaining time and provide flight transit steps.

### 3.6 Sequence Diagram



*Figure 3.3 User Sequence Diagram*

#### **Open application**

1. User open an application.
- 1.1 System provide main menu for user to select.

#### **Check-in**

2. User check-in to the flight by entering their identification (passport number or id card number) and booking number.
- 2.1 System will check the accuracy of check-in functionality and if it's successful, then system will provide flight information to user and save in their device automatically.

### **Open navigation feature**

3. User open the indoor location map feature.

3.1 System will provide the airport with current position of user, nearby places, and estimated distance from user.

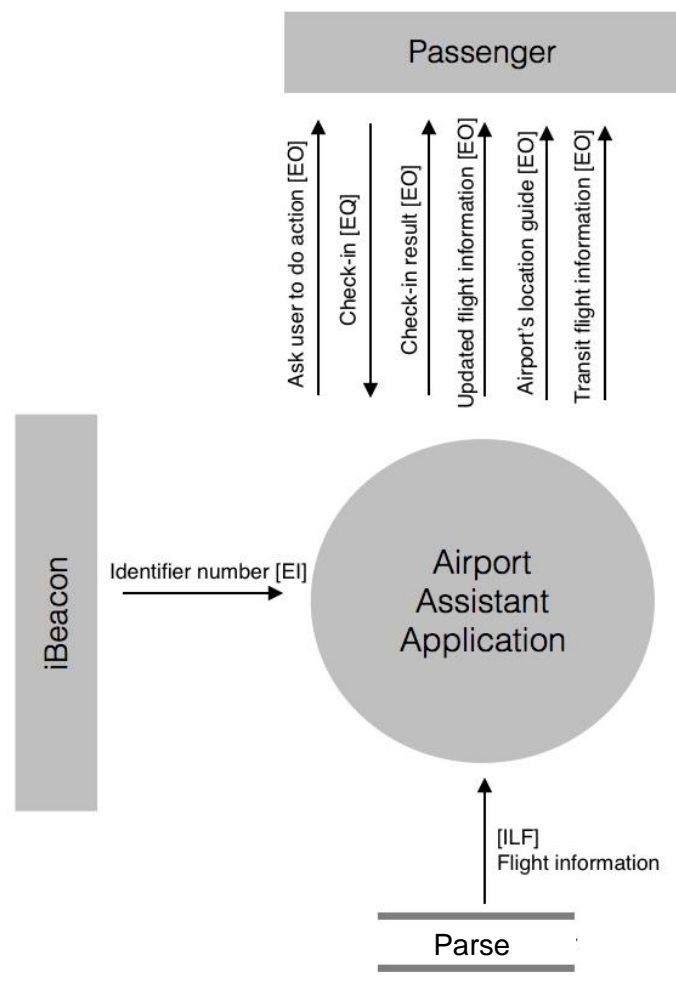
### **Notifications**

4. System will send notifications to user if there is any change with flight such as flight is delayed, cancelled or the boarding time is getting closer.

### **Flight transit information**

5. User will receive the flight transit information automatically. These information will be stored in 'More Information' menu in flight information feature.

### 3.7 Architectural Context Diagram



**Figure 3.4** Architectural Context Diagram

There are 4 main components in this project which are application, Parse, beacon with iBeacon technology, and passengers' device. A beacon will use the iBeacon technology and send the identifier to the application. Application will ask for information from Parse server. Passengers can check-in and receive the result and flight information. Moreover, passengers can receive the indoor location map, their current position, and flight transit information via our application.

### 3.8 Database Design

#### Installation Table

channels	deviceToken
["global","TZ298","TZ031","NH808","CX616"]	31b4ccd169a0cd59c3f9150ecfe3d10e7c6b60a05a6556e874f7335ae2fab5d4

This table called “Installation”. It contains the information of each device that install this application. ‘channels’ column contains all flights that are checked-in successfully by each device. While ‘deviceToken’ contains the token string of each device that install the application. Each devices will have different device token.

#### Booking Table

airline	booking_number	Identification
Nokscoot	SCOOT01	11111

This table called “booking”. It contains 3 main information about passenger’s booking which are airline, booking number, and identification (passport number or id card number). These information will be used to authenticate when passenger want to check-in via our application.

#### Check-in Counter Table

airline	counter
Qatar Airways	F

This table called “checkinCounter”. This table contains 2 main columns which are airline and counter. After user check-in successfully, the application will query information from this table by comparing the airline name then it will let user know which counter they need to go to in order to drop their luggage.

#### Flight Information Table

firstname	lastname	booking_number	flight_number	airline
VADER	TEST01	CATHAY01	CX616	Cathay Pacific Airlines
departure	destination	departure_time	departure_date	gate
BKK	HKG	09:49:00	31 May 2016	C8

This table called “flightInformation”. It contains 10 columns of information. These information will be saved and available on used device after they’ve checked-in successfully.

*\*Please be noted that we only show columns that contain necessary information but in Parse database there are few more columns that contain some kind of system-generated string or number so we decided not to put them here.*



### 3.9 User Satisfaction Evaluation

After the application has been successfully implemented, we need to conduct the questionnaire with the user in order to know their satisfaction, opinions, and suggestions about this application for further improvement. We decided to use Google Forms to create online questionnaire which is very effective and convenient. Below is list of questions which are designed by us.

#### Airport Assistant Application Evaluation

1. Gender\* ☐ Male ☐ Female
2. Age\* ☐ Lower than 18 ☐ 18-22 ☐ More than 22
3. User Interface of application is easy to understand and use\*  
Hard ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 Easy
4. Rate your satisfaction with check-in function\*  
Not satisfied ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 Greatly satisfied
5. Rate your satisfaction with notification function\*  
Not satisfied ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 Greatly satisfied
6. Rate your satisfaction with flight transit information provided\*  
Not satisfied ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 Greatly satisfied
7. Rate your satisfaction with location and direction information provided\*  
Not satisfied ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 Greatly satisfied
8. Suggestions:  

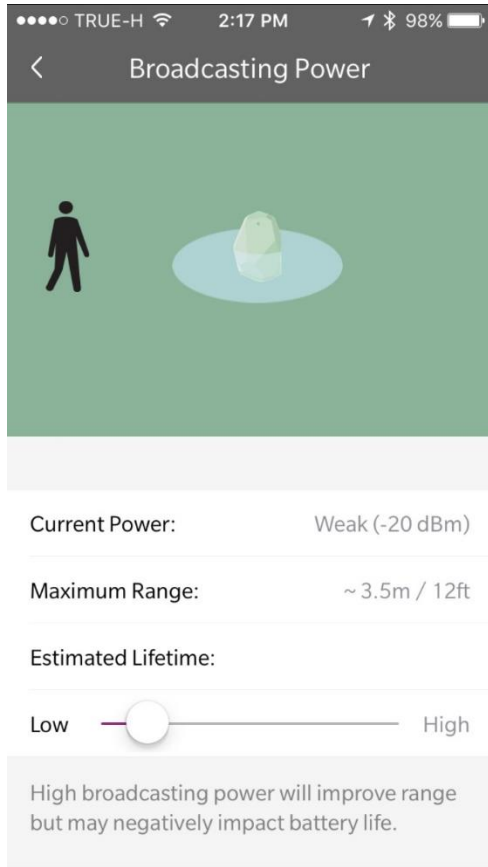
---

*Questions with \* symbol are required to answer.*

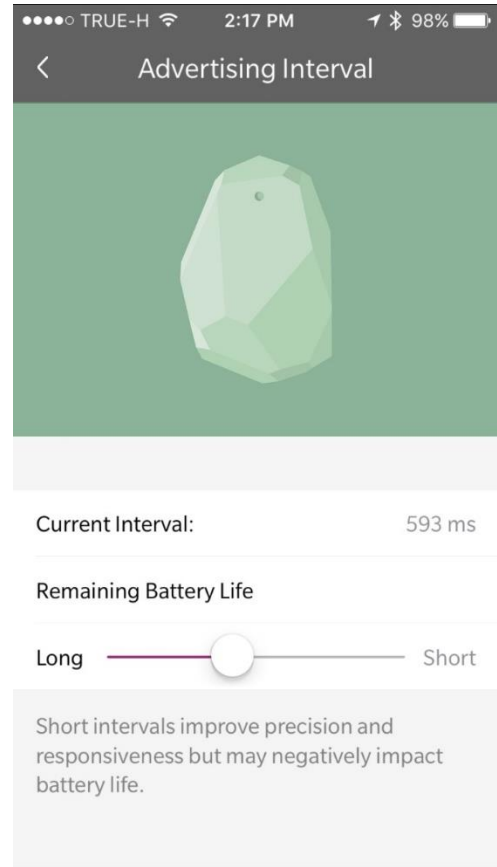
**Online questionnaire link:** <http://goo.gl/forms/ETxeMTIGT3>

## Chapter 4: Results and Discussion

### 4.1 Screenshots



**Figure 4.1** Beacon setting screen 1



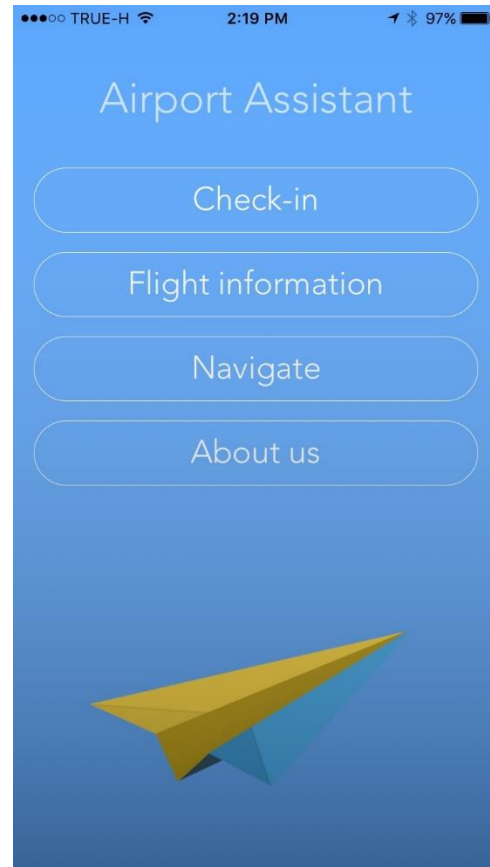
**Figure 4.2** Beacon setting screen 2

Figure 4.1 is captured from Estimote application which is used for managing beacon. We set the broadcasting power to be low so its range is about 3.5 meters. The lower broadcasting power, the lower battery consumes.

Figure 4.2 is also captured from the Estimote application. The current interval time will control how long does it take for beacon to broadcast the signal one time, likes a frequency of broadcasting. Shorter intervals will consume more battery.



*Figure 4.3 Welcome screen*



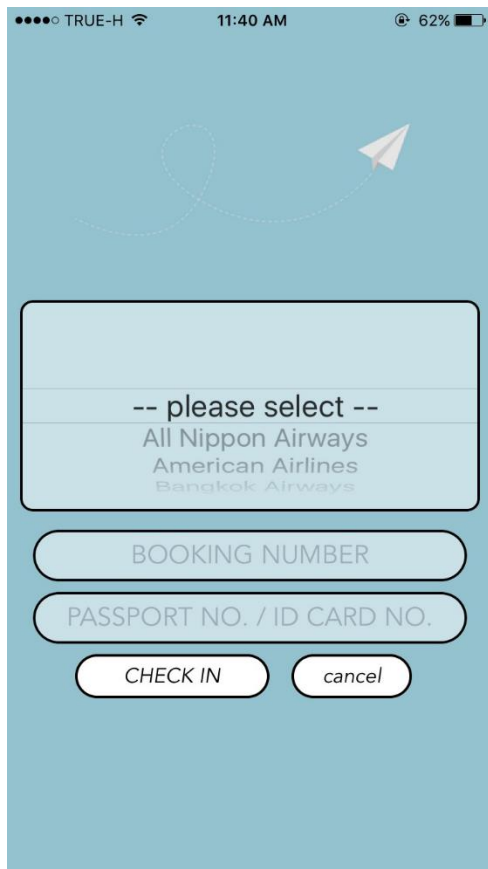
*Figure 4.4 Main menu screen*

Figure 4.3 is the first screen that user will see when open application and waiting for the application to load the main menu.

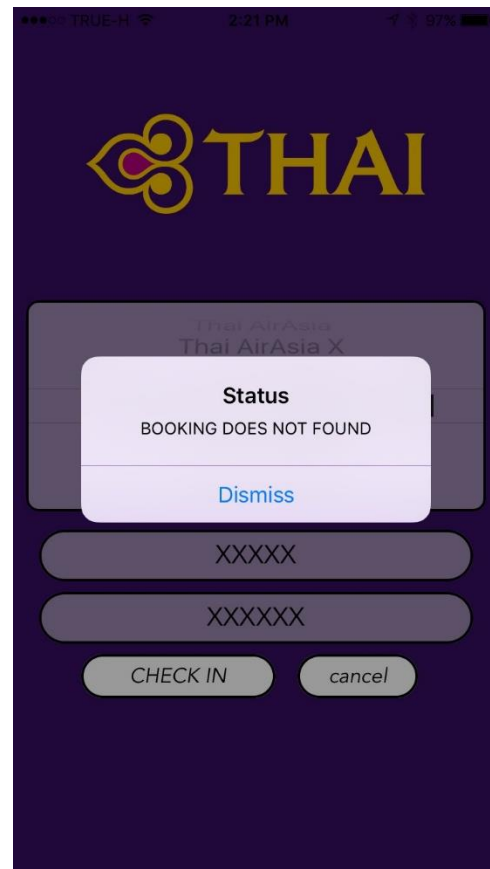
After the application finished loading, Figure 4.4 screen will be shown. It's a main menu screen which contain 4 menus for user to select.

**Available menus for user**

1. Check-in: Allow user to check-in to their flight via this application.
2. Flight Information: Contains flight information after user have successfully checked-in.
3. Navigate: Allow user to know their location and places which are located nearby them.
4. About us: Contains information about application developer.



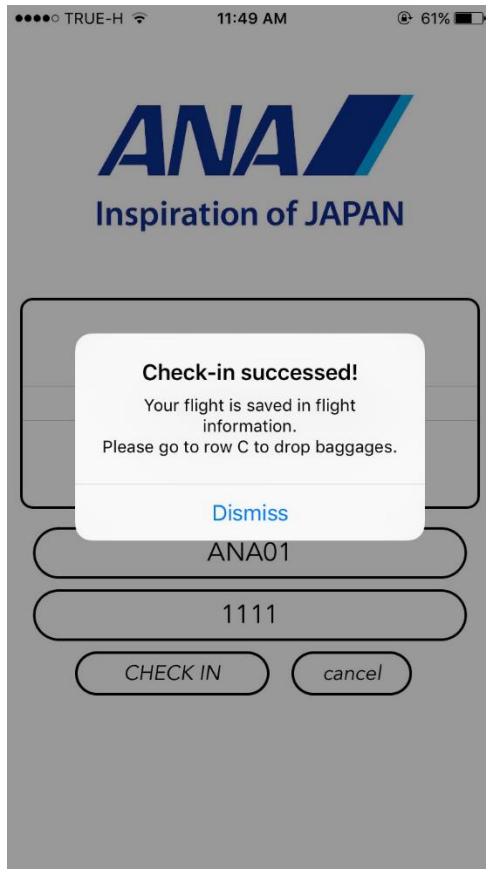
**Figure 4.5** Check-in screen 1



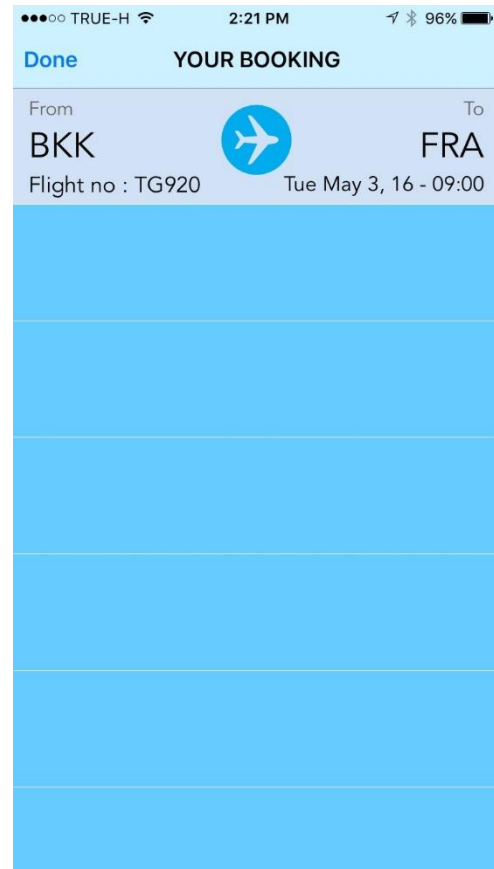
**Figure 4.6** Check-in screen 2

When user select Check-in menu, they will be redirected to the screen shown in Figure 4.5. There are 3 spaces for user to select the airline, fill in their booking number and identification (passport number or id card number).

Figure 4.6 screen show what will happen when user entered the wrong information and press CHECK IN button. The application will notify them that their booking isn't found. So user need to press Dismiss to leave this notification.



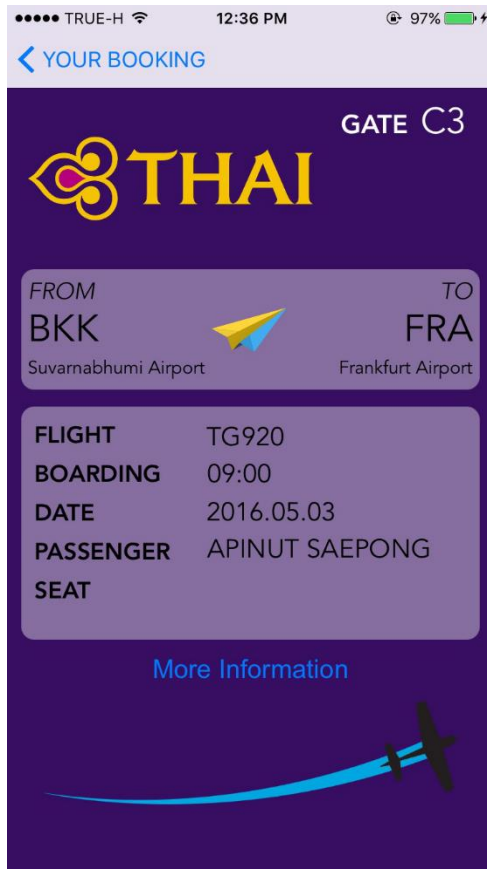
**Figure 4.7** Check-in screen 3



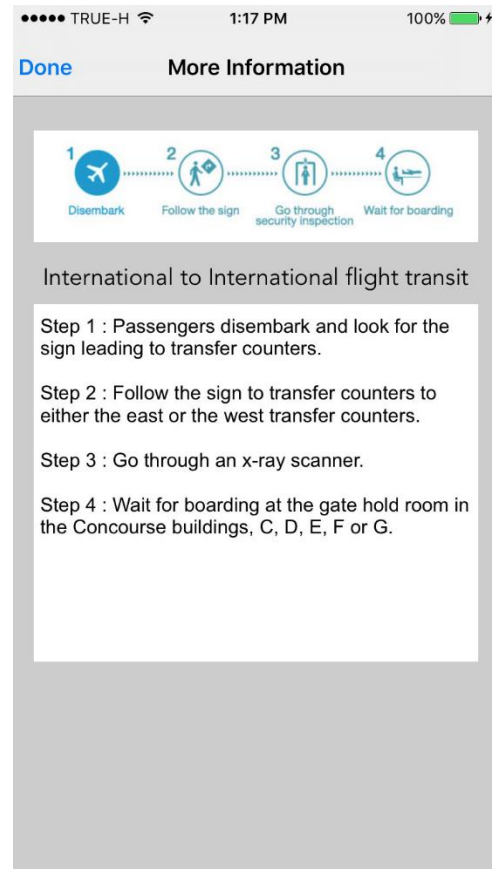
**Figure 4.8** Flight Information Screen

Figure 4.7 will be shown if user select the right airline and fill information correctly. Then after they press CHECK IN button, there will be a notification like this to notify user that their check-in is successful. The notification message not only let user know that their flight information has been saved in Flight Information menu but also let the user know which row they need to go in order to drop their baggage. Application will query information about row that passenger need to go from Parse database.

Menu in Figure 4.8 will show the list of flight information that have been saved after user have check-in successfully. Each cell will show where the flight will take off and arrive, flight number and flight date. User can tap a cell for more information or swipe left to delete a cell.



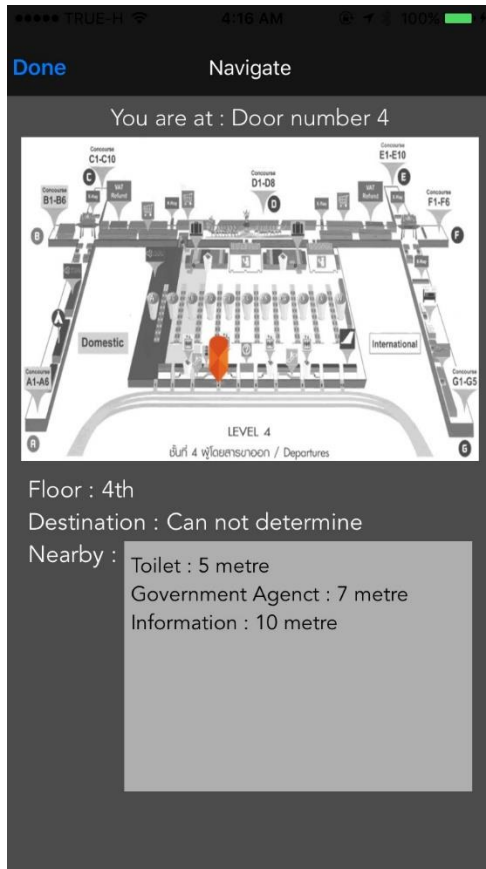
**Figure 4.9** Flight information screen 2



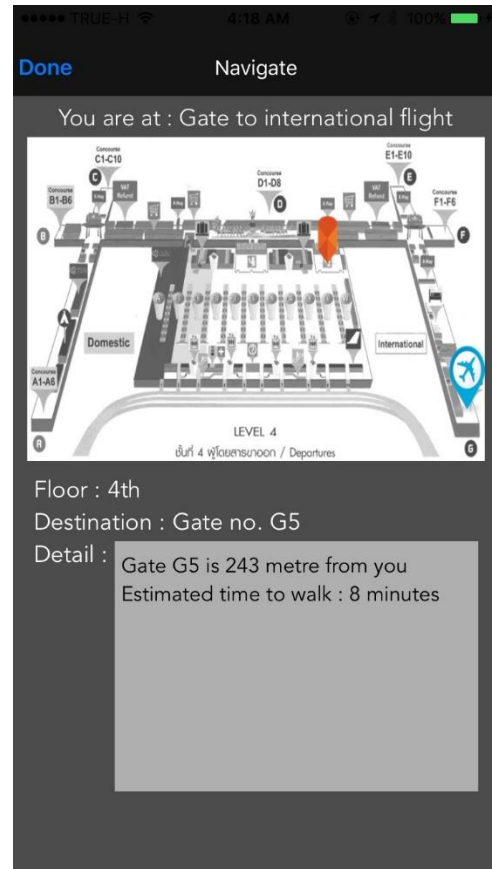
**Figure 4.10** More information screen

After user tap a flight information cell, they will be redirected to a screen shown in Figure 4.9. It will show more flight information than the previous screen. Some additional information will be shown in this such as flight gate, and passenger's name. For more information, passengers can press and they will be redirected to another screen.

After passengers pressed more information button, they will be redirected to a screen shown in Figure 4.10. It will show more information about something that passengers might need to know or might be confused such as flight transit step.



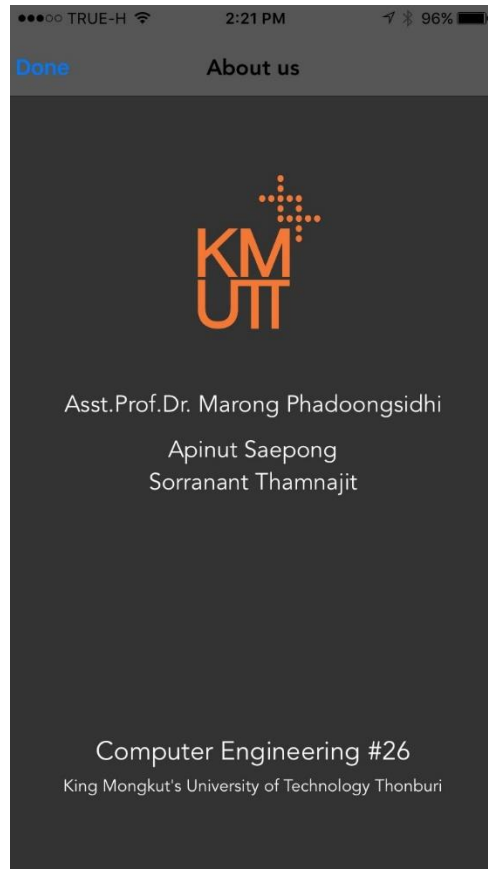
**Figure 4.11** Navigate feature screen 1



**Figure 4.12** Navigate feature screen 2

Figure 4.11 will be shown if user select navigate menu. The information that are provided in this screen consist of current location of user with orange symbol to show where user are, airport map, current floor that user receive the signal from beacon, destination, and nearby places. In this screen, user haven't checked-in yet so the application will show 'Can not determine' for destination'.

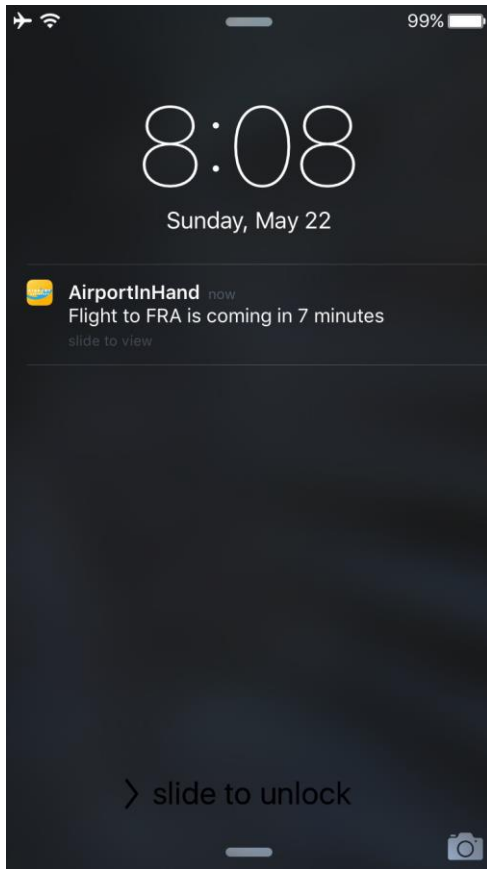
Figure 4.12 screen is also from navigate feature. It looks almost exactly the same as the previous one but the destination has been determined already. User will be able to see their destination only if they check-in successfully.



***Figure 4.13 About us screen***

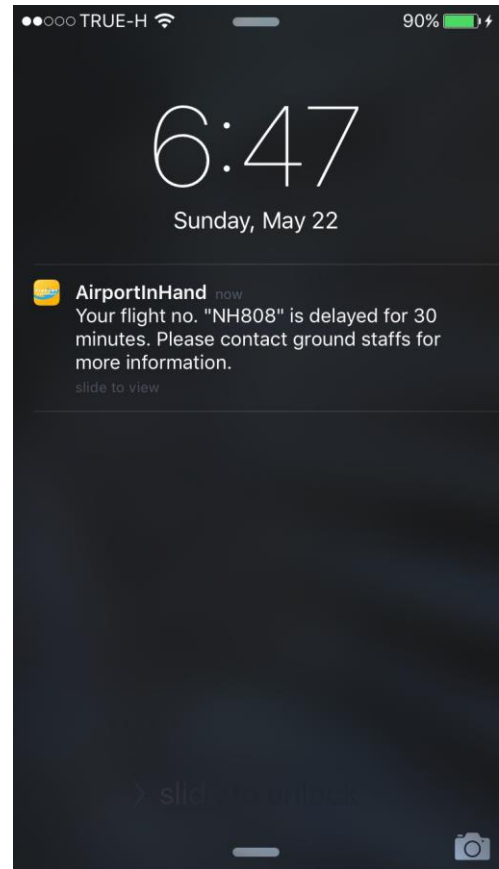
This screen will show University's logo and name, our advisor name, our name, and the department name.





**Figure 4.14** Notification screen

Figure 4.14 screen show the notification which will be automatically sent to user device when boarding time is coming within 30, 15, and 7 minutes.



**Figure 4.15** Notification screen 2

Figure 4.15 screen show the notification which is sent by an administrator via Parse service in order to notify passenger for some important information.

## **4.2 Application and Beacon Performance**

The overall application performance is acceptable. There is no problem like crashing or having to wait for a long time for application to response unless the internet connection is not stable.

### **4.2.1 Check-in Function**

#### **User**

- User are able to select airlines provided on the screen.
- User are able to fill in their booking number and their identification (passport number or id card number) in order to check-in.
- User are able to press the ‘Check-in’ button in order to submit the check-in information.
- User are able to press ‘cancel’ button in order to return to main menu.

#### **Application Performance**

- Provide airlines list for user to select.
- Background color will change according to the airline color.
- Authenticate information which is entered by user with the data contained in a database.
- Show message to tell user that their check-in is successful in case that the information from user and database are matched.
- Show message to tell user that their check-in isn’t successful in case that the information from user and database aren’t matched.
- Query the row from Parse database and notify user by the notification message after they check-in successfully.
- Send the flight transit information to store in ‘Flight information’ feature automatically.

### **4.2.2 Navigate Function**

#### **Application Performance**

- Application provides information where user are.
  - Current location
  - Airport map with orange symbol to mark the current location.
  - Floor that user receive beacon signal.
  - Destination which will only be shown after user have checked-in.
  - Detail for nearby places, estimated distance and walking time.

### 4.2.3 Notifications

#### Application Performance

- Send welcome message to passenger when they arrive the airport.
- Notify passenger when the boarding time is coming.
- Notify passenger if there is any change with their flight.

### 4.2.4 Beacon

We set each beacons to the low signal broadcasting power so it will consume least battery. The range that beacon will be able to detect devices is within 1.5 meter around beacon. We also set the advertising to 621 ms which is considered as a long interval so it will consume less battery than short interval. All beacons' UUID are set to default while major number will be set differently.



Color: Mint Cocktail  
Major: 1  
Minor: 123  
Location: Entrance gate

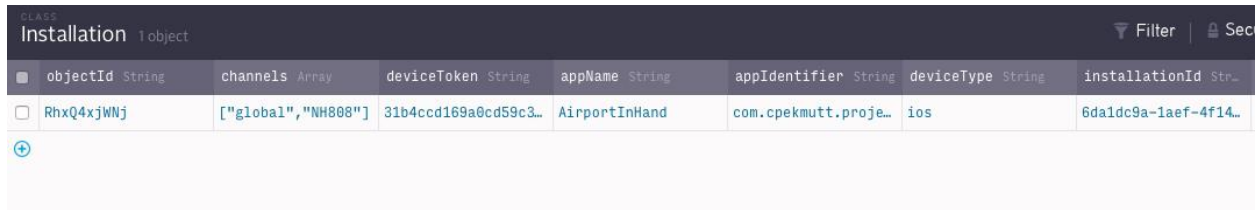


Color: Icy Marshmallow  
Major: 2  
Minor: 1  
Location: International Gate



Color: Blueberry Pie  
Major: 2  
Minor: 2  
Location: Domestic Gate

## 4.2.5 Parse database

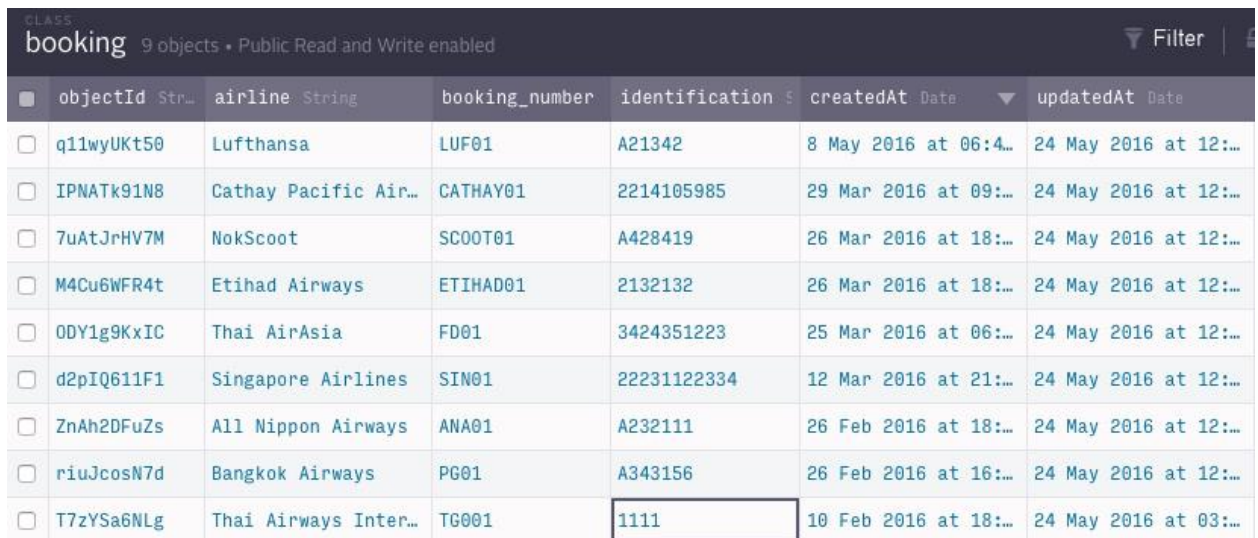


CLASS: Installation 1 object

objectId	String	channels	Array	deviceToken	String	appName	String	appIdentifier	String	deviceType	String	installationId	String
<input type="checkbox"/>	RhxQ4xjWNj	["global", "NH808"]		31b4ccd169a0cd59c3...		AirportInHand		com.cpekmutt.proje...		ios		6da1dc9a-1aef-4f14...	

**Figure 4.16** Installation Table

This table contains information about device which is already installed this application.



CLASS: booking 9 objects • Public Read and Write enabled

objectId	String	airline	String	booking_number	identification	String	createdAt	Date	updatedAt	Date
<input type="checkbox"/>	q11wyUKt50	Lufthansa		LUF01	A21342		8 May 2016 at 06:4...		24 May 2016 at 12:...	
<input type="checkbox"/>	IPNATk91N8	Cathay Pacific Air...		CATHAY01	2214105985		29 Mar 2016 at 09:...		24 May 2016 at 12:...	
<input type="checkbox"/>	7uAtJrHV7M	NokScoot		SC00T01	A428419		26 Mar 2016 at 18:...		24 May 2016 at 12:...	
<input type="checkbox"/>	M4Cu6WFR4t	Etihad Airways		ETIHAD01	2132132		26 Mar 2016 at 18:...		24 May 2016 at 12:...	
<input type="checkbox"/>	0DY1g9KxIC	Thai AirAsia		FD01	3424351223		25 Mar 2016 at 06:...		24 May 2016 at 12:...	
<input type="checkbox"/>	d2pIQ611F1	Singapore Airlines		SIN01	22231122334		12 Mar 2016 at 21:...		24 May 2016 at 12:...	
<input type="checkbox"/>	ZnAh2DFuZs	All Nippon Airways		ANA01	A232111		26 Feb 2016 at 18:...		24 May 2016 at 12:...	
<input type="checkbox"/>	riuJcosN7d	Bangkok Airways		PG01	A343156		26 Feb 2016 at 16:...		24 May 2016 at 12:...	
<input type="checkbox"/>	T7zYSa6NLg	Thai Airways Inter...		TG001	1111		10 Feb 2016 at 18:...		24 May 2016 at 03:...	

**Figure 4.17** Booking Table

The table contains 3 important information which will be used for comparing with what passengers have filled in in order to authorize the check-in procedure.

- Airline
- Booking number
- Identification (Passport number or ID card number)

CLASS

checkinCounter

18 objects • Public Read and Write enabled

Filter

Security

	objectId String	ACL ACL	airline String	counter String	createdAt Date	updatedAt Date
<input type="checkbox"/>	sABqRp0II9	Public Read + Write	Qatar Airways	F	6 Apr 2016 at 16:4...	6 Apr 2016 at 17:1...
<input type="checkbox"/>	UfV6MY8BqC	Public Read + Write	Turkish Airlines	U	6 Apr 2016 at 16:4...	6 Apr 2016 at 16:5...
<input type="checkbox"/>	1mgf4Sq71S	Public Read + Write	Thai Smile	E	6 Apr 2016 at 16:4...	6 Apr 2016 at 17:0...
<input type="checkbox"/>	wAFMTU1Bk3	Public Read + Write	Thai Airways Inter...	H	6 Apr 2016 at 16:4...	6 Apr 2016 at 16:5...
<input type="checkbox"/>	jLVp101LI3	Public Read + Write	Thai Lion Air	Z	6 Apr 2016 at 16:4...	6 Apr 2016 at 17:4...
<input type="checkbox"/>	QmT0bc1Jwc	Public Read + Write	Thai AirAsia X	Z	6 Apr 2016 at 16:4...	6 Apr 2016 at 17:4...
<input type="checkbox"/>	q5kK9N4vvM	Public Read + Write	Thai AirAsia	Z	6 Apr 2016 at 16:4...	6 Apr 2016 at 17:4...
<input type="checkbox"/>	U7tgBXfAfk	Public Read + Write	Singapore Airlines	D	6 Apr 2016 at 16:4...	6 Apr 2016 at 17:4...
<input type="checkbox"/>	SxbapkXv14	Public Read + Write	Orient Thai Airlin...	Z	6 Apr 2016 at 16:4...	6 Apr 2016 at 17:4...
<input type="checkbox"/>	hDyPDeSDGR	Public Read + Write	NokScoot	Z	6 Apr 2016 at 16:4...	6 Apr 2016 at 17:4...
<input type="checkbox"/>	jEW67WcNdd	Public Read + Write	Nok Air	Z	6 Apr 2016 at 16:4...	6 Apr 2016 at 17:4...
<input type="checkbox"/>	LzcBY7qYzF	Public Read + Write	Lufthansa	G	6 Apr 2016 at 16:4...	6 Apr 2016 at 16:5...
<input type="checkbox"/>	yAiGwpy1DR	Public Read + Write	Etihad Airways	P	6 Apr 2016 at 16:4...	6 Apr 2016 at 17:0...
<input type="checkbox"/>	cDaKZpFZdp	Public Read + Write	Emirates	E	6 Apr 2016 at 16:4...	6 Apr 2016 at 17:4...
<input type="checkbox"/>	vp9p7TqSoo	Public Read + Write	Cathay Pacific Air...	M	6 Apr 2016 at 16:4...	6 Apr 2016 at 16:5...
<input type="checkbox"/>	haHH5wrWk0	Public Read + Write	Bangkok Airways	F	6 Apr 2016 at 16:4...	6 Apr 2016 at 16:5...
<input type="checkbox"/>	dCp7q1SGPa	Public Read + Write	American Airlines	Z	6 Apr 2016 at 16:4...	6 Apr 2016 at 17:4...
<input type="checkbox"/>	Ssa7k6TKhf	Public Read + Write	All Nippon Airways	C	6 Apr 2016 at 16:4...	6 Apr 2016 at 17:4...

**Figure 4.18** Check-in Counter Table

This table contains the counter of each airline that passenger can go to drop their baggage after they've finished check-in process.

CLASS flightInformation 11 objects • Public Read and Write enabled											Filter	Security	Ed
objectId	String	booking_number	firstname	String	lastname	flight_number	airline	String	departure	destination	gate	departure_date	Date
<input type="checkbox"/>	5RpSjaZQK0	LUF01	JOHN		SMITH	LF4321	Lufthansa		BKK	CNX	C13	23 May 2016	at 12:50:00 ...
<input type="checkbox"/>	gKe8N1uoNo	LUF01	JOHN		SMITH	LF0123	Lufthansa		FRA	BKK	C10	23 May 2016	at 10:41:00 ...
<input type="checkbox"/>	k6otQABNo4	SC00T01	PATEE		TEST01	TZ031	NokScoot		KIX	NRT	-	30 Apr 2016	at 05:14:00 ...
<input type="checkbox"/>	WmKfmK11Se	SC00T01	PATEE		TEST01	TZ298	NokScoot		DMK	KIX	-	29 Apr 2016	at 09:25:00 ...
<input type="checkbox"/>	g19fRpyCaH	CATHAY01	VADER		TEST01	CX616	Cathay Pacific Air...		BKK	HKG	C8	31 May 2016	at 09:49:00 ...
<input type="checkbox"/>	rdeW06DpSS	ETIHAD01	MR.AR BUNG		TEST01	EY401	Etihad Airways		BKK	AUH	B3	31 Mar 2016	at 09:50:00 ...
<input type="checkbox"/>	0Xwcr40GeR	FD01	AROI		TEST01	FD1150	Thai AirAsia		DMK	HDY	A5	16 May 2016	at 06:15:00 ...
<input type="checkbox"/>	X81TCRVHMK	SIN01	SORA		TEST01	SQ890	Singapore Airlines		SIN	HKG	D8	14 Apr 2016	at 07:35:00 ...
<input type="checkbox"/>	0kK1vFs2uE	PG01	John		TEST01	PG255	Bangkok Airways		USM	BKK	A8	19 Apr 2016	at 12:00:00 ...
<input type="checkbox"/>	JmkzxI2KKR	ANA01	Apinut		TEST01	NH808	All Nippon Airways		BKK	NRT	G5	6 June 2016	at 15:00:00 ...
<input type="checkbox"/>	6kJ03k9KyT	TG001	APINUT		SAEPONG	TG920	Thai Airways Inter...		BKK	FRA	C3	8 June 2016	at 07:28:00 ...

**Figure 4.19** Flight Information Table

This table contains information that will be saved in 'Flight Information' feature.

## **4.3 Summarizing**

### **4.3.1 Project's benefits, new knowledge, system or software**

- We have learned how to work as a team for a long time and how to handle problems that can occur all the time.
- We have improved our problem solving skill and critical thinking skill too. We really need these skills while managing our project to go as we planned and to solve unexpected problems.
- We have learned how to use beacon and iBeacon technology and beacon hardware.
- We have learned how to use Swift language in order to implement an application which works on iOS platform.
- We have learned how to use Parse to take responsible for back-end system and push notification directly.
- We have learned how to use Estimote Cloud to manage and setup each beacon.

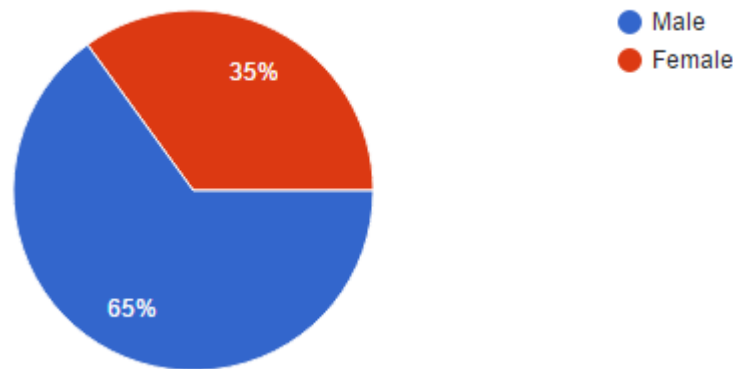
### **4.3.2 How our project can solve problems stated in Chapter 1?**

- Check-in via our application can be helpful for passengers. For example, if they have an accidents during their way to the airport and they think that they won't make it in time, so this function will help them to be able to check-in from wherever they are. Another situation that might happen is at a check-in counter, there will be a lot of passengers waiting in the queue, so our application will help them to be able to check-in if they don't want to waste their time waiting in the queue. After check-in, user will also get the flight information saved in their phone to reduce the problem of passengers carry and lost their boarding pass. Flight transit information will also be stored with passengers' information if needed.
- Location service is also available in our application. One of the biggest problem for people when they come to an airport is location or direction. Each airport has their own location and sometimes it's very complicated. Even the communication is efficient nowadays however it's still hard to walk to some places or make an appointment with someone in the airport. So, this location service will help everyone by showing their current position in the overall map to let them know where they are and how far they are from their destination, and also let them know the estimated walking time.

- Notification is one of the most important function for passengers. Because every process in the airport need to be completed within time. This function will notify them in many ways such as notify passengers that the time passengers have to get on board is coming or sometimes there are accidents so a flight need to be delayed, but passengers won't notice it unless they come to see the screen that show flight status. So this function will be very helpful for them.

## 4.4 Evaluation

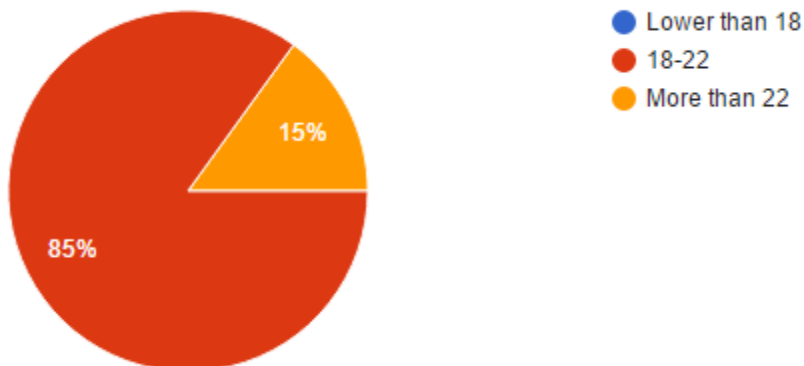
### 4.4.1 Gender



*Figure 4.20 Participants' gender Chart*

Participants who took questionnaire are both male and female with the proportion of male 65% and female 35%. The total number of participants is 20 people.

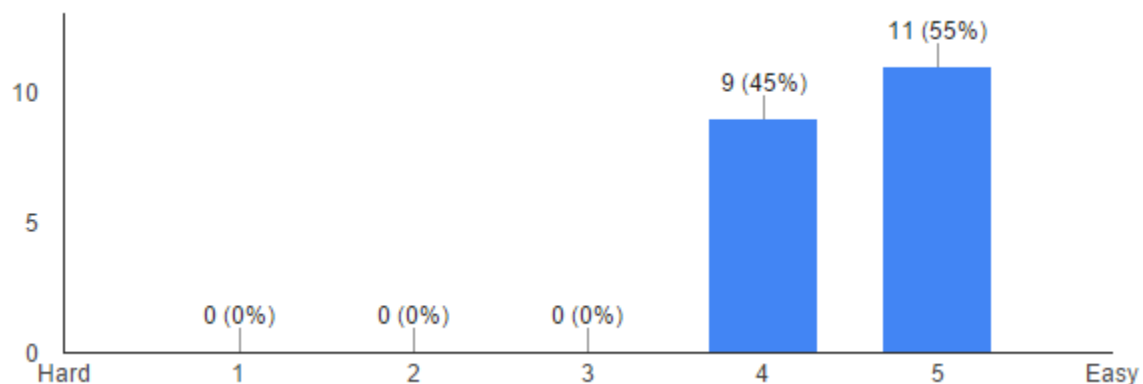
### 4.4.2 Age



*Figure 4.21 Participants' Age Range Chart*

Almost all participants' age is between 18-22 because we did this evaluation with students in Computer Engineering Department, KMUTT. There are also 3 people whose age are more than 22.

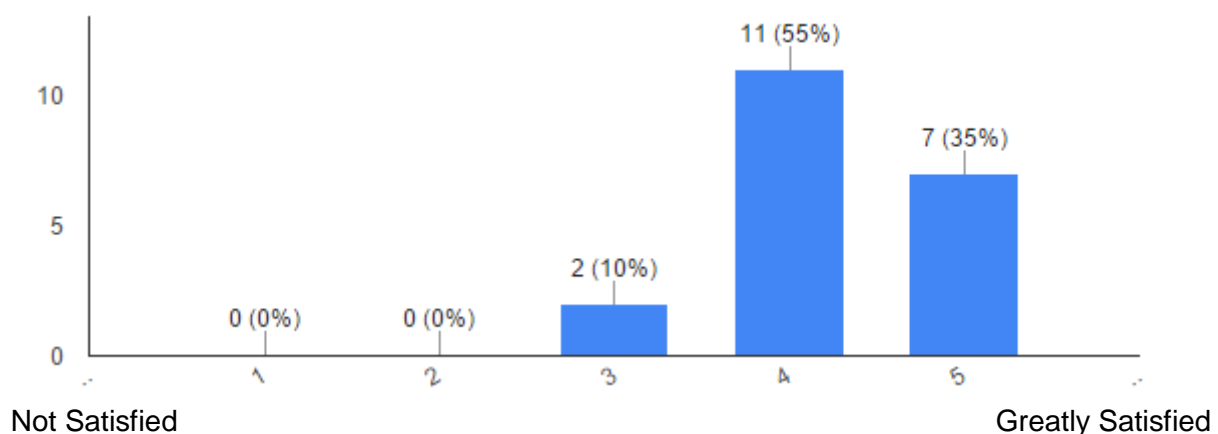
#### 4.4.3 Easiness of application's user interface to be understood



*Figure 4.22 Easiness of user interface to be understood Chart*

This chart show how user interface is easy for participants to understand. 55% of participants rated 5 which mean it's easy to understand and the rest, 45% rated 4. So we can summarize from this chart that this application's user interface is designed well and easy to understand for people who haven't used or tested it before.

#### 4.4.4 Participants' satisfaction with check-in function

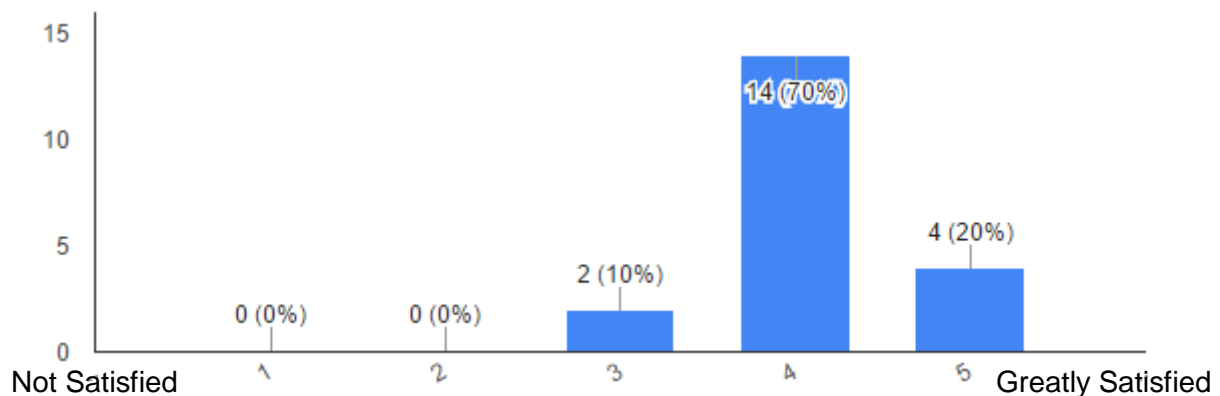


*Figure 4.23 Participants' satisfaction with check-in function Chart*



This chart shows how participants satisfied with check-in function. About 90% of participants rated between 4 and 5 which means they very satisfied with check-in function. 2 people rated 3 which means they normally satisfied. To summarize, these results show that all participants satisfied with check-in function.

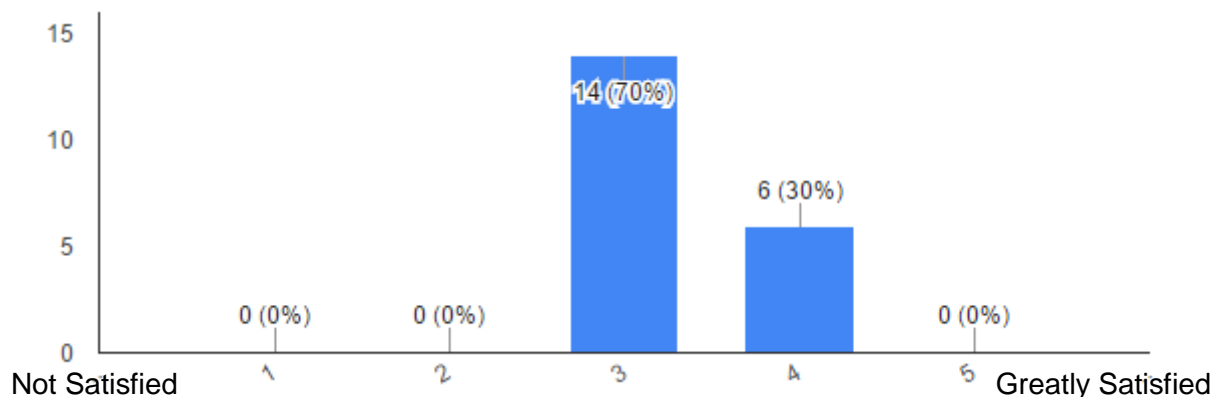
#### 4.4.5 Participants' satisfaction with notification function



*Figure 4.24 Participants' satisfaction with notification function Chart*

The results are almost the same as the previous chart, but this question, participants rated 4 for 70%, 5 for 20%, and the rest 10% is rated 3. So we can summarize that participants still satisfies with notification function. However, there are some suggestions and comments from participants that this function can be improved to use for more purposes.

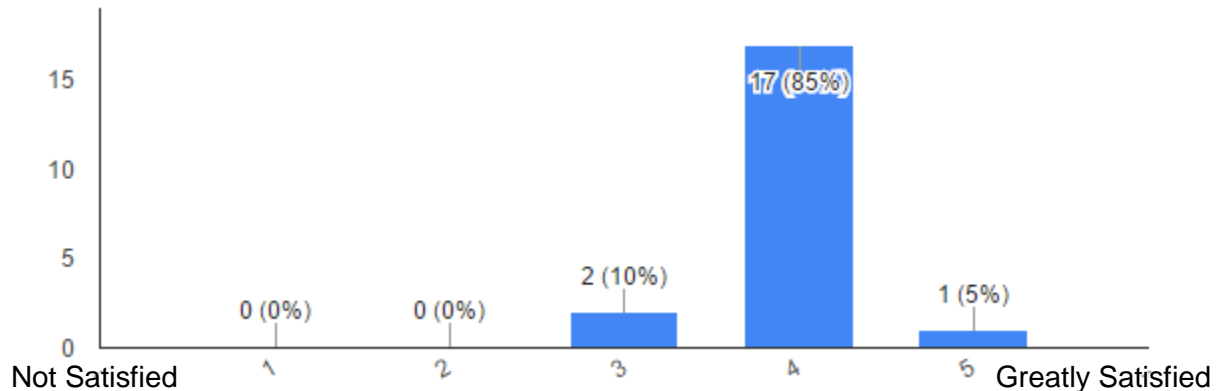
#### 4.4.6 Participants' satisfaction with flight transit function



*Figure 4.25 Participants' satisfaction with flight transit function Chart*

This question participants only rated 3 for 70% and 4 for 30%. None of them rated 5 which means this function may not made them greatly satisfied with it. So we can conclude that it's an acceptable result but can be improved to make it better.

#### 4.4.7 Participants' satisfaction with location and direction function



**Figure 4.26** *Participants' satisfaction with location and direction function Chart*

The result show that most of participants rate 4 for their satisfaction with location and direction function which is a satisfied result. While 2 people and 1 people rate 3 and 5 respectively.

## Chapter 5: Conclusion

### 5.1 Completion Status

Tasks	Not Started	Partially Completed	Completed
Kickoff meeting			✓
Conduct a survey			✓
Gathering data			✓
Requirement analysis			✓
Research more about beacon, airport, and iOS application development			✓
Software prototype design			✓
<b>iOS application development</b>			
• User Interface			✓
• Connect application with Beacon			✓
• Push notification			✓
• Database design and development			✓
• Check-in			✓
• Location system			✓
Software testing			✓
User acceptance evaluation			✓
Final debugging			✓
Document			✓

## **5.2 Problem we have faced while doing the project**

- All technology that are used in this project are new for us. We haven't used Swift language, Parse, Beacon, Estimote Cloud, and iBeacon before. So, it's take time for us to find information and learn about these technologies. Then we find out that these technologies can be work efficiently if we use them in the right way. Sometimes we also consult our advisor and senior for some important suggestion and information which help us a lots.
- The number of beacons available are limited because it's quite expensive. This problem make us hard to set up the beacon which will be used for location service. So, we need to did some experiments to find out which way gave the highest accuracy with the amount of beacons we have. We also need to plan how to get the most out of available beacons.
- Working as a group, miscommunication or disagreement are unavoidable. Sometimes we have different thoughts or ideas. So we need to do more frequently meeting together or consult with our advisor to find the best idea.

## **5.3 How the project could be extended?**

- This project can be applied to be used with every airport.
- This project can be improved whether for business or society objectives.
- The navigation feature in this application might not be working with 100% accuracy so it can be improved in the future for better accuracy map, direction, and walking time with or without beacon.
- The result that we got from doing experiments to find the best way of setting up beacons, can be used for further experiment and development technology integrating with beacon.

## References

- [1] “Estimote Developer Docs,” Estimote Inc., [Online], Available: <http://developer.estimote.com/> . [2015, October 25]
- [2] “Beacon,” Wikipedia, the free encyclopedia, [Online], Available: <https://en.wikipedia.org/wiki/Beacon>. [2015, October 25]
- [3] “iBeacon,” Wikipedia, the free encyclopedia, [Online], Available: <https://en.wikipedia.org/wiki/IBeacon>. [2015, October 25]
- [4] “Estimote Cloud,” Estimote Inc., [Online], Available: <https://community.estimote.com>. [2015, October 25]
- [5] “Swift,” Apple Inc., [Online], Available: <https://developer.apple.com/swift/> . [2015, October 26]
- [6] “Parse Server,” Parse, [Online], Available until 28 January 2017: <https://parse.com/docs> . [2016, January 6] .

## Appendices

### Appendix A – API

#### Parse API

```
Parse.enableLocalDatastore()  
Parse.setApplicationId("UGSS427C07tVuMu4xwWQD7Q4tDE4zrs2EnBjB3p0",  
    clientKey: "69hlni1AZuSL0X3xYiuhj f960a7h1xHXATLYyK0K")  
  
PFAalytics.trackAppOpenedWithLaunchOptions(launchOptions)
```

This figure show lines of code that we use for connecting our iOS application with Parse database.

```
let query = PFQuery(className:"booking")  
query.whereKey("booking_number", equalTo: bookingNoText.text!)  
query.whereKey("lastname", equalTo: lastnameText.text!)  
query.whereKey("airline", equalTo: airlineName!)
```

This figure show lines of code that we use for authenticating the information filled in by user to the booking information in check-in feature.