CHILD TRACKING SYSTEM

LEE CHUN HONG

A project report submitted in partial fulfilment of the requirements for the award of Bachelor of Science (Hons.) Software Engineering

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DECLARATION

I hereby declare that this project report is based on my original work except for citations and quotations which have been duly acknowledged. I also declare that it has not been previously and concurrently submitted for any other degree or award at UTAR or other institutions.

Signature : ______________________

Name : Lee Chun Hong

ID No. : 1302808

Date : 13/9/2016

APPROVAL FOR SUBMISSION

I certify that this project report entitled **"CHILD TRACKING SYSTEM"** was prepared by **LEE CHUN HONG** has met the required standard for submission in partial fulfilment of the requirements for the award of Bachelor of Science (Hons.) Software Engineering at Universiti Tunku Abdul Rahman.

Approved by,

Signature :

Supervisor : Dr. Sugumaran Nallusamy

Date : 13/9/2016

Specially dedicated to

my beloved grandmother, mother and father

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CHILD TRACKING SYSTEM

ABSTRACT

Child tracking system, or also known as kid's tracker, is an app that can track and monitor the child location. Child monitoring is always come to a problem for those parent who need to work day and night in the company. The parent will get problem in knowing where their child going or leaving during their working hour. However, with the child tracking system the parent can track and monitor their child location in just a simple app when the parent is in office. Thus, the aim of the project is to create a system to allow the parents to keep track of their kids when their child is out of their view. A study of the existing systems has been made to study the existing problem of the system and through the study, there is a few limitations of the existing system that need to be enhanced to improve the user experience, e.g. no limitation on the number of geofence creation. A survey is also conducted to ensure there is a needs for the system among Malaysian parent and also get the user requirement to the system. Based on the result received from the survey, there is 85% of the parent looking forwards to the product. The required functionalities are also listed based on the analysis results and the system is then being modeled and developed. At last, a series of testing, which are local unit testing, user interface testing and user acceptance testing are carried out to test for the system functionalities and user satisfaction. The testing results shows that the system functionalities work without error and the users are satisfied with the system.

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LIST OF SYMBOLS / ABBREVIATIONS

km	Kilometre
m	Meter
A-GPS	Assisted GPS
CCTV	Closed-Circuit Television
CDMA	Code Division Multiple Access
DSL	Digital Subscriber Line
FDMA	Frequency Division Multiple Access
GLONASS	Global Navigation Satellite System
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile Communications
GST	Goods and Services Tax
IFTTT	If This Then That
IRNSS	Indian Regional Navigation Satellite System
LBS	Location-Based Service
SDLC	Software Development Life Cycle
SMS	Short Message Service
SVN	Subversion
TTFF	Time to First Fix
TX	Texas
UAT	User Acceptance Test
UI	User Interface
US	United State

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CHAPTER 1

INTRODUCTION

1.1 Background

The world is full of unknown. We cannot predict or determine what will happen next to us in next seconds. This is the same scenario as we cannot acknowledge of when will we be targeted by an evildoer, but we can make precaution prevent it from happening. As for the great parents, their greatest concerns are their child, especially regarding the safety of the child. The parents start to take care of the child since they are born. The child is a creature that makes their life become more joyful and meaningful. However, parents cannot take care of their child from every moment. As the days went past, the child will be grown up and starting their school life. The parent is not possible to always stay beside of them as most of the parents needs to go for work to earn some income to sustain a family. Parents will start to feel anxious about their child current status every second because they cannot see what their child is doing currently or what affairs will happen on them. Today's child is easier influenced by their friends, and they might even get cheated or kidnapped by any of the strangers, as what had happened to a girl, named Nurlin Jazlin, who had gone missing on August 20, 2007 after she went alone at a night market in Kuala Lumpur. She was found dead in a sports bag after a month of investigation by police *(Theage.com.au, 2016)*. To minimize this tragedy from happening again, the preliminary action needs to be taken to deal with the problem.

With the advancement in technology, the child tracking system is invented and was used significantly, especially in the foreign country to reduce the missing child problem. There are some sophisticated systems that were widely used in the foreign country, for example, AngelSense device (AngelSense, 2016), TraxPlay device (Traxfamily.com, 2016), Filip device (FiLIP, 2016) and etc. These systems offer the features in which the parents can track their child in real time and the alarm triggering feature which will trigger the alarm when counter with a specific event. However, according to the observation, the child tracking system still haven't got the concerns of the Malaysian. The limited number of choice, price, feature provided and the limited supported country is the main issues which cause the system are not popularize in Malaysia.

The system is proposed to solve the above by implementing the feature and design that will meet with the collected requirements from the parent in Malaysia.

1.2 Problem Statements

Childs missing issue has caused many concerns in the worldwide after the murder of Nurlin Jazlin in 2007 *(Theage.com.au, 2016)*. However, the missing case, especially in Malaysia, is still prevalence especially in Johor, Selangor and Kedah which are the states with the highest number of missing children case. There are a total number of 2015 children reported missing in 2014, 1782 cases reported in 2015 and 140 cases was reported just on January of this year. (Rahim, 2016). Those figures have shown the seriousness of missing case in Malaysia that needs parent concerns regarding to the cases. The parent is hardly to keep a watch on their child without the use of technology, especially when the child is in the outdoor. The parent even cannot avoid the negligence that will make by us in the future day. As observed by the Malaysia Digest, the parent tends to let their children play unsupervised inside the supermarket because they are absorbed in their mobile devices (Teh, 2016). The observation can conclude that the parent nowadays is busying with their smartphones which may cause them overlook of their child for a few second or even minute that may place their child in the risk of going missing in just a few seconds of out of sight. There is a need for a solution for the parent to keep track of their child's location when the child is not beside them and get alerted when their child reaches or leaves a certain destination.

The evolve of technology also had enables us to keep tracking our child by sound recorder or even CCTV. However, each of them have their own limitation and disadvantages, for example, CCTV can only use to supervise the child via the camera and can only use in the indoor but not for outdoor. We can't monitor the child when they are outside the CCTV view; the sound recorder can only use to record the sound, and we cannot know their real-time status and the location they have gone, which was impractical. There is a need to find a different approach to solve the current limitation of using those technologies to monitoring the child.

In addition, even though there has been an existing child tracking system sold online, however, based on the observation on the usage of technology devices among Malaysian parents, the child tracking system, however, do not receive greet response by most of the parent in Malaysia. The advertisement even never publishes about the information about the child tracking system in the Malaysia before. This is the reason why there are only minority of the parent do realize about the existence of the system. Based on my research through the official and unofficial selling website, there are only a limited choice of the system for the Malaysia's parent to choose from. Some of the device is only working on particular country and the require feature may not meet with the requirement of the Malaysia's parent. Even if available, most of the devices need to be imported and the price is in US dollar or Euro, which was quite expensive when converted to Malaysian ringgit. However, the smartphone solution can be a better choice for parent to monitor their child. Since nowadays, smartphone is a solution for all. Smartphone can do almost everything from calling to monitoring, so most of the kids do has their first smartphone since they are small and the parent do not need to buy extra tracking device just to monitor of their kids. According to the survey carried out by the Malaysian Communications and Multimedia Commission (2014), there are 58% of the kids own the smartphone in the age range between 1 to 12 year olds. Besides, in today technological era, smartphone even allow to bring into the classroom in some of the country and international school in our country, because of its incredible versatility and internet capabilities which allowed the kids to access and search for more information online. There is even one elementary school in Houston, TX, practice this by allowing the students to bring the smartphone, and the results are encouraging as the overall math and science scores have improved from the last year.(Marcus, 2016) We have seen the future of smartphone, and that is the reason there is a need to analyze the existing solution on the different system and an elicitation of the requirement from the Malaysian parent regarding to the system to integrate the required functionality into the app that will satisfy their demands.

1.3 Goals and Objectives

The goal and objective of the project is described in the sub-section below.

1.3.1 Goal

The main goal of the project is to create a system to allow the parents to keep track their kids when their child is out of their view.

1.3.2 Objectives

The objectives of the project are listed as follow:

1. Examine the existing feature used in the child tracking system that fits with the needs of the Malaysian's parents.

2. Develop the application that consists of the feature and design required by the Malaysian parents with the implementation using suitable approach and methodology.

3. Verify and validate the developed system by performing unit testing and user interface testing and have it tested by the user to ensure the user satisfactory with the system.

1.4 Project Scope

This project will consist of creating an affordable and marketable system in which the design and feature of the system will be evaluated based on the result of the survey carried out. The project is expected to be completed by September, 2016. The listing below will explain the target user, platform, general features and the workflow of the project will be going to cover and vice versa.

1.4.1 Target User

The system will be targeted for the middle-class parent with child at the age range of 4 to 12 years old.

1.4.2 Platform

The app will be working on the Android platform and is used for GPS tracking between different mobile devices. The app is responsible to keep track the location of the device and respond to the message sent by the device. Android platform is chosen because it is a free and open platform in which the library is easily accessible, whereas the GPS is used for locating the device with the aids of the cellular network. The app in the device will update the location of the child to the app using the GPS+GLONASS and GPRS technology. The parent is free to adjust the location update frequency that fit with their need.

1.4.3 Feature

I. The app will include the two-ways communication where the parent can communicate with their child as needed.

II. The app will include the geo-fence feature with some enhancement where the parent is able to schedule the geo-fence to be activated for monitoring according to the schedule.

III. The app will include the route history trace where the parent track for the route their child traversed during a certain period of time.

IV. The app will include the functionality of getting child's real-time location.

V. The app will include the group monitoring feature where the parent can share the tracker with the predefined trusted group to help track their child.

1.4.4 Things not covered

I. The system that operates on the others platform, for example, IOS, other than Android. This is because there is limited freely accessible library and creating an IOS app required the user with the IOS account which was controversial with the Android platform that was open source and is free access to the library.

II. The ways to improve the reliability, accuracy and availability of the GPS technology as this required deep learning of the algorithms and this is out of the scope of the project.

III. Website view of the system. The project will only operate on the Android mobile application device.

IV. The indoor positioning solution where it uses to locate the child in the indoor.

1.5 Justification

This section will justify the motivation that leads to the ideas of the project, the needs of the project in Malaysia and the contribution that will be served to the Malaysian parent. The detailed description will be provided in the sub-section below.

1.5.1 Innovation

Missing child case is still very prevalent in Malaysia even the polices have taken action. For those children who go to school without parent accompany, there is a risk for them went missing on the way to school either intentionally or unintentionally. There is a need for the parent to know their child's location and even monitor their child when they are in the outdoor. Thus, the ideas of the proposed system are to help the parent to monitor and keep tracking their child's location when the child is in the outdoor that prone to danger.

1.5.2 Needs

I. There is lack of the variety of the system for the parent to choose from that enable them to monitor multiple children in Malaysia.
II. There is no available functionality in the system currently in Malaysia that enable the parent to record the route their child passed through during the chosen period.

III. There is the limited number of geofence can be created by the parent for the current system in which there may have some restriction for those parent who wish to create the geofence more than the limited number.

IV. For current available app, to create geofence, the parent needs to manually use the child phone to set the settings but not on the parent phone.

V. (Crotty, 2015) Child tracking system solution can help the parent to keep tracking their child's location, especially for those with disorder, who gone missing in a sudden.

1.5.3 Significant of the project

I. Reduce the child missing case.

II. Provide tracking solution for the parent to keep tracking their child location in the outdoor by using GPS+GLONASS as well as A_GPS to improve the tracking accuracy and availability.

III. Provide a solution for the parent to call their child in just a click in case of emergency to know what happened to their child.

IV. Provide a solution to schedule and monitor certain areas to get alerted when their child reaches or leaves the particular area.

V. Display a more significant information that wishes to see by the Malaysian parent during tracking.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Tracking system has been used worldwide in the market, either for the commercial or personal usage. According to the consumer reports (2016), there is an increasing trend of using the tracking technology by the retailer to surveillance the consumer's shopping habit so as they can improve their service with the goal of get you to shop more and spend more. Besides, in 2014, Waze, the world's largest community-based traffic and navigation app even announced that they reached 50 millions of users globally with Malaysia and Indonesia in top 10 lists (Chandra, 2016). Those statistics have shown that tracking system has caught the concern from the worldwide market. Recently, to cope with the missing case that is happening on the kids, pets or even on the senior citizens, the personal GPS tracker has also been existed in the marketplace. Personal GPS tracker has help a mom to find his son with autism who when missing by just a two minutes of distraction (Crotty, 2015). Besides, the GPS device has even help to alert a mom about her daughter's sexual assault (Lindgren, 2016). Even though there have been many cases about the helpful of the personal GPS tracker to the people, nevertheless, the recent survey made by the 1130 numbers of parents living in the UK has shown that 43% of the respondents had decided against the use of location tracking and for the others, 39% if the respondents never heard about the location tracking, 16% of the respondents are in favour of the location tracking and only about 1.7% of respondents are using the tracking system (Vasalou, Oostveen, and Joinson 2012). Based on the result of the survey, we can see that in UK, many people are still lack of knowledge about the location tracking or even against about it.

Furthermore, as stated by one of the article, with the same price levels and technical capabilities for the same child location tracking technology, there will be the different in the feature of the technology depending on the social context (Oostveen, et al., 2014).

There are a large number of studies of the tracking system in the different areas. However, since the focus of this research is on the child tracking system, these will not be reviewed in detail and will only be referred to as appropriate. The review will be focusing on the technology and feature that will act as a guidance in practicing the best approach for building the tracking system for child in Malaysia.

2.2 Location Tracking Technologies

Location tracking technology have been used to track the location of the object since the innovation of GPS. However, GPS alone cannot fulfil the needs of some of the country, for example Russia and China. Therefore, each of the country have developed their own navigation system to provide more accuracy location tracking for them, for example, GPS navigation system in US, GLONASS navigation system in Russia, Galileo navigation system in European, BeiDou navigation system in China and IRNSS in India. According to the European Space Agency, there is a needs for them to develop its own global satellite navigation system, which is called Galileo, to provide an alternative locating technologies other than GPS or GLONASS satellites in case the signal is turned off or degraded tomorrow which is uncontrolled by them. However, currently, there are only GPS and GLONASS navigation system created completely. In the sub-section below, the comparison of the GPS and GLONASS navigation system which are globally supported will be described.

2.2.1 GPS

The Global Positioning System (GPS) is a satellite-based navigation system that was developed by the U.S. Department of Defence. It made up of a network of 24 satellites that is flying 20350KM above the earth surface which transmitting microwave signal via medium earth orbit satellite constellation, allowing GPS receiver to identify its velocity, position and time. To provide continuous, worldwide coverage, each satellite circles the planet twice a day in one of six orbits. There are two low power radio signals transmitted by the GPS satellites, designated L1 and L2 with L1 frequency being used by the world wide civilian users carrying frequency of 1575.42 MHz in the UHF band (Garmin, 2016). There are 3 different bits of information carried by the GPS signal, that is pseudorandom code, ephemeris data and almanac data. The pseudorandom code is an I.D code that distinguishes which satellite is transmitting data. The ephemeris data is transmitted by each satellite constantly and is used for determining a position. The almanac data tells the location of each GPS satellite ought to be at any time throughout the day to the GPS receiver. When GPS device receives the radio signals, the exact time of arrival will be noted and is used to calculate its distance from each satellite in view (Gps.gov, 2016). To calculate the 2-D position (latitude and longitude), the signal of at least 3 satellites must be locked on by the GPS receiver. However, to determine the user's 3-D position, four or more satellites must be used (Garmin, 2016). The figure 2.1 below show the overall flow of the GPS which has been discussed above.

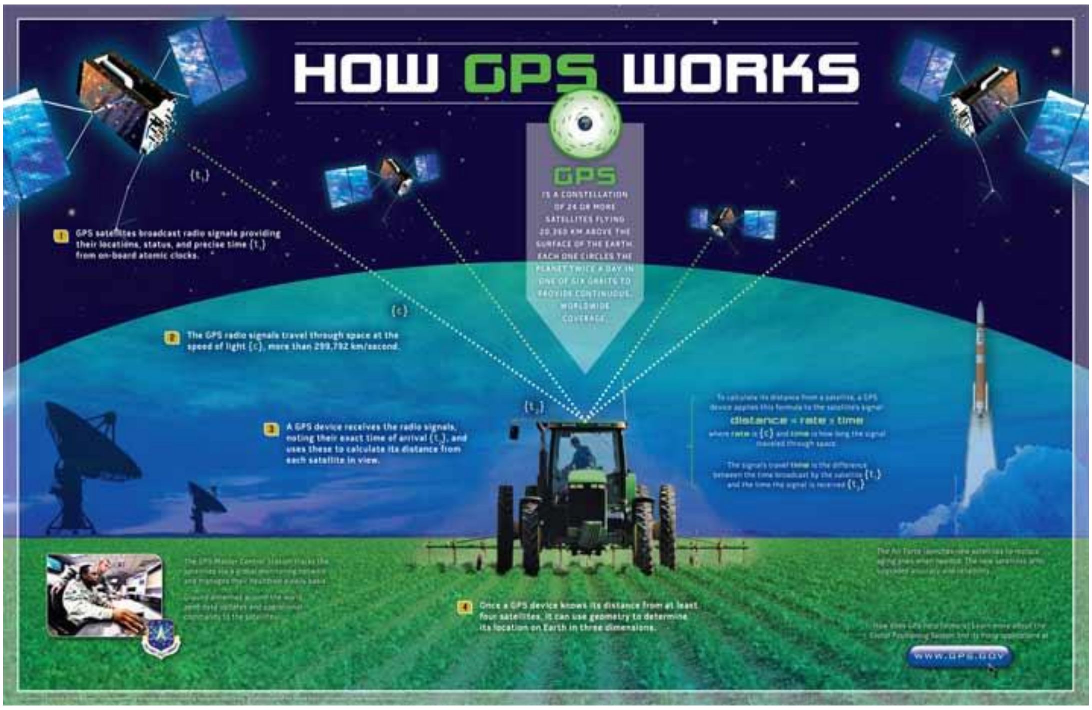


Figure 2.1: How GPS work (Gps.gov, 2016)

However, the UHF banded signals that is transmitted by GPS satellites cannot pass through most solid object or exterior wall such as buildings and mountains, the problem or poor signal condition will be occur in the urban areas. Besides, the signals can also be weakened by tree canopy or meteorological conditions. Satellite signal fracture is a problem that will be occurred when the standalone GPS navigators can’t fix a position in the poor satellite conditions and must wait until a better satellite reception occur to provide the correct location (NAVSTAR GPS,1996).

2.2.2 A-GPS

A-GPS, abbreviation for Assisted-GPS is a system that is used to improve the start-up performance of a GPS, called time-to-first-fix (TTFF) by acquires and stores satellites location information via the cellular network so the information does not need to be downloaded via satellite (Zahradnik, 2016). With the U.S. Federal Communication Commission's 911 requirement to make cell phone location data available to emergency call dispatchers, A-GPS has been widely used in the GPS-capable cellular phones (LaMance, DeSalas and Jarvinen, 2002). Besides, it also uses the cell tower data to enhance the quality and precision of the GPS when the GPS receiver is in poor satellite signal condition by using the proximity to cellular towers to calculate the position (Zahradnik, 2016). However, it required internet connection to an Internet Service Provider (ISP) for it to work with.

Thus, the combination of GPS and A-GPS will improve the accuracy of the position by using both the GPS satellites system and the A-GPS through cellular network to get the location. The system should have both technologies to result in satisfactory location accuracy.

2.2.3 GLONASS

Global Navigation Satellite System (GLONASS) is a satellite-based navigation system developed in Russia and started by Soviet Union in 1976. It is the second alternative navigational system after GPS and achieved global coverage in year 2011. The satellite is placed in middle circular orbit, inclined with a degree of 64.8 at 19,100 kilometres altitude and a period of 11 hours and 15 minutes (Polischuk, et al., 2002). GLONASS is suitable for the place where getting a GPS signal is very problematic, especially in thigh latitudes (north and south) (Moskvitch, 2016).

GLONASS uses the FDMA (Frequency Division Multiple Access Method) channel access method to communicate with satellites. To allow compatible with GPS satellites, GLONASS has used CDMA (Code Division Multiple Access technique) since 2008 (Eissfeller, et al., 2007).

2.2.4 Comparison of GPS and GLONASS

The comparison of the accuracy of GPS and GLONASS navigation system has been depicted in table 2.1 and table 2.2 below.

Table 2.1: Navigation error of GPS only solution in five different reference stations (SDCM, 2016)

Station	Error of navigation definitions (p=0,95)			Mean number of NSV in nav. def.
	latitude (m)	longitude (m)	altitude (m)	
Arti	5.16	4.14	13.76	11
Bellinsgauzen	6.19	4.55	16.86	10
Bilibino	4.31	4.45	15.72	12
Vladivostok	7.83	3.95	12.93	10
Gelendzhik	6.57	4.34	12.12	10

Table 2.2: Navigation error of GLONASS only solution in five different reference stations (SDCM, 2016)

Station	Error of navigation definitions (p=0,95)			Mean number of NSV in nav. def.
	latitude (m)	longitude (m)	altitude (m)	
Arti	5.75	6.30	16.21	8
Bellinsgauzen	6.76	7.09	16.33	8
Bilibino	6.78	6.41	15.90	9
Vladivostok	5.03	8.97	16.04	8
Gelendzhik	6.85	8.25	18.72	8

Based on the table 2.1, the GPS horizontal precision is in the order of 4 – 8m whereas the vertical error is in the order of 12 -16 meters. However, in table 2.3, the GLONASS precision is determined and is slightly less accurate than GPS, in which the horizontal precision is in the order of 5 – 9m and vertical error is in the order of 15 – 19 meters. Besides, the mean number of GPS satellites in view is also higher than GLONASS. The tables have concluded that GPS provides high accuracy as compared to GLONASS. In the next section, the combination of both GPS and GLONASS will be discussed.

2.2.5 The combined solution

GLONASS can be used in conjunction with GPS especially in the area of where there is large amount of cloud coverage or when the device is surrounded by high-rise buildings to increase the availability of satellites. The increased availability of the operational satellites caused by the combination of the GPS and GLONASS, will improve the overall position accuracy as the device to being monitored by any of the fifty-five satellites around the world. However, to preserve the battery, GLONASS will only be activated when the GPS signal is poor. The navigation error provided by GLONASS in combination with GPS, as well as the means number of satellites in view in five different reference stations is shown in Table 2.3 below.

Table 2.3: Navigation error of combined solution in five different reference stations (SDCM, 2016)

Station	Error of navigation definitions (p=0,95)			Mean number of NSV in nav. def.
	latitude (m)	longitude (m)	altitude (m)	
Arti	3.92	4.16	12.29	19
Bellinsgauzen	4.71	5.16	12.47	18
Bilibino	4.42	4.40	11.28	20
Vladivostok	4.33	4.01	11.75	18
Gelendzhik	4.79	4.93	12.73	18

From the table 2.3 above, the overall navigation error of latitude, longitude and altitude in the five different reference stations has been decrease by approximately 2m as compared to table 2.1 and 2.2 above. Based on the comparison, the combined approach will definitely increase the accuracy of the position and thus, if implemented in the locating system, will surely improve the accuracy and availability of the signal if compared with the stand-alone approach.

In conclusion, the proposed system should use the combined approach where GPS and GLONASS navigation system is used to track the location to improve the accuracy and availability of location tracking.

2.3 Existing child tracking system

There have been different kinds of child tracking system implemented in most of the country. The research has been made to analyse the different business model provided by the different system. The table 2.4 show the different features provided by the 6 different GPS tracker. Each of them come with their own business model. Nevertheless, among the 6 systems, all have some similarities in the features provided.

First of all, both tracker can provide the child's location information in real-time. This feature is important to make sure the parent can see their child's location in real-time as needed. Secondly, both of the device can create geo-fence. Geo-fence is the barriers that can be draw by the parent in a certain area on the app so as the parent will be notified when their child is leaving or entering the boundary. Thirdly, they both can trace the history of the tracker. They history enables the parents to see the location their child had pass through, the number of alert triggered and so on. Lastly, most of them have the emergency button except GPS smartsoles. Emergency button is a types of button which is installed on the tracker to be pressed by the child during the emergency. The different action will be triggered depending on the tracker used. The further discussion of their differences will be conducted in the subsection below.

2.3.1 AngelSense (AngelSense, 2016)

The AngelSense is a GPS tracker that come with the voice-monitoring solution. It is design for the children with special needs.

First of all, the tracker comes with the smart search mode which was used to find the location of the child. With the mode activated, the parent is able to track the direction to their child on a map with a child exit alerts and the live 10-seconds update interval.

Besides, the tracker also come with the listen-in capability. This feature enables the parent to validate their child situation by just listen in to their child's location and base on the sound to determine whether they are in safe or not.

Furthermore, the first responder group alarm feature of the tracker can ease in helping the parent to find a lost child. With just one click, the live view of the lost child's location and direction to the lost child will be sent to a predefined trusted group of people via SMS.

In addition, the tracker also provides a school dashboard for the child school. It is an interface that will be used by the school stuff to ensure that the child is safe during school hours.

Lastly, the AngelSense's customer service department in which the staff is the parents of the special needs children who work at home make it becomes one of the unique feature of the tracker. The parent who call the customer service for help will be help by the expert users who know the situation of the parent who make the call as they the staff there is also a parents of special needs children.

The AngelSense's tracker is only working in United State country and is come with the price of $149 and the service cost is $39.99 per month.

At last, the AngelSense GPS tracker is most suitable for the parents who need to take a special care for their child and also in favour of their customer service. The special features help the parent in monitoring the child's location and situation and also sent the lost child location to a trusted group of people with just a one click together with the customer service whose people will always aware of the situation and assist the parent.

2.3.2 GPS SmartSoles (Gpssmartsole.com, 2016)

GPS smartsoles is a GPS tracker that is located in the insoles of the shoes. The tracker is designed with the main concept of tracking without the need to carry an external device and is targeted for the adult with cognitive memory disability that need a special care from the family member.

The discreet monitoring is a capability of the tracker that make it unique from others. The discreet monitoring works in the ways that it provides tracking by just hide the tracker inside the insoles without the needs of wearing or carrying any device to start the tracking.

Besides, the GPS smartsoles do provides the customized alerts which will send notification to the owner whenever the tracker is entering or leaving the geozones. To enable the tracker to be track by the others trusted people, the owner can even share the tracker with the multiple caregivers.

The tracker come with the price of $299 with the service cost of $24.96 per month. It is supported in some of the country only excluding Malaysia.

In short, the GPS smartsoles is suitable for the parent who just in-need of some basic functionality to keep track of their eldest and in favour of its design that is integrated in the insole.

2.3.3 TraxPlay (Traxfamily.com, 2016)

TraxPlay is a GPS tracker for both pets and kids. The tracker depends on the GPS & GLONASS to improve the accuracy of retrieving the location together with the GSM/GPRS quad-band to send the position to the smartphone.

The feature of the TraxPlay GPS tracker that make it unique is that it does provide the augmented reality feature. Augmented reality is a feature used in locating which will show the image of the tracker together with the distance in pointed direction with the use of built-in camera. This feature enables the parent to see their child position clearer and exact.

Moreover, scheduling capability of the tracker's unique point. With the scheduling feature, the parent can set the geo-fence with a specific schedule, which enable the parents to monitor certain areas on certain days and times. The geo-fence zone will automatically activate once the set schedule is reached.

Additionally, the tracker also has a feature called proximity fence. The feature enables the owner to create a fence that is surrounding him/her. Whenever the owner moves, the fence will also move with the owner. This feature is great as it will notify the owner whenever their child or pet is reached too far from the owner or crossed the border.

Besides, the speed of the tracker can also be set by the parent. This is the unique capability of the tracker that will send an alert to the parents whenever the tracker exceeds the set speed limit.

Lastly, multiple devices & sharing is the feature that is provided by the tracker which enable the parent to track multiple tracker and share a tracker to multiple accounts. With the ability, the parents can track multiple child with just one app and share the tracker account to trusted group of people to help in keeping track of your child whenever the parent is busy.

The price of the device will cost $99 with the service cost depending on the plans chosen, that is either choosing $4.99 per month for 2 years of service or $8.99 per month for single year of service. The tracker can work on 33 countries including Malaysia.

To conclude, the TraxPlay GPS tracker is suitable for the owner who needs to keep track both the child and the pets and also in favour of their unique features discussed above. The augmented reality enabled the tracker to show the direction to the child or pet more accurately and clearer. The proximity fence and scheduling geo-fence provide an excellent approach to monitor the child location and the multiple devices and sharing features is best suitable for those who have multiple child to track with and can even share the tracker to multiple people to help keeping track of.

2.3.4 Filip (Filip, 2016)

Filip is a wearable GPS tracker that is designed for kids. It is a tracker that look like a normal watch with date and time shown and is depending on these three technologies –Wi-Fi hotspot triangulation, GSM voice/data and cell tower location, assisted GPS, to ensure the reliable location detection and communication.

Furthermore, one of the attracting feature provided by the tracker is the ability to make voice calling with the two-way GSM cellular voice capability. However, the tracker can only store five contact numbers and the tracker can only make and receive call from those number.

Besides, with the help of GPS, GSM and WIFI, the smart locator ability of the tracker allows the parents to track their child in real-time manner accurately either indoor or out. To track multiple children, the parent can also create a profile for each child in the app.

In addition, intelligent emergency feature enables the tracker to response smarter when the red button / SOS button is pressed for four seconds during emergency. During the emergency mode, the tracker will perform three task, that is calling simultaneously to five contact number until the call is accepted, recording background noises and the call and lastly automatically update the location of the child for every 60 seconds until the emergency mode is cancelled.

Lastly, to enable quick communication, the parent can also send one-way text message to their child without calling. However, the child can only see the message but cannot reply to the message.

With the feature provided, the Filip device is come with the cost of $149.99 with the service cost of $10 per month and is only available and working in United State country only.

To conclude, Filip GPS tracker is suitable for the family who in favour of watch-like wearable device and can also perform two-ways communication. They can be use as normal watch but can also acts as a communication tools to contact with their parents.

2.3.5 Findster (Indiegogo, 2016)

Findster is a GPS tracker that provides solution for both kids and pets. Unlike the other trackers, the special about Findster is that they are free from monthly fees. The reason for that is because they do not need to use a cellular connection to send the coordinate, instead, they are using the proprietary radio frequency protocol to establish the connection. Cellular network has been utilized by other tracker to retrieve and send the location of the tracker to the smartphone via the GPRS and GPS technology. This is because GPRS technology can provide data services with data rates up to a maximum of 172 kbps which can be utilized in the system which requiring data transfer. (Poole, 2016). However, Findster is depends on their three separating elements, that is child module, parent module and one base station to establish connection via the innovative wireless communication system. The Findster ecosystem, as illustrated in Figure 2.2, has shown the elements required by the Findster GPS tracker for it to work. The parent module enables long-range bi-directional communication between the child module and the smartphone by serving as a gateway between both. The parent module communicates with the child module via the radio frequency protocol with range up to 1km between both modules, and send the data to smartphone via Bluetooth technology. To enhance the range of the communication, the base station is used to provide the commutation distance of up to 2km.

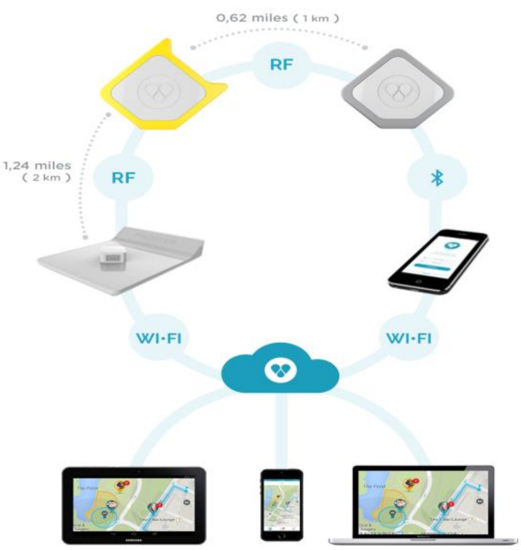


Figure 2.2: The Findster ecosystem

The Findster GPS tracker do also come with their own unique capability. One of the capability is that the app is able to monitor several Findster modules of up to 30 modules simultaneously. It means that the parent can monitor multiple child simultaneously with just one app.

Besides, the group monitoring feature of the tracker enable the same module to be monitored by several people through the web console or the app. The owner can just share the module account to the other trusted users to activate the feature.

Furthermore, the fall detection feature enables the parent to be alerted when their child is fallen. This feature is functioned with the aids of 3-axis accelerometer technology.

In addition, the owner can also set three different types of geo-fences to be monitored, that is circular, irregular and route. The ability to set different types of geo-fences enables the owner to have an option to set an area range or route to be monitored manually. The owner can choose either to use panning or drawing to set the geo-fence. With the aids of the locate mode, the owner can even detect the direction and distance to where the child or animal is.

Lastly, one of the unique capability of the FILIP tracker is that they do sign up for IFTTT service. IFTTT stands for “If that, then that”, and is a free web service and mobile apps that will increase the productivity of the users by automate the web-based tasks or making popular apps works together. IFTTT service enables the app to set and trigger the reminder whenever a certain condition specified by the user was met.

With the features provided, the device will cost $99 and there is no need for the service cost as they are using their proprietary radio frequency communication protocol to communicate among the modules instead of cellular communication which is charged based on data transfer rate. It supports and works in any of the country.

To summarize, the FILIP GPS tracker is suitable for the owner who need a solution to track both the pet and their kids with the range of not up to 2km. With the group monitoring and fall notification capability, the owner can even take a good care of their child by being help by others to monitor the child when the parent is busying and get notified when the child is fall off. With the IFTTT service, the owner can even set the reminder to inform of doing a certain task whenever the set condition is met.

2.3.6 Shieldz (Shieldz, 2016)

Unlike the others tracker, Shieldz Kids Smartwatch is a GPS tracker made in Malaysia. It provides the price as low as RM399 before GST.

Shieldz come with the call functions. It allows the child to call a preconfigured set of numbers just a simple touch. Besides, it also come with the SOS button to deal with the emergency situation. After the SOS button is pressed, 3 pre-set phone number will be call periodically.

Furthermore, Shieldz also come the health tracking. It allows the parents to keep track of their child’s health status. It will track for the number of steps taken by their child and distance, calorie burn and the sleeping quality of their child.
In addition, with the use of the GPS + LBS technology, it allows the parent to locate their child with the most accurate location information, both indoors and out.

Moreover, the watch also come with alarm where the watch will be ringed when the parents wants to find it misplaced or it is being detached from their child.

Lastly, the watch does also come with reward function which praise the child for good behaviour. The parents can reward the child for their good behaviour by sending a with a Heart to the watch.

To conclude, Shieldz kid’s smartwatch is a local made smartwatch which has the calling functionality, SOS to deal with emergency, health tracking to monitor the child health status, the alarm to be triggered when it is misplaced or detached from child, the rewards to promote the good behaviour among the child, and of course, the GPS tracking and monitoring ability to track and monitor of the location.

Table 2.4: The feature provided by the 5 different GPS tracker

Feature Similarities				
• Location information in real-time • Create geo-fences • History • Push notification • Emergency button except GPS smartsoles				
Differences				
Product	**Positioning Technique**	**Unique Capability**	**Price**	**Support in Malaysia**
AngelSense (AngelSense, 2016)	GPS	Smart Search Listen-in Capability First Responder Group Alarm School Dashboard Customer service staffed by parents	Device price: $149 Service cost: $39.99/month	No.
GPS Smartsoles (Gpssmartsole.com, 2016)	GPS	Discreet Monitoring Customized alert	Device price: $299 Service cost: $24.95/month.	No

TraxPlay (Traxfamily.com, 2016)	AGPS, GPS and GLONASS	Augmented Reality Scheduling Proximity fence Speed Alerts Multiple devices & sharing	Device price: $99 Service cost: 1. $4.99/month for 2 years of service 2. $8.49/month for single year of service.	Yes
Filip (Filip, 2016)	GPS & Wi-Fi triangulation	Voice Calling Smart Locator Intelligent Emergency Messaging Time and Date	Device price: $149.99 Service cost: $10.00/month.	No.
Findster (Indiegogo, 2016)	GPS, Radio Frequency, Bluetooth & Wi-Fi	Multiple Findster modules monitoring capability Group monitoring Multiple type of geo-fence Fall Detection Locate Mode IFTTT services	Device price: $99 Service cost: No	Yes

Shieldz **(Shieldz, 2016)**	GPS+LBS technology	Call Function SOS Health Tracking Alarm Reward	Device price: RM399	Yes

2.4 Comparison of The Existing System

Based on the discussion above, we can observe that each of the system come with their own speciality. This section will make analysis on each of the different trackers that will fit with the different set condition. The condition is set base on categorization of the overall features provided by the trackers to solve the concerns of the parent.

Firstly, the analysis will base on how easy the parent can contact with their child. According to the oxford dictionary of English, when contact is used as verb, it gives the meaning of communicate with (someone), typically in order to give or receive information. From the definition, we can see that contact is related to giving or receiving the information, so form here, we can say that the ability for the parent to contact with their child is very important during tracking in order to get or receive the information about their children. Among the 5 tracker being compared, Filip, Shieldz and AngelSense GPS tracker is the only devices that enable the parent to contact with their child. Shieldz GPS tracker standout from the others by providing both voice monitor and two-ways communications functionalities. For the Filip GPS tracker, it is able to make two-ways communication between the child and parent and do also providing one-way communication via messaging form the parent. In contrast, for the AngelSense GPS tracker, it can just enable the parent to listen to the child environment without making direct contact with their child.

Secondly, the analysis will be focus on the solution in monitoring certain area. All of the trackers do provide the geo-fence feature to monitor the certain area, in which when they entered or leaved a set geo-fence, the notification will be triggered to the parent to inform the parent their child is entering or leaving a certain area. However, Traxplay GPS tracker and Findster GPS tracker do some little trick on that. The geo-fence provided by the Traxplay GPS tracker provide the scheduling in the geo-fence to enable the parent to track certain area at particular time. Besides, Trackplay GPS tracker also provide the proximity fence, which is used to monitor the area surrounding the owner with the range adjustable by the owner. As for the

Findster GPS tracker, they enable the parent to create different types of fence for the area to be monitor, that is either circular, irregular or route.

Thirdly, the analysis will be focus on the ease in searching for the child. AngelSense, Filip and Findster GPS tracker contain the feature that allow the parent navigates to their child position in which the system will find the shortest path to the child location. For TraxPlay, they have the feature called augmented reality in which the smartphone built-in camera will be used as the tools in perform the searching. This feature enabled the predefined profile picture of that particular tracker will be display in the real environment when the camera is pointed to tracker's direction. For Shieldz GPS tracker and GPS Smartsoles, they do not provide the searching functionality.

Next, the analysis will be based on their approach in dealing with the emergency. Based on the analysis, only AngelSense, Filip, Findster and Shieldz GPS tracker did provide the solution to deal with the emergency with a SOS button. For AngelSense and Findster GPS tracker, when the SOS button is pressed during emergency, both of them will send an alert to the multiple caregivers to inform of emergency. However, for the Filip GPS tracker, it will perform calls, records and communicates location to the 5 predefined contacts. For the Shieldz GPS tracker, 3 pre-set phone number will be call periodically, after the SOS button is pressed.

Lastly, the analysis is based on the ability of the trackers to perform group monitoring or multiple tracker monitoring. All the tracker can provide group monitoring and multiple tracker monitoring, except AngelSense GPS tracker and Shieldz smartwatch. AngelSense GPS tracker can just able to perform first responder group alarm which can be triggered by the parent to assist the help form the predefined trusted group to search for the lost child and is not able to track multiple tracker.

To conclude, there are various commendable features that can be found in the product as compared above, thus, it is aspired to incorporate as much of these features into the system as possible. One of the features which the system should adopt is the voice monitor and two-ways comunication which is currently implement in the Shieldz GPS tracker. This is because the voice monitor allows the parent to listen to the child's surrounding to make sure whether are in the safe zone or not and the two-ways communication to enable the parent to communicate with their child as needed. Besides, the features that can also adopted into the project are the creation of multiple fences with scheduling which from the TraxPlay GPS Tracker. This allows the parent to pre-set the fences which needed to be monitored. Furthermore, the locate mode inside the AngelSense, Filip and Findster GPS tracker can also be implemented into the project which can provide location and direction to the child position during emergency. Lastly, the feature which the system can be adopted is the group and multiple tracking monitoring. This feature allows the parent to track multiple children with multiple subscription to the device and sharing of the tracker to trusted group of people to help monitoring when the parent is busying.

CHAPTER 3

PROJECT METHODOLOGY AND PLAN

3.1 Introduction

This chapter will explain about the methodology that will be used in the project. Every software project need to follow a framework call software development lifecycle (SDLC) to make sure a high quality software is created. This is because SDLC defines the task to be performed at each step in the software development process which will make sure our work is planned, organized and following the schedule. Figure 3.1 shows the stage involved in the SDLC.

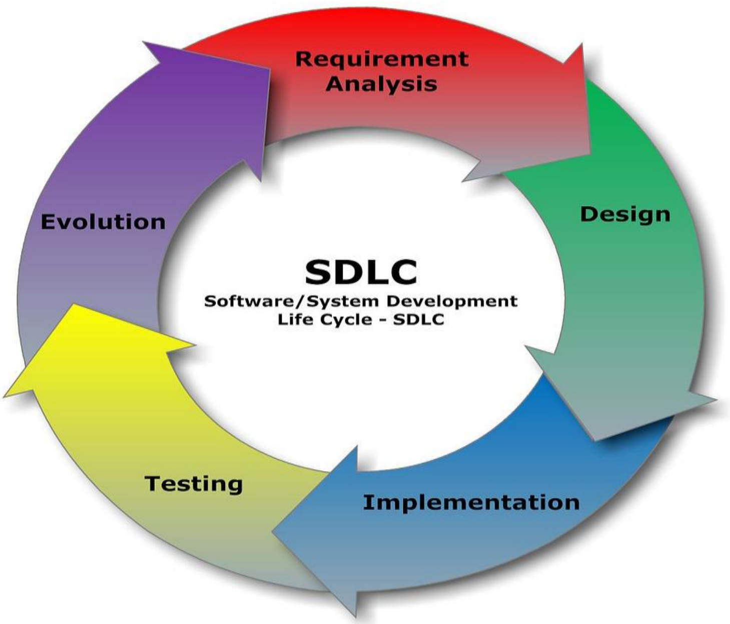


Figure 3.1: Software Development Life Cycle (SDLC) (Stylusinc, 2016)

There are various software development life cycle models in which the steps sequence is unique to its type. The models that this project will be used is incremental prototyping model. This is because incremental prototyping model is best suit for the project with time and cost constraint. Besides, the functionality of the system can be subdivided into module with each module to be developed assigned on each iteration. This enable the milestone can be clearly seen where the successful of each iteration depict the completion of the required functionality or iteration. Furthermore, the model enables the module or functionality with the highest priority place into the first iteration to be the first release with the subsequent iteration for the lower priority requirement. With the user involvement at the end of each iteration, this will increase the user satisfactory of the product. Figure 3.2 show the phases involved in incremental prototyping model. The work involved in FYP1 will be covered until analysis phase with a brief system design. The later phase of the project, which was design, develop/build, test, deployment and maintain phase will be covered on FYP2.

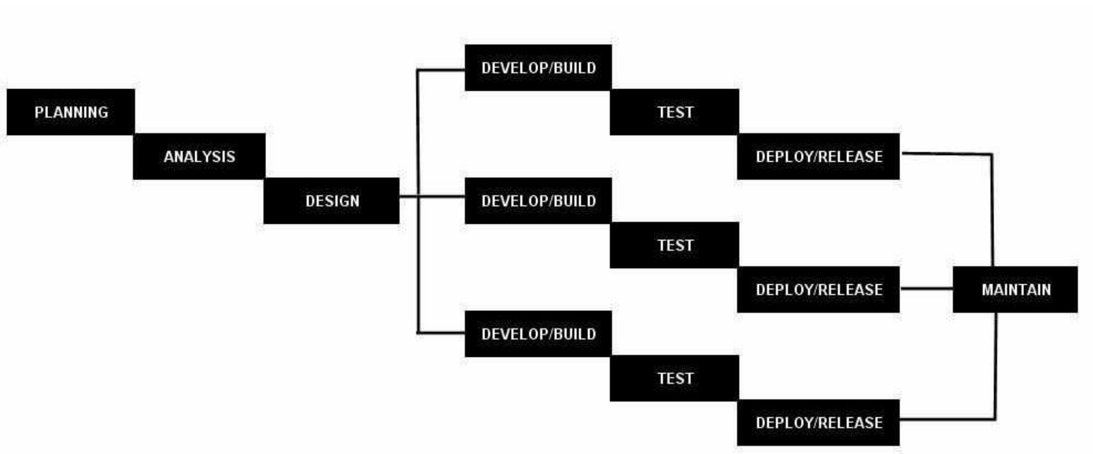


Figure 3.2: Incremental Prototyping model (Sami, 2016)

3.2 Planning

Inside the planning phase, the solid plan to develop the system is determined. Planning is an essential part to ensure the successful of the IT project as the tasks of the project is pre-planned and scheduled as well as planning for the strategies to implement the project. The work involved in the planning phase discussed in the following subsection. The objective and the scope of the project has described in section 1.4 and 1.5 respectively.

3.2.1 Milestone

The milestone of the project is listed in table 3.1 below. The milestone of the project is determined based on the successful completion of each phase involved in the project. The details scheduling can be referring to the section below which will include the WBS and the project schedule.

Table 3.1: Milestone of the project

Milestone	Description	Date
Complete requirement gathering	All requirement to develop the system must be determined and collected.	1/4/2016
Complete the system designs	The architecture, components, modules, interface, and data for the system should be depicted.	28/4/2016
Complete system coding	All coding completed will result in the fully functional software prototype come from the combination of the different modules developed.	7/7/2016
Complete the testing and debugging	All functionality of the system is tested and the identified errors is corrected as well as the user satisfactory of the final product.	8/8/2016
Complete transition	Completed software and documentation transitioned to the university department to begin production.	10/8/2016

3.2.2 Work Breakdown Structure (WBS)

The work involved in the project is showed in the figure 3.3 where each phase involved consist of the tasks that needs to be completed to finish the project.

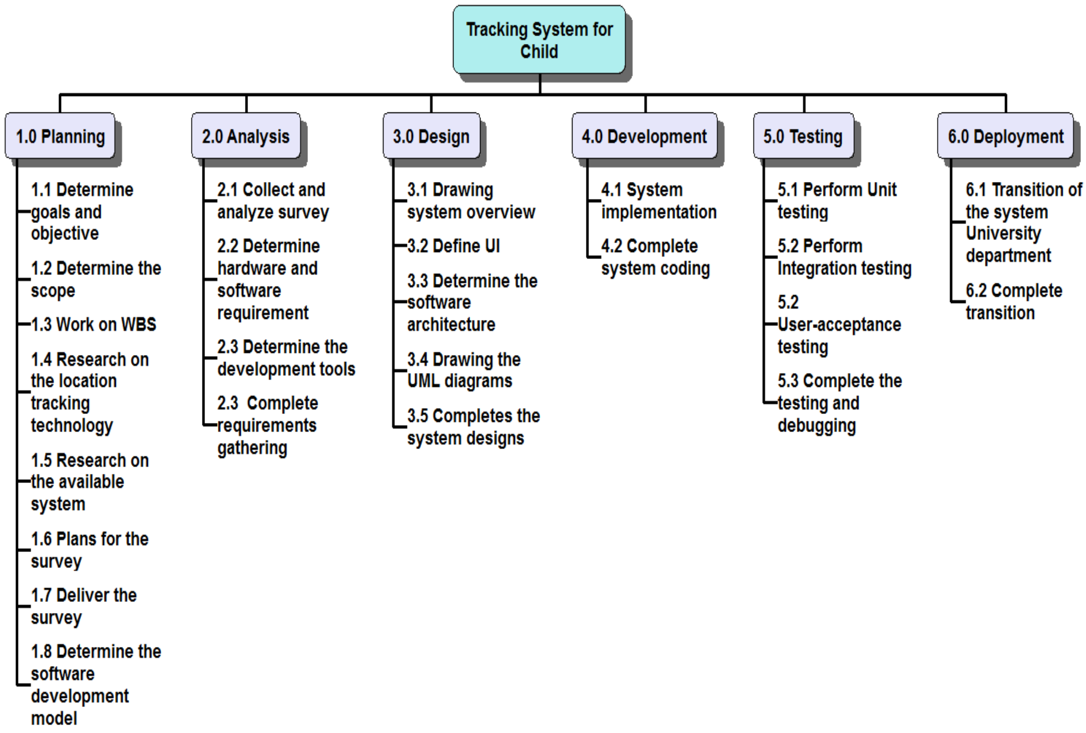


Figure 3.3: Work breakdown structure (WBS)

3.2.3 Gantt Chart

The scheduling of the work involved in the project is depicted in the Figure 3.4. As show in the Figure 3.4, the task of the project is schedule and categorized according to the phases with the time range from February to August. The project starts with the planning phase and end with the deployment phase where the project is considered to be completed and the system is ready to deployed. The clearer view of each tasks is shown in the Figure 3.5.

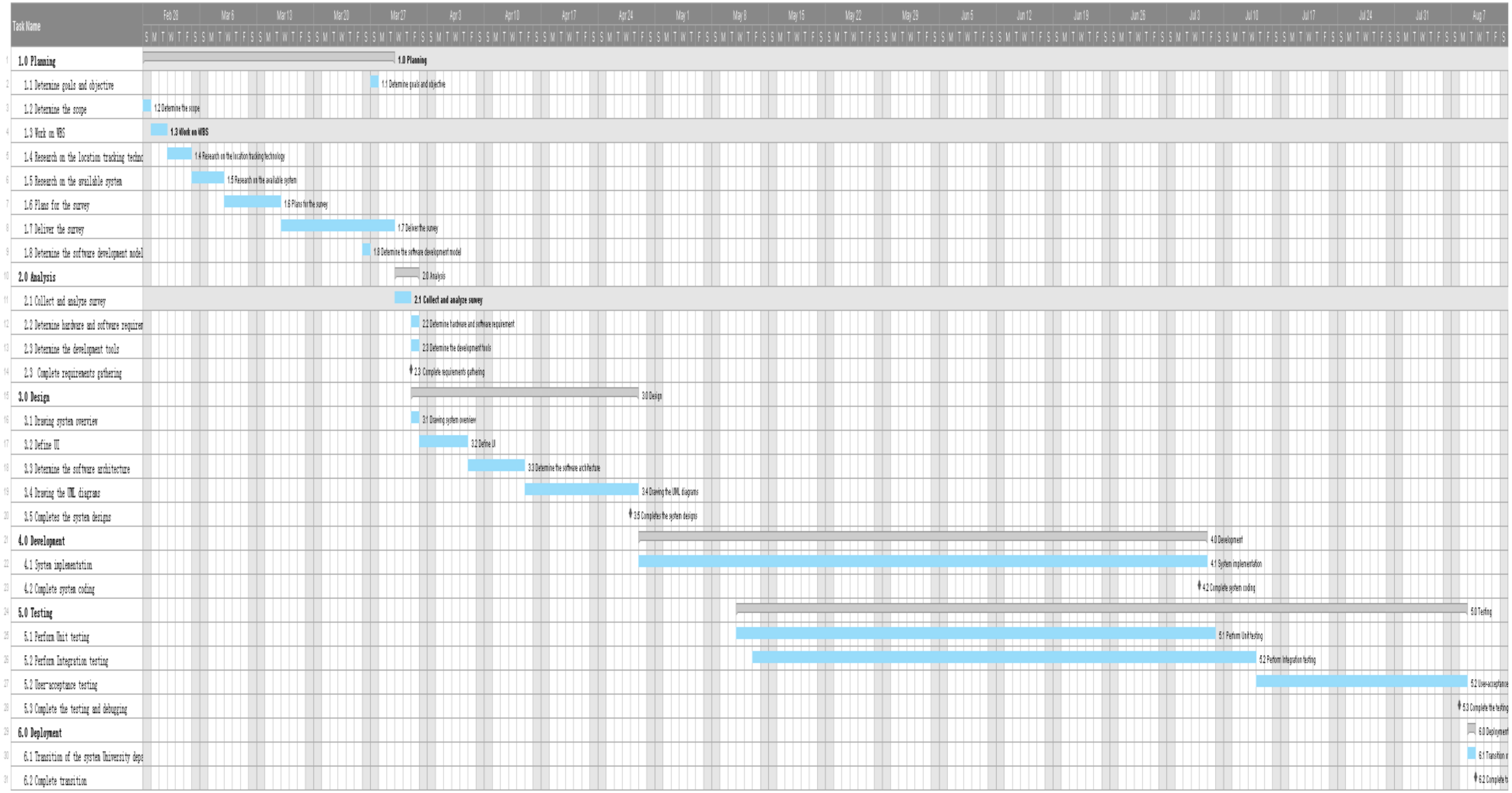


Figure 3.4: Gantt Chart

Task Name	Start Date	End Date	Duration
1.0 Planning	28/02/16	29/03/16	23d
1.1 Determine goals and objective	27/03/16	27/03/16	1d
1.2 Determine the scope	28/02/16	28/02/16	1d
1.3 Work on WBS	29/02/16	01/03/16	2d
1.4 Research on the location tracking technology	02/03/16	04/03/16	3d
1.5 Research on the available system	05/03/16	08/03/16	3d
1.6 Plans for the survey	09/03/16	15/03/16	5d
1.7 Deliver the survey	16/03/16	29/03/16	10d
1.8 Determine the software development model	26/03/16	26/03/16	1d
2.0 Analysis	30/03/16	01/04/16	3d
2.1 Collect and analyze survey	30/03/16	31/03/16	2d
2.2 Determine hardware and software requirement	01/04/16	01/04/16	1d
2.3 Determine the development tools	01/04/16	01/04/16	1d
2.3 Complete requirements gathering	01/04/16	01/04/16	0
3.0 Design	01/04/16	28/04/16	20d
3.1 Drawing system overview	01/04/16	01/04/16	1d
3.2 Define UI	02/04/16	07/04/16	5d
3.3 Determine the software architecture	08/04/16	14/04/16	5d
3.4 Drawing the UML diagrams	15/04/16	28/04/16	10d
3.5 Completes the system designs	28/04/16	28/04/16	0
4.0 Development	29/04/16	07/07/16	50d
4.1 System implementation	29/04/16	07/07/16	50d
4.2 Complete system coding	07/07/16	07/07/16	0
5.0 Testing	11/05/16	08/08/16	64d
5.1 Perform Unit testing	11/05/16	08/07/16	43d
5.2 Perform Integration testing	13/05/16	13/07/16	44d
5.2 User-acceptance testing	14/07/16	08/08/16	18d
5.3 Complete the testing and debugging	08/08/16	08/08/16	0
6.0 Deployment	09/08/16	10/08/16	1d
6.1 Transition of the system University department	09/08/16	09/08/16	1d
6.2 Complete transition	10/08/16	10/08/16	0

Figure 3.5: Zoom view of Task and duration

3.3 Analysis

During the analysis phase, the conducted survey is being analysed. Besides, the requirement of the project which include software and hardware requirement, development tools is also determined. The detailed discussion will be performed in the sub-section below.

3.3.1 Survey analysis

Survey have been carry out by sending out the questionnaire to the target group of parent with the child of between 4 to 12 years old. The objective of carry out the survey is to get the user requirements and opinions about the child tracking system. The questions are categorized into 2 categories, that is demographic background, and the feature requirement. The sample of the questionnaire is attached to Appendix A. The results based on the 20 responses are collected and being analysed and discussed below.

I. Category 1: Demographic Background

The questions in category 1 will focus on the demographic background of the parent. The purpose of the questions is to study the characteristic of the populations.

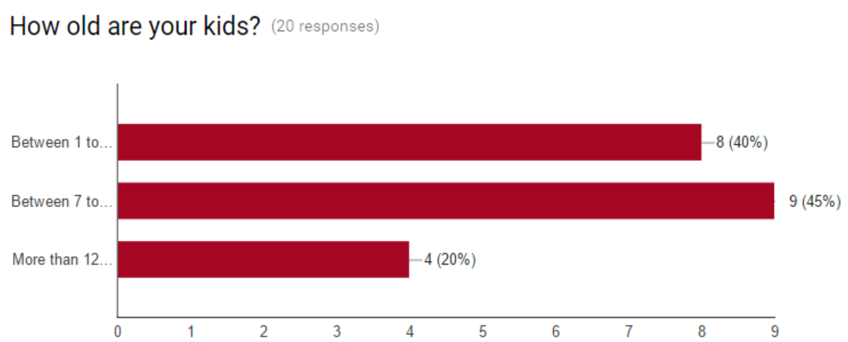


Figure 3.6: How old are your kids

In Q1, the question was asked to know about the age of the kids. The parent opts to choose more than 1 answer if they have more than 1 child. Based on the analysis, within 20 responses, there are 8 parents who have the child in the age between 1 to 6 years old, 9 parents with the child in the age of between 7 to 11 years old and 4 parents with the child in the age of between 13 to 17. The result shows that most of the parent with the child at the age of between 7 to 12 years old in which most of the child have started or just started the school and may spend most of the time at outdoor without being watched by the parent. Those children in that particular age range meet with my targeted focus group and the parent may have the high chance in favour of the proposed system which can act as a tools to help them monitoring their child.

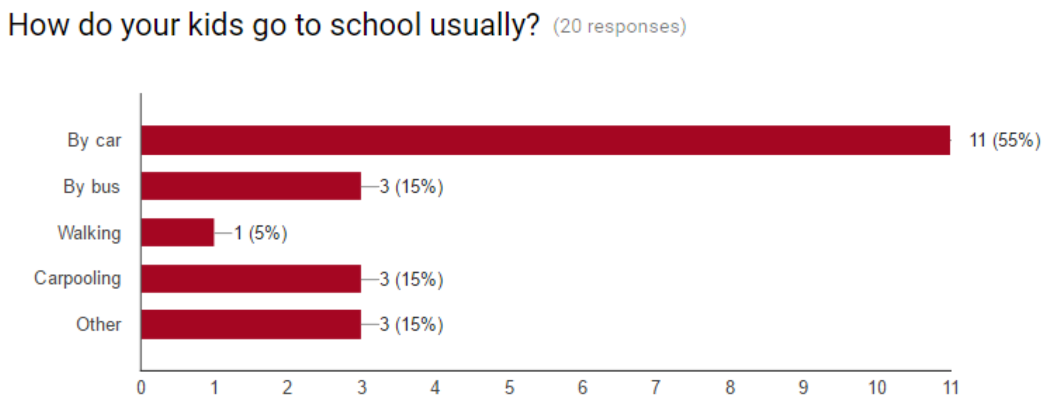


Figure 3.7: How do your kids go to school usually

In Q2, the question was asked to know about the ways their kids go to school at usual. Based on the analysis, within 20 responses, there are 11 children who go to school by car, 3 children by bus, 1 children walk to school, 3 children use carpooling and 3 responses chose others with the reason of their child have not started school yet. The overall percentage shows that there are 35% of the child which constitute of the child who goes to school by bus, walking and carpooling who may have a high chance of needs to take much care from the parent and may needs a tools to help them monitoring or trace the path went through by them and get alerted when the child reach the destination compared to others who take car to school. Even though there are 55% of the child go to school by car, however, the parent may need the proposed system to help them monitoring their child from playing truant.

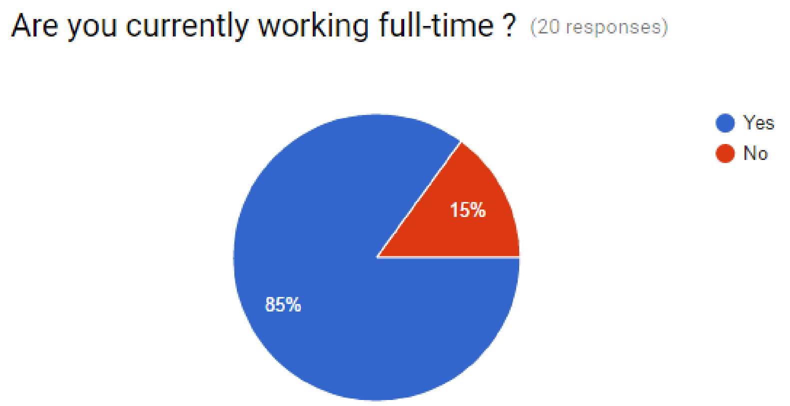


Figure 3.8: Are you currently working full-time

In Q3, the question was asking about the number of parent who currently works as full-timer. Based on the analysis, there are 85% of the parent currently work as a full-timer and only 15% of the parent currently either working as part-timer or not working at all, which means there are 85% of the parent who is not at home most of the time and may have a high chance of needing a tools to help them in monitoring their child during their working hour.

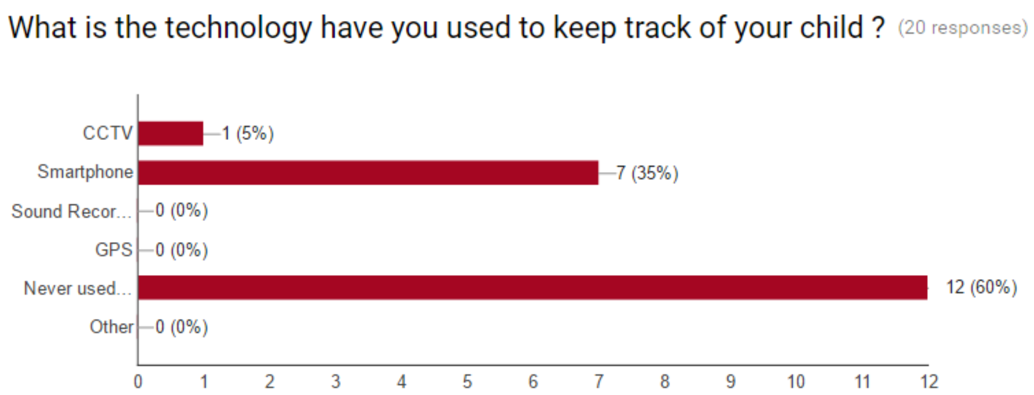


Figure 3.9: What is the technology have you used to keep track of your child

In Q4, the question was asking about the current technology used by the parent to keep track of the child. Based on the analysis, the majority of the parent never used any technology to keep track of their child, that is 60% of them and none of the parents are using the sound recorder and GPS to keep track their child. There are 35% of the parent who use smartphone to keep track of their child and 5% of the parent is using CCTV. The analysis result can help to make a conclude that about 60% of the parents did not aware of the child missing issue will cause that never use any technology to keep track of their child. There are only 35% of the parents who did use the smartphone to keep track of their child but is not feasible if their child is heading to school as most of the school is prohibited for the child to bring the smartphone to school, and the smartphone is not suitable for a kids below 6 years old to bring along. Moreover, the CCTV can only be used to monitor the child behaviour inside the house. There is a needs to advocate the issue to the public and the needs of the proposed system to help most the parent in keep tracking their child.

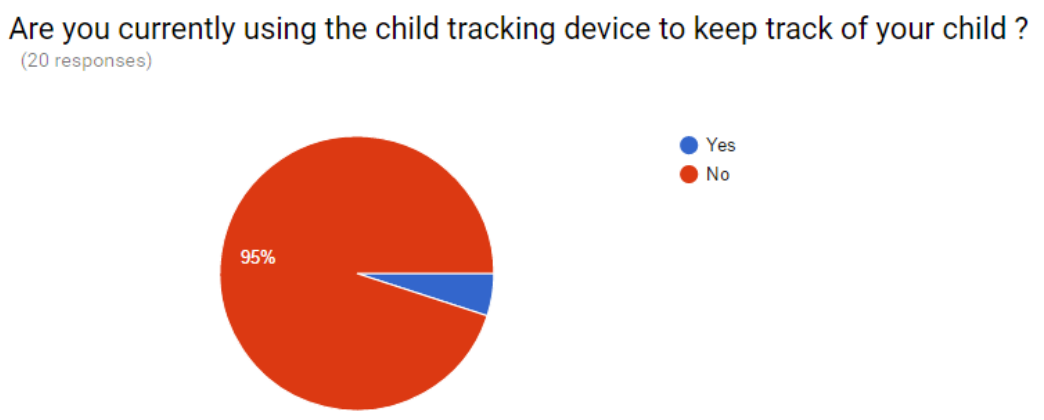


Figure 3.10: Are you currently using the child tracking device to keep track of your child

In Q5, the question was asking about whether the parent is using the child tracking system to keep track of their child. Based on the analysis it can be clearly seen that majority if the parent, that is 95% of them are not using the child tracking system and only 5% of them are using the existing system to keep track of their child. The result can further confirm most of the parent did not use the child tracking system. It can be due to the existing system is not approachable and affordable to the Malaysia's parent. The result of the question can act as a guidance to retrieve the further requirement of the parent regarding to the system.

II. Category 2: Feature Requirement

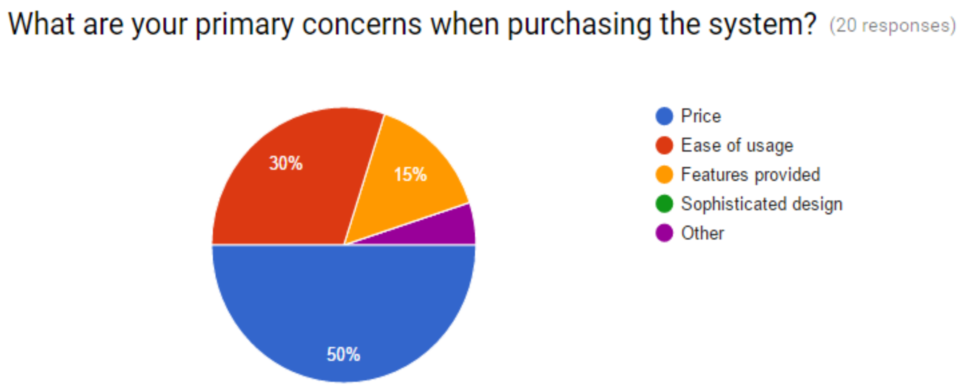


Figure 3.11: What are your primary concerns when purchasing the system

In Q6, the question was asking about the primary concerns of the parents when purchasing the system. Based on the analysis, about 50% of the parent look into the price of the system before make decision to buy. There are about 30% of the parent who look into the ease of usage and 15% of the parent look into the features provided. Based on the analyse result, the price and ease of usage should take as priority when designing the system. This is because there are total of 80% of parent who look into those considerations before buying the system, with the features provided taking as low priority as only 15% of parent look into it.

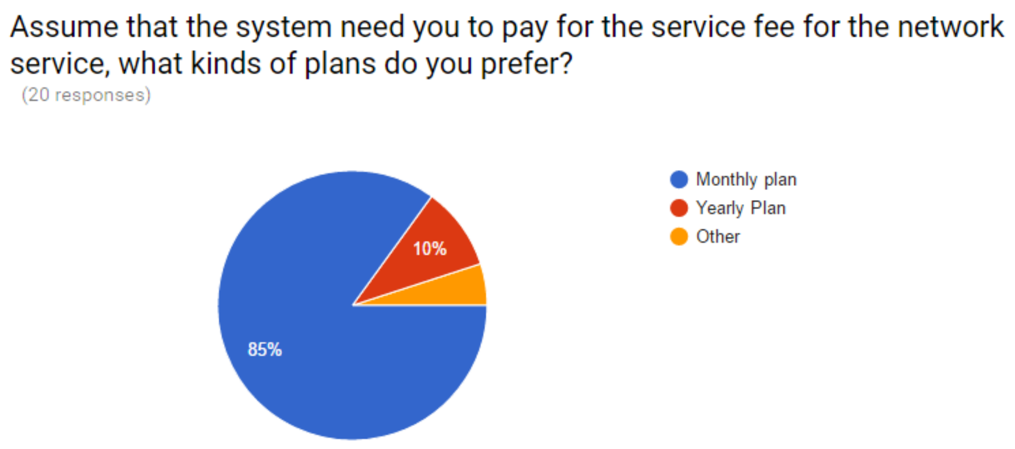


Figure 3.12: Assume that the system need you to pay for the service fee for the network service, what kinds of plans do you prefer

In Q7, the system was asking about the preferable plan for them to pay for the service fee of the system. The service fee is come the cellular network service which provided by the Internet Service Provider (ISP). Based on the analysis, there are 85% of the parent prefer monthly plan and only 10% of the parent preferred yearly plan. This question can help in determining the suitable telco service that will meet with the requirement of most of the parent in Malaysia.

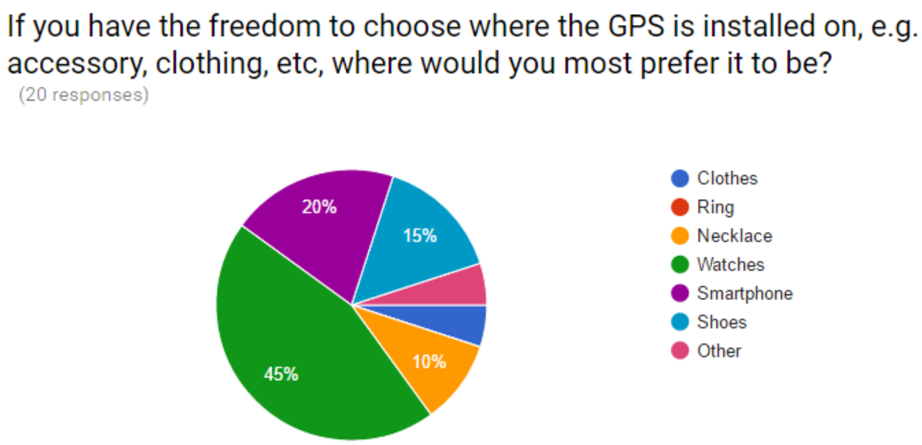


Figure 3.13: If you have the freedom to choose where the GPS is installed on, e.g. accessory, clothing, etc., where would you most prefer it to be

In Q8, the parent is asked to choose the preferable GPS receiver to install on the child. Based on the analysis, there are 45% of the parent choose to install the GPS device on watches, 20% of the parent choose on the smartphone, 15% of the parent choose to install on the shoes and 10% of the parents choose to install on the necklace. There are only 5% of the parents choose to install it on the clothes. However, there are no parent prefer to install GPS receiver on the ring. The result statistic has help to determine the most preferable place to install the GPS for the project.

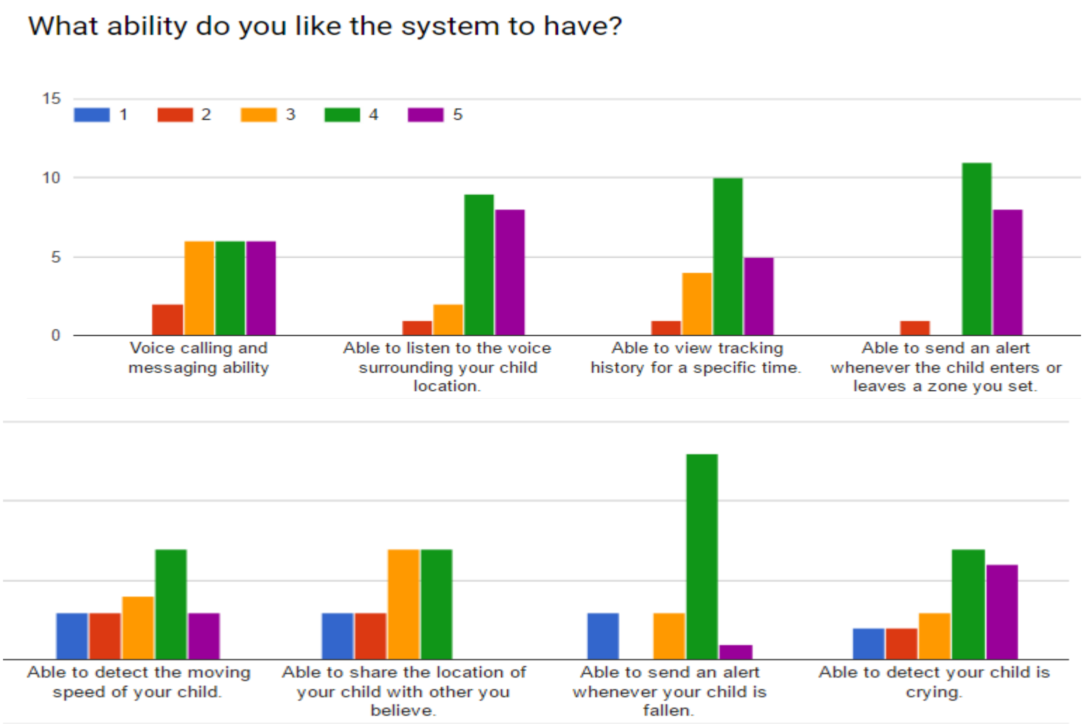


Figure 3.14: What ability do you like the system to have

In Q9, the question was asking about the ability of the system they are most preferred. The question was set to ask the parent to choose number 1 to number 5 in each of the ability to be denoted as not important to very important. Based on the analysis, the graph has shown that most of the parent are demanding for the ability, that are the ability where the system can send an alert to them when their child is entered or leaved a set zone, the ability of the system to let the parent to listen to the voice surrounding their child's location, the ability to view tracking history, the ability to send an alert when the child is fallen, the ability to detect the child is crying and the ability to voice calling and messaging is important for them. However, for some ability, for example, the ability to detect the moving speed of the child, the ability to share the location of the child with the trusted people caught a few parent concerns only. The result statistic has help to determine the abilities where most of the parent think was important should be implemented into the project as possible.

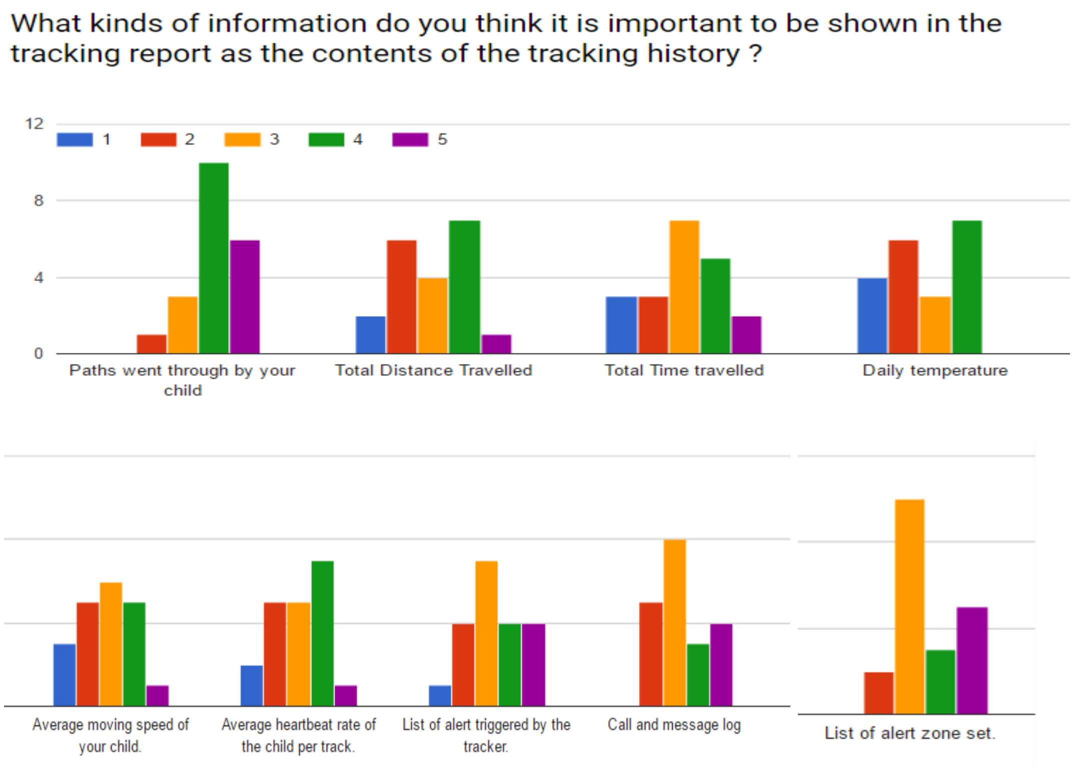


Figure 3.15: What kinds of information do you think it is important to be shown in the tracking report as the contents of the tracking history

In Q10, the question was asking about the information the parent would like to see in the tracking reports. Based on the analysis, the paths went through by the child get most concerns from the parent, that is 16 responses rated it as important and very important. The total distance travelled, the total time travelled, the daily temperature, the average heartbeat rate of the child, the alert triggered by the tracker, the call and message log and the list of alert zone set get approximately 7 to 8 responses rated it as important and very important which should be consider to be implemented as possible. However, the average moving speed of the child get the least responses, that was 5 of them rated it as important and 1 person rate it as important with 3 responses rated as not important.

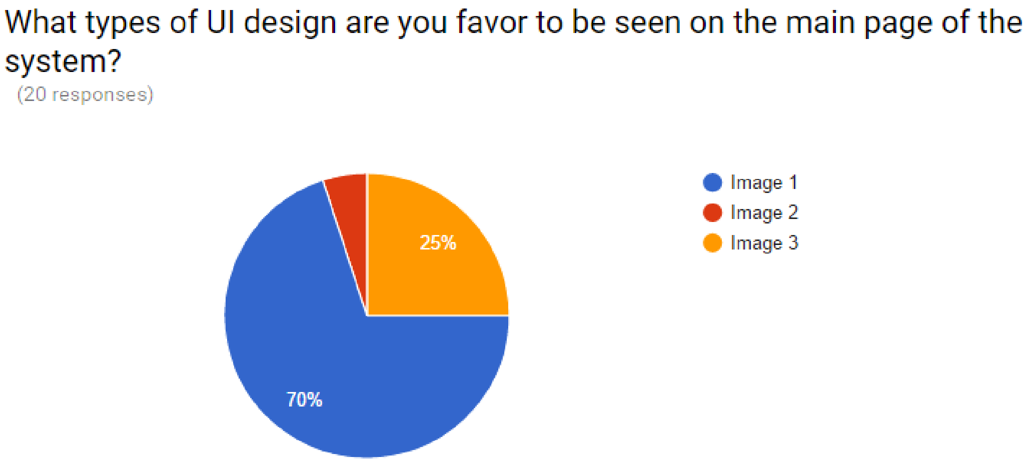


Figure 3.16: What types of UI design are you favour to be seen on the main page of the system

In Q11, the question was asked to know about the UI design they would like to see on the main page of the system. The image showed in the questionnaire is attached in the Appendix behind of the project. Based on the result, there are 70% of the parent are in favour of image 1, 25% of the parent are in favour of image 2 and only 5% of the parent are in favour of image 3. The result get from the question has shown that many of the parent do like the simple interface for the system and will act as a guidance in creating the user interface that suit with most of the parent.

Is there anything else that you would like to see on the system ? (7 responses)

None
the location that the kid been visited.
No
No
images of the area where the kids at.
The current position of my child located
The zone on the location

Figure 3.17: Is there anything else that you would like to see on the system

In Q12, the question is being asked to know about the further information they would like to see on the system. Based on the result collected, the parent who gave the response suggest that they would like to see the location their kid has been visited. Besides, there are also a response who suggest that they would like to see the images of the area where the kids at. The others two suggestion, which was the current position of the child located and the zone on the location has been integrated to the proposed system. Those opinions from the question can help in make further improvement on the system to make sure the needs of the parents can be fully implemented as possible.

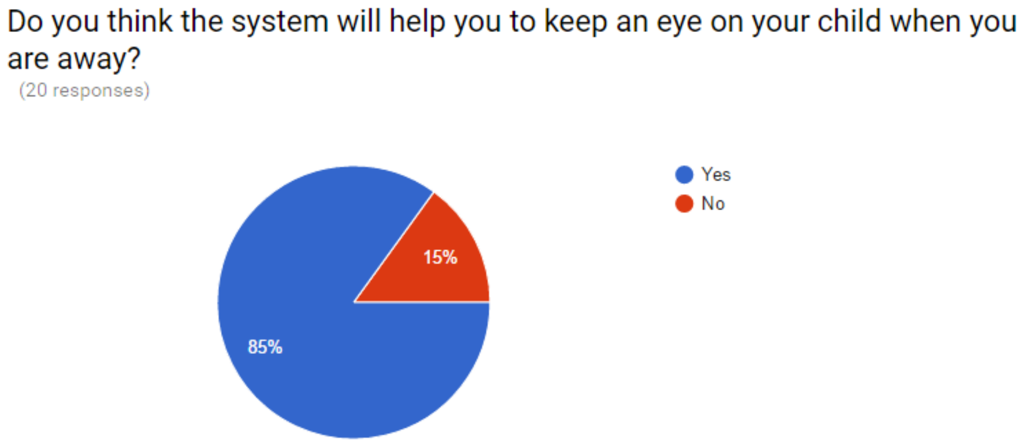


Figure 3.18: Do you think the system will help you to keep an eye on your child when you are away

In Q13, the question was asking about the opinion regarding the feasibility of the system in helping the parent to keep track of their child. Based on the statistic collected, there are 85% of the parent believe that the system can help them to keep track of their child and only about 15% of the parent not agree with the system. Based on the analysis, we can conclude that the project is feasible where there are 85% of the parent are believe that the system can help them in keep tracking their child.

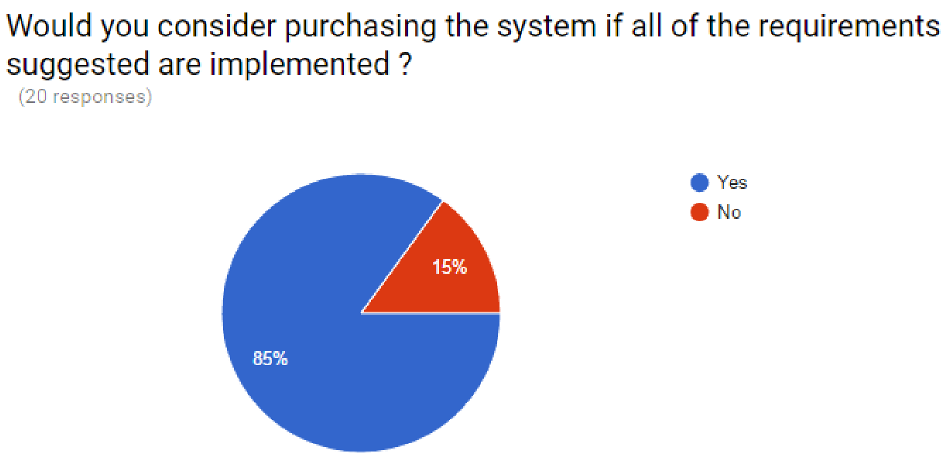


Figure 3.19: Would you consider purchasing the system if all of the requirements suggested are implemented

In Q14, the question was asking about the possibility of the parent in buying the system if the system fulfil with their requirement. Based on the analysis, there are 85% of the parents said they will buy the system and only 15% of the parents will not buy the system. Based on the statistic collected, we can further confirm that the project is feasible where there are 85% of the parent will consider buying the system.

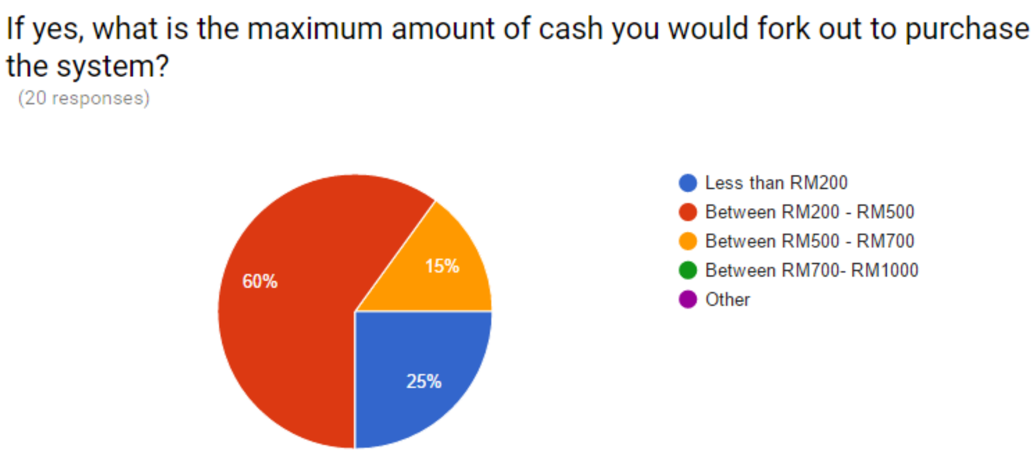


Figure 3.20: If yes, what is the maximum amount of cash you would fork out to purchase the system

In Q15, the question was asking about the maximum amount of cash the parent would like to fork out to purchase the system. Based on the statistic collected, there are 60% of the parent can fork out between RM200 to RM 500 to buy the system, 25% of the parent can fork out less than RM200 and 15% of the parent can fork out RM500 to RM700. The result of the analysis can help in further determine the technology that should be used inside the system so as the price of the system is within the budget of the parent and the requirement of the parent can be fulfilled as possible.

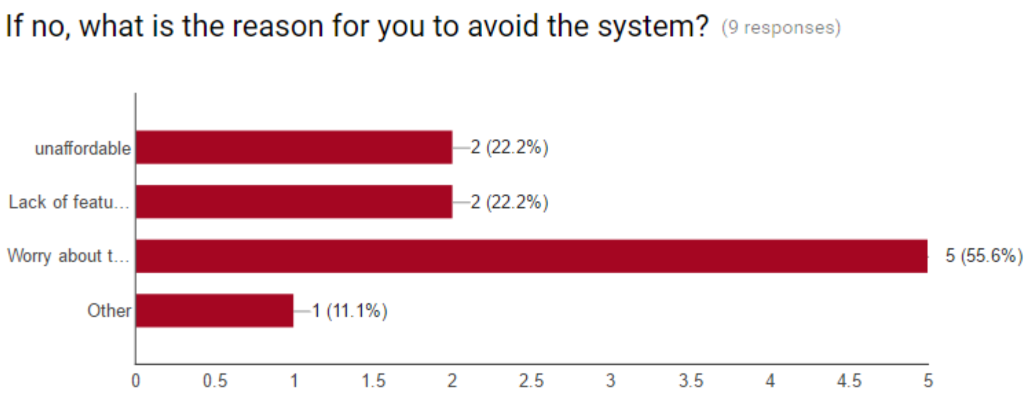


Figure 3.21: If no, what is the reason for you to avoid the system

In Q16, the question was asking on the reason for the parent to not using the system. Based on the statistic collected, among those who will not buying the system, there are 22.2% of the them claims that the system is unaffordable and lack of feature. There are about 55.6% of the parent worry about the side effect of the technology towards the health of their child and 11.1% of them chose others with the comment of scaring the side effect of the technology towards the health of their child. The result of the analysis can help in further acknowledge about the problem that lead them to not buying the system so as the enhancement measure can be taken.

3.3.2 Software Requirement

In this section, the description of the software system to be developed which is the system's functional and non-functional requirement is being analysed.

1. Functional Requirements

1. The app should be able to let the parent to make registration, login and edit account.
2. The app should be able to detect the current location of the tracker.
3. The app should be able to let the parent to create multiple geo-fence to monitor their children together with monitoring period.
4. The app should be able to guide the parent to child direction.
5. The app should be able to provide two-ways communication for the parent to communicate with their child as needed.
6. The app should be able to trigger an alert whenever the tracker is entering or leaving the set geo-fence.
7. The app should be able to trace the history of the route went through by the tracker.

2. Non-Functional Requirements

1. The location of the tracker should be retrieve in less than 10 second at outdoor in a stable GPS and network connection.
2. The alert should be trigger with the maximum allowed delay of not more than 5s.
3. The server must have a minimum up-time of 99%.
4. The system should be able to cope with minimum 50 user connection.

3.3.3 Hardware Requirements

In this section, the hardware required for the project is being stated and analysed.

1. Android smartphone

The system needs a smartphone running in the Android platform to install the app. There are two smartphone needed to demonstrate the app, that is one install the app to login as parent and the other one install the app to login as child to be tracked by parent. The app needs the smartphone always keep open the location and network connection to be able to run the functional requirement stated above correctly.

3.3.4 Development Tools

The development tools requirement to create the project is discussed in this section.

1. Android Studio

Android Studio is an IDE created officially by Intellij IDEA for Android app development. Android studio is freely available under the Apache License 2.0. It comes with the variety of features which will enhance the productivity when building an Android app such as the most astonishing one is their flexible Gradle-based build system where the Android developer can simply use the declarative Domain-Specific Language (DSL) to configure Gradle builds which was widely support on Android devices and App stores. Besides, it also come with lint tool which is a static code analysis tools to check for the potential bugs in the project as well as providing optimization improvements for performance, usability, security and some other improvement.

2. Notepad++

Notepad++ is a text-editor and even a source code editor for the Microsoft Windows. According to the Stack Overflow survey in 2015, it is voted as the most common used text-editor in the worldwide (Stack Overflow, 2016). It supports code folding and syntax highlighting for many of the programming, scripting and markup languages which make it the popular source code editors in the world.

3. Git

Git is the distributed version control system for software development. It is free and open source, released under the GNU General Public License version 2.0. Unlike the other system, it come with the branching model and the staging area where the branching model come with the ability to create multiple local branches and staging area allowed the commits to be formatted and reviewed before send to the server. It is even small and fast as compared to SVN.

4. Wamp Server

WampServer is a Windows web development environment to create the web application with Apache2, MySQL database and PHP. It allows easily manage of database via PhpMyAdmin.

3.4 Design

During the design phase, the system is being designed and modelled. There are 5 modeling being done in this project, that is use case diagram, class diagram, sequence diagram, state diagram and ERD diagram. Each of the diagram is showed and explained in Chapter 4 of this project. The architecture design for this project is showed in Chapter 5.

3.5 Development/Implementation

The development phase of the project will be run in iteration where each iteration will involve the creation of the new module with different features allocate to different module. During the development, the important module that is critical to the system, the module that have most demand from the parent will be seek as high priority, for example detect the user current location and create geo-fence will be developed first. After the of the module have been developed completely, the combination of the module will be carry out at the last increment to create a complete system. The explanation for how the implementation is done in this project is done in Chapter 5.

3.6 Testing

The testing phase of each iteration involve the conduction of unit testing and user interface testing where unit testing will be conducted testing of single functionality in the module and user interface testing involve the testing for the presence of the defect in the user interface of the system. The user acceptance test is also carry out on the final iteration when all the modules have been combined and being tested without error to ensure the system can satisfy with the customer and fulfill the specification. The details explanation of each testing is provided in Chapter 6 of this project.

3.7 Deployment

The deployment phase in each iteration will involves the small release of each of the completed increment to the surrogate user to try with the provided feature to ensure user satisfactory with the product. The system is fully released when all the increment has been successfully integrated into the system and the system is transitioned to the university department to prepare for deployed.

CHAPTER 4

SOFTWARE MODELING

4.1 Introduction

This chapter is divided into 6 parts, that is use case diagram, class diagram, sequence diagram, state diagram and ERD diagram respectively. The description of each of the use case, which is use case description is provided as the sub-part of the use case diagram section.

4.2 Use case

The use case diagram depicts the interaction between the child and the parent to the system is shown in the Figure 4.1. There are 9 use cases and 2 extended use cases in the diagram. The description of each of the use case is provided in the sub-section.

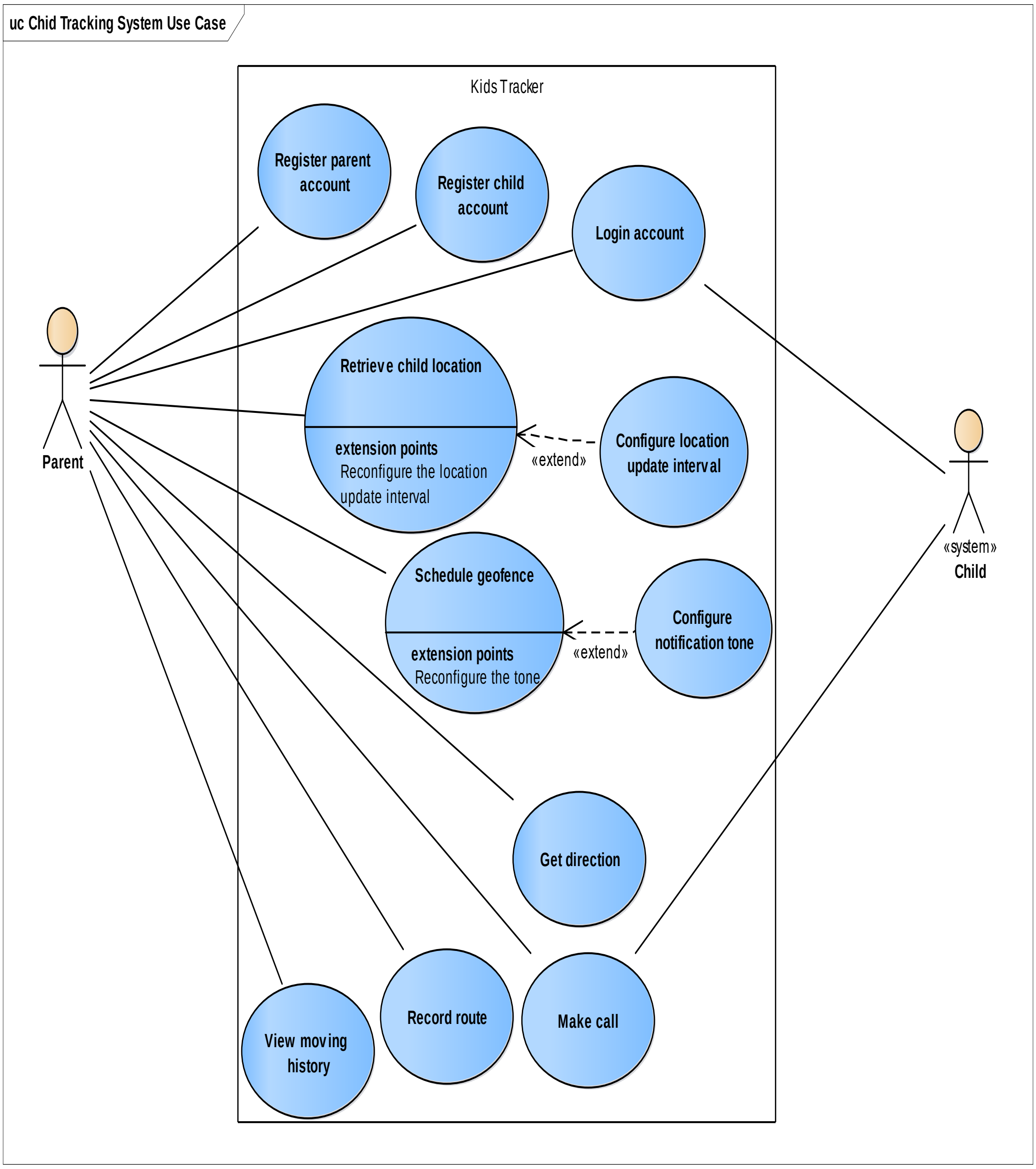


Figure 4.1: Use case diagram

4.2.1 Use case Specification

In this section, the description of each of the use case is being done. The description is focusing on describing each of the use case to have a better understanding of the objective, flow and constraint of each of the use case.

Table 4.1 Register Parent Account Use Case Description

Use Case Identification and History			
Use Case ID:	1		
Use Case Name:	Register Parent Account	**Version No:**	0.1
End Objective:	To enable the parent to register their own account for using the app.		
User/Actor:	Parent		
Trigger:	Parent want to using the app for the first time.		

Basic Flow		
Step	**User Actions**	**System Actions**
1	The parent enter the username, email, phone number and password.	The system checks for the existing user records in database.
2.	The parent redirects to the login activity to proceed to login.	

Exception Flow		
1	The parent entered the username or email address which are already existing in the database records. (Basic Flow, Step 1).	The system shows the invalid message and asks for retry of the details. The basic flow resumes at Step 1.

Table 4.2 Login Account Use Case Description

Use Case Identification and History			
Use Case ID:	2		
Use Case Name:	Login Account	**Version No:**	0.1
End Objective:	To authenticate user before using the app		
User/Actor:	Parent & Child		
Trigger:	Parent or child registered and want to login to use the app.		

Preconditions
The parent or child need to have a registered login credentials before can login.

Basic Flow		
Step	**User Actions**	**System Actions**
1	The parent enter the username and password	The system checks for the parent records in database to authenticate the parent.
2.	The parent log into the system.	

Alternate Flow		
Step	**User Actions**	**System Actions**
1	The parent/child enter the username and password of the child.	The system checks for the child records in database to authenticate the child.
2.		The system will send a notification to the parent regarding the child successfully logon.
3.	The child log into the system	

Exception Flow

1	The parent/child enters the wrong username or password (Basic Flow, Step 1) or (Alternate Flow, Step 1) in case "login as child" button is triggered.	The system shows the invalid message and asks for retry of the details. The basic flow resumes at Step 1 if login as parent or else the alternate flow will resume at Step 1 for child login.

Post conditions
1. The system will enter the main activity for the parent login and enter to the child main activity for child login where when successfully entered, most of the required task can start to perform.

Table 4.3 Register Child Account Use Case Description

Use Case Identification and History			
Use Case ID:	3		
Use Case Name:	Register Child Account	**Version No:**	0.1
End Objective:	To enable the parent to register a account for the child to track and monitor their location.		
User/Actor:	Parent		
Trigger:	Parent want to register the account in order to be used on the child phone to track his/her child.		

Preconditions
The parent already registered and logon to their account.

Basic Flow		
Step	**User Actions**	**System Actions**
1	The parent key-in the name, password and telephone number of the child.	The system checks for the existing child record in the database.
2.	The parent will be redirect to the main activity.	

Exception Flow		
1	The parent entered the username which are already existing in the database records. (Basic Flow, Step 1).	The system shows the invalid message and asks for retry of the details. The basic flow resumes at Step 1.

Table 4.4 Retrieve Child Location Use Case Description

Use Case Identification and History			
Use Case ID:	4		
Use Case Name:	Retrieve Child Location	**Version No:**	0.1
End Objective:	To get the latest location of the child.		
User/Actor:	Parent		
Trigger:	Parent first enter to the map view or manually click on the child name listed in the map view.		

Preconditions
1. The child needs to be and logon and connected. 2. The parent needs to enter the map view.

Basic Flow		
Step	**User Actions**	**System Actions**
1	The parent enter to the map view.	The system request the server to get all the available connected children's location and the children device status.
2		The system send the children location to the parent together with the details about the location and device status.

Alternate Flow 1		
Step	**User Actions**	**System Actions**
1	The parent clicks on the listed child name.	The system will search for all the available connected children's location.

Alternate Flow 1		
Step	**User Actions**	**System Actions**
2		The system send the children location to the parent together with the details about the location and device status.

Alternate Flow 2		
Step	**User Actions**	**System Actions**
1	The parent configured the system to update the child latest location periodically.	The system gets and send the latest of the connected child to the parent periodically based on the time value set.

Exception Flow		
1	The parent clicks on the child name to get his/her location which is not connected. (Alternate Flow 1, Step 1)	The system will display error message informing of child is not connected.

Includes or Extension Points

<u>Extension Point</u>

4.2 Configure Location Update Interval

Sub-Flows		
Step	**User Actions**	**System Actions**
1	The parent go to the setting and set the desired location update interval.	The system will store the selected value.
2.		The system performs the retrieve location function periodically based on the value.

Table 4.5 Schedule Geofence Use Case Description

Use Case Identification and History			
Use Case ID:	5		
Use Case Name:	Schedule Geofence	**Version No:**	0.1
End Objective:	To monitor the certain areas and get notified when the child		

	reach that area.
User/Actor:	Parent
Trigger:	Parent wishes to know the area the child has gone to ensure the child safety.

Preconditions
1. The child needs to be and logon and connected.

Basic Flow		
Step	**User Actions**	**System Actions**
1	The parent chooses the area he/she wants to monitor, the radius of the circle to monitor, the duration to monitor and types of the area he/she is concerned.	The system sends the selected details to the server.
		The server send the details to the child app to request the system form the child side to set for the geofence to start the monitoring.
2		When the geofence is triggered, the system will send the notification to the parent about which types of area the child is entered/exited.

Post conditions
1. The geofence will continue to listen to the next trigger unless the duration reached.

Includes or Extension Points
Sub-Flows
Extension points 4.1 Configure Notification Tone

Step	User Actions	System Actions
1	The parent go to the setting and set for the desire notification tone.	The system save the selected tone.
2.		The system sounds the selected tone when the geofence is triggered.

Special Requirements
1. The parent should not create multiple geofences at the same area.

Table 4.6 Get Direction Use Case Description

Use Case Identification and History			
Use Case ID:	6		
Use Case Name:	Get Direction	**Version No:**	0.1
End Objective:	To get the direction to the child location.		
User/Actor:	Parent		
Trigger:	Parent want to head to the child place when emergency happen.		

Basic Flow		
Step	**User Actions**	**System Actions**
1	The parent click on the marker in the map which represent child current location.	The system will pop out a get direction icon.
2	The parent click on the icon.	The system redirect the user to the google map direction.
3.		The google map get the child current location and calculate the route to the child location.
4.		The google map direction displays the direction to the child location.

Table 4.7 Make Call Use Case Description

Use Case Identification and History			
Use Case ID:	7		
Use Case Name:	Make Call	**Version No:**	0.1
End Objective:	To make contact with each other.		
User/Actor:	Parent & child		
Trigger:	Parent or child wants to contact each other in case of emergency.		

Preconditions
1. The parent needs to register for the child's phone number during the child registration. 2. The parent needs to choose which child to make contact to.

Basic Flow		
Step	**User Actions**	**System Actions**
1	The parent click on the call button.	The system search on the server for the telephone number of the registered child.
2		The system make connection with the received telephone number and dial to that number.

Table 4.8 Record Route Use Case Description

Use Case Identification and History			
Use Case ID:	8		
Use Case Name:	Record Route	**Version No:**	0.1
End Objective:	To records the route travelled by the child.		
User/Actor:	Parent		
Trigger:	Parent want to know the route the child travelled during that interval.		

Preconditions
1. The parent needs to choose which child he/she want to record his/her child routes.

Basic Flow		
Step	**User Actions**	**System Actions**
1	The parent clicks on the record route button.	The system ask for the duration he/she want to record the route.
2	The parent selects the desire duration.	The system saves the selected value to send to the server to wait for sending to the child app.
3.		The system of the child app receive the setting and call for service to record the location at interval based on the selected value.
4.		When the interval reached, the system of the child app will stop recording for the location and send the list of recorded location to the server to be stored.
5,	The parent will be notified regarding the stop of location recording.	

Table 4.9 View Moving History Use Case Description

Use Case Identification and History			
Use Case ID:	9		
Use Case Name:	View Moving History	**Version No:**	0.1
End Objective:	To view the recorded location travelled by child.		
User/Actor:	Parent		
Trigger:	Parent want to see the recorded route travelled by child.		

Preconditions
1. The parent needs to trigger the record route function first before can see the recorded route.

Basic Flow		
Step	**User Actions**	**System Actions**
1	The parent clicks on the child name to see the recorded route.	The system get the selected child name and send that string to the server.
2		The server search for the recorded route with that particular child name.
3.		The server send back the list of recorded route to the system and display them according to date and time recorded.
4.	The parent click on the particular row of the recorded location from a list record.	The system will display the child start and end point of the location together with the route travelled in interval.

4.3 Class Diagram

The class diagram consists 7 classes which consisting of User class, Parent class, Child class, LocationItem class, SettingItem class, GeofenceItem class and CircleItem class is shown in Figure 4.2. The User class will be inherited by Parent class and Child class as they both are the user using the device. The Parent class and Child class will both using LocationItem class in which Parent depends on the LocationItem class to get the location history of their child and the Child class is using the LocationItem class to record their current location and add to a list. Besides, the Parent class will also use the GeofenceItem class to set the geofence to monitor the child and the GeofenceItem class is then passing the geofence information set by the parent to the Child app by using the Child class to add that information into Geofence API called from the Child app. The CircleItem class is the composition of GeofenceItem class in which whenever the geofence is created, a circle will be draw on the map of the parent app via the CircleItem class and whenever the GeofenceItem class is removed, and so is it for CircleItem class. The SettingItem class will be the aggregation of LocationItem class and GeofenceItem class in which SettingItem class is responsible to set location update interval for the LocationItem class or set the notification tone for the GeofenceItem class whenever the value modified by the parent.

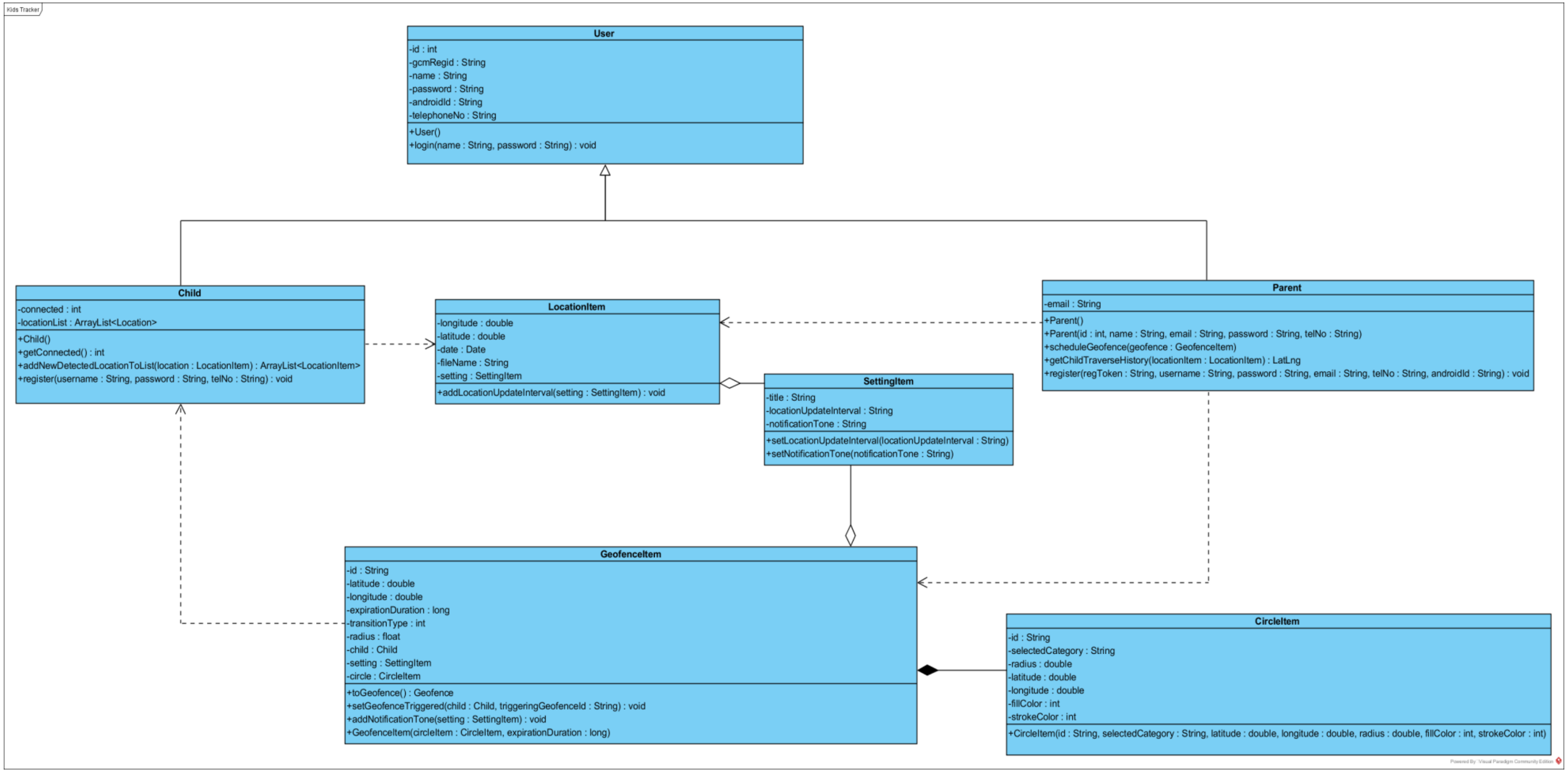


Figure 4.2 Class Diagram

4.4 Sequence Diagram

The total of 9 sequence diagrams is drawn in the project and is shown in Figure 4.3 to Figure 4.11. Each of the diagram depicts the behaviour of the system for each of the use case shown above in Figure 4.1.

Figure 4.3 shows the flow of logic when parent register for the account. The flow starts with the “Parent” actor who is responsible to trigger the flow and go through a series of validation process, that is data validation and duplicate record check before the registration process is finished to ready to go to the Parent Login Activity to login.

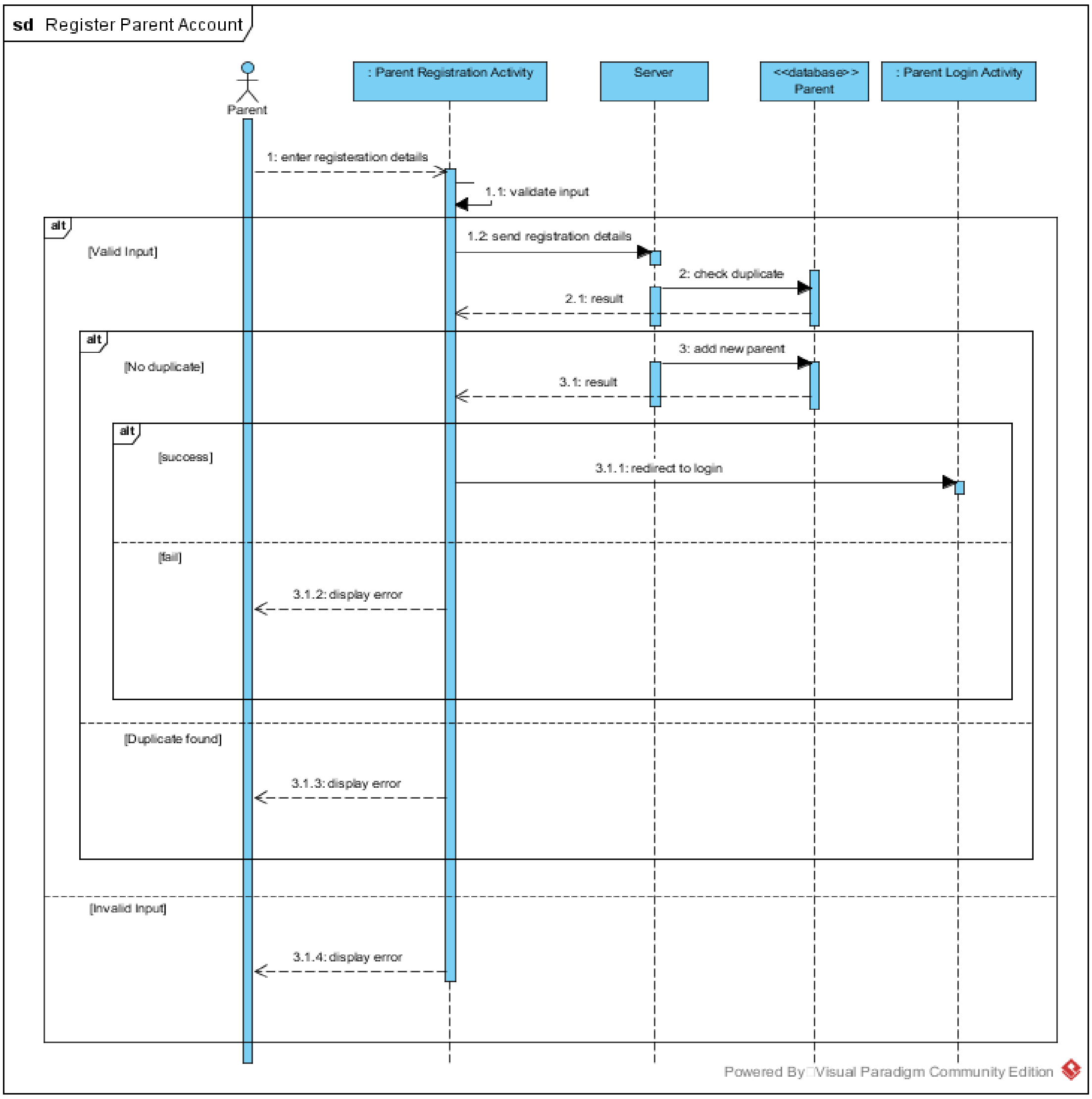


Figure 4.3 Register Parent Account

Figure 4.4 shows the flow of logic when parent register for the child account. The flow starts with the “Parent” actor who is responsible to trigger the flow to register for their child and go through a series of validation process, that is data validation and duplicate record check before the registration process is finished to ready for their child to login.

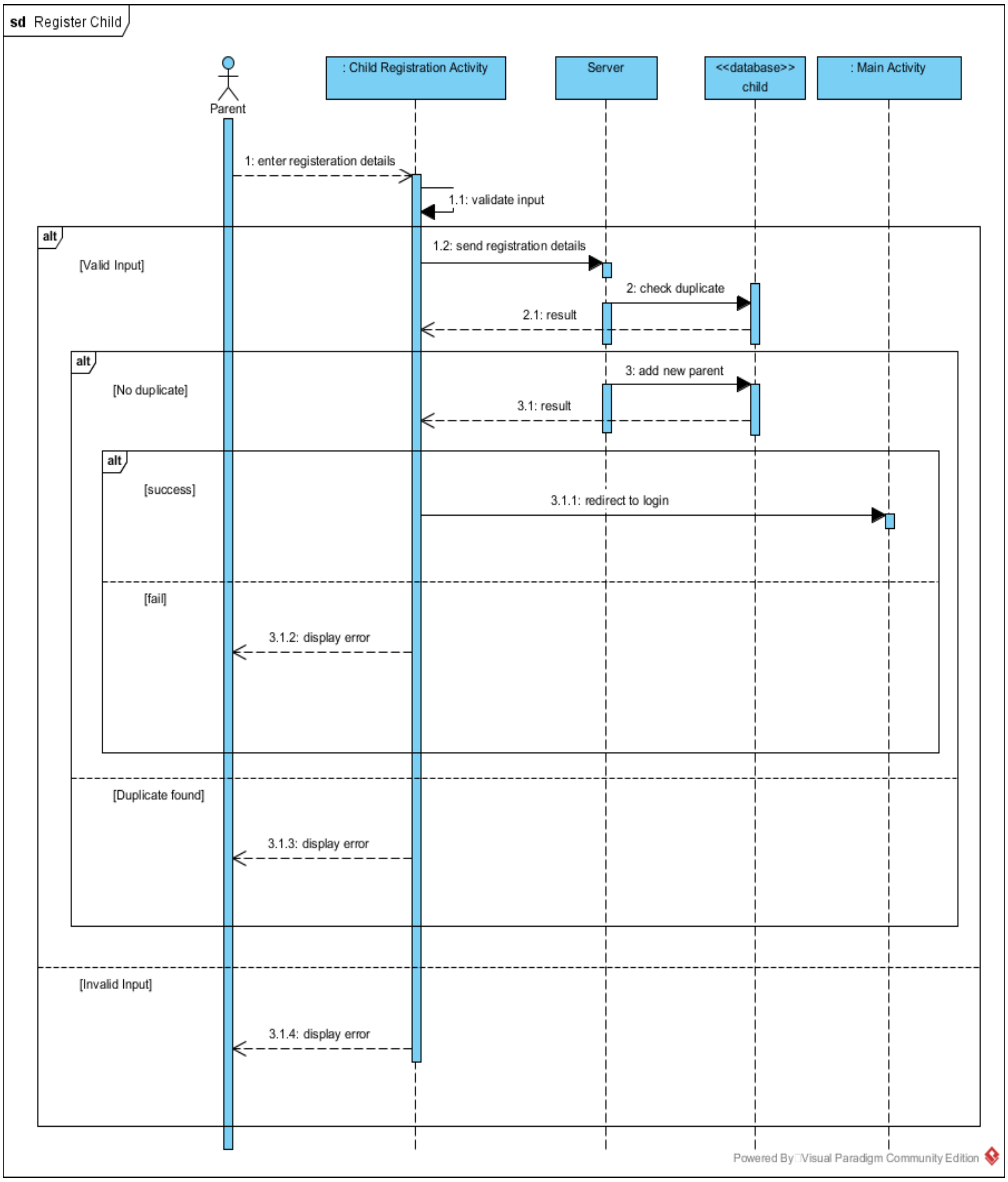


Figure 4.4 Register Child Account

Figure 4.5 shows the flow of logic when parent or child login to their respective account. The flow starts with the “Parent” or “Child” actor who is trying to login to start to use the system. There are two validation flow being performed, that is input validation and authentication check. If both of the validation passed, the parent will be redirect to Main Activity and child will be redirect to Child Main Activity.

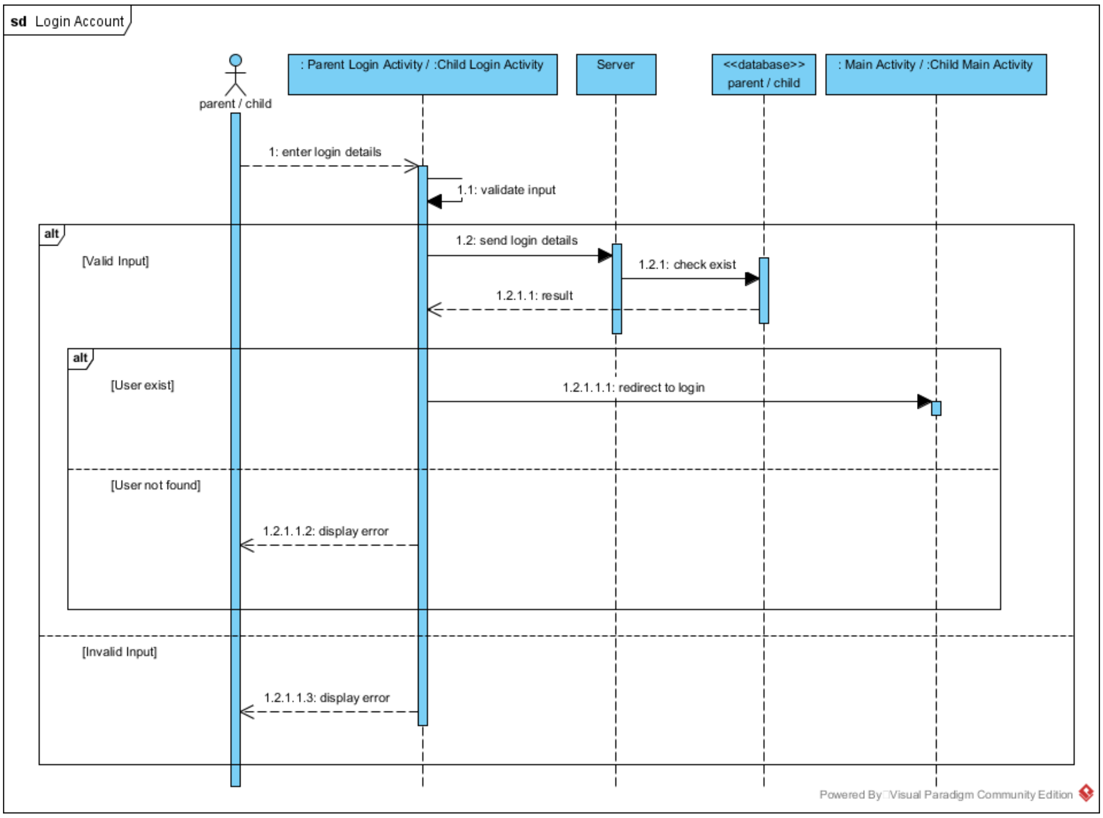


Figure 4.5 Login Account

Figure 4.6 shows the flow of logic when parent wants to get direction to the child location. The flow starts with the “Parent” actor who is clicking on the child location marker in order to start navigate to their child direction using Google Maps application. The google maps is using the Google Direction API to get the direction of the child and based on the location, the API may be success or failed to calculate route to child location depending on whether the place have a way to go.

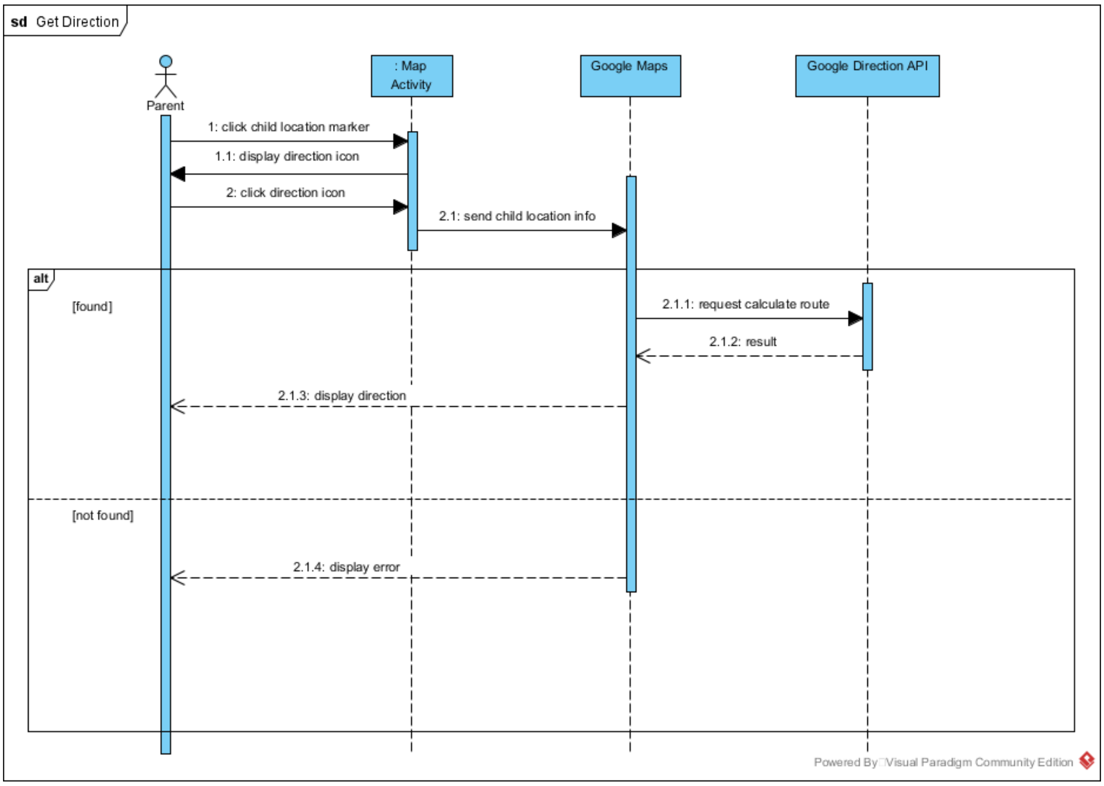


Figure 4.6 Get Direction

Figure 4.7 shows the flow of logic when parent or child wants to make call to each of them. The flow starts with the "Parent" actor request for making call in Maps Activity or in Child Main Activity for "Child" actor. Then the system will search for database for the phone number which will then call the Telephony Manager object to making call.

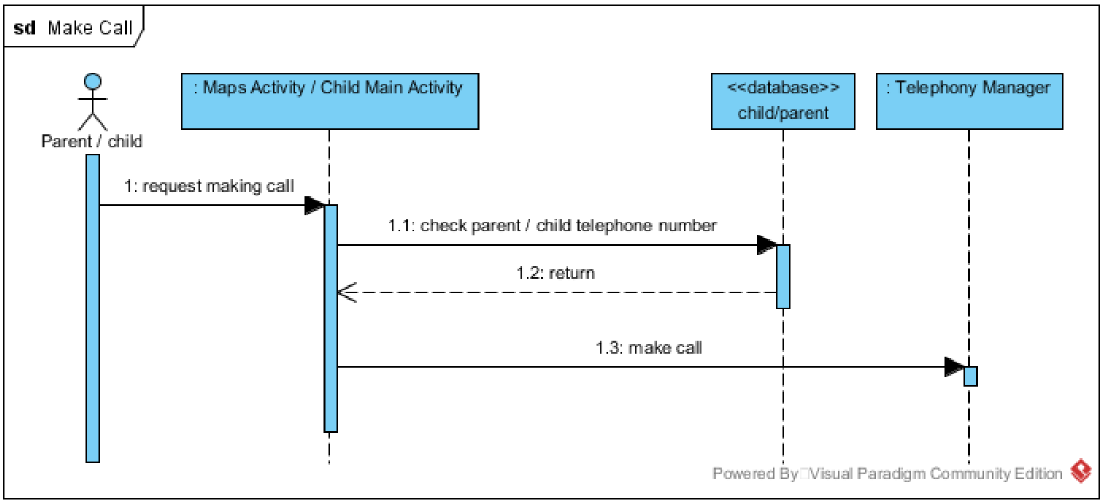


Figure 4.7 Make Call

Figure 4.8 shows the flow of logic when parent wants to records the route traverse by the child. The flow starts with the "Parent" actor select the duration to records in the Maps Activity and the selected value will be send to the Child App's location service through GCM server. The location service will get the child location at interval until the duration is reached and add all the location to a list in ChildMainService class. Then the list will be store to the folder in the server through http post request.

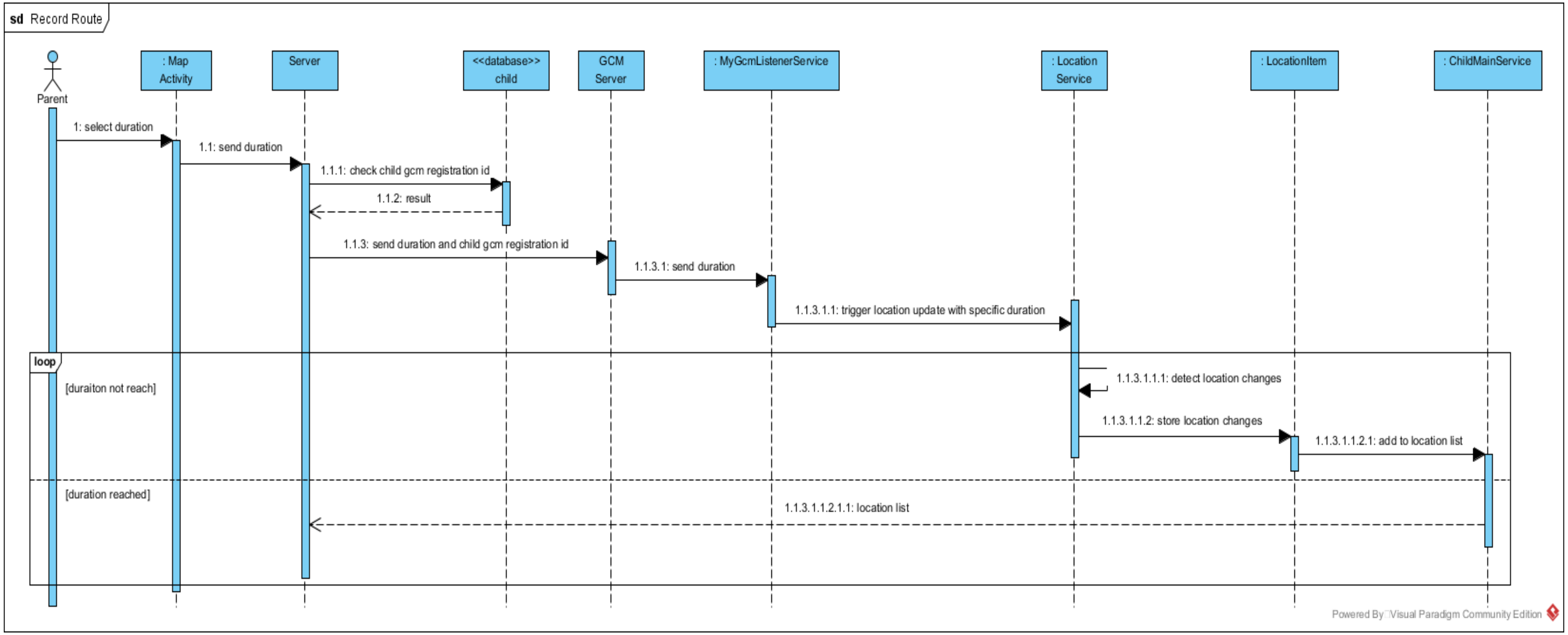


Figure 4.8 Record Route

Figure 4.9 shows the flow of logic when parent wants to retrieve the child location. The flow starts with the “Parent” actor select the child to get the location in Maps Activity. Then through the flow, the request will be send to the Fused Location API of the Child App and the API will get the location of the child. After getting the location, the result will be send back to the parent through the GCM Server.

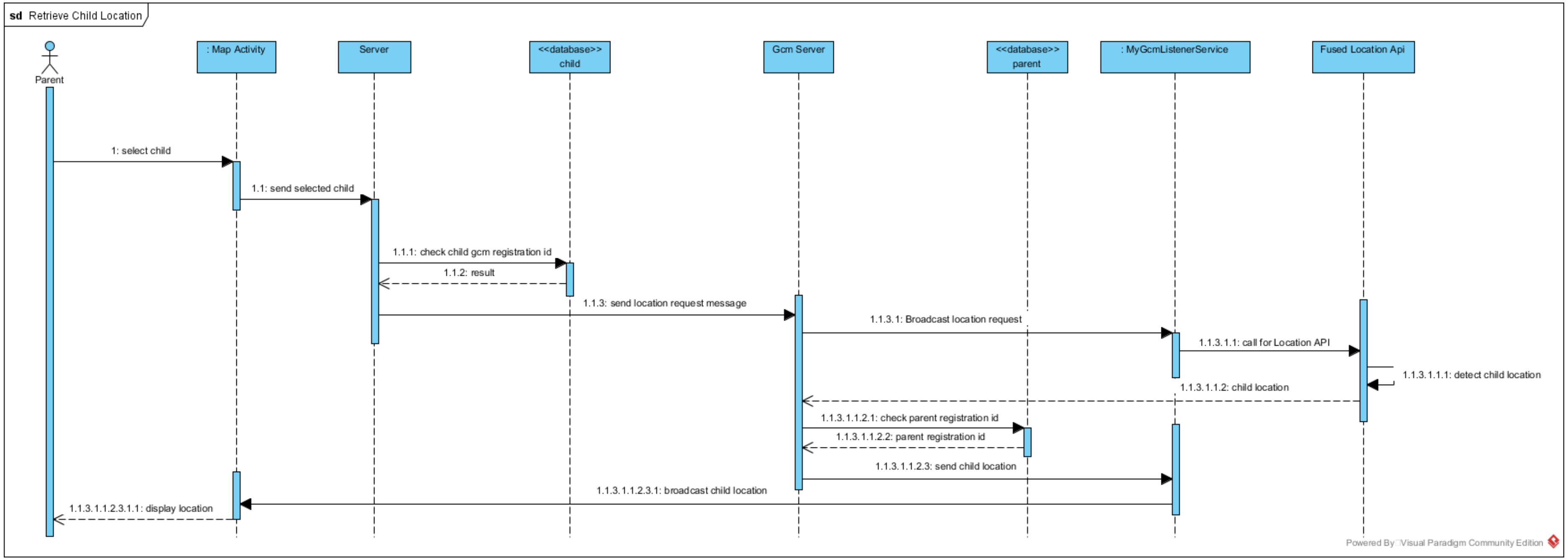


Figure 4.9 Retrieve Child Location

Figure 4.10 shows the flow of logic when parent wants to create geofence to monitor the child. The flow starts with the “Parent” actor inputting for the geofence options in Maps Activity of the system. The input value will then send to the Child App to be set to the Geofencing API to start the monitoring process. When the child triggered the geofence, the Geofence Transition Service will be called and the parent will receive the notification.

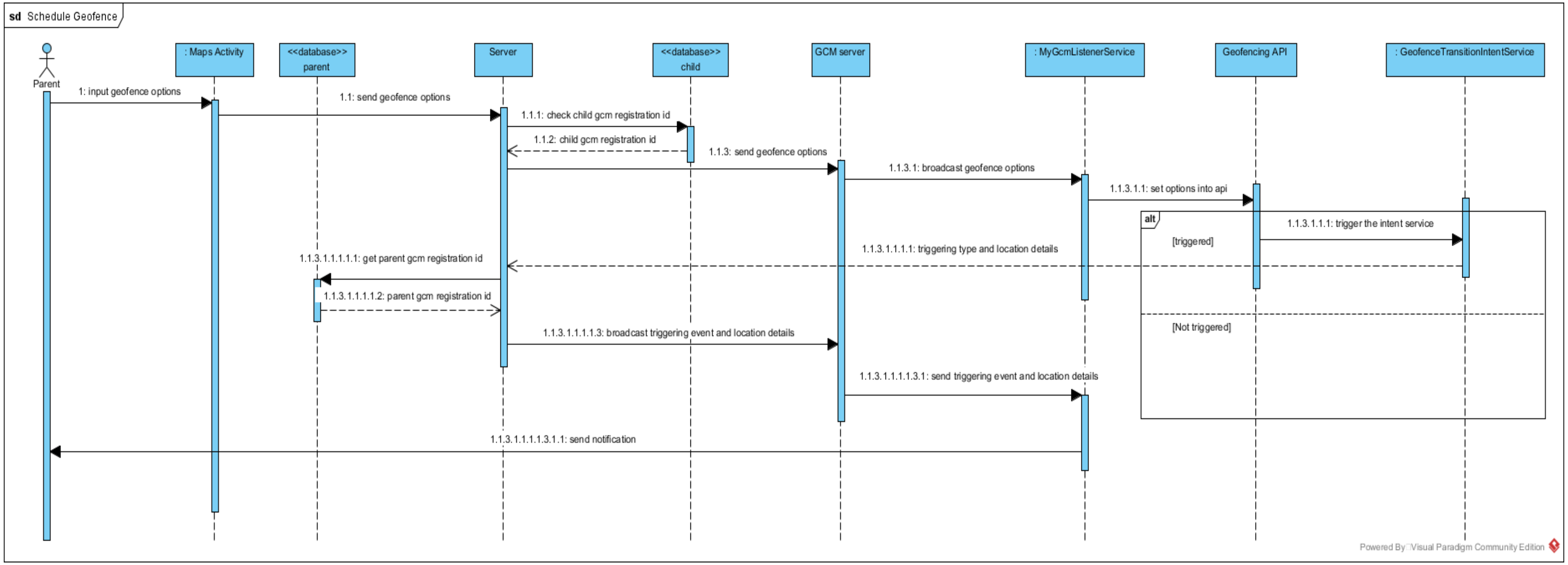


Figure 4.10 Schedule Geofence

Figure 4.11 shows the flow of logic when parent wants to view the moving history traversed by the child. The flow starts with the “Parent” actor selects for the child to view his/her moving history. Then, the flow will continue by checking the record on the server and display the record in Location History Activity if records exist. If not, the not found message will be displayed. After the records is clicked, The History Map Activity will show the markers on starting and ending position respectively.

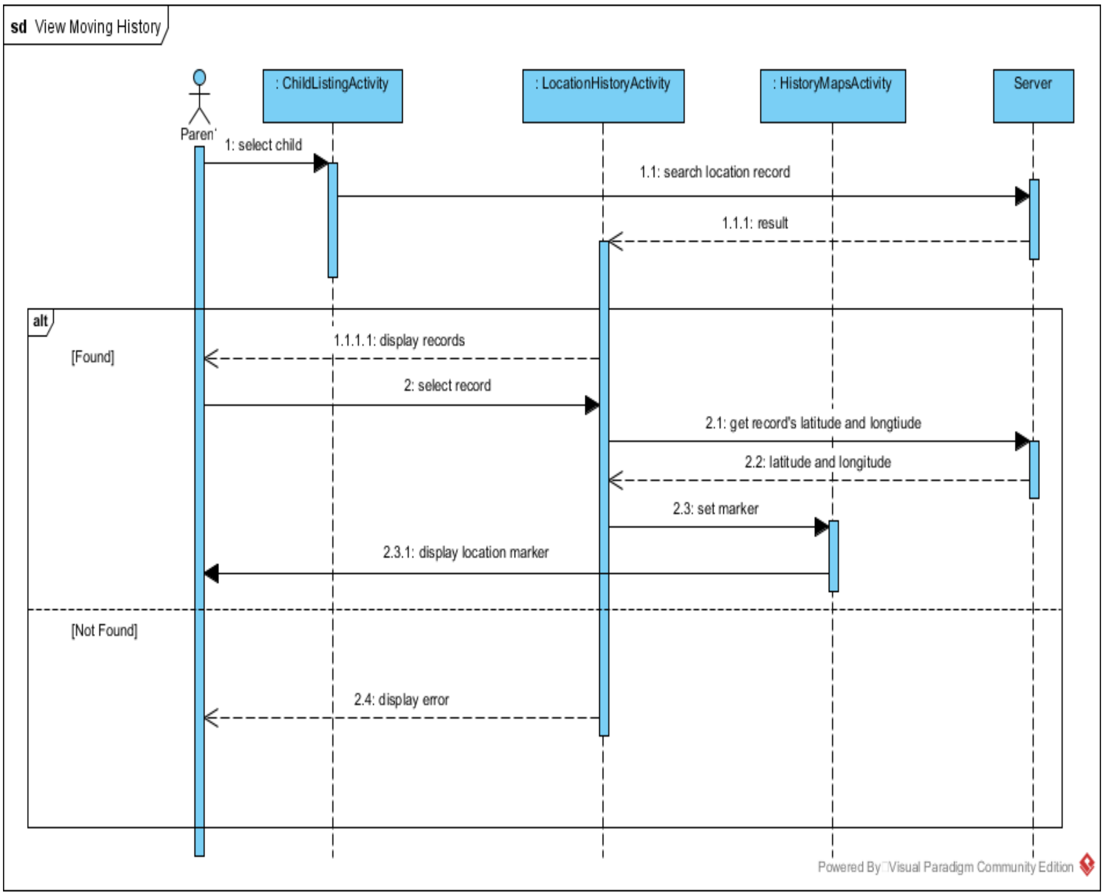


Figure 4.11 View Moving History

4.5 State Diagram

The total of 9 state diagrams is drawn in the project and is shown in Figure 4.12 to Figure 4.20. Each of the diagram depicts the state of the system for each of the use case shown above in Figure 4.1.

Figure 4.12 shows the state when parent registers for the account. The system will first enter the “waiting” state and displaying the input fields for user to enter the details. Then after the user input is received, the system will enter the “verifying” state to verify the input entered by user. If the verification state failed, the system will return to the “waiting” state to wait for another input. However, if the verification state success, the system will enter the “verified” state and prepare to save the user record to database and the “saved” state is entered. If save success, the system will go to parent login activity, but if failed, the system will enter to the “waiting” state again.

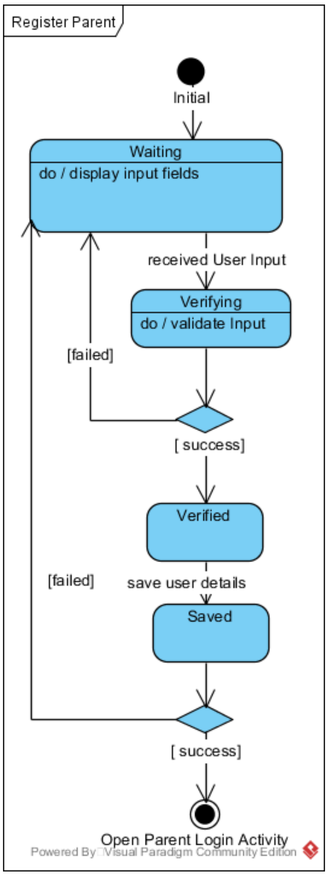


Figure 4.12 Register Parent Account

Figure 4.13 shows the state when parent registers for the child account. The state is roughly the same as the parent registration state. The system will first enter the “waiting” state and displaying the input fields for user to enter the details. Then after the user input is received, the system will enter the “verifying” state to verify the input entered by user. If the verification state failed, the system will return to the “waiting” state to wait for another input. However, if the verification state success, the system will enter the “verified” state and prepare to save the user record to database and the “saved” state is entered. If save success, the system will go to main activity, but if failed, the system will enter to the “waiting” state again.

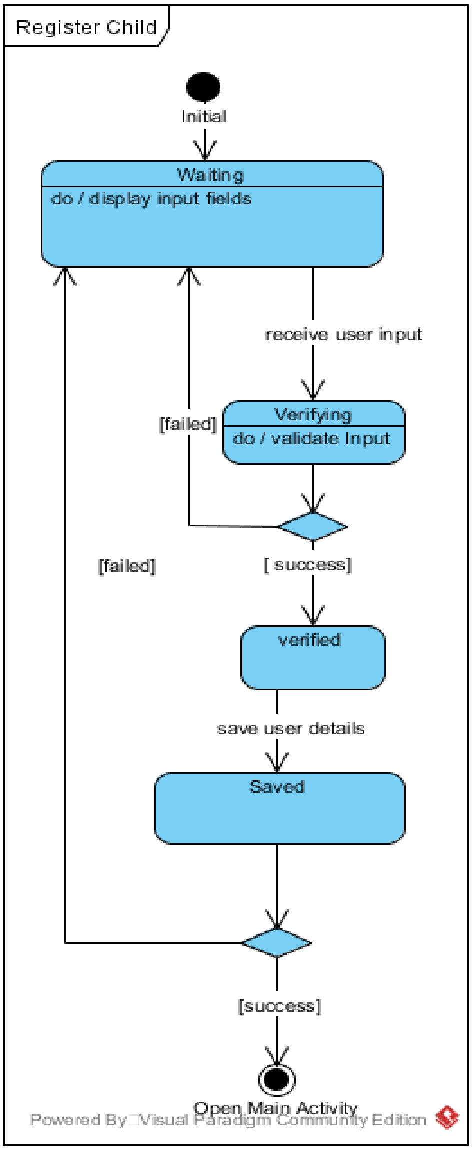


Figure 4.13 Register Child Account

Figure 4.14 shows the state when the parent or child login to the account. The system will first enter the “waiting” state and displaying the input fields for user to enter the username and password. Then after the user input is received, the system will enter the “verifying” state to verify the input entered by user. If the verification state failed, the system will return to the “waiting” state to wait for another input. However, if the verification state success, the system will enter the “verified” state and prepare to check for the existing user record in the database and then the “checked” state is entered. If credential correct after checking, the system will go to main activity, but if failed, the system will enter to the “waiting” state again to wait for another input.

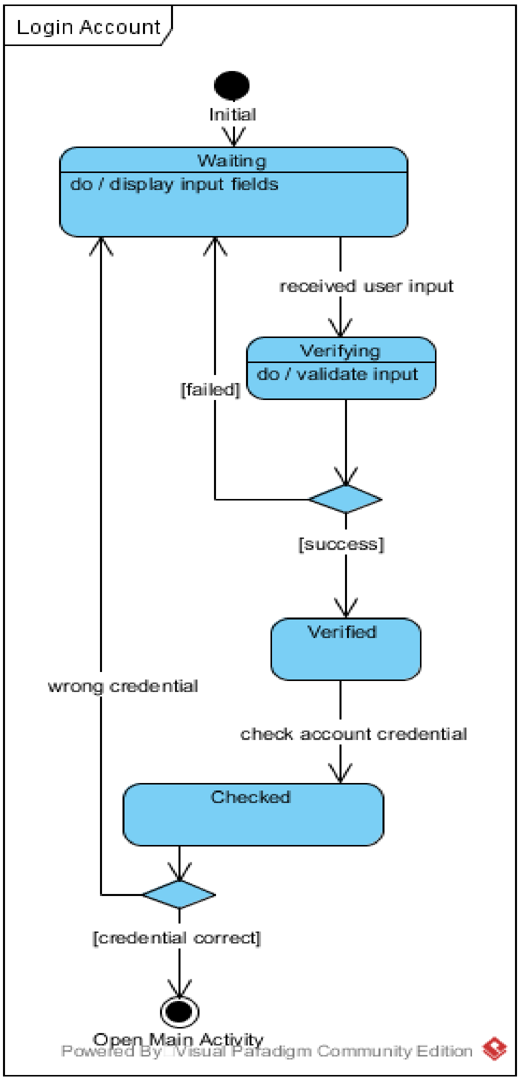


Figure 4.14 Login Account

Figure 4.15 shows the state when the parent want to get direction of the child. The state start with the assumption that the child position marker is being click and the system will enter the “waiting” state and displaying the direction icon waiting for the user to click. Then when the icon is clicked, the system will open the Google Maps application to start the navigation.

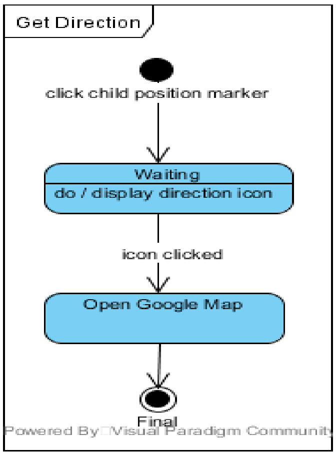


Figure 4.15 Get Direction

Figure 4.16 shows the state when making call to the child. The state start with the assumption that the child to call for is being selected. Then, the system will go to the “waiting” state and display the available operation parent can perform. When the call button is clicked, the “calling” state will be entered. The “called” state will be entered when the call is received and after the “called” state, the system will enter the end state by returning to the previous activity.

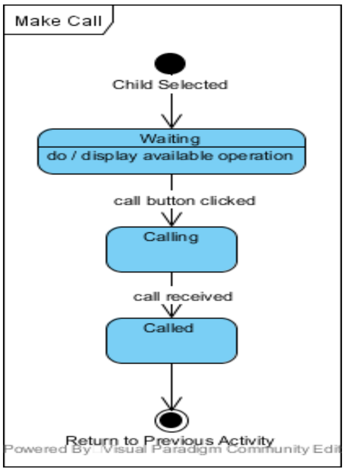


Figure 4.16 Make Call

Figure 4.17 shows the state when the parent wants to record the route traversed by the child. The state start with the assumption that the child to call for is being selected. Then, the system will go to the "waiting" state and display the available operation parent can perform. When the user input is received to perform the record route, the "Duration Selection" state will be entered to enable the user to select the record duration. After the duration is selected, the system will enter the "Sending" state to send the selected duration to the Child App via http request. After finish sending the system will enter to the "Sent" state and directly go the end state to continue with the Maps activity.

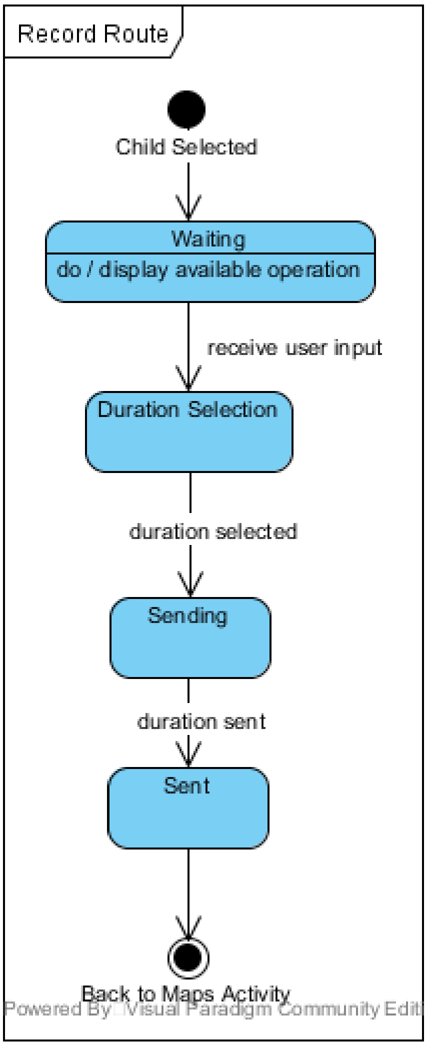


Figure 4.17 Record Route

Figure 4.18 shows the state when the parent retrieves for child location. The state start with the assumption that the parent is logon to the system. Then the system will enter the “Waiting” state and display the child list. When the child is selected, the system will enter the “Selected” state and start to retrieve for child location. When the retrieval failed, the system will end the state and display the error message on the Maps Activity, but if the retrieval success, the system will enter the “Retrieved” state and display the child location in the Maps Activity.

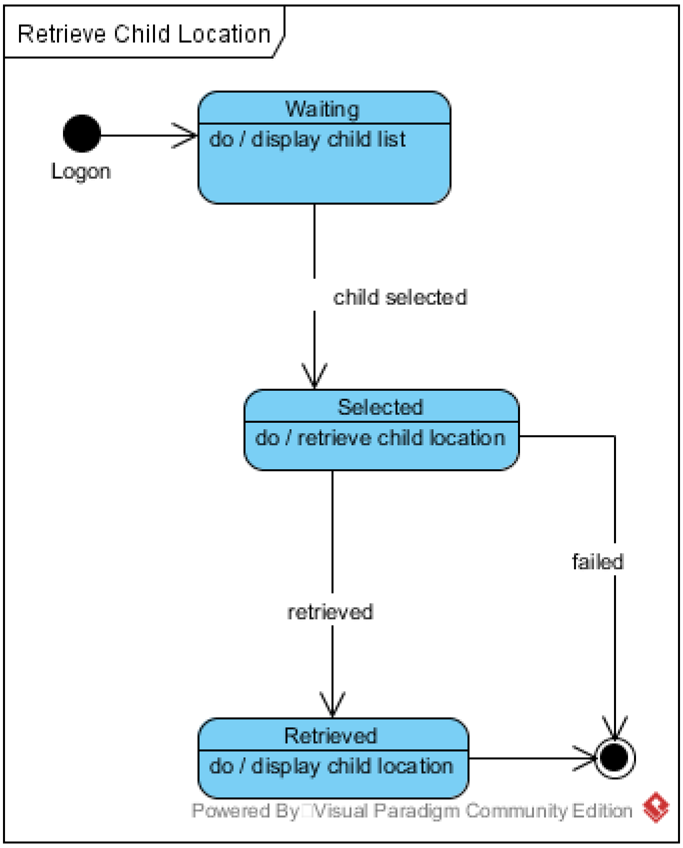


Figure 4.18 Retrieve Child Location

Figure 4.19 shows the state when the parent want to create a geofence. The state start with the assumption that the parent entered the maps activity. Then, the system will enter the “Waiting” state to wait for the user to request for create geofence. When the system receive the request to create geofence, the system will enter the “Creating” state. After the creation is done, the system will enter the “Sending” state to send the geofence setting to the Child App via http request. After that, the system will enter the “Created” state and the geofence creation is finished. The user can also cancel the geofence creation in the "Creating" state and the state will be ended and continue with the Maps Activity.

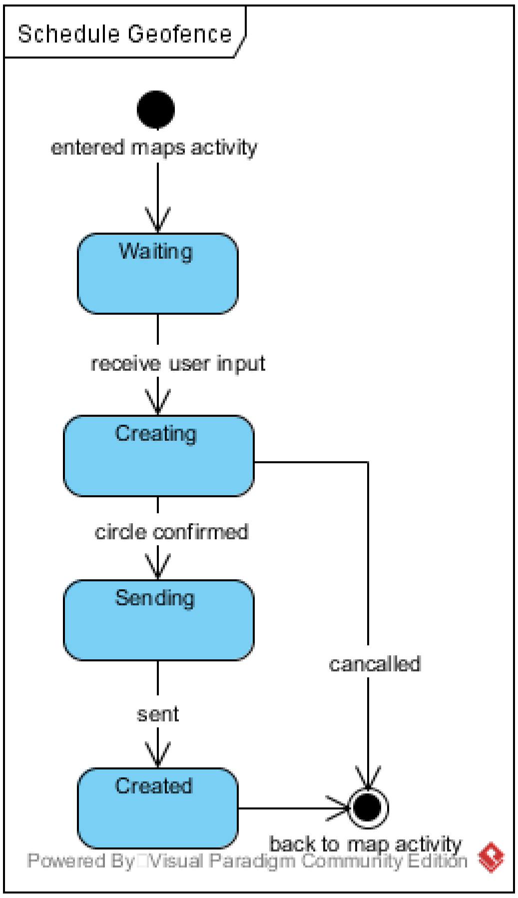


Figure 4.19 Schedule Geofence

Figure 4.20 shows the state when the parent wants to view the recorded child traversed history. The state start with the "Child Selected" state where the system will check for the child existence and display the child list. If there is no records found, the state will be ended and the error message will be shows in the Child Listing Activity. But if the child exists and the parent selected the child to view, the system will enter the "Record Selection" state where the system will check for the record existence in the database and display location records as list. If there is no record found, the state will be ended and the error message will be displayed in the Location History Activity. However, if the records exist and the record is selected, the system will enter the "View" state where the system will display the child traverse path and the state is finished.

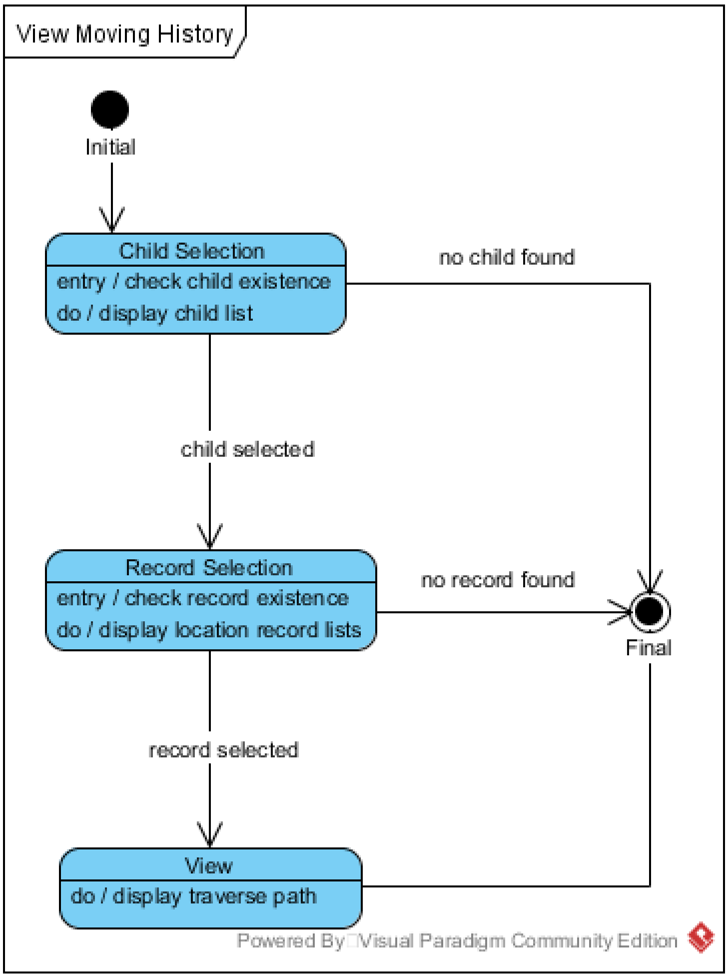


Figure 4.20 View Moving History

4.6 ERD Diagram

The ERD diagram that consist of 3 tables, which is Parent, Child and Geofence table is shown in Figure 4.21. The relationship between parent object and child object is One to Many relationship as the parent can have more than one child. The same rule is applying to the relationship between parent object and geofence object as the parent can create more than one geofence to keep track of the child. The child object and geofence object both have the parent name as the foreign key to identify which parent created the particular tuple in that table.

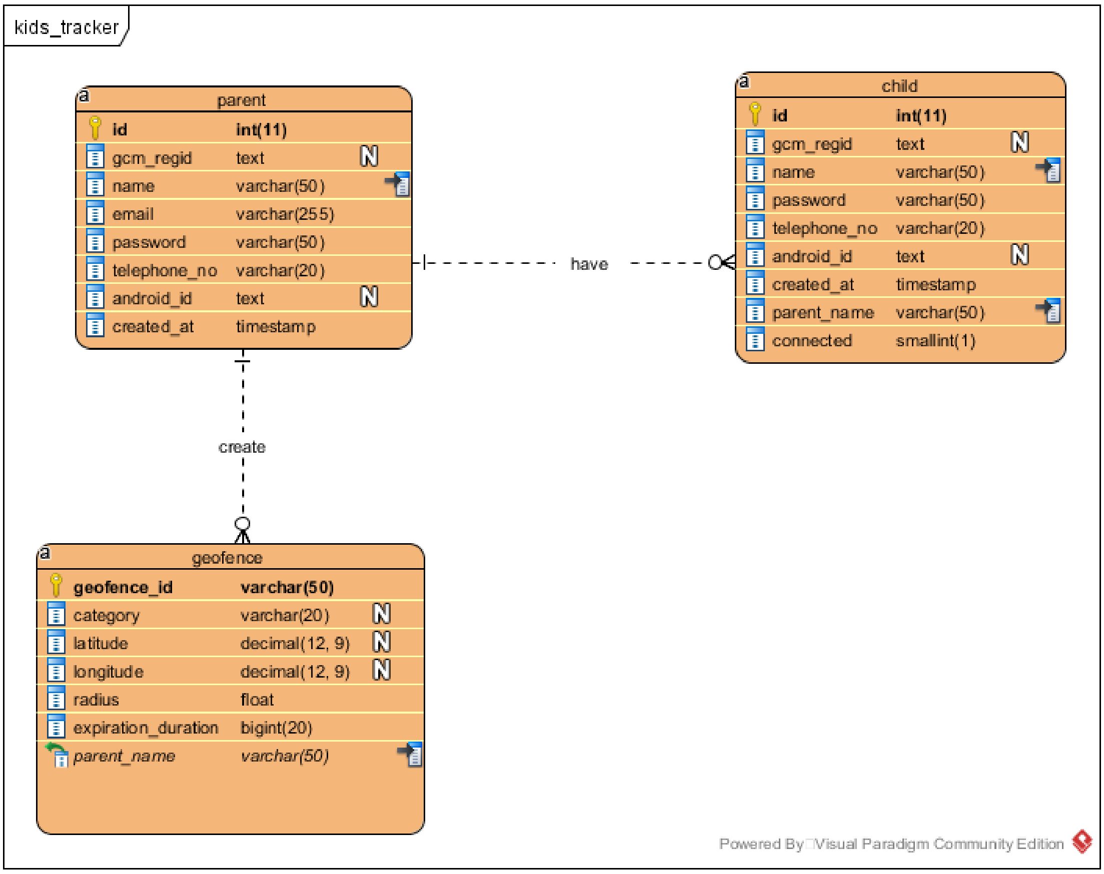


Figure 4.21 ERD Diagram

4.6.1 Data Dictionary

This section will explain about the data dictionary for the kid tracker database. Table 4.10 will describe about the parent table, Table 4.11 will describe about the child table and Table 4.12 will describe about the geofence table.

Table 4.10 Parent Table

Key	Field Name	Caption	Data Type	Size
PK	id	Parent id, auto generated.	int	11
	gcm_regid	GCM registration Id	text	
	name	Parent name	varchar	50
	email	Parent email	varchar	255
	password	Parent password	varchar	50

	telephone_no	Parent phone number	varchar	20
	android_id	App id	text	
	created_at	Account creation date	timestamp	

Table 4.11 Child Table

Key	Field Name	Caption	Data Type	Size
PK	id	Child id	int	11
	gcm_regid	GCM registration Id	text	
	name	Child name	varchar	50
	password	Child password	varchar	50
	telephone_no	Child phone number	varchar	20
	android_id	App id	text	
	created_at	Account creation date	timestamp	
FK	parent_name	Parent Name	carchar	50
	connected	Child connection status	smallint	1

Table 4.12 Geofence Table

Key	Field Name	Caption	Data Type	Size
PK	geofence_id	Geofence id	varchar	50
	category	Geofence category	varchar	20
	latitude	Geofence latitude	decimal	12,9
	longitude	Geofence longitude	decimal	12,9
	radius	Geofence radius	float	
	expiration_duration	Geofence expiration duration	bigint	20
FK	parent_name	Parent name	varchar	50

CHAPTER 5

IMPLEMENTATION

5.1 Introduction

The communication between the smartphones involving a server that responsible to transfer the message from the sender to the target. In this project, titled child tracking system, communication between the smartphones is mainly done through the server, which is the application server and the Google Cloud Messaging server. Both servers are required to ensure the real-time communication between the smartphones under the stable network connection. There are 2 users needed to demonstrate the workflow of the project, that is the parent which is the sender and the child which is the receiver. The details explanation of the server and the workflow is provided in the following section.

5.2 Architecture Design

Client-server architecture is used as the architectural pattern in this project where the system is segregated into two applications. The client, which is the android devices, requests to the server to either sending or getting the required data, and the server, which is a database with application logic represented as stored procedures. The diagram is shown in Figure 5.1.

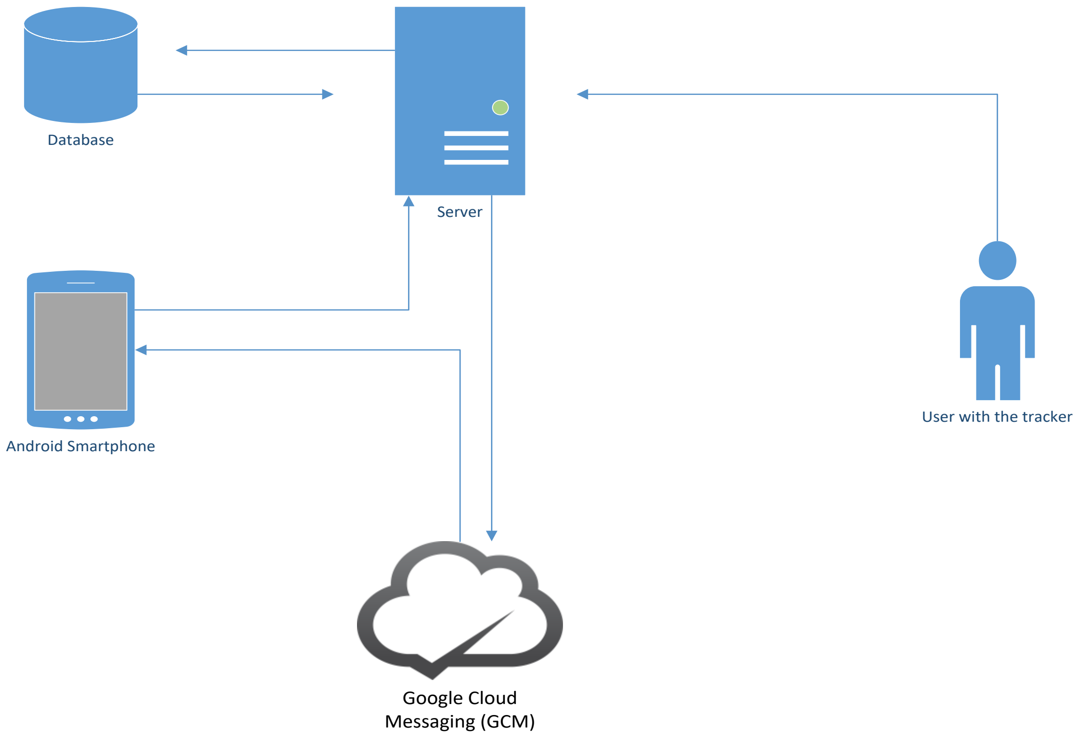


Figure 5.1 Client Server Architecture

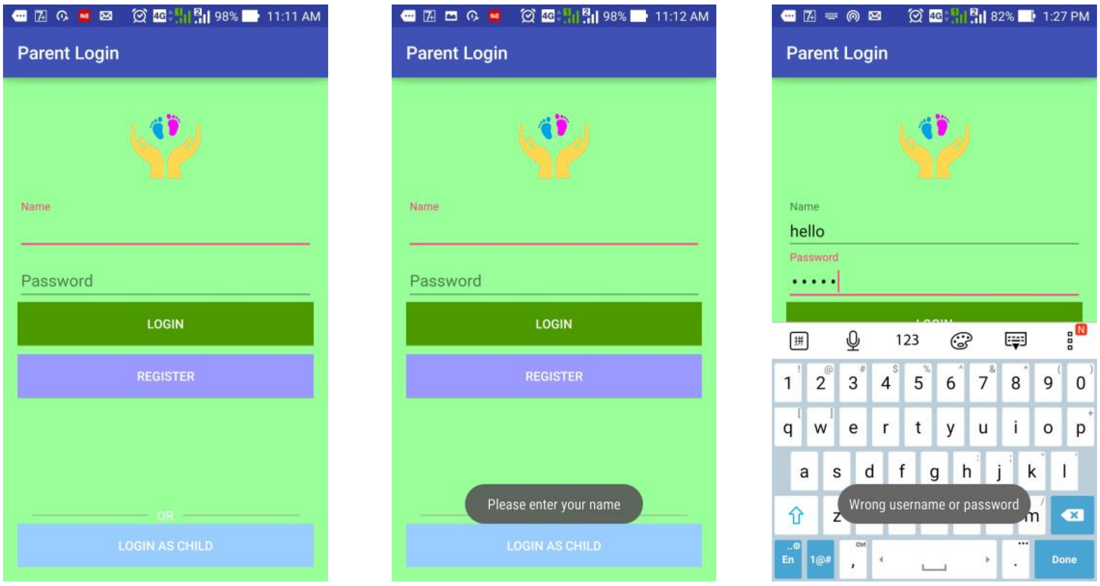
In this project, there are generally 2 servers involved, which is Google Cloud Messaging(GCM) and application server which is using PHP as the scripting language. An application server is used to store and retrieve the data to/from the database. The GCM is used to retrieve the required data from the server and alert the targeted devices about some new data. There are generally 2 users involved in the client side, that is the parent app and child app, for example, the parent sends a HTTP request to the server for the location of the child, and the server will send the request through the GCM server to the child app about the request. When the request received and location retrieved, the child app will send the HTTP request again to the server about the newly detected location. The server then will send the details to the GCM server to alert the parent about the new location and show the latest location inside the map of the app.

5.3 Project Activity Explained

In this section, the activities involved in the project is explained. There are 6 subsection provided in this section where each of these sections will involve the explanation of the activities involved in that particular activity. Those activities described in the next subsection will be written in Java for Android programming language as frontend and PHP scripting language as backend.

5.3.1 Parent Login Activity

Figure 5.2 (a) shows the Parent Login Activity which allow the user, which is the parent to login to the system. If the login button is clicked while input field is empty, the error message will be pop out as shown in Figure 5.2 (b). However, if the login field is filled but there are no matching records in the database, the error message will be shown as in Figure 5.2 (c). Figure 5.2 (d) shows the implementation logic of the logic function. Inside this function, the conditional statement is used to validate the username and password entered by the parent through the Validation static class call. If all the validation pass, the final else statement will be run and the system will check for the network connection by calling to the new instance of AsyncTask object called NetCheck before sending to the server to check for the existing record in the database.



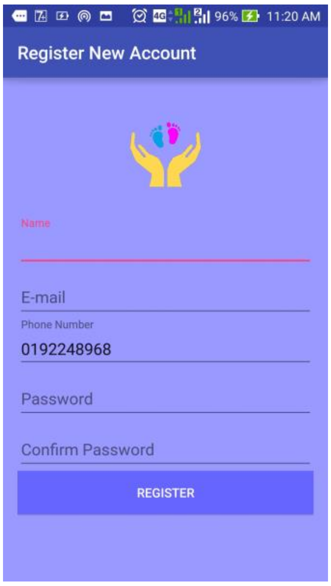
(a) (b) (c)

```
public void login(View view) {
    if(!Validation.hasText(parentNameET.getText().toString())){
        Toast.makeText(ParentLoginActivity.this,"Please enter your name", Toast.LENGTH_SHORT).show();
    }else if(!Validation.hasText(parentNameET.getText().toString())){
        Toast.makeText(ParentLoginActivity.this,"Please enter your password", Toast.LENGTH_SHORT).show();
    }else{
        String parentName = parentNameET.getText().toString();
        String parentPassword = parentPasswordET.getText().toString();
        parent.login(parentName, parentPassword);
        new NetCheck().execute();
    }

}
```

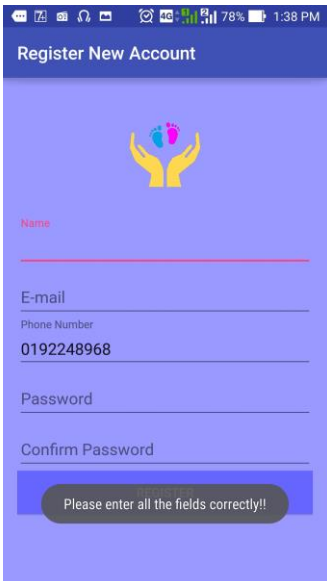
(d)

Figure 5.2 Parent Login Activity

If the parent is not register yet, he/she can choose to register for a new account and the parent registration activity will be shown as in Figure 5.3 (a). The validation message will be pop out as shown in Figure 5.3 (b) if the user enters the wrong information or no records found in the database. Figure 5.3 (c) shows the implementation logic of the register function. Inside this function, the conditional statement is used to validate the input field entered by the parent. If all the validation pass, the final else statement will be run and the system will check for the network connection by calling to the new instance of AsyncTask object called NetCheck before sending to the server to check for the existing record in the database.



(a)



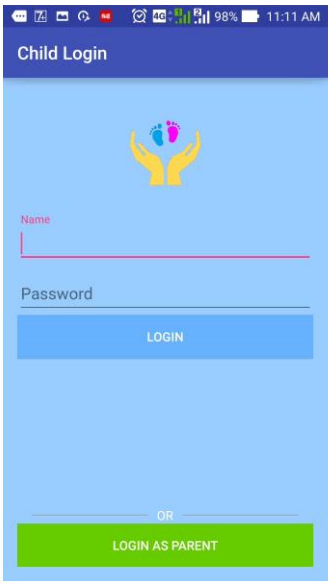
(b)

```java
public void register(View view) {
    username = nameET.getText().toString();
    password = passwordET.getText().toString();
    confirmPassword = confirmPasswordET.getText().toString();
    email = emailET.getText().toString();
    telNo = telNoET.getText().toString();
    if(!(username.isEmpty() || password.isEmpty() || telNo.isEmpty() || confirmPassword.isEmpty()) && Validation.isEmailAddress(email, true) == true){
        if(!password.equals(confirmPassword)){
            Toast.makeText(getApplicationContext(),"Password not match with confirm password.", Toast.LENGTH_SHORT).show();
        } else if(username.length() <= 4) {
            Toast.makeText(getApplicationContext(),"Username should be minimum 5 characters", Toast.LENGTH_SHORT).show();
        }
        else{
            parent.register(sharedPreferences.getString("reg_token", "no token"), username, password, email, telNo, android_id);
            // parent = new Parent(sharedPreferences.getString("reg_token", "no token"), username, password, email, telNo, android_id);
            new NetCheck().execute();
        }
    }else {
        Toast.makeText(this,"Please enter all the fields correctly!!", Toast.LENGTH_LONG).show();
    }
}
```

(c)

Figure 5.3 Parent Registration Activity

Besides, there is also an options which allow the user to switch between child mode or parent mode. In this case, when the button is clicked, the child mode will be triggered and will go to the Child Login Activity as shown in Figure 5.4 (a). Figure 5.4 (b) shows the implementation logic of the switching activity function from Parent Login Activity to Child Login Activity by using the Intent class. Flag is added to the intent via addFlags function call to make sure the previous existing activity is cleared before starting this activity.



(a)

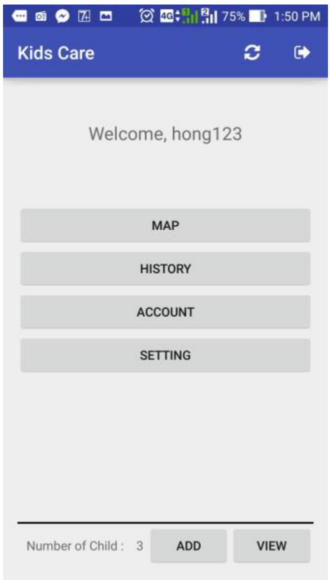
```
public void switchToChildMode(View view) {
    Intent childModeIntent = new Intent(ParentLoginActivity.this,ChildLoginActivity.class);
    childModeIntent.addFlags(Intent.FLAG_ACTIVITY_CLEAR_TASK| Intent.FLAG_ACTIVITY_NEW_TASK );
    startActivity(childModeIntent);
}
```

(b)

Figure 5.4 Parent/Child Activity Switching

5.3.2 Main Activity

The main activity is an interface, where most of the other activities will be called from here. Figure 5.5 (a) shows the main activity that is triggered after the parent is successfully login. The switching of this activity to different activities is mostly done through the Intent class call. Figure 5.5 (b) shows the function for switching the page from Main Activity to Maps Activity via the Intent call. The conditional statement is made to make sure the child is registered before the parent can access to that activity. The maps activity is shown in Figure 5.6.



(a)

```java
public void accessToMap(View view) {
    if(childList.size() > 0) {
        Intent mapViewintent = new Intent(this, MapsActivity.class);
        startActivity(mapViewintent);
    }else{
        Toast.makeText(MainActivity.this,"Please register for child account first.", Toast.LENGTH_SHORT).show();
    }
}
```

(b)

Figure 5.5 Main Activity

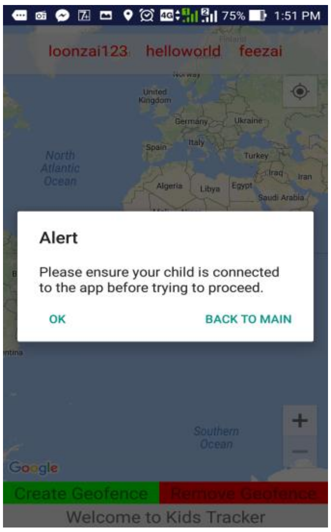
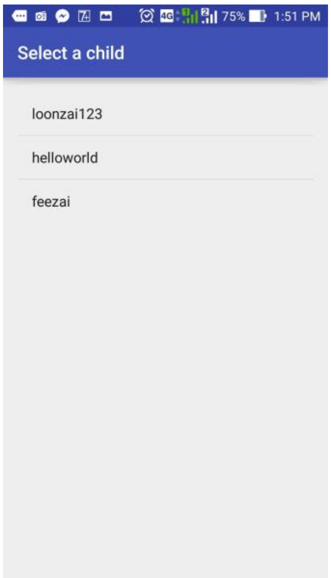
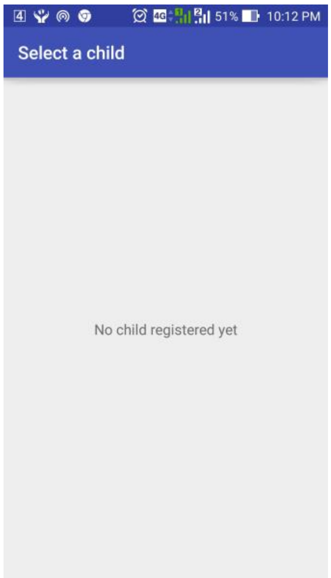


Figure 5.6 Map Activity

Besides, the parent can also go to the history page by clicking on the history button to check the records history of the route traversed by the child. However, the parent need to choose the child from the child listing activity before they can check for the route traversed by the child as shown in Figure 5.7 (a). Figure 5.7 (b) shows the page that will display when the page is entered without register the child. The implementation logic of adding a list of registered child is shown in Figure 5.7 (c). The Array Adapter object is used to add the child name to the list and the item click listener is used to handle the user click event and redirect to the Location History Activity when the row is clicked.



(a)



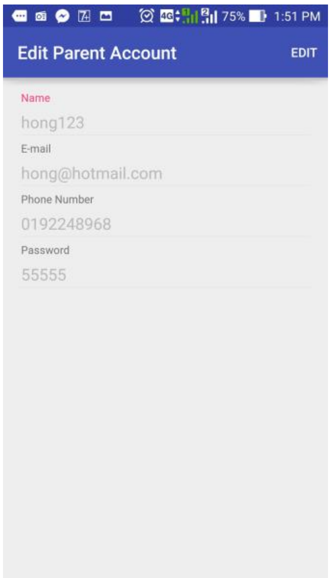
(b)

```
            ArrayAdapter<String> adapter = new ArrayAdapter<>(ChildNameListingActivity.this,android.R.layout.simple_list_item_1, childNameList);
            listView.setAdapter(adapter);
            listView.setOnItemClickListener((parent, view, position, id) -> {
                    String childName = parent.getItemAtPosition(position).toString();
                    Intent intent = new Intent(ChildNameListingActivity.this, LocationHistoryActivity.class);
                    intent.putExtra("childName", childName);
                    for (int i = 0; i < childList.size(); i++) {
                        if(childList.get(i).getName().equals(childName)){
                            SharedPreferences.Editor editor = sharedPreferences.edit();
                            editor.putString("childId", String.valueOf(childList.get(i).getId()));
                            editor.commit();
                        }
                    }
                    startActivity(intent);
            });
        }
    }else{
        Toast.makeText(ChildNameListingActivity.this,"Unfortunately, our server have down....", Toast.LENGTH_SHORT).show();
    }
} catch (JSONException e) {
    listView.setVisibility(View.GONE);
    noChildFoundLinearLayout.setVisibility(View.VISIBLE);
```

(c)

Figure 5.7 Child Listing Activity

Figure 5.8 (a) shows the Edit Parent Activity that will be displayed when click on the account button to edit the parent account. By default, the field is set to read-only mode. If the parent wishes to edit the account, they need to click on the Edit button at the top right corner of the page. The implementation logic of the edit parent account is shown in Figure 5.8 (b). Inside this function, the conditional statement is also used to validate the input field entered by the parent. If all the validation pass, the final else statement will be run and the system will check for the network connection by calling to the new instance of AsyncTask object called NetCheck before sending to the server to update the record in the database.



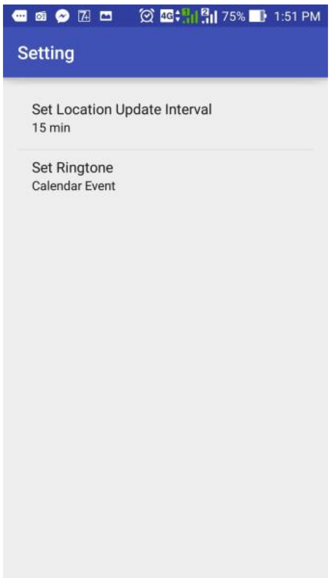
(a)

```
public void edit(View view) {
    username = nameET.getText().toString();
    password = passwordET.getText().toString();
    email = emailET.getText().toString();
    telNo = telNoET.getText().toString();

    if(!(username.isEmpty() || password.isEmpty() || telNo.isEmpty())){
        if(username.length() > 4) {
            //parent = new Parent( parent.getId(),username, email,password, telNo);
            parent.edit(parent.getId(),username, email,password, telNo);
            new NetCheck().execute();
        }
        else
            Toast.makeText(getApplicationContext(),"Username should be minimum 5 characters", Toast.LENGTH_SHORT).show();

    }else {
        Toast.makeText(this,"Please enter all the fields!!", Toast.LENGTH_LONG).show();
    }
}
```

(b)

Figure 5.8 Edit Parent Activity

To set the location update interval for the child and notification tone for the alert of the geofence, parent needs to click on the setting button from main activity. Figure 5.9 (a) shows the example of the page that will displayed when setting button is clicked and Figure 5.9 (b) shows the implementation logic of displaying the list. The Array Adapter object is used to add the title and value of the setting to the list and the display result is as shown in Figure 5.9 (a).



(a)

```
listView.setAdapter(new ArrayAdapter(SettingActivity.this, android.R.layout.simple_list_item_2, android.R.id.text1, settingItems)
{
    public View getView(int position, View convertView, ViewGroup parent) {
    View view = super.getView(position, convertView, parent);
     text1 = (TextView) view.findViewById(android.R.id.text1);
        text2 = (TextView) view.findViewById(android.R.id.text2);
    text1.setText(settingItems.get(position).getTitle());
    text2.setText(position == 1? title : settingItems.get(position).getLocationUpdateInterval());
    return view;
}
});
```

(b)

Figure 5.9 Setting Activity

In the main activity, the parent can also see the number of the child registered and even register and edit the child account here. To register for the child, the parent can just click on the add button in the bottom of the page and the child registration activity will be shown as in Figure 5.10. The implementation logic will be the same as the parent register function as shown in Figure 5.3 (c) above.

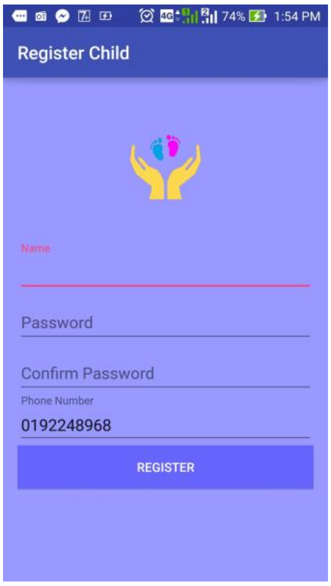
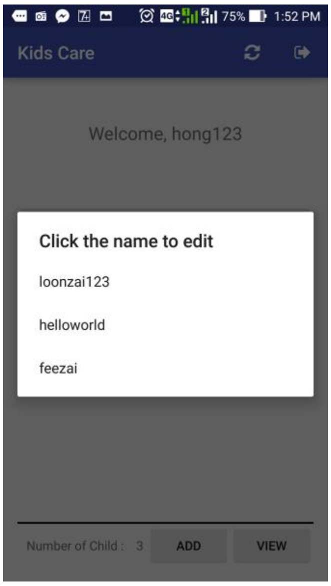


Figure 5.10 Child Registration Activity

To edit or view the child account, the parent can click on the view button, a dialog will be pop out and display a list of the registered child as shown in Figure 5.11(a). Figure 5.11 (b) shows the implementation logic of viewExistingChild function when the view button is clicked. Firstly, the childList variable is used to add a list of registered child to a list, then, AlertDialog object is called to handle for the displaying of the child name inside the list together with the on click event call.



(a)

```java
public void viewExistingChild(ArrayList<Child> childList) {
    final CharSequence[] items = new CharSequence[childList.size()];

    for (int i = 0; i < childList.size(); i++) {
        items[i] = childList.get(i).getName();
    }
    AlertDialog dialog =new AlertDialog.Builder(MainActivity.this).setTitle("Click the name to edit").setItems(items, new DialogInterface.OnClickListener() {
        @Override
        public void onClick(DialogInterface dialog, int which) {
            Log.d(TAG, "item selected: " + String.valueOf(items[which]));
            editChildTask = new EditChildTask();
            editChildTask.execute(String.valueOf(items[which]));
        }
    }).show();


}
```

(b)

Figure 5.11 Edit child dialog

Figure 5.12 shows the edit child activity that will be displayed when the parent clicks on the child name they which to edit in the edit child dialog as shown in Figure 5.11 above. The implementation logic will be the same as the edit function in Parent edit activity as shown in Figure 5.8 (b) above.

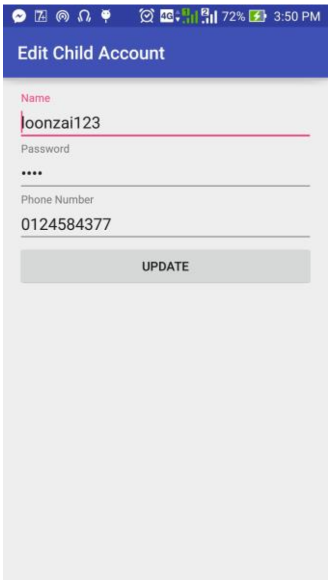


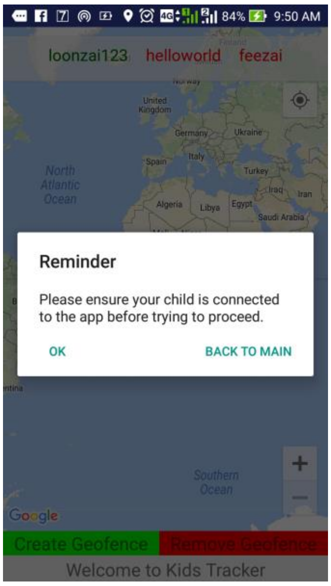
Figure 5.12 Edit Child Activity

To logout from the system, the parent needs to click on the logout icon on the top right of the main activity where when clicked, the parent will be redirect to the parent login activity as shown in Figure 5.2 (a) above.

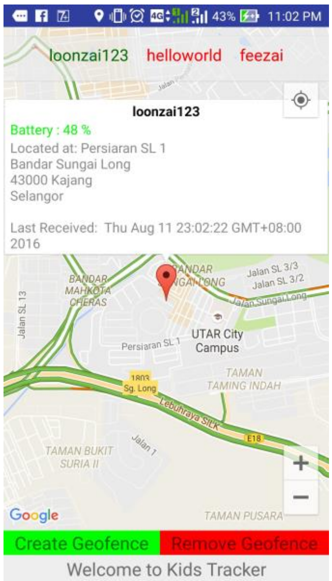
5.3.3 Maps Activity

The maps activity is using the Google Maps API to display the maps on this activity. This is the activity where the parent can set for the geofence, records location, get direction of the child and etc.

Before the parent starts to use the app, a reminder will be pop out to alert the parent as shown in Figure 5.13 (a) to ensure the child is open and connected to the app before trying to proceed further as the app needed an internet connection and GPS for it to work properly. After the child is connected and OK button is clicked, the system will send an https request to the server to tell the server to get the latest location of the child. Through the GCM service, the get location request will be send to the system on the child side and the Fused Location API will be triggered to detect the current location of the child. When the location is detected, the location result together with the battery level of the child's smartphone will be send back to parent through the GCM service again and the result will be displayed as shown in Figure 5.13 (b). The parent can also manually trigger to get the child latest location or call for the child by clicking at the child name on the top row of the page. Figure 5.13 (c) shows the implementation logic of the get location process. The GetAllChildLatestLocationTask object will handle the implementation logic as described above and the Handler object is used as the timeout for the location retrieving process, that is, after 10 seconds, if the location is not retrieved, an error message will be shown. However, if the child location is retrieved within 10 seconds, the error message will be ignored and the location is displayed as in Figure 5.13 (b).



(a)



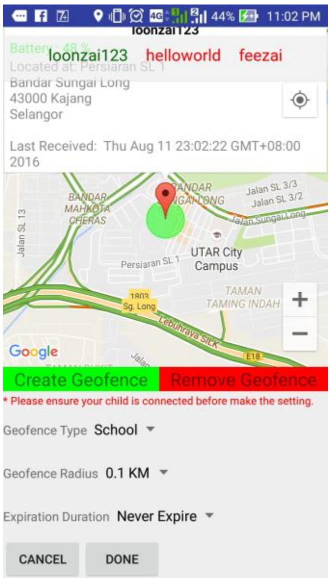
(b)

```
new AlertDialog.Builder(MapsActivity.this).setTitle("Reminder").setMessage("Please ensure your child is connected to the app before trying to proceed.")
        .setNeutralButton("OK", (dialog, which) -> {
            getChildLatestLocation = new GetAllChildLatestLocationTask();
            getChildLatestLocation.execute();
            // handler for the result status of location finding
            Handler handler = new Handler();
            handler.postDelayed(() -> {
                if(locationReceived == true){
                    return;
                }else{
                    findingLocationPDialog.dismiss();
                    Toast.makeText(MapsActivity.this,"Location not found.Your child might not have internet connection",Toast.LENGTH_SHORT).show()
                    if(locationReceived == true){
                        locationReceived = false;
                    }
                }
            }, 10000);
        }).setNegativeButton("Back to Main", (dialog, which) -> {
        Intent backIntent = new Intent(MapsActivity.this, MainActivity.class);
        startActivity(backIntent);
}).show();
```

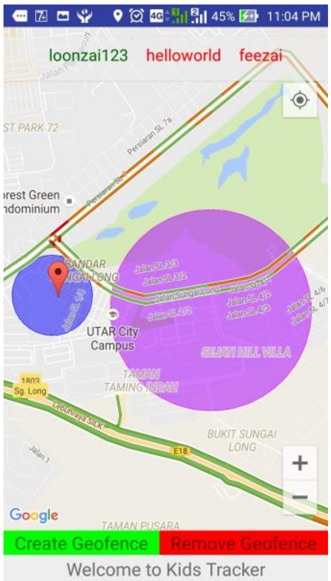
(c)

Figure 5.13 Get Location Process

To monitor the child reach or exit a certain area, the geofence functionality is added to the system. Figure 5.14 (a) shows the interface that will be displayed when the create geofence button is clicked There are 4 options available to choose from in the geofence type, that is, School, Home, Work and Other. The parent can even choose the radius of the geofence to monitor. The smallest radius available is 100m and the largest radius available to choose from is 10km. And the last is the period of the geofence to stay in active state, which is the expiration duration of the geofence. When the duration reached, the geofence will be remove automatically and that area will no longer being monitored. When the done button is clicked, a circle will be draw on the map and the set value will be send to server to be send to the system from the child side through GCM service to start monitoring. The colour of the circle will be different depending on the geofence type chosen, green colour represent school, blue colour represent home, magenta colour represent work and yellow colour represent other. The parent can even create multiple geofence as shown in Figure 5.14 (b). The figure 5.14 (c) shows the implementation logic of how the circle is added to the map. The location object distance between method is used to make sure the circle will not be overlapping with each other by preventing the user to create the geofence on the same location.



(a)



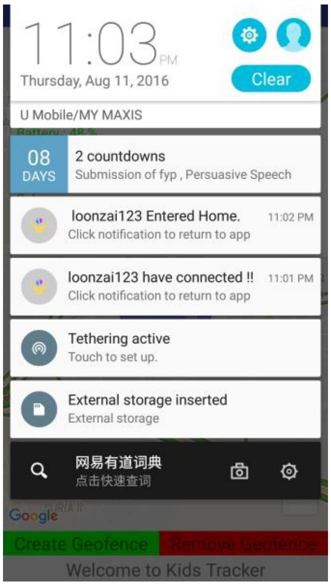
(b)

```
        Location.distanceBetween(previewCircle.getCenter().latitude, previewCircle.getCenter().longitude, center.latitude, center.longitude, distance);
        overlapped.add(distance[0]  < radius+radius);
    }
    if(overlapped.contains(true)){
        Toast.makeText(MapsActivity.this, "geofence cannot be overlap", Toast.LENGTH_SHORT).show();
        Log.d("overlapped","overlapped");
    } else {
        mMap.setOnCameraChangeListener(null);
        geofenceLayout.setVisibility(View.GONE);
        if (childListClicked == true) {
            contentLayout.setVisibility(View.VISIBLE);
        } else {
            welcomeLayout.setVisibility(View.VISIBLE);
        }
        Circle confirmedCircle = mMap.addCircle(drawCircle(previewCircle.getCenter(), previewCircle.getRadius(), previewCircle.getFillColor(), previewCircle.g
        long nextTrigger;
        // check if the geofence is NEVER_EXPIRE
        if (milli != Geofence.NEVER_EXPIRE) {
            nextTrigger = calendar.getTimeInMillis() + milli;
        }
```

(c)

Figure 5.14 Create Geofence

Figure 5.15 (a) shows the notification that will be pop out when the child reaches the monitoring area and Figure 5.15 (b) shows the implementation logic for showing notification where the notification builder is used to set the required setting for the notification and the NotificationManager object is used to display the notification by calling the notify method.

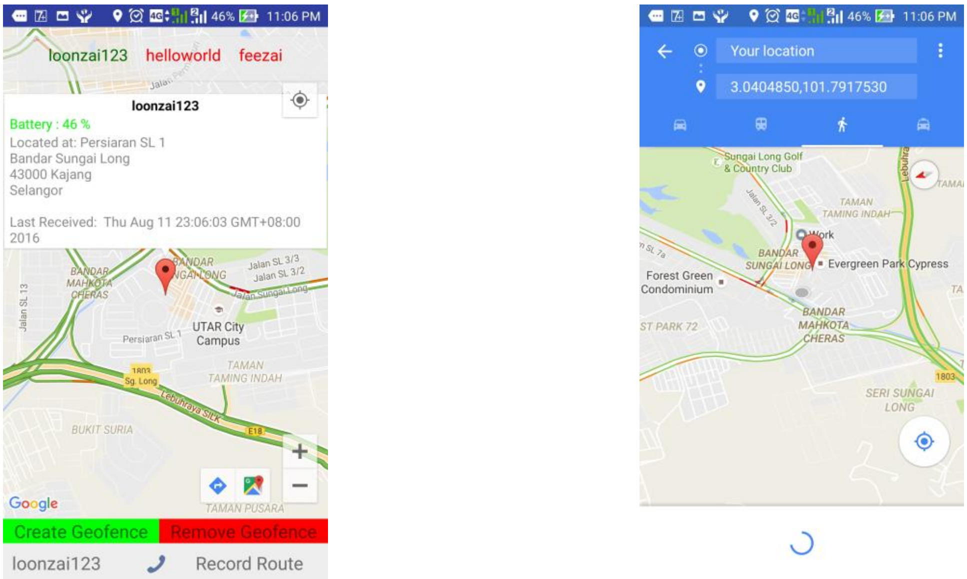


(a)

(b)

Figure 5.15 Child entered notification

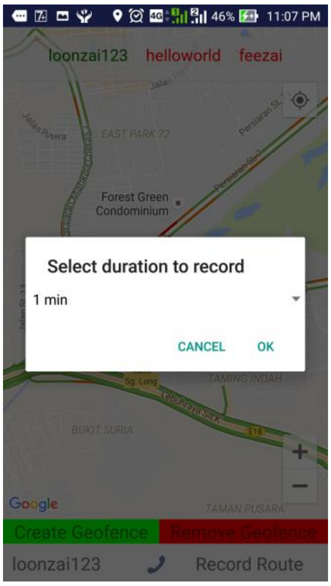
To get the direction to the child location, parent can click on the marker display on the map and the 2 icon will be displayed on the bottom right of the map as shown in Figure 5.18 (a). When the parent clicks on the direction icon, the page will the redirect to the google map application to start the navigation process as shown in Figure 5.18 (b).



(a) (b)

Figure 5.16 Get Child Direction

To record location, the parent needs to click on the record route button as shown in Figure 5.17 (a). A dialog will then be appeared to select the duration to record the location. When the duration is set and ok button is clicked, the setting will be send to the system from the child side through GCM service to start recording the location. Figure 5.17 (b) shows the implementation logic of recording location based on the duration set. The set duration will be use to trigger the removeLocationUpdate method call which when called, the location update will be stop and the location data will be stored into the server.



(a)

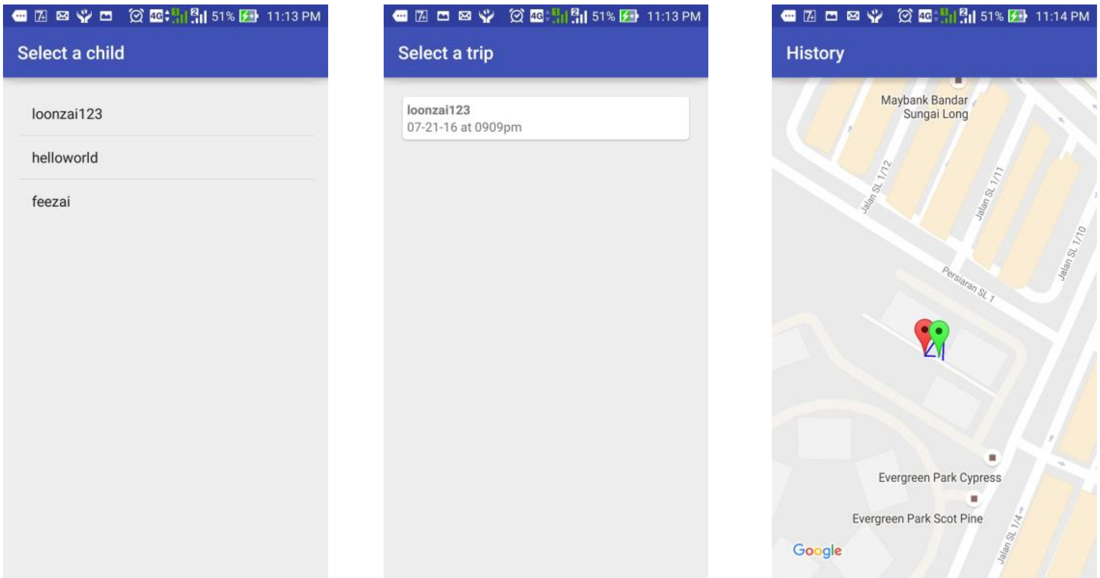
```
locationManager.requestLocationUpdates(LocationManager.NETWORK_PROVIDER, 1000, 0, this);
locationManager.requestLocationUpdates(LocationManager.GPS_PROVIDER, 1000, 0, this);

if(milli != 0) {
    removeLocationUpdateDelay.postDelayed(new Runnable() {
        @Override
        public void run() {
            removeLocationUpdate();
        }
    }, milli);
}else{
    removeLocationUpdateDelay.removeCallbacksAndMessages(null);
    removeLocationUpdate();
}
```

(b)

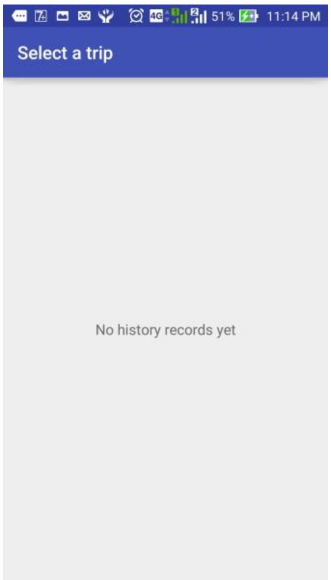
Figure 5.17 Record Route

5.3.4 Location History Activity

The location history activity, is an activity that allow the parent to get the records history of the route traversed by the child. After the child is selected from the child listing activity as shown in Figure 5.18 (a), the server will search for the folder that contains the records of the corresponding child and display a list of records in this activity as shown in the Figure 5.18 (b). When the particular row is clicked, a new page, which is history maps activity will be displayed and the path traversed by the child from start point to the end point will be shown as in Figure 5.18 (c). The start point is marked as green colour and the end point is marked as red colour. When there are no location records after the child name is clicked in child listing activity, the “No history records yet” message will be displayed at the centre of the page as shown in Figure 5.18 (d). Figure 5.18 (e) shows the implementation logic of how the markers is added into the history map activity as shown in Figure 5.18 (c). At first, the conditional statement is added to check for the first and last location to add the green and red colour marker to those two position respectively. Then the camera of the map is move to the centre between the two location by calling the animateCamera functions and the blue line is added by calling the addPolyline function.



(a) (b) (c)



(d)

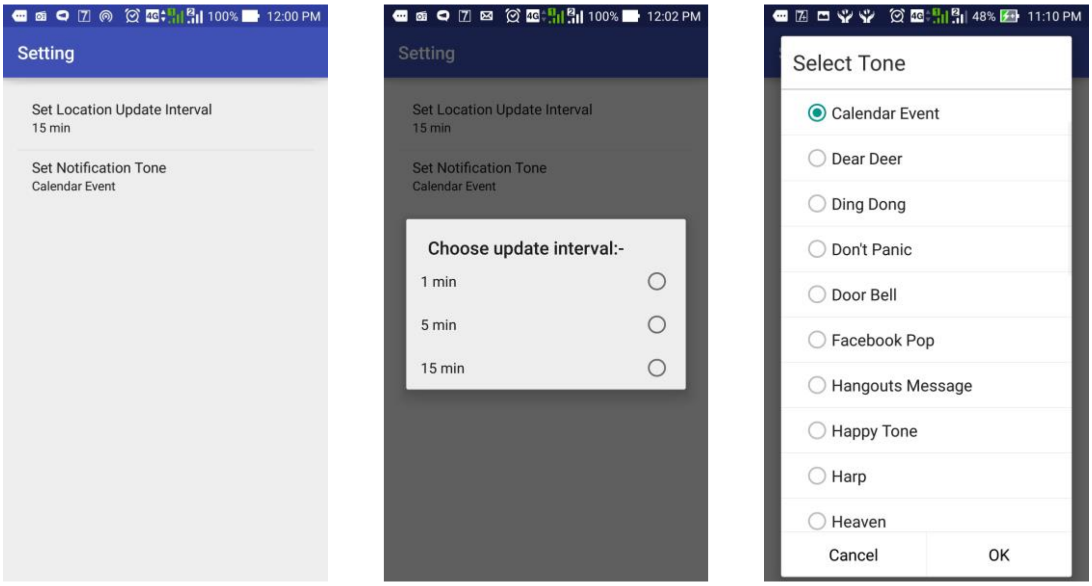
```java
            if(i == 0){
                mMap.addMarker(new MarkerOptions().position(latLng).icon(BitmapDescriptorFactory.defaultMarker(BitmapDescriptorFactory.HUE_GREEN)));
            }
            if(i == jsonArray.length()-1){
                mMap.addMarker(new MarkerOptions().position(latLng).icon(BitmapDescriptorFactory.defaultMarker(BitmapDescriptorFactory.HUE_RED)));
            }
        } catch (JSONException e) {
            e.printStackTrace();
        }
    }
    LatLngBounds.Builder builder = new LatLngBounds.Builder();

    for(LatLng latLng : latLngList){
        builder.include(latLng);
    }
    LatLngBounds bounds = builder.build();
//  CameraUpdate cameraUpdate = CameraUpdateFactory.newLatLngBounds(bounds, 0);
    mMap.animateCamera(CameraUpdateFactory.newLatLngZoom(bounds.getCenter(), 18));
//   mMap.animateCamera(cameraUpdate);
    mMap.addPolyline((new PolylineOptions()).addAll(latLngList).width(5).color(Color.BLUE).geodesic(true));
```

(e)

Figure 5.18 Child Listing Activity

5.3.5 Setting Activity

The setting activity is an activity that allow the parent to set for location update interval and notification tone for the triggered geofence as shown in Figure 5.19 (a). When the set location update interval row is selected, a dialog will be pop out to let the parent to choose the time interval to update. There are 3 selections available, that is 1 minute, 5 minutes and 15 minutes as shown in figure 5.19 (b). When the set notification tone is clicked, the dialog will be pop out that shows a list of tones to be chosen by the parent as shown in figure 5.19 (c). The implementation logic is shown in Figure 5.9 (b).

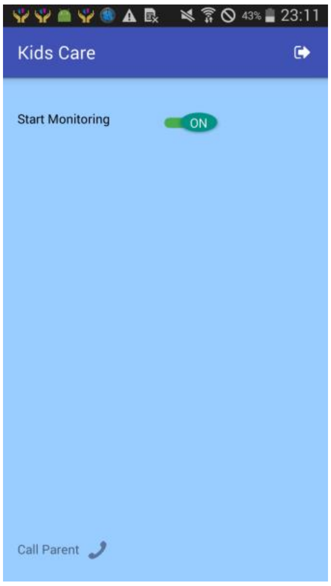


(a) (b) (c)

Figure 5.19 Setting Activity

5.3.6 Child Main Activity

The child main activity is an important activity as without this activity, the monitoring process will not be done. Figure 5.20 (a) shows the child main activity that will be redirected to after the child have been login from the child login activity. This activity involves the using of Geofencing API and Fused Location API with each of them responsible to create the geofence and get the location respectively. Both calls are triggered by the data sent from the server after the parent has set the data in Maps Activity. They are running inside a service and controlled by a switch. When a switch is on, the service is started and the parent will receive a notification that the child is connected, however, if the switch is off, the service is stopped and the parent will receive a notification that the child is disconnected. The child can even call the parent by clicking on the call parent button at the bottom left of the page in case of emergency. Figure 5.20 (b) shows the implementation logic of the geofence triggering handle event after geofence is created. At first, Geofencing Event object is called to get the triggering geofence. After getting the event, the getGeofenceTransition method is called to get the type of triggering with the switch case handling the result. At last, the notification will be send to the parent with the geofence triggered message via GCM service.



(a)

```java
@Override
protected void onHandleIntent(Intent intent) {
    sharedPreferences = PreferenceManager.getDefaultSharedPreferences(getBaseContext());
   GeofencingEvent geofencingEvent = GeofencingEvent.fromIntent(intent);
    Location geofenceTriggeringLocation = geofencingEvent.getTriggeringLocation();
    String address = getCompleteAddressString(geofenceTriggeringLocation.getLatitude(), geofenceTriggeringLocation.getLongitude());
    Log.v(TAG, "onHandleIntent");
    if(!geofencingEvent.hasError()) {
        int transition = geofencingEvent.getGeofenceTransition();
        String notificationTitle;

        switch(transition) {
            case Geofence.GEOFENCE_TRANSITION_ENTER:
                notificationTitle = "Geofence Entered";
                Log.v(TAG, "Geofence Entered");
                break;
            case Geofence.GEOFENCE_TRANSITION_DWELL:
                notificationTitle = "Geofence Dwell";
                Log.v(TAG, "Dwelling in Geofence");
                break;
            case Geofence.GEOFENCE_TRANSITION_EXIT:
                notificationTitle = "Geofence Exit";
```

(b)

Figure 5.20 Child Main Activity

CHAPTER 6

TESTING

6.1 Introduction

In this chapter, 3 types of testing are being carry out on the project, that is local unit testing, user interface testing and user acceptance testing. The unit testing is used to test for the functionality of the system and the user acceptance testing is used to test for the user satisfactory of the system.

6.2 Local Unit Testing

Local unit test is used for the unit test that has no dependencies or only has simple dependencies on Android. In this project, 3 local unit test has been carried out using the Junit testing framework for Java. The test class is called ValidationTest and is constitute of 3 test method that, is testPhoneNo(), testEmailAddresss() and testHasText() methods. This test is used to test the correctness of the user input validation for login, edit and register account. The test cases are displayed in the Table 6.1 to Table 6.3 below and the test result is displayed in the Figure 6.1 below respectively.

Table 6.1 Test Case for testPhoneNo

No	Test Case Description	Result
1	To test for the user input for telephone no during the login, edit and register user account.	Pass
#	**Input**	**Expected Result, Obtained Result**
1	"0124298968", true	True, True
2	"01922", true	False, False

Table 6.2 Test Case for testEmailAddress

No	Test Case Description	Result
1	To test for the user input for email address during the login, edit and register user account.	Pass
#	**Input**	**Expected Result, Obtained Result**
1	"name@email.com", true	True, True
2	"nameemail.com", true	False, False

Table 6.3 Test Case for testHasText

No	Test Case Description	Result
1	To test for the no user input during the login, edit and register user account.	Pass
#	**Input**	**Expected Result, Obtained Result**
1	"hello"	True, True
2	“ ”	False, False

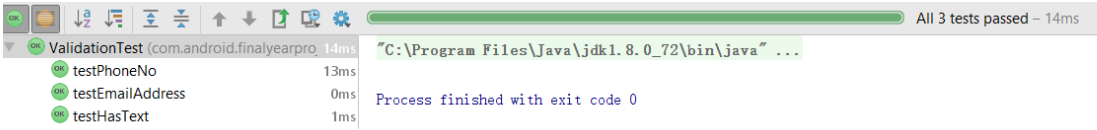


Figure 6.1 Result of ValidationTest

6.3 User Interface Testing

User Interface(UI) testing is carried out to test for the presence of the defect in the user interface of the system. The testing is done on the physical devices or emulator using the Espresso testing framework. The framework provides a set of APIs that enable us to write automated UI tests to test user flows within an app.

There are 9 UI testing carries out in the project which is wrapped inside different classes respectively, that is ParenLoginTest, LocationHistoryTest, MainActivityTest, MapsActivityTest and ChildLoginTest classes. The test cases for each of the classes are shown from Table 6.4 to Table 6.8. The test suite that run the test classes and the test result is shown in Figure 6.2 and Figure 6.3 respectively.

Table 6.4 Test case for ParentLoginTest class

Step No	Action	Input Required	Expected Result
1	Fill field and click login.	Valid username and password. OR Invalid username or password.	Go to Main Activity page. OR Error message shown.

Table 6.5 Test case for LocationHistoryTest class

Step No	Action	Input Required	Expected Result
1	Select child name from the child list in previous page. OR No child found.		Go to Location History Activity page to check for the existing records. OR No child found text message will be displayed.
2	Select history records from the list. OR No records found.		Show the route the child traversed from start point to end point. OR --

Table 6.6 Test Case for MainActivityTest

Step No	Action	Input Required	Expected Result
1	Click either map, account, setting or logout button.	-	<u>Clicked Map Button</u> Redirect user to map view. <u>Clicked Account Button</u> Redirect user to edit account page. <u>Clicked Setting Button</u> Redirect user to setting page to set for

			notification tone for geofence and location update interval. Clicked logout Button Redirect user to login page.

Table 6.7 Test Case for MapsActivityTest

Step No	Action	Input Required	Expected Result
1	Select connected child name from the child list in the top row of the page. OR Select unconnected child name from the child list in the top row of the page.		The dialog box will pop out showing the message of locating child position. OR The dialog box will pop out showing the child is not connected yet.

Table 6.8 Test Case for ChildLoginTest

Step No	Action	Input Required	Expected Result
1	Fill field and click login.	Valid username and password. OR Invalid username or password.	Go to Child Main Activity page to start the monitoring process. OR Error message shown.

```
@RunWith(Suite.class)
@Suite.SuiteClasses({ParentLoginTest.class,LocationHistoryTest.class, MainActivityTest.class,MapsActivityTest.class,ChildLoginTest.class })
public class KidsTrackerTestSuite {
    public KidsTrackerTestSuite(){

    }
}
```

Figure 6.2 Test Suite

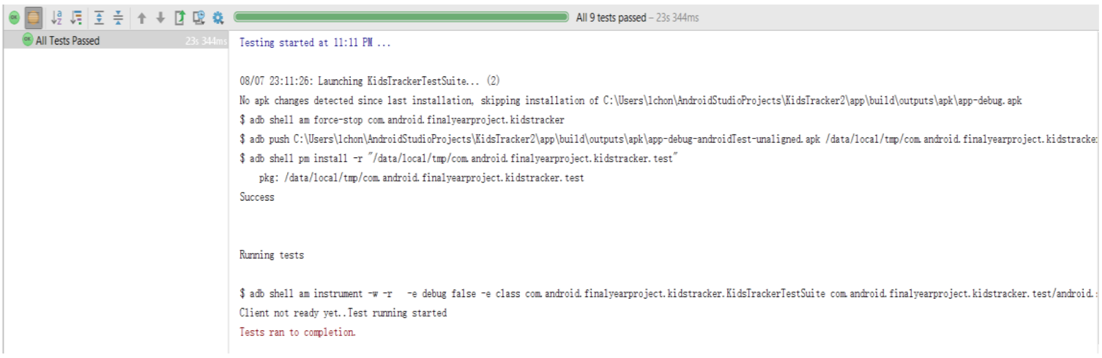


Figure 6.3 Test Result

6.4 User Acceptance Testing

User Acceptance Testing(UAT) is being carried out to check for the user satisfactory to the system. In this testing, 3 parents have been chosen to test for the system. The sample of the user acceptance test and results is provided in the Appendix 2.

Based on the result collected, most of the parents are satisfied with the current system functionalities, however, there is some parent asks for improvement on the location updating functionality and the route record history functionality. They suggest that the location should be updated in real-time instead of triggered by certain duration once the app is open like what the "Uber" application has done and they also seek for more information displayed on the route record history like the address of starting and ending destination. Besides, there is some of the parent suggests to improve the UI of the system so as it is more arousing when using the app. Furthermore, some parent even asked whether is it possible for them to track the child without smartphone as some schools do not allow the child to bring the smartphone to school.

The suggestions made by the parents during user acceptance testing enable the system to be further enhanced so as the system is more user-friendly and attracting to most of the parent. Enhancement will be made on the functionalities of the system together with the UI of the system in the future so as the system can be work in more real-time manner and the UI can be more attracting to the users. However, for the suggestion of not using the smartphone to track the child, the suggestion will be treated as a deployment that will be made on the future enhancement once a suitable replacement is found.

CHAPTER 7

CONCLUSION AND RECOMMENDATION

7.1 Conclusion

Malaysian parent, especially who live in urban area, needed to work day and night to sustain the family which causes them cannot know where is their child going during the working hour. However, with the child tracking app, parent can track and monitor their child with just a simple app.

This project is on schedule and ended with the achieving of all of the listed objective as below,

1. **Examine the existing feature used in the child tracking system that fits with the needs of the Malaysian's parents.** A survey has been done to examine of the parent regarding to the system and their requirement to the system.

2. **Develop the application that consists of the feature and design required by the Malaysian parents with the implementation using suitable approach and methodology.** The incremented prototyping model has been chosen as the suitable methodology to deal with this project and the required functionalities, have been implemented into this project as well using the client/server architecture as the architectural design.

3. **Verify and validate the developed system by performing unit testing and user interface testing and have it tested by the user to ensure the user satisfactory with the system.** 3 testing have been done to sure system working in a well-manner and the users are satisfied with the system.

7.2 Limitation

This project contains several limitations.

1. The project is largely depending on the GPS and network connection of the devices. If there is some GPS fault on the device or the network connection failed, the system will not work as expected.

2. The project is mostly working based on the Google API, like Geofencing API, GCM service and FusedLocationAPI, where this project has no control over it, and hence, the accuracy and call back of the result is depending on the API.

7.3 Recommendation

1. Enhances the geofencing experience by creating own geofencing api using suitable algorithms that will enable the parent have different ways of creating geofence instead of just drawing a circle for a geofence.

2. Enhances the route history experience by creating own algorithm for calculating and optimizing the position estimation to solve the problem of position fluttering when the child is at the same position.

3. The group monitoring feature where the parent can share the tracker with the predefined trusted group to help track their child will be added in the future for those who subscribe to the product.

4. Improves the location update to make it operates in more real-time manner.

5. Finds a better replacement to replace the use of smartphone to track the child so as it is available to carry by the school-going children.

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APPENDICES

APPENDIX 1: Sample Questionnaires

APPENDIX 2: Sample of User Acceptance Test and Results