HEALTH MONITORING SYSTEM

BY

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A REPORT

SUBMITTED TO

Universiti Tunku Abdul Rahman

in partial fulfillment of the requirements

for the degree of

BACHELOR OF COMPUTER SCIENCE (HONS)

Faculty of Information and Communication Technology

(Perak Campus)

JANUARY 2015

DECLARATION OF ORIGINALITY

I declare that this report entitled "**HEALTH MONITORING SYSTEM**" is my own work except as cited in the references. The report has not been accepted for any degree and is not being submitted concurrently in candidature for any degree or other award.

Signature   :

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Date   : 13 April 2015

ACKNOWLEDGEMENTS

I have taken many efforts in this project. However, this project would not be completed without the support and guidance of many individuals.

Therefore, I would like to take this opportunity to express my profound gratitude and deep regards to my supervisor, Mr. Tan Teik Boon, for all the time and effort to guide me throughout the whole process. He has been working really hard to help me out with my project, trying his best to clear all my doubts.

Besides that, I would like to express my gratitude towards my friends who are willing to help me with their knowledge and assist me to complete the project.

I would also like to take this opportunity to thank a very special person in my life, Ms Meigi for her patience, endless support and encouragement and for standing by my side during hard times. Finally, I would also like to extend my heartfelt thanks to my dearest parents and family for their unconditional love, encouragement and also support throughout the course.

ABSTRACT

This project works on a basic health and fitness systems. It is developed through the Android platform and the features will be further described in the report. The reason Android is chose as the development platform, is simply because of the availability of plenty of API's that can be integrated into a system. Prototyping is being used as the methodology during the system development process. It allows the system to have the basic working framework in the early phase where further integration and improvement can be implemented on it without having much hassles. The system aims to help users to keep track of their exercise progress and also allow them to measure their body condition with the health calculators provided in the application. At the end of the development of the system, there will be the delivery of an application which works as a health and fitness system.

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LIST OF ABBREVIATIONS

3D   3-Dimensional

ADB   Android Debug Bridge

ADT   Android Development Tools

API   Application Programming Interface

BMI   Body Mass Index

GPS   Global Positioning System

IDE   Integrated Development Environment

OS   Operating System

SDK   Software Development Kit

SMS   Short Message Service

UI   User Interface

URL   Uniform Resource Locator

USB   Universal Serial Bus

XML   Extensible Markup Language

Chapter 1: INTRODUCTION

1.1 Background and Motivation

Smartphone has been part of everyone today ever since the introduction of the IBM Simon in 1992. Simon is widely considered as the first true smartphone, having a black and white touchscreen display, and running familiar basic applications such as the calendar, address book, note pad and calculator (Wright R., 2013). Since then, smartphone starts to evolve into a device that can assist human with their daily work. It is no longer a mobile device that is meant for making calls and sending text messages. It is rather a well-developed touch-based computer that embeds features of an Operating System, internet access, third party application and acts as your reminder of important tasks and many more. Smartphone changed pretty drastically between 2002 and today, from Symbian OS which has been used widely by nearly all the smartphones until they are wiped out by Android, iOS and Blackberry today.

Android will be the main platform for the development of the system in this project. Android is an open-source project which initially backed by Google, creating robust and reliable operating system that could be installed onto any number of devices (McCarty B., 2011). It also has the ability to have third-party application installed in the devices. This is one of the reasons Android is selected as the platform for the system to build on. Having Google to further develop the OS, Android currently has a plenty of available APIs which can be used by developer for free. There are also a number of functions available that enable the development of this system.

Having a number of supports from the Google API documentations and forums like StackOverflow motivates the development of this project using Android. They have complete documentations that can readily be found from the Google developer's site. Another problem that gives the motivation to this project is that there are a number of people who struggle with exercising too much. Some of them do not even realize that they are over exercised. When the amount of exercise exceeds the capability of the body to recover, it can give side effects such as slowing you down instead of getting stronger and faster (Smith, 2013). That is the reason why an application that can help user to calculate their exercise capacity is needed in the market.

1.2 Problem Statement

Apparently, people nowadays are getting lazy to exercise regardless of them having free time or not. Having said that, there are also those who like to exercise but they might not know how much they have exercise, which route they have ran on and how far they have ran. Knowing all the information recorded for every set of training, they can know how much they have improved from previous workouts.

Also, it is very commonly that people breakdown half way when they are exercising, which might be caused by many reason; either they over exercised, had heart failure or overexposed to heat from sun for a long period of time. Some of them who broke down during exercise; there is a possibility that there are no people around there that time. This can be very dangerous for them if they do not get any immediate help from other people.

Using the system developed in this project which has the ability of calculating one's maximum cardiovascular capacity and also allow user to instantly send out message which consist of request for help and also the location of the user which the recipient can open the location with their GPS application to bring them there to the associated contact (Phone number being saved before-hand). The system could be it, something that can assist users with their workout routines without having to worry about all these issues and allowing them to exercise effectively.

1.3 Objectives

The main purpose of the mobile health monitoring system from this project is to enable users to briefly keep track of their exercise progress and also let them to calculate their body fitness. Hence, the main objective of the project is **to help users to briefly keep track and let them know about their body fitness**. Basically, the application can perform the following functions:

1. Track the route on Google Map where user has run during his/her jogging session along with information such as distance travelled, speed, duration and calories burnt. It also allows user to share the image of that particular route onto social media such as Facebook and Twitter.

2. Send out emergency or inviting message to the contact number assigned in the application. The contact number is assigned by users in the application and the message by default is to ask for help and contains the current location of the user where the recipient can access to view that particular location with GPS application which then guides them there.

3. Calculate an individual aerobic fitness by using user's heart rate with the Uth-Sørensen-Overgaard-Pedersen equation (J. Stone, 2011) so that user can know what his/her maximum oxygen intake capacity when exercising is. This equation will be able to calculate the maximum amount of oxygen that a person can utilize during intense or maximal exercise (E. Quinn, 2014) which is called as VO2Max. The value of VO2Max is different from one to another, depending on many factors which includes age and sex. The calculation will be explained in the methodology section.

4. Determine the Body Mass Index (BMI) value of an individual. It is use to determine whether an individual is underweight, healthy weight, overweight or clinically obese. People who are clinically obese have a greater risk of developing diabetes, stroke and cardiovascular diseases.

1.4 Highlight of what have been achieved

In this application, it is able to provide users with two **Health Calculators**, in which are the BMI calculator and VO2Max calculator. The **BMI calculator** as explained earlier, it is to calculate an individual's body mass index (BMI) with their height and weight. It is used to give you an idea whether you are underweight, overweight or in the ideal weight. It allows you to be aware of your weight category so that you know what you should do to maintain a good health. People with higher BMI value have higher chance of getting diseases such as heart attack, stroke and diabetes.
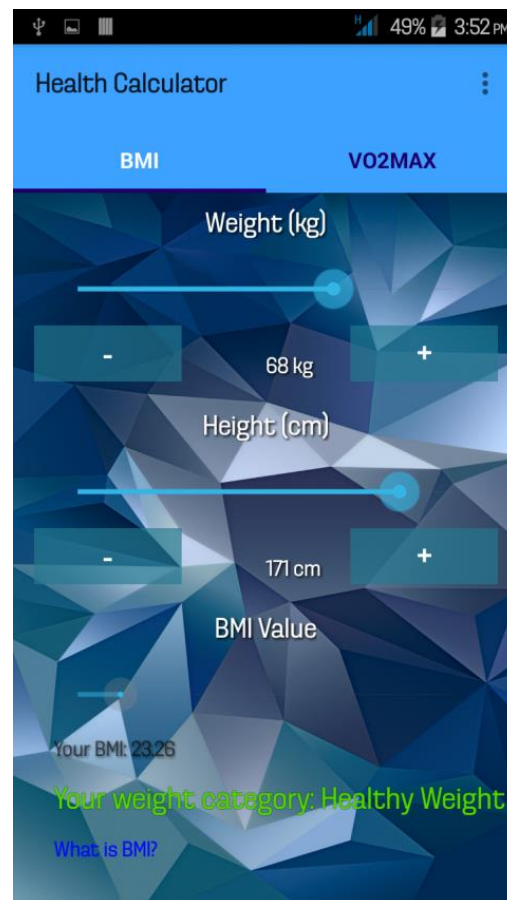
Figure 1.0 BMI calculator

Next is the **VO2Max calculator** that helps an individual to calculate their aerobic capacity. In particular, VO2Max, or maximal oxygen uptake, is a factor that can be used to determine an individual's capacity to perform sustained exercise and it is linked to aerobic endurance (Quinn E., 2014). There are a few factors that are affecting the value of VO2Max which are age, gender and also heart rate. All these values are substituted into the *Uth-Sørensen-Overgaard-Pedersen equation* to get the VO2Max value of an individual. By comparing the VO2Max value with the standard VO2Max Values table (Barder, n.d.), we will be able to identify that particular individual's classification from "Very Poor" to "Excellent". On top of that, the unit that is used to define the value of VO2Max is mL/kg/min.
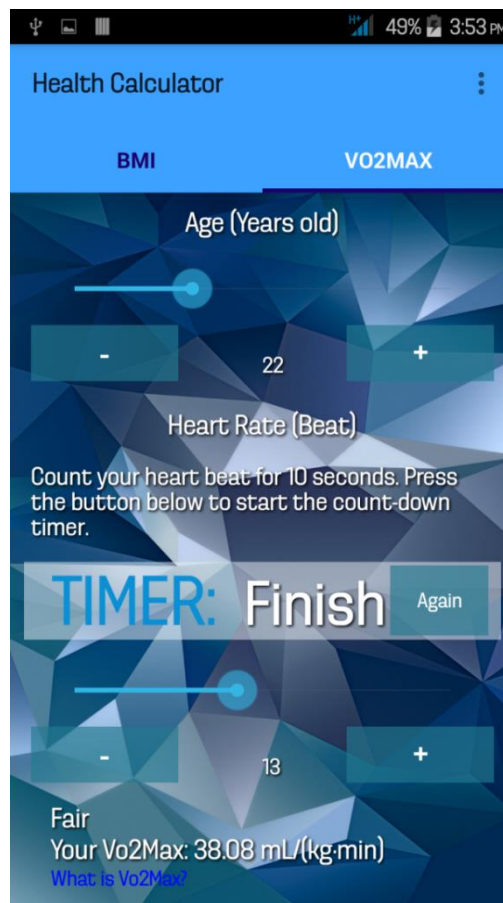
Figure 1.1 VO2Max calculator

Apart from that, the application also able to work along with the **Google map API**. From the given API, it is able to get a few data from the map which includes the speed, latitude and longitude of your current position on map and also the distance travelled in the map. It is enabled in the application to track the current location of the user on the map and use Polyline to draw on the map to keep track of the route the users has gone through. It allows user to share out the route that he/she has gone through on the map to social media such as Facebook, Gmail and Twitter in the form of an image as well. Being able to acquire the speed from the devices while the user is moving from one place to another, the application gets the highest speed value and assign to the top speed variable which will be stored as the record so that user will know their top speed of their previous workouts, along with the total distance travelled, and also time taken for the whole workout. Below shows the screenshots of the route tracing, and sharing on social media functions.
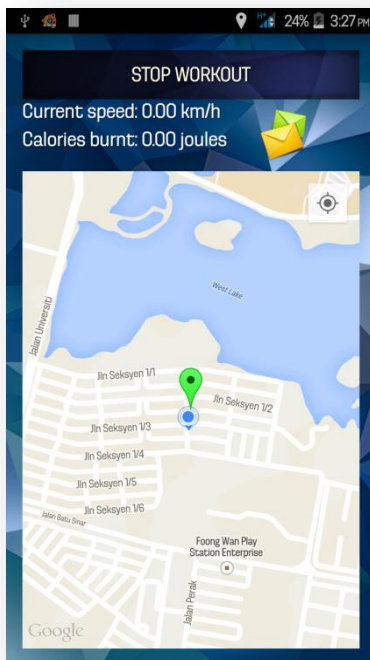
Figure 1.2 Route tracking   Figure 1.3 Share to Facebook   Figure 1.4 Share to Gmail
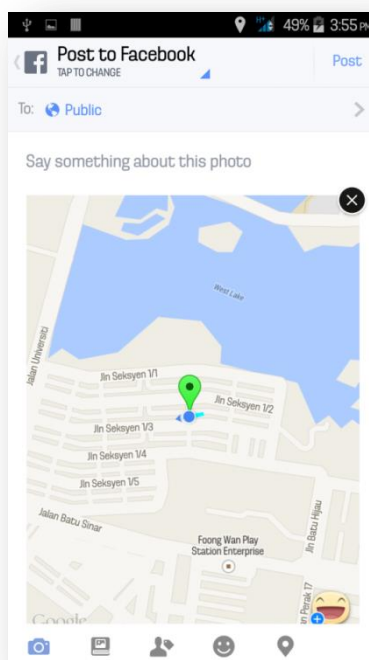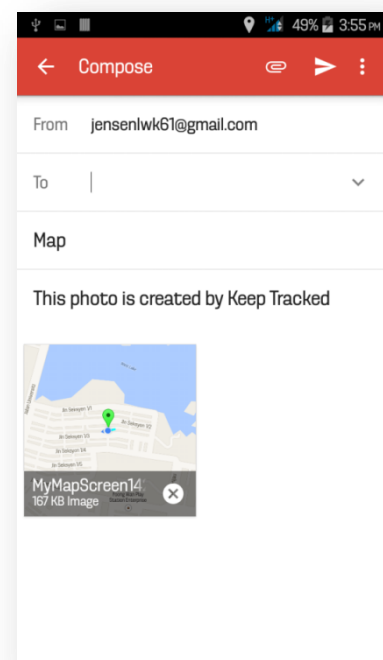
Furthermore, there is also another remarkable feature in this application which is the ability of the application to allow user to send out emergency or inviting message to the contact number assigned in the application. By having this feature, whenever the user feels uncomfortable or not feeling well, he/she can directly in the application itself send out a message. This might be a good feature that can save a person life given that if he/she needs a special medication which people around might not be having. A call for help to the associated person might be the best way to do so; the recipient can either get to the place if it is not very far away, or if it is really emergency, he/she can give a call to the user's phone to which then will be picked up by passerby to guide them what to do next before his/her arrival. To add on, the contact number is assigned by users in the application and the message by default is to ask for help and contains the information of the current location of the user where the recipient can access to view that particular location with GPS application which then can guides them there.
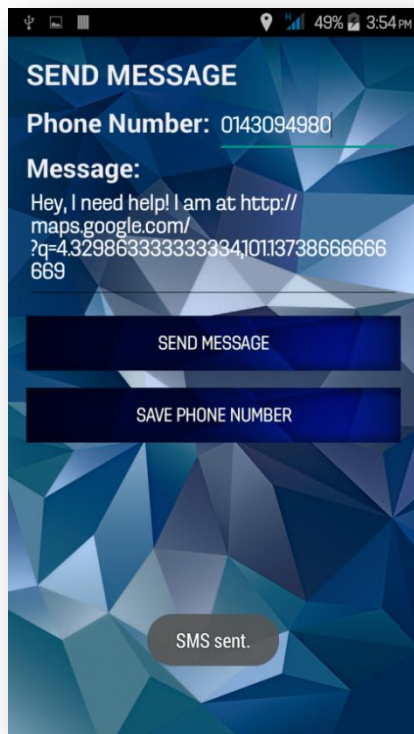
Figure 1.5 Prepare message   Figure 1.6 Sending Emergency message
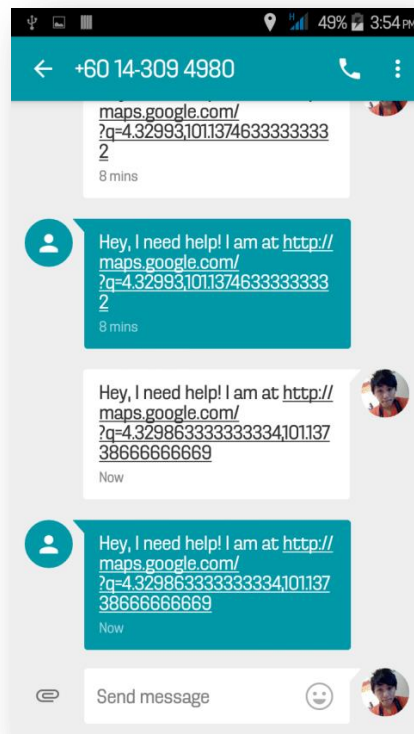
Besides, there is also another feature in the application which allows users to save their workout records. Users are given a choice whether to save their record into the database or not. It will be storing information such as data, time taken for the workout, distance travelled, calories burnt and also the top speed. Users are also allowed to view their previous workout's records. The records will be shown in a list in which user can choose to delete them too. The descriptions are illustrated below.
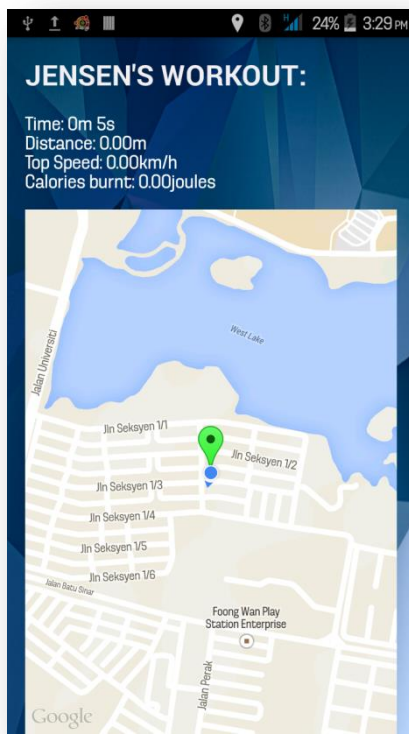
Figure 1.7 Workout Result   Figure 1.8 Save Record   Figure 1.9 View Records
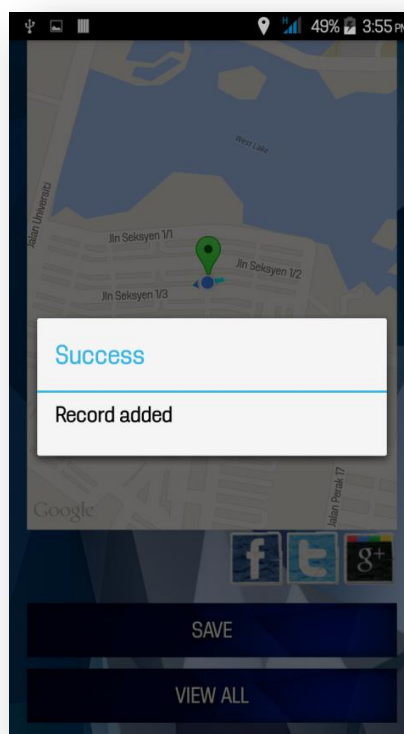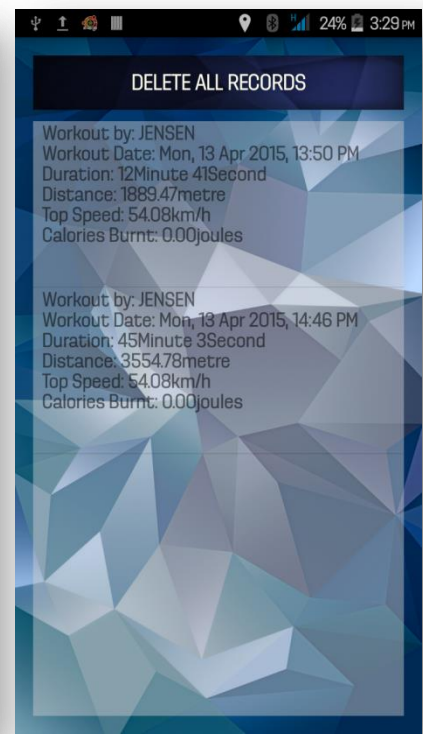
1.5 Report Organization

This report is basically divided into a few parts where each of them explains different things that can be integrated as a whole system. Ignoring the cover page and content page, the report starts with an abstract which works like a formal summary of the system. It describes the main points of the application, problem statement, methodology, approaches used, result obtained and also the conclusion of the project to help reader to decide if they should read the entire report.

Moving on to the next part, this section will be further separated into a few chapters where every chapter will describe thoroughly each part about the system. It will be divided into 6 parts as following:

Chapter	Title
1	Introduction
2	Literature Review
3	System Design
4	Proposed method and approaches
5	Implementation and Testing
6	Conclusion

Table 1.0 Chapter Summary

In Chapter 1, it explains briefly about the introduction where problem statements, background and motivations and objectives of the project are described. It tells the reader about what the project is all about, and what purpose does the system serves.

In Chapter 2 which is the literature review chapter, reviews and comparison of previous works are done here showing what you have research and study about the topic. It involves facts finding and data collection, collecting relevant information to the project to study other people's work. It shows briefly what you know about your topic and what idea you have acquired from previous developers. By doing this part, it gives a better and in-depth understanding on the

system development and also knowing what should be placed into the application and what should not.

In Chapter 3, it is all about the system. It explains entirely how the system works through graphical presentation such as use cases and sequence diagram. It gives the reader a better understanding on how the system runs, from the very beginning to the closure of the application. It contains a several system designs such as the architectural design, database design, and also the User Interface (UI) design. In other word, the description and explanation on how the system is designed. It also explained in this chapter about how the program is being developed, using which method, class or API. Everything about the system development can be read from this chapter, and it should be able to guide reader to rebuild the system by reading this chapter.

In Chapter 4 and 5, methodology and tools that are used in the application development is being discussed. Also, the system specification, requirement and the type of types that have been carried out during the testing of the system are also discussed in this chapter.

Lastly in Chapter 6, will be the conclusion chapter. Project review, discussions and conclusions will be described here. It will summarized once more about the whole project on what have been achieved in the project, problems encountered during the development of the application and also personal insight into the research experience obtained from the project.

Chapter 2: <u>LITERATURE REVIEW</u>

In the past ten years, many developers have been focusing on mobile health application in order to come out with a system that can help people in better managing their health because they find potential in all these applications in the coming future and in fact, these applications already got a place in the market. Healthcare access, affordability and convenience have always been the issues for many people and this breakthrough allows mobile devices to be used to help with these challenges. Through the advancement of mobile technology, mobile health applications, sensors and remote patient monitoring systems, things became more convenient and cost saving by facilitating the delivery of health care (West, 2013). Based on a study by research2guidance, the number of health related application published on Android and iOS is reaching more than 100,000 units in the market in 2014 (Miller, 2014).

2.1 Literature Review on Mobile Health and Fitness Application

As mentioned earlier, Mobile Health and Fitness applications have been growing in a very quick manner these few years. In the year 2014, Google came out with an end-of-year analysis of which application category has been the most popular. Interestingly, Health and Fitness application appears to be the fastest growing application category for that year (Boxall, 2014). It simply reflects how much the mobile industry focusing on our well-being and how much people are buying into it.

Based on a study by research2guidance, the number of health related application published on Android and iOS is reaching more than 100,000 units in the market in 2014 (Miller, 2014). There is another study that research on the innovations from mobile health application developers found out that more than half of the developers plan to use ubiquitous wearable devices such as pedometer, wristbands and smart watches for their application (Faulder, 2014). They believe that using all these devices allow healthcare applications to be even closer to the user, helping them to get a more accurate reading.

There is no doubt that all these applications are useful at some point and in many ways. For instance, application such as iWander for Android devices is used for patients suffering from dementia, a disease that causes the loss of cognitive functioning in a person. The most common form of dementia is Alzheimer's disease. The application makes use of GPS function to track the patient's location to check if the individual travels out of the confined area and if the individual goes out of the area, the system will then notify the associated person for further action to be taken (Sposaro et al., n.d.).

Even though the number of this type application has reached 100,000 in the market, there is only a few of them that stand firm as the upfront application of the category. Among the top health and fitness application, there are these four that have very high ratings from its users which are MyFitnessPal, Lose It!, MapMyRun and RunKeeper.

2.1.1 MyFitnessPal: Health Application using Calories counter

To begin with, MyFitnessPal is a health application that uses the concept of a calorie counter to help its users to lose weight. The application has the access to the world's biggest nutrition and calorie database that consist of information about more than 5 million foods. The application simply tracks user's diet by prompting users to save and add entries about their meals. The application is able to create and design a personalized diet and exercise program for its users. Besides, it also allows users to view their progress over time with available charts and records for motivation. Below are a few screenshots of the application.
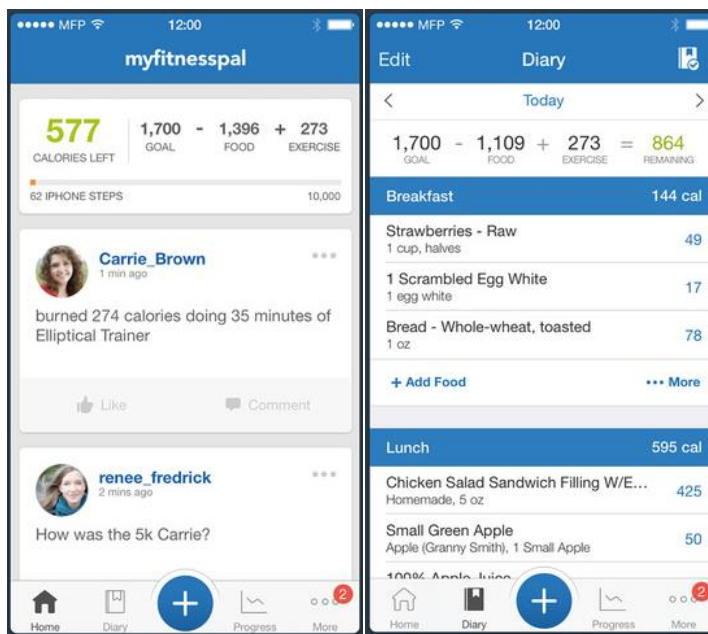
Figure 2.0 Screenshots of MyFitnessPal

2.1.2 Lose It!: Weight Reduction Application

Lose It! is a health and fitness application that works similarly like how MyFitnessPal. It has all the basic functionalities such as nutrient tracking, exercises planning and others. It allows users to set daily goal and calorie budget for users to meet them. It also has a function to help users to have their meal tracked and categorized into different food categories such as protein, fats and carbohydrates which allows users to know their daily nutrients intake. Furthermore, Lose It! also allow detailed reports to be printed directly from your devices as reference. In term of exercise, Lose It! keeps track of its user's cardiovascular exercises and measures the amount of calorie burned from that particular workout. The features that this application provides are helpful enough that it can be the top among the 100,000 health and fitness applications in the market. Below shows the screenshot of the application:
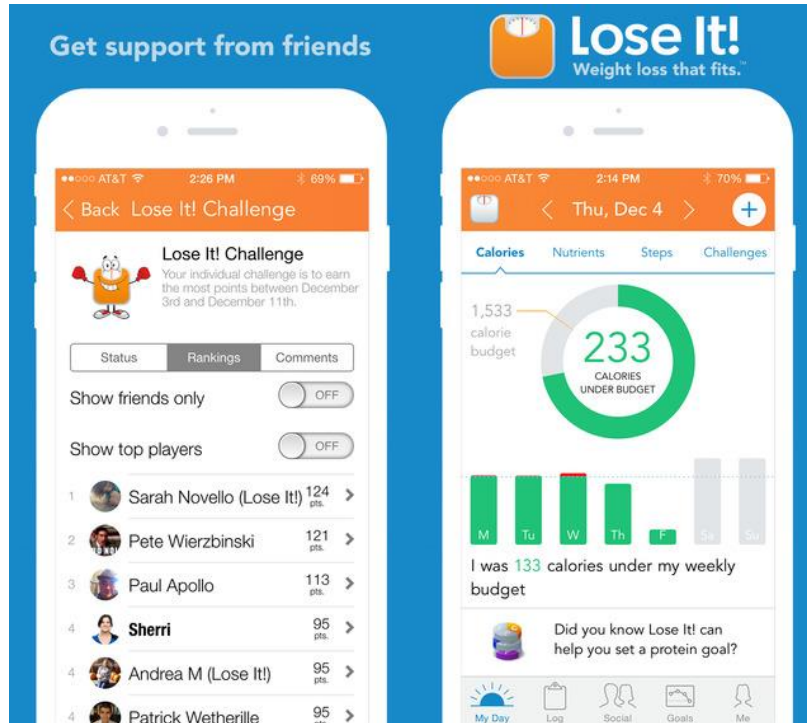
Figure 2.1 Screenshots of Lose It!

2.1.3 MapMyRun: Workout Tracking and Fitness Application

 MapMyRun is an application developed for the purpose of tracking user's workout routines. It is specially designed to keep track of users' physical activities by keeping track of user's workout location and route by using built-in GPS in the mobile devices. It also allow user to share their exercise to their friends and also ask for challenges. Besides challenges by users themselves, the application once a while will creates some virtual exercises competition and prizes will be given out for winners as motivations. It also helps to monitor user's sleeping patterns, steps taken and display them into graphs for analysis. The following are the screenshots:
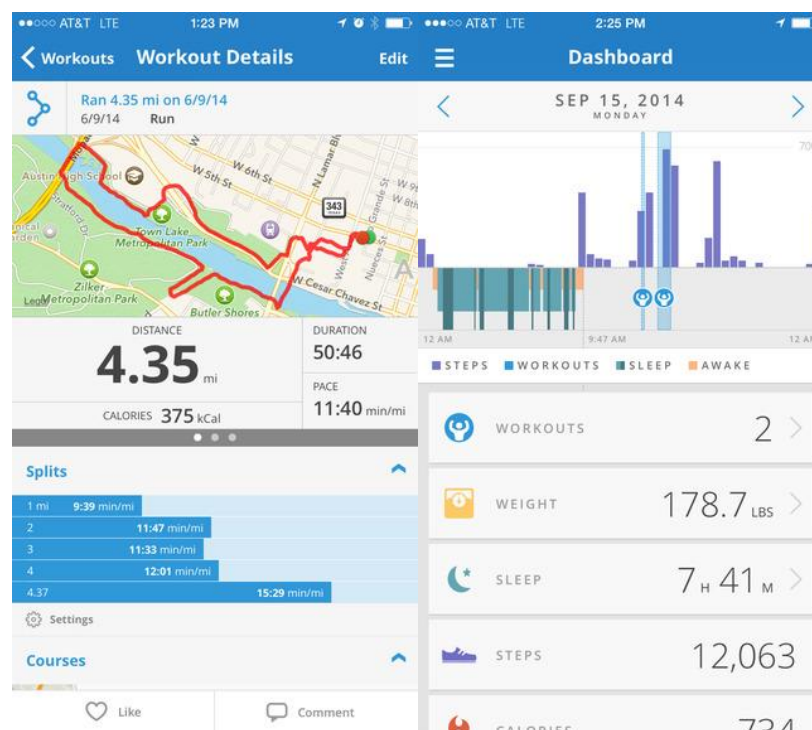
Figure 2.2 Screenshots of MapMyRun

2.1.4 RunKeeper: Health and Fitness Application

RunKeeper is one of the most useful cardiovascular activities tracking application available for Android and iOS users. It works similarly like MapMyRun by having the features of tracking user's workout route using GPS in their mobile devices and store the relevant information such as calories burnt, distance travelled and others. It also allows users to set goal for their workout and also keep track of their total workout distance which allow them to keep track of their progress. The application can also work with third-party devices such as smart watches and Heart rate monitors. The following shows the screenshots of the application:
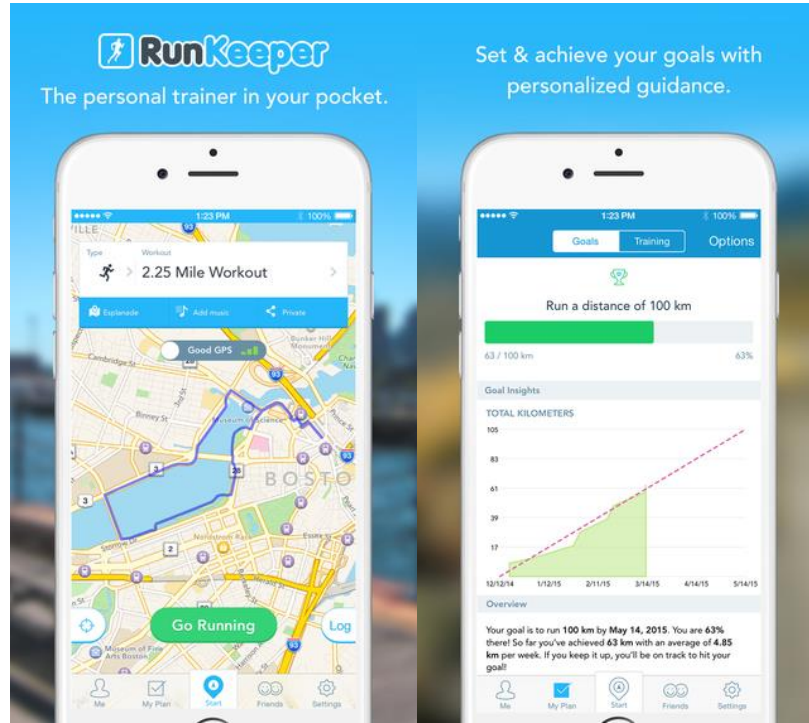
Figure 2.3 Screenshots of RunKeeper

2.1.5 Comparison of four Health and Fitness Application

Application Features	MyFitnessPal	Lose It!	MapMyRun	RunKeeper
Hardware components Used	Accelerometer, pedometer and gyroscope	Accelerometer, pedometer and gyroscope	Accelerometer, pedometer, GPS and gyroscope	Accelerometer, pedometer, GPS and gyroscope
Strength	Able to keep track of user's diet and has world's biggest nutrition and calorie database	Calculates calories intake and tracks physical exercises and plan out exercise program.	Track the routes and provide relevant information to users about their workout and able to share with friends.	Track the routes and provide relevant information and analysis. Able to set workout goal as well.

Table 2.0 Comparison of four Health and Fitness Application

2.2 Literature Review on Ubiquitous Devices for Healthcare Purpose

The next thing that comes after smartphones are now emerging into the market rapidly is wearable. The most commonly marketed wearable today is nothing much but an electronic watch, a smart watch that are able to collect certain data from users such as getting heart rate, keeping track of number of steps taken by the user to move from one place to another and also able to synchronize these data with a connected device such as mobile phone or tablets to process the data into more useful information. A smart watch is a computerized wristwatch with such features as a calorie counter, event reminder and contact list (Costa, 2014).

The reason wearable are getting much attention from the market is because of several reasons which include the growing of installed based smartphones, component cost/performance improvements, an established software ecosystem and new application/business models (Pitzer, 2013). Figure 1 (below) shows the rapid increment of smartphone users from the year 2010 to current. This is a strong reason why developers are moving into this field and bring it further.
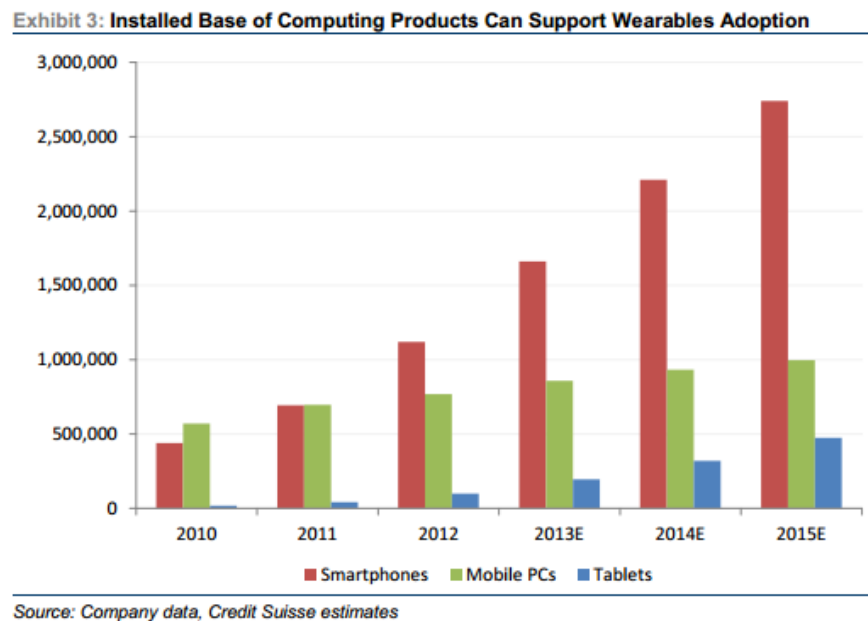
Figure 2.4 Installed Based of Computing Products Can Support Wearable Adoption (Pitzer, 2013)

There are several companies out there which started developing further into this field simply because they realize the potential in growth of this technology. They include Samsung, Google, LG, Sony, Motorola and also NIKE. These companies have actually marketed some of the wearable products, mostly are used as reminder, time telling device, health tracker and also as a music player. Usually all these wearable are connected to a mobile device so that they can synchronize data with each other and also perform some function that requires connection from these two devices.

Some of the companies are more innovative that they apply the concept of the wearable technology into some device that can ease human's daily activities such as the Motorola Solutions wearable product which is able to give their workers an advanced mobile computing and scanning devices to perform their job more efficiently and effectively in a warehouse; Scanning and picking up items can be done almost at the same time. Besides, Google have been trying hard to fully develop their current big project, the Google glass is also considered as one type of wearable. The Google Glass is a small headband-like computer that puts a screen in front of the users' eyes, allowing them to navigate the web, take pictures, and manage their various social media and communication (Stone, 2013).

Google Glass is among the best high-technology products being developed so far, that has the intention of being worn on the user as an accessory. This is actually a very interesting gadget that is not to be missed by anyone. The reason it is so interesting is simply because the way it outputs data to the user. It presents information directly onto the glass, in the users' view such that they can view the information and also the reality at the same time, using the technology known as augmented reality. Augmented reality system aims to enhance the user's perception of and interaction with the real world through supplementing the real world with 3D virtual objects that appear to coexist in the same space as the real world (Azuma et al., 2011). This made the wearable more convenient for the users especially when process data or to do something such as taking a photo or sharing it to the social media.

It might look almost complete as a technology that is interesting enough and able to give much convenience to users, it has several drawbacks too. As asserted by Stone, such portable technology with social media sites and cloud storage being prevalent in our daily lives, it becomes more and more difficult to maintain a sense of privacy and security. Also, it can be misused in some situation such as capturing video of situation which is not allowed to be shared to the public. That is why there are still a lot to be improved in this field.

2.3 Literature Review on Excessive Exercising and Heart related issues

The science behind exercising and fitness can be confusing at times because there are just too many definition of both the meaning out there (Smith, n.d.). One minute, a study supports a type of effective exercise, and in the next minute, another newer research reports that doing the same type of exercise is the most ineffective exercise you can do. There is no actual definition of which is the best and the worst, simply not doing an exercise the wrong way is already beneficial to our body in many ways. In fact, it is essential for improving our overall health, maintaining fitness and helps to prevent us from many types of diseases, especially cardiovascular diseases, hypertension, and obesity ("Exercise", n.d.). According to a survey that was conducted by Centers for Disease Control and Prevention (CDC), more than one-third of the U.S. adults are obese ("Adult Obesity Facts", 2014). From here, we can see that people actually do need to take more care and concern about their health, by doing more exercise, control diets and also prevent unhealthy practices.

Having said so, exercise can be sometimes harmful to us if we do it in the wrong way. According to Dr. Mercola, too much of exercise, particularly long cardio exercise such as marathon and triathlon training can do more harm than good (Mercola, 2013). Over-exercised can lead to an increase in the resting heart rate, the heart rate when an individual is at rest. Based on a research published in "Journal of Athletic Training", if the heart rate of an individual increased by more than five beats per minute, that individual is probably experiencing Overtraining Syndrome which can cause an individual to have unexplained weight loss and lose appetite (Perna, 2013).

In addition to that, some can even see that they are performing relatively worse during fitness testing due to this.

As a matter of fact, over exercise will not only cause an individual to have the syndrome, in some even more serious cases, it can bring fatality to the individual. It is not common to be able to see from news that an elite athlete suddenly dropping death. Many think that running the marathon or triathlon is actually healthy but it is not exactly true (Mercola, 2013). As a matter of fact, high-endurance training will put the extraordinary stress onto the heart. Although giving the heart some stress usually makes the heart stronger but extremely high stress can backfire (O'Keefe et al., 2012). In short, exercise gives a lot of impact towards the human heart and should not be done wrongly.

The normal heart is a strong, hardworking pump made of muscles tissue. It has four chambers which are named atria and ventricles (American Heart Association, 2011). It is one of the vital organs in human body and in fact, it plays a very important role. It is needed to pump blood to the whole body to allow oxygen to be transferred to all the cells and tissues in the body. Without this pump, the cells and tissues would not be able to get oxygen, which will eventually kill the cell and it will affect the other organs too. That is why the heart must be taken care very carefully.

Pain in the chest can be one of the signs that can tell if there is a heart attack. The pain will spread to the arms, neck, back and jaw area. It may be coupled with sweating, dizziness or shortness of breath too (The Patient Education Institute, Inc, 2013). Knowing the heart rate can give a person more information too. The normal resting heart rate should be ranged from 60 to 100 but it might also be affected by many factors such as age, level of heart and lung fitness, environmental temperature, altitude, anxiety and cigarette smoking. A good average heart rate stays around 70 to 75 beats per minute.

That is why if we can get an application that allows users to send out emergency message; it would be useful, at least being able to notify others before they are going to break down. Having

an inconsistent heart rate and keep beating with a rate of above 100 beats per minute, the person is said to be experiencing a condition called Tachycardia where his/her heart pumps relatively fast. This condition can cause sudden death because when the heart pumps too fast, the heart does not get sufficient oxygen, it will causes death to the heart muscle tissues and eventually the heart will die (Eckardt L. et al., n.d.). This condition is called as ischemia. Tachycardia can be caused by many factors which include damage to heart tissues from heart disease, exercise, sudden stress such as fright, high blood pressure and many more.

On the other hand, if the heart rate beats lower than 60 times per minute, a person is experiencing a condition called bradycardia. As asserted by Austin Heart, bradycardia is a general term that describes a number of conditions in which the heart beats at an unusually slow rate (Costa, 2002). It can be a serious problem if the heart does not pump enough oxygen-rich blood to the body, causing the cells and tissues around the body to lack of oxygen. That is why bradycardia can also be fatal to a person. Besides that, dehydration might be another issue too because when an individual do not drink enough water, his/her muscles will get tired very easily (Healthwise, 2013). That is why it is also important to protect oneself from dehydration in extremely hot and dry weather.

In brief, exercise might be beneficial but if it is overdone it will bring harm to the body. Doing exercise in just adequate amount based on their capacity will be sufficient. Based on the US government guideline, it recommends adults to perform aerobic exercise for five times a week for half an hour for maximum health benefits (Hope, 2012).

Chapter 3: SYSTEM DESIGN

3.1 Introduction

In this chapter, there will be explanation on how the system is designed and the overall architecture of the system. System design is the process of defining the elements in the system such as architecture, components, modules and the data that runs in the system (Mitre, 2009). Graphical documentation such as use-case models, sequence diagram, and other supporting requirements information will be used to describe the overall system design.

3.2 Architecture Design
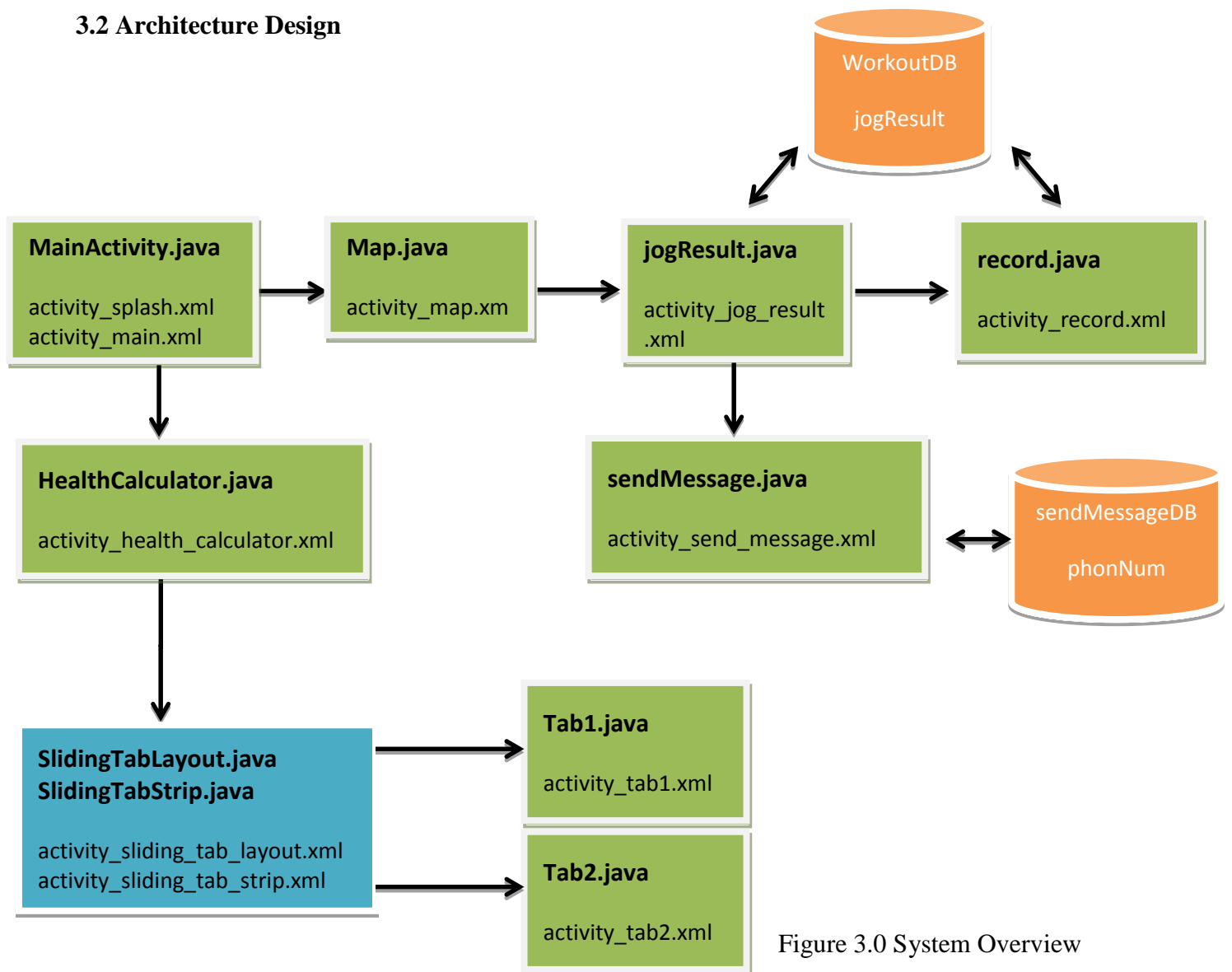
Figure 3.0 System Overview

As mentioned before, the system works entirely on Android platform and the application developed requires minimum of API Level 18, which is the Android 4.3 Jellybean running the maximum requirement will be API Level 19, which is the Android4.4 Kit Kat running on the smart phone. The architecture design of the system above shows all the associated programming files, which consists of Android/java code file and also XML layout file. Extensible Markup Language (XML) files are files that are used to transport and store data, and help modifying and editing the User interface layout easily rather than using code. The following are the Android/Java files and their associated XML files.

No.	Android/Java file	XML file
1	MainActivity.java	splash.xml
		activity_main.xml
2	map.java	activity_map.xml
3	jogResult.java	activity_jog_result.xml
4	record.java	activity_record.xml
5	sendMessage.java	activity_send_message.xml
6	SlidingTabLayout.java	activity_sliding_tab_layout.xml
7	SlidingTabStrip.java	activity_sliding_tab_strip.xml
8	HealthCalculator.java	activity_health_calculator.xml
9	Tab1	activity_tab1.xml
10	Tab2	activity_tab2.xml

Table 3.0 List of Android/java and associated XML files.

3.3 System Development

MainActivity.java

This would be the main activity of the system, meaning that it will be the first activity to run after the user starts the application. Right after executing the application, users will be able to see a splash screen with the application's logo and name in view. The activity requires an input from the user to move on to the next content. The splash screen is created using only a single layout XML file (splash.xml).

The main activity then set its content view to this splash.xml to place the view onto the screen by using setContentView (R.layout.splash). The XML file is built on a Linear Layout, placing the logo in the center of the screen and also a Text View informing users that they need a tap on the screen to move on to the next view. It is simply done by assigning a listener to the layout defined in the XML file, in this case the linear layout mentioned earlier. Any touches detected within the layout will trigger the calling of mainActivity function defined in the MainActivity.java. Right after calling into this function, it will change the content view by changing the XML file. It is done using setContentView (R.layout.activity_main). This will change the layout and view from the splash screen to the main menu and proceed on. The images below show the view change transition.
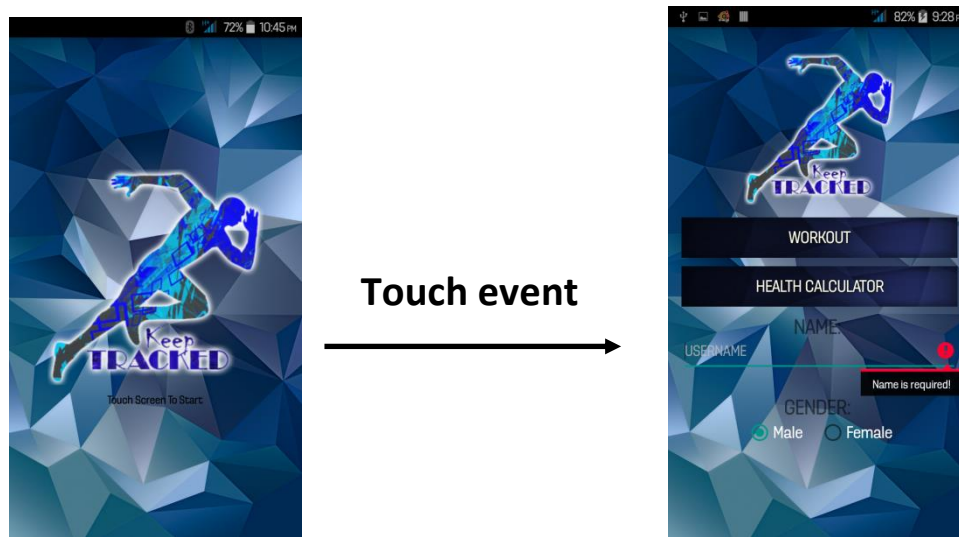
Figure 3.1 Touch Event in main activity

Map.java

Right after getting into the main activity, users are given two options which are "WORKOUT" or "HEALTH CALCULATOR". Choosing the first choice, "WORKOUT" will direct users to this activity (map.java). This activity works with the Google Maps Android API v2 as the main function of the activity. The Google map is placed in a fragment in the layout of the activity. Particularly, certain functions and calculations are used to get the speed, distance, calories burnt and also the user's current location on the map. It works along with the map.XML for the layout.

Initially when this activity is executed, it will check if user has turn on the GPS location sensor in the mobile device using the buildAlertMessageNoGps() function in the activity. Right after getting the GPS sensor on, it will work along with internet connection and also the mobile network to get a more accurate reading of the user's current position. It will be more energy consuming if this mode of positioning is used (GPS, Internet connection and mobile network) but it will be the most accurate one to be used. Slight changes in movement can also be detected (up to +-1km/h accuracy). That is why it can provide more precise result to the user. Subsequently, right after getting the user's current position, the application will place a marker onto the map indicating the starting point of the workout with googleMap.addMarker(marker) function. By this, user will know where they start running. Also, to keep track of the route where the user will go, polyline is used to track down the locations that user gone through. This is done by this line of code: googleMap.addPolyline((new PolylineOptions()).add(prev, current).width(7).color(Color.CYAN).visible(true)). This gives them the overview of the whole workout, which road the users has gone through.

To place the map fragment into the activity, there are a few steps that have to be taken carefully in order for the map to work. Prior to placing the map fragment into the activity, user has to first install the Android SDK, update the Google Play service in your device and most importantly is to get an API key for the map, which will need you to register a project in Google Developer Console and get a signing certificate for the application. The reason you need to get the Android

certificate and Google Map API key is to allow you to access the Google server with the Map API.

Next, go to https://console.developers.google.com/project and create a new project and enable the required API in the API tab. After that, go into the Credentials page to obtain the API key. To get an API key, you will have to enter the application SHA-1 fingerprint, which can be obtained by generating the following command in windows terminal:

Keytool -list -v –keystore %USERPROFILE%\.android\debug.keystore" -alias androiddebugkey -storepass android -keypass android

After that, get the API key and place it in the application's Android Manifest file. Paste the key into the file. Another thing that has to be taken into account is to place permission in the same file. The permissions that need to be placed in the Manifest in order for the map to run are as following:

```
<uses-permission android:name="android.permission.INTERNET"/>
<uses-permission android:name="android.permission.ACCESS_NETWORK_STATE"/>
<uses-permission android:name="android.permission.WRITE_EXTERNAL_STORAGE"/>
<uses-permission android:name="android.permission.ACCESS_COARSE_LOCATION"/>
<uses-permission android:name="android.permission.ACCESS_FINE_LOCATION"/>
```

All these permissions are to gain permission from the user before installing the application to allow the application to use those functions. These functions are needed to perform all the functions such as to access the GPS, internet and mobile network for location detection, writing information to external storage (SD card, internal memory) and others.

There is also one more thing that is important for the Google map to appear in the view. The Google map uses OpenGL ES Version 2 to render the map; that is why it has to make sure that it is installed in the device. The code below is again placed in the Android Manifest file to make

sure Google Play store do not show this application to devices that do not support this version of OpenGL.

```
<uses-feature
        android:glEsVersion="0x00020000"
        android:required="true" />
```

After all the setups, now the map fragment can be placed into the activity and working as expected, which is to get the current location of the user. Described above are the steps to get the Google map running in your application. In order for the map to have more functions, more research has to be done on integration with the Google Map v2and available APIs. The map will be as shown in the image below.
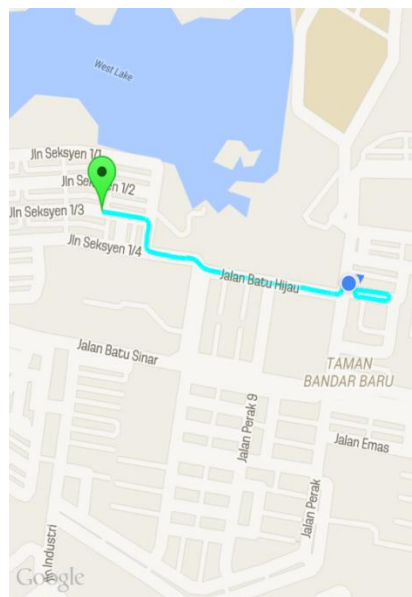
Figure 3.2 Google Map v2

To obtain the current speed of user on the map, the activity simply uses location.getSpeed() and to get the distance travelled, the total distance travelled is added to it every second because the function illiterates at every one second. Using the location.getSpeed() will be able to obtain the speed with the unit of meter per second. Meaning that every second, the speed obtain from location.getSpeed() is able to determine in that one second, how far the user has travelled, stored in term of meters.

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For calories, simple If-Else statements is used to estimate the calories values an individual can burn, measuring the speed of the user because speed has to be taken into account to calculate the amount of calories burnt. The table below shows the speed of an individual when running and the amount of calories burnt if the activity is performed for 15minute and 1 hour. The value has been divided to obtain the amount of calories burnt per second, getting a more consistent and accurate value, to the precision of 1 second.

Calorie burning activity	15 min	1 hour
Running, 5 mph 12 min/mile	119	476
Running, 5.2 mph 11.5 min/mile	136	544
Running, 6 mph 10 min/mile	153	612
Running, 6.7 mph 9 min/mile	170	680
Running, 7 mph 8.5 min/mile	179	714
Running, 7.5 mph 8 min/mile	196	782
Running, 8 mph 7.5 min/mile	213	850
Running, 8.6 mph 7 min/mile	221	884
Running, 9 mph 6.5 min/mile	238	952
Running, 10 mph 6 min/mile	255	1,020
Running, 10.9 mph 5.5 min/mile	289	1,156

Figure 3.3 Calorie Burning amount and Activity (CalorieLab, n.d.)

jogResult.java

In this activity, it serves the function exactly as what it has been renamed; it shows the workout result to the users. Information such as time taken, distance, top speed and also calories burnt will be displayed in this activity. Come along, there will be a screenshot of the route that user has ran that can be shared onto Social media such as Facebook, Twitter and also Gmail. From here, user can choose whether to share their route to their friends or not.

To share the image of the map, intent method is used to share the images to the social media. The only disadvantage of using this method to share images is that it can only append extra text as the image description for Twitter and Gmail. It will not append an image caption for sharing the image to Facebook. The reason is because Facebook requires the use of their SDK for sharing things to their network. The reason to insist of using intent is because it will need more time to integrate Facebook SDK into this application, time constraint will be an issue. Sharing only image without pre-written text would be enough because user can add in messages themselves.

From this activity also, user can choose whether to save the workout information into the database for later retrieval. The database that is being used in this system will be the SQLite database. The reason is because there won't be much hassle to set up this database and it does not have a server either and it is appropriate for the application to use this database system because it only needs to store a few data into it.

Using SQLite database would be more than enough compare to other SQL databases engines that requires setup procedures and servers. The following codes show how to create the database and the table to store the required data into it:

```
db=openOrCreateDatabase("database_name", Context.MODE_PRIVATE, null);
db.execSQL("CREATE TABLE IF NOT EXISTS table_name(item TYPE);");
db.execSQL("INSERT INTO table_name VALUES('"+item+"');");
```

Record.java

This activity perform only a few functions that include retrieving workout records from the SQLite database and place it into a list view where each record is arranged into a row of a scrollable list. It also has a Delete button that allows user to delete all the records in the list. A cursor is used to retrieve all the data from the table. A cursor represents the result of a query and is basically pointing to one row of the query result before moving onto the next row with cursor.moveToNext(). The following code is used to execute the database query:

```
Cursor c=db.rawQuery("SELECT * FROM table_name", null);
```

The reason why cursor is used in the system is because it does not need to load all the data into the memory while retrieving data from the database. As mentioned before, it only points to each row at a time and data retrieval will be performed then. The design of the database and the overview of an Android SQLite database are as illustrated below.
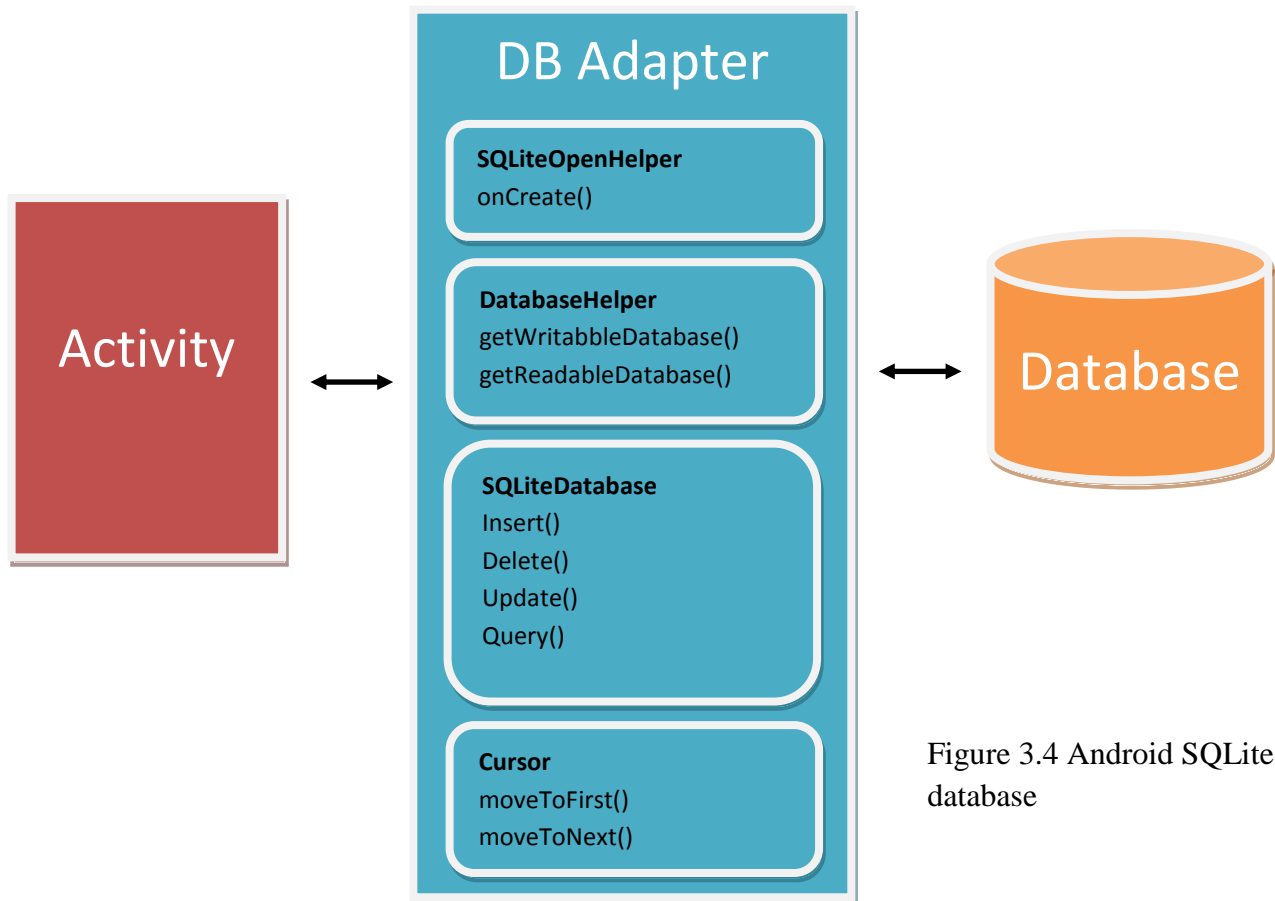
Figure 3.4 Android SQLite database

sendMessage.java

Basically, there is only one single function which is to send out messages. By default, it serves to send out emergency messages; it has pre-written text message that comes together with the location of the current user. However, users can choose to use it in other ways such as to invite his/her friends for a jog or some workout. As mentioned earlier, it has included the current location of the user where the recipient of the message can open the location detail in their GPS application or through Google map. To be able to send out messages, the SMS manager API is being implemented. Messages can be easily sent out by just filling in the parameters into the following codes:

```
smsManager = SmsManager.getDefault();
smsManager.sendTextMessage(phoneNo, null, textMessage, null, null);
```

On the other hand, the location information that is included in the default message is actually an URL which consists of the longitude and latitude of the user's current location. The longitude and latitude is placed into the following URL, where longitude and latitude is dynamic and depending on user's location.

```
http://maps.google.com/?q=<Latitude>,<Longitude>
```

For instance, if the Latitude of the user's current position is 4.32933333333 whereas the Longitude is 101.1376666666, then the location URL of the user current position will be at http://maps.google.com/?q=4.32933333333,101.1376666666. Clicking into the link allow the recipient to open in GPS application to bring them to the location.

SlidingTabLayout.java and SlidingTabStrip.java

Both of these Android files serve nothing more than providing a layout for the Health Calculator in the application. SlidingTabLayout.java provides the horizontal scrollable layout that allows the tabs in the Health Calculator to be able to swipe horizontally. The whole file is used to customize the appearance of the slide-able layout, working along with the SlidingtabStrip.java that defines the colors and thickness of the tab strips.

HealthCalculator.java

This activity acts as the health calculator that helps user to calculate some health related calculations. They include BMI calculator and a VO2Max calculator to measure an individual's weight category and aerobic fitness respectively. This activity holds the View Pager that allows both the calculator to slides horizontally from one to another. The two calculators are then placed in within to serve the two parts of the pagers.

Tab1.java

This activity is the Body Mass Index (BMI) calculator that helps user to calculate their BMI value and telling them which weight category they are belong in. BMI is a measure of body fat of an individual based on height and weight. There are two units of measurements used by the BMI calculator which include the standard measure that uses the unit feet and inches for height and pounds for weight to calculate the BMI value and metric measure that uses the unit centimeters for height and kilograms for weight. For the BMI calculator in the application, metric measure is used, using centimeters and kilograms simply because the formula is slightly simpler than using the standard one. The formulas to calculate the BMI are as following:

$$\text{Metric: BMI} = \text{Mass}_{kg} / (\text{Height}_{m})^{2}$$
$$\text{Standard: BMI} = \text{Mass}_{lb} / (\text{Height}_{in})^{2} * 703$$

After calculating the BMI value, it is used to compare with a BMI table to determine the weight category that you are in. The table is as following:

Weight Categories	BMI (kg/m²)
Underweight	< 18.5
Healthy Weight	18.5-24.9
Overweight	25-29.9
Obese	30-34.9
Severely Obese	35-39.9
Morbidly Obese	≥40

Table 3.1 BMI Table (Bariatic Center, n.d.)

Tab2.java

This activity is aVO2Max calculator which helps individual to calculate their VO2Max value. The value is to determine an individual's aerobic fitness. VO2Max is defined as the highest rate of consumption of oxygen attainable during the maximum level or exhaustive workout, a point where there will be no increase in oxygen consumption regardless of continuation of exercising exhaustively (Quinn, 2014). The table below explains the definition of VO2Max.
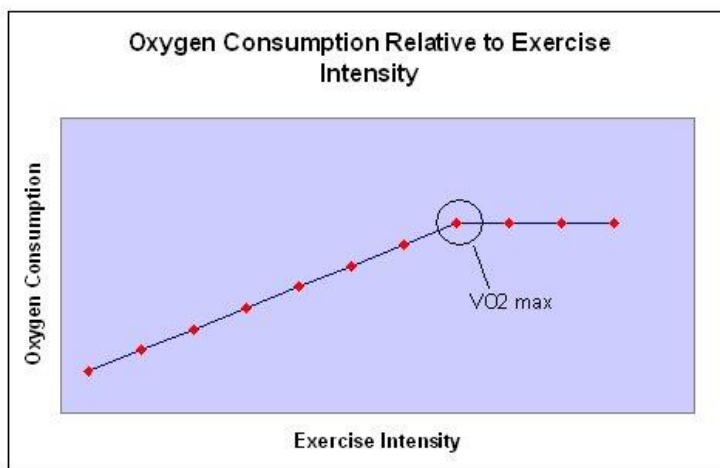
Figure 3.5 Oxygen Consumption Relative to Exercise Intensity (Phil, n.d.)

VO2Max value is usually measured in milliliters of Oxygen per kilogram of body weight per minute (ml/kg/min). There are many ways of calculating or estimating the VO2Max of an individual which include Cooper test, Multi-stage fitness test, Rockport Fitness Walking Test and lastly the method that will be used in this calculator, which is the Uth–Sørensen–Overgaard–Pedersen estimation. The following is the equation:

$$VO_2Max \approx 15 * HR_{Max} / HR_{Rest}$$

, where HR_{Max} is the Maximum heart rate and HR_{Rest} is the resting heart rate.

The maximum heart rate can be estimated by using the age of the individual and also the gender of the individual. It can be estimated as following:

Maximum Heart Rate = 220 – age (Men)
Maximum Heart Rate = 226 – age (Women)

The other method to measure maximum heart rate is only by using a heart rate monitoring devices such as a smart watch while performing very strenuous exercise until the heart rate maxes out, which will be difficult to achieve. On the other hand, the Resting heart rate can be simply measured by measuring the number of beats an individual has in a minute. After obtaining the value from the estimation, it will be used to compare with the VO2Max table that defines an individual's aerobic fitness based on their age, gender and VO2Max value. The table is as following:

WOMEN							
Age (years)	Very poor	Poor	Fair	Average	Good	Very good	Excellent
20-24	< 27	27-31	32-36	37-41	42-46	47-51	>51
25-29	< 26	26-30	31-35	36-40	41-44	45-49	>49
30-34	< 25	25-29	30-33	34-37	38-42	43-46	>46
35-39	< 24	24-27	28-31	32-35	36-40	41-44	>44
40-44	< 22	22-25	26-29	30-33	34-37	38-41	>41
45-49	< 21	21-23	24-27	28-31	32-35	36-38	>38
50-54	< 19	19-22	23-25	26-29	30-32	33-36	>36
55-59	< 18	18-20	21-23	24-27	28-30	31-33	>33
60-65	< 16	16-18	19-21	22-24	25-27	28-30	>30

MEN							
Age (years)	Very poor	Poor	Fair	Average	Good	Very good	Excellent
20-24	< 32	32-37	38-43	44-50	51-56	57-62	>62
25-29	< 31	31-35	36-42	43-48	49-53	54-59	>59
30-34	< 29	29-34	35-40	41-45	46-51	52-56	>56
35-39	< 28	28-32	33-38	39-43	44-48	49-54	>54
40-44	< 26	26-31	32-35	36-41	42-46	47-51	>51
45-49	< 25	25-29	30-34	35-39	40-43	44-48	>48
50-54	< 24	24-27	28-32	33-36	37-41	42-46	>46
55-59	< 22	22-26	27-30	31-34	35-39	40-43	>43
60-65	< 21	21-24	25-28	29-32	33-36	37-40	>40

Table 3.2 VO2Max Table (Stone, 2011)

After all the java files are ready, the next step would be compiling these files and building them into .APK file that will be the executable file that will be sent to Android devices for installation. Not to miss out the compiler that is used in this project, which is Android Studio. Android Studio has been chosen as the Integrated Development Environment (IDE) to be used in this project. All the coding work was done in this IDE throughout the project. Android Studio is the new Android development environment which provides new features and improvement over Eclipse ADT. When compiling the application, it will have to go through a several steps which can be basically summarized into:

1. Generate R.java file
2. Compile the .java files into .class files
3. Converts all the .class files into Dalvik bytecode (all .class files -> single .dex file)_
4. Adds the .dex file into android .apk file

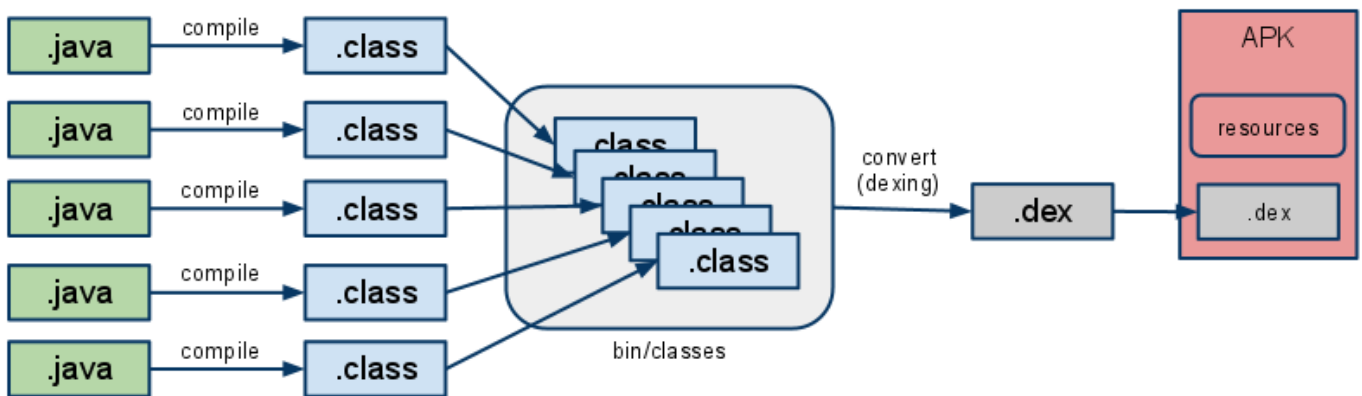To further describe the process, it is illustrated as below:

Figure 3.6 Compiling Android applications (Inazaruk, 2011)

Another illustration on the Android application compilation and the delivery to Android devices is as shown below:
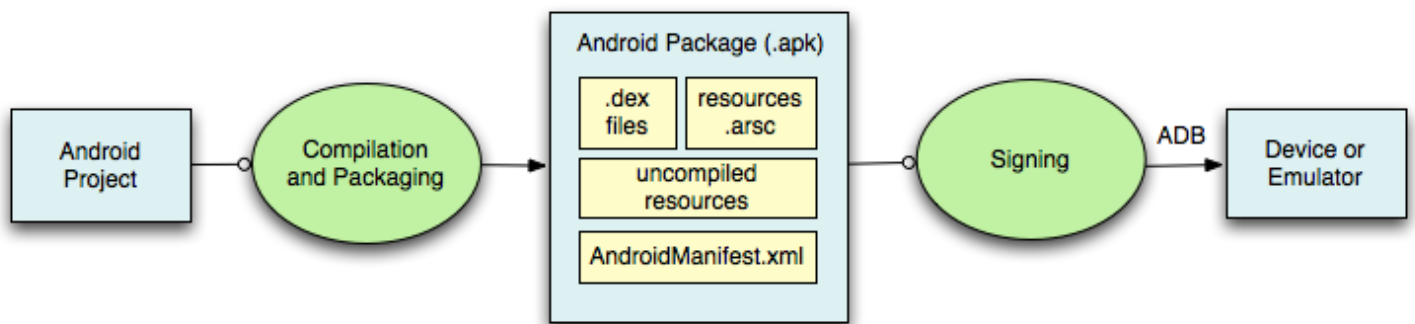

Figure 3.7 Components involved in building and running Android applications (Android Developer, n.d.)

From the illustrations above, it clearly depicts how the entire process of compiling and passing the application to the android devices for execution. There are two methods that have been used in this project to deliver the installation file (.apk file) to my Android devices. The first method is through the Android Debug Bridge (ADB). ADB is used as the medium to connect both the Android device and computer. It allows the compiler to build the application and directly install the application into the device. Using ADB also allow debugging to be done, checking the code from line to line and see changes in variables.

Another method that is used in this project is to obtain the .apk file directly from the compiler build folder and send it over to the device, either through Bluetooth connection or a USB connection. The reason this method is used in the project is because when the application tries to run on other Android device through ADB, it could not connect the device to the computer. The drawback for this method is debugging is not possible because the compiler is not connected directly to the device. The following is the directory to which the .apk file (mobile-debug.apk) can be found. The directory is for Android Studio users.

C:\Users\USER_NAME\AndroidStudioProjects\PROJECT_NAME\mobile\build\outputs\apk

3.4 System Flow

As mentioned earlier, the whole system runs on the Android platform and activities are the fundamental building blocks of the application. These activities can exist in a number of different states such as Created, Started, Paused, Resumed, Stopped and Destroyed. All these states runs within the activity lifecycle. The activity lifecycle begins with an instantiation and ends with destruction. Basically, these states can be distributed into four main groups:

1. **Active or Running**

Activities are considered active or running in the foreground, and it is also known as the top of the activity stack, having the highest priority in the application. Having highest priority means that the activities can only be killed by the OS in situation such that the system is out of memory and cause the user interface to become irresponsive too.

2. **Paused**

The activity is considered in the paused state when it is still visible but has partially hidden by new, or non-full sized activity. Paused activities are considered still 'alive' and maintaining all the state and information it held. It is considered as the second highest priority but it does not receive user input and will not able to execute any codes.

3. **Stopped**
In this state, the activity is completely obscured by other activity and hidden from users. These activities tries to retain as much information as possible but it cannot execute any codes. It has the lowest priority among the three states as such it will kill activities that are in this state to provide necessary memory for the higher priority activities.

4. **Restarted**

It is only considered as restarted state if the application is not run for the first time, that if the user chooses to re-launch the application after it has been killed. After the activity is restarted, it will restore back to its previous saved state and display it to user.
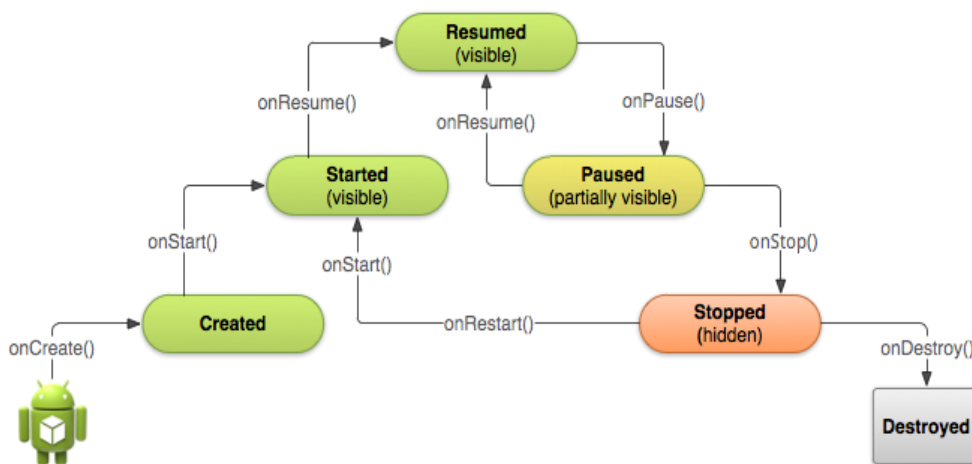
The diagram depicts the states which an activity can go through during its lifetime:

Figure 3.8 Activity Lifecycle of Android

3.5 Use Case Diagram

Figure 3.9 Application Use Case Diagram

3.6 Use case description

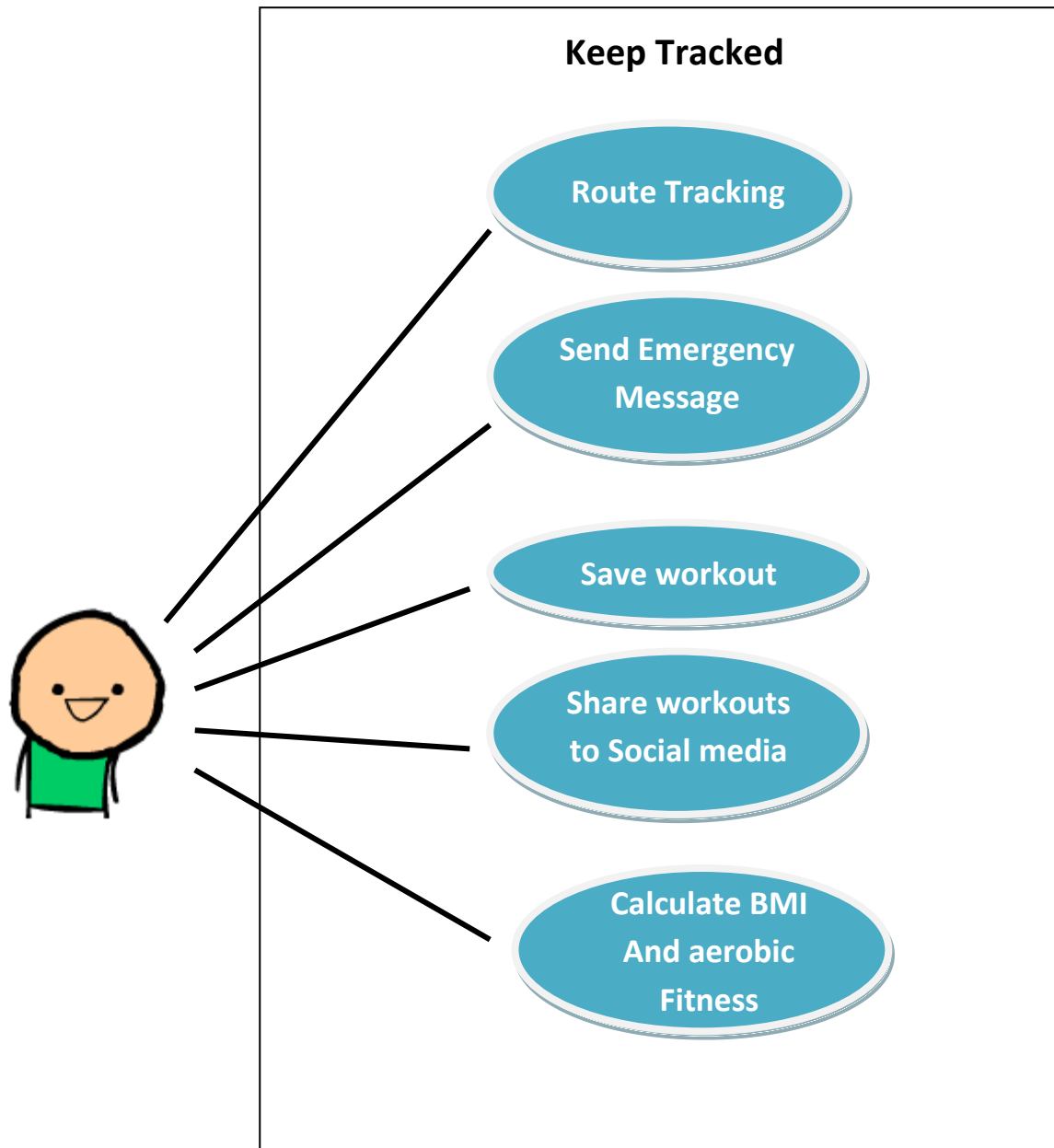| Use Case Name	Route Tracking
Triggering Event	When the user choose the "Workout" choice on the main screen
Brief Description	The application will track user's current location and draw it on the map to show the route that user has run. It also tracks the current speed of the user in km/h along with the distance travelled and calories burned.
Actors	User of the application
Preconditions	The user is preferably to be at outside instead of staying indoor for accurate and stronger GPS signal.
Flow of activity	1. User opens the application. 2. Enters name and press "Workout" 3. Google map starts to find for GPS signal to track current location of the user 4. Google map starts drawing the route on the map according to user's location 5. Use case ends.
Exception Conditions	If the signal is not strong enough, inaccurate reading will occur and polylines drawn on the map will scribble around until it gets a stronger GPS signal.

Use Case Description 1.0 Route Tracking

Use Case Name	Send Emergency Message
Triggering Event	When the user press in the route tracking activity.
Brief Description	It allows user to send out message to the associated person for help. The message sent includes the messages and the location of user.
Actors	User of the application
Preconditions	The user is preferably to be at outside instead of staying indoor for accurate and stronger GPS signal.
Flow of activity	1. User opens the application. 2. Enters name and press "Workout" 3. User press on the icon on top of the Google map 4. User will then be directed to the send message activity. 5. User can save the particular number or change the message before sending out to the recipient. 6. Use case ends.
Exception Conditions	If user's mobile device is out of credit, they will not be able to send out emergency messages.

Use Case Description 1.1 Send Emergency Message

Use Case Name	Save Workout
Triggering Event	When user presses the "Save" button after stop working out.
Brief Description	User can choose to save information of the record such as top speed, distance travelled, calories burnt and the duration of the workout which can be retrieved later on.
Actors	User of the application
Preconditions	-
Flow of activity	1. User opens the application. 2. Enters name and press "Workout" 3. User press "Stop workout" to go to the next activity 4. User will then be shown some information of the workout 5. User can save the particular record by pressing on "Save" button for later retrieval 6. Use case ends.
Exception Conditions	-

Use Case Description 1.2 save workout

Use Case Name	Share workouts to Social media
Triggering Event	When the user press in the record activity.
Brief Description	It allows user to share out their workout activity onto social media such as Facebook, Twitter, and Gmail.
Actors	User of the application
Preconditions	The user must have installed these social media applications beforehand. Internet connection is required for the sharing of the record.
Flow of activity	1. User opens the application. 2. Enters name and press "Workout" 3. Then press on the "Stop workout" button 4. User will then be directed to the Record activity 5. There user can choose to press on the social media icons to share on that particular social media. 6. Use case ends.
Exception Conditions	-

Use Case Description 1.3 Share workouts to Social Media

Use Case Name	Calculate BMI and Aerobic Fitness
Triggering Event	Adjusting the related seek bar in the activity.
Brief Description	It helps user to calculate their BMI value and VO2Max that determines the individual's aerobic fitness. Users will have to input some required information through the available seek bars.
Actors	User of the application
Preconditions	To have a more accurate result, users should have their height and weight measured with other devices.
Flow of activity	1. User opens the application. 2. Enters name and press "Health Calculator" option 3. Swipe between 2 tabs in the activity (BMI calculator by default, swiping to right side brings you to the VO2Max calculator.) 4. User will then adjust the values of required information with the seek bar 5. Results will be displayed directly on the same activity. 6. Use case ends.
Exception Conditions	-

Use Case Description 1.4 Calculate BMI and Aerobic Fitness

Chapter 4: PROPOSED METHOD AND APPROACHES

4.1 Methodology and Tools

Before developing the designs into an actual working system, there are certain steps that are to be taken to ensure that the development process can run smoothly and effectively. As asserted by Radack (n.d.), the most effective way is to put everything into the development process which starts with the ignition, analysis, design, and implementation, and continues through the maintenance and disposal of the system. System Development Life Cycle methodologies are mechanisms that ensure that software system meet the requirements. These methodologies impose various degrees of discipline to the development process with the goal of making the process more efficient (Wolak R., 2011).

Out of all the models, prototype model will be used as the System Development model during the development of the system. It is a method where a model of the system is first build in a simpler manner as the early approximation of the final system, meaning that a simple workable system is built to see the rough function and idea of how the actual system will work. The prototype is built, tested and then reworked as necessary until an acceptable prototype is finally achieved from which the complete system can be then developed (Intelligence on TAP, 2009).

The reason this model is chose because the rough interface and system can be built out in the early stage, giving the developer to have more views on the system in which it might give developers more inspiration and idea to amend the system. Another reason is that this model is actually time and cost saving because the quality of the prototype can be improved from time to time. Early determination of what the users really want can give developer a clearer path when developing the software, without having the need to add functions into a complete system.

In the first phase of the development process which is the planning phase, the requirements of the system are being figured out depending on what the system can do and also what the user needs or in other words, find the scope and objective of the project. Also, have to be taken into account in the next phase, which is the analysis phase; the costs and also time needed for the

project so that the project will have sufficient time to develop. For the proposed system, some studies on what a smart watch can give as the input data are studied, along with which smart watch provides an API for developer to developer software that can be used with the smart watch and mobile devices.

Moving on to the next phase; the design phase is one of the most important phases because it is in this phase that the rough idea how the system would be will be planned here. It describes the features and operations that is needed in details, including the interfaces, business rules, pseudo code and also some other documentation.

The next phase would be the development phase, where the coding work starts here. First thing to do in this phase is to get used to the Platform that will be used to develop the system. For instance, in this system, Android platform will be used to develop the smart watch application. Getting to the next phase after all the coding works are done, developer will then test the software and see if there is any bugs that need to be fixed and also what should be added or changed from the working prototype.

Basically, the testing phase and also the design phase along with the development phase will keep repeating until the system is thought to be completed by the developers or users. Figure below shows how exactly the system development process works using the mentioned methodology.
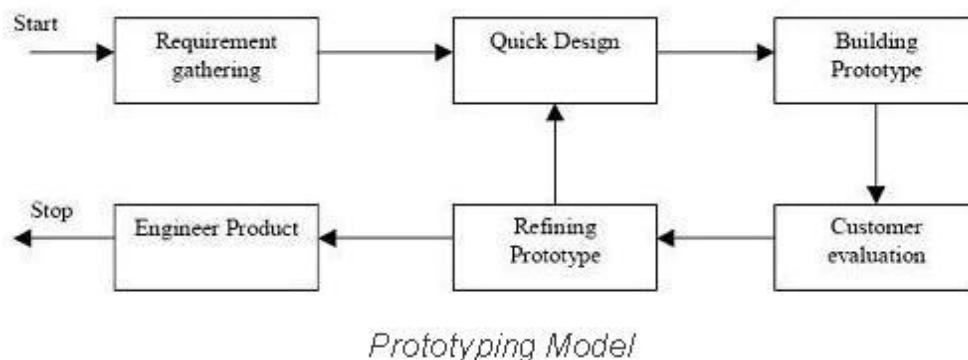
Figure 4.0 Prototyping Model (ISTQB exam certification, 2012)

There are a several tools that are needed in this project which includes both hardware and software. The table below summarizes the tools that will be used to develop the system.

Tools	Description
Android phones	• Android phones running on Android version 4.4 and above (Android Kitkat) • Supports ADB connectivity
Android Studio	• The Integrated Development Environment (IDE) that will be used to develop the application

Table 4.0 Tools used

4.2   Functional Requirements

The system shall be able to provide user with its current location given it has GPS signal and internet connection.

1. The system shall allow users to share the image of the route on the map onto social network such as Facebook, Twitter and Gmail.

2. The system should be able to save the workout record as required by users and able show records to users.

3. The system should be able to calculate user's BMI and VO2Max value with the provided health calculators.

4.3   Verification Plan

In the end of the development of this application, there is a need to verify whether the application works exactly like what it needs. This can be matched with the functionality of the working application with the objectives stated earlier in the document. Also, each activity of the application has to be tested and verified to ensure the input and output of data is as expected.

Objectives:

1. Track the route on Google Map where user has run during his/her jogging session along with information such as distance travelled, speed, duration and calories burnt. It also allows user to share the image of that particular route onto social media such as Facebook and Twitter.

   Verification: The application is able to track user's current and moving location in the Google Map during his/her jogging session and able to display necessary information such as distance travelled, speed, duration and also calories burnt. Users are also able to share their workout route to their social network such as Facebook and Twitter.

2. Send out emergency or inviting message to the contact number assigned in the application. The contact number is assigned by users in the application and the message by default is to ask for help and contains the current location of the user where the recipient can access to view that particular location with GPS application which then guides them there.

   Verification: Users are able to send out emergency message to the contact number they assigned in the application. They are also able to change the message content from the default message which requests for help to the desired one. They are able to change and save the assigned contact number as well, so that next time when user opens the application, they are able to send the message to the same number they saved. The message also by default contains the user's current location placed into an URL where user can access it with their GPS application and Google map.

3. Calculate an individual aerobic fitness by using user's heart rate with the Uth-Sørensen-Overgaard-Pedersen equation (J. Stone, 2011) so that user can know what his/her maximum oxygen intake capacity when exercising is. This equation will be able to calculate the maximum amount of oxygen that a person can utilize during intense or maximal exercise (E. Quinn, 2014) which is called as VO2Max. The value of VO2Max is different from one to another, depending on many factors which includes age and sex. The calculation will be explained in the methodology section.

4. Determine the Body Mass Index (BMI) value of an individual. It is use to determine whether an individual is underweight, healthy weight, overweight or clinically obese. People who are clinically obese have a greater risk of developing diabetes, stroke and cardiovascular diseases.

Verification: The application is able to calculate user's BMI value and also VO2Max which refers to the aerobic fitness of that particular individual. The application is able to display their BMI weight category and also VO2Max category of that individual given they have input the required parameters for the calculation such as height, weight, age and gender.

4.4 Project Plan

4.4.1 Gantt Chart

No	Month	October			November			
	Week	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
1	**Chapter 1**							
2	Motivation and Problem Statement							
3	Project Scope							
4	Project Objectives							
5	Impact, Significance and Contribution							
6	Background Information							
7								
8	**Chapter 2**							
9	Literature Review							
10								
11	**Chapter 3**							
12	Methodologies and General Work Procedures							
13	Tools to Use							
14	System Design/ Overview							
15	Implementation Issues and Challenges							
16	Timeline							
17								
18	**Chapter 4**							
19	Conclusion							
20								
21	**Prototype**							
22	Working with Smartwatch Emulator							
23	Testing and Evaluation							

Figure 4.1 Gantt chart for Project I

No.	Month	January			February				March				April		
	Week	Week1	Week2	Week3	Week4	Week5	Week6	Week7	Week8	Week9	Week10	Week11	Week12	Week13	Week14
1	**Chapter 1**														
2															
3	**Chapter 2**														
4	Facts Finding														
5	Literature research and review of previous work														
6															
7	**Chapter 3**														
8	System Design														
9															
10	**Chapter 4,5**														
11	Methodology and Tools														
12	Requirement														
13	Specification: Analysis and Verification Plan														
14	Implementation and Testing														
15															
16	**Chapter 6**														
	Project Review, Discussions and Conclusion														
	Future Work														

Figure 4.2 Gantt chart for Project II

4.4.2 Hardware Specification

Processor	Intel® Core™ i5 CPU M450 @ 2.40GHz
RAM	4.00 GB
Operating System	Windows 8.1 Pro
Graphic Card	NVIDIA® GeForce® GT 335M
Display	15.6 inch 1366 x 768 pixels
Battery	6-cell Li-ion battery
USB Port	3

Table 4.1 Hardware Specification

4.4.3 Software Specification

The system that is used to develop the application has the hardware specification stated in the table above (Table 4.1). For the application that has been developed, it runs entirely on Android platform and only supports API level 19, which is on Android KitKat. Devices with Android API level below that might not be functioning well for some functions due to support issues. The compiler that is used to develop the Android application will be the Android Studio.

Chapter 5: IMPLEMENTATION AND TESTING

5.1   Test Design

5.1.1   Features to be tested

The following is the table that contains the function ID and its corresponding functions and estimated risk level.

Function ID	Functions	Risk level
F001	Input Verification – Phone Number (Send Message)	High

5.1.2 Approach Refinements

Test cases for the system will be designed using five techniques which are covered in this section. Techniques are applied based on suitability of techniques according to nature of feature.

The techniques that will be applied are as follows:
➢ Equivalence Partitioning
➢ Boundary Value Analysis
➢ Decision Table Testing
➢ Use Case Testing

Nature of feature as below:

- F001 Input Verification – After keying in phone number, user checks the message and prepare to send out to that particular contact number or save the number.

5.1.3 F001 Input Verification

Four techniques are identified for designing test for this function, including:

➢ Equivalence Partitioning

➢ Boundary Value Analysis

➢ Decision Table Testing

➢ Use Case Testing

The following is the equivalence partitioning testing for the input of F001.

1. Equivalence Partitioning

```
0                          10              10                      15
        Invalid                  Valid              Invalid
|←— Phone Number < 10 digits —→|←— Phone Number = 10 digits —→|←— Phone Number > 10 digits —→|
```
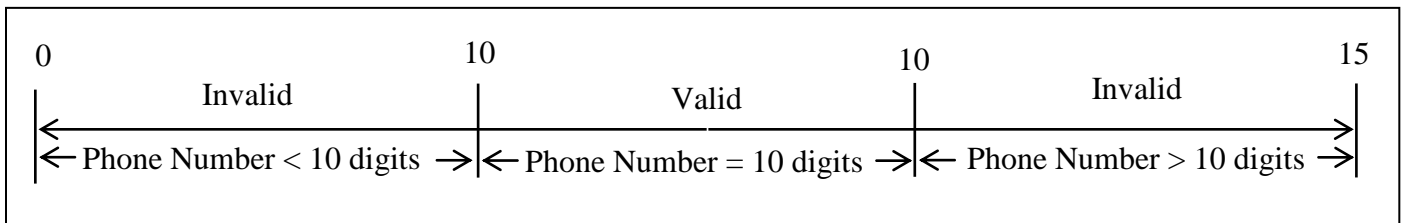
Figure 5.0 Phone Number Equivalence Partitions

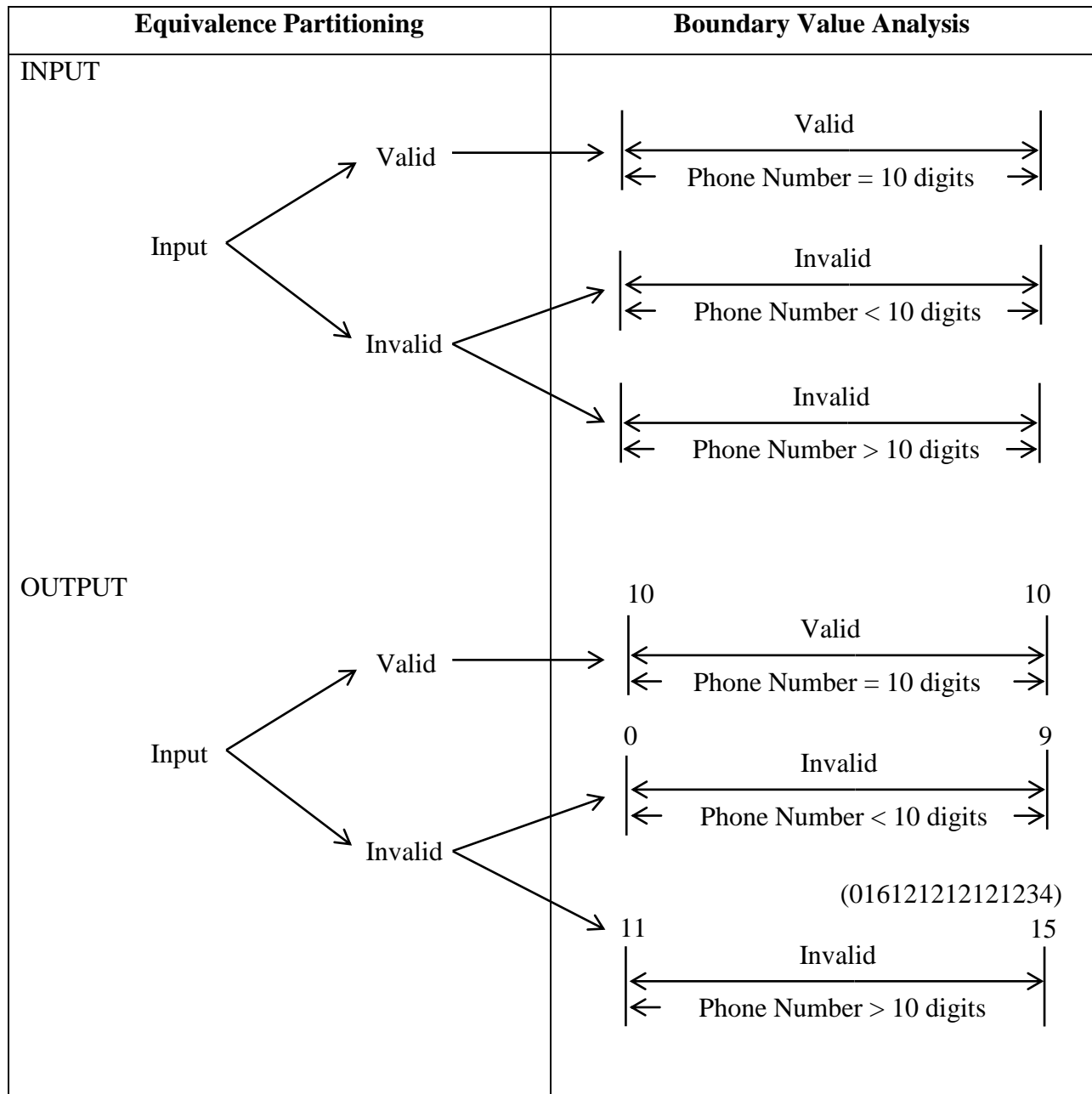| Equivalence Partitioning	Boundary Value Analysis
INPUT	

Figure 5.1 Phone Number Equivalence Partition and Boundary Value Analysis

No.	Test Condition	Test Coverage	Example of Test Data
1	0 <=Phone Num.< 10 digits	0<=Phone Num. < 10 digits (Invalid)	0 digits
2	Phone Num. = 10 digits	Phone Num. = 10 digits (Valid)	0140000123
3	10 < Phone Num. >=15 digits	10 < Phone Num. >= 15 digits (Invalid)	123456789
4	Valid Phone Num.	Valid Phone Num. (Valid output)	0140000123
5	Invalid Phone. Num.	Invalid Phone Num. (Invalid Output)	-

Table 5.0 Phone Number Equivalence Partitioning Test Conditions and Coverage
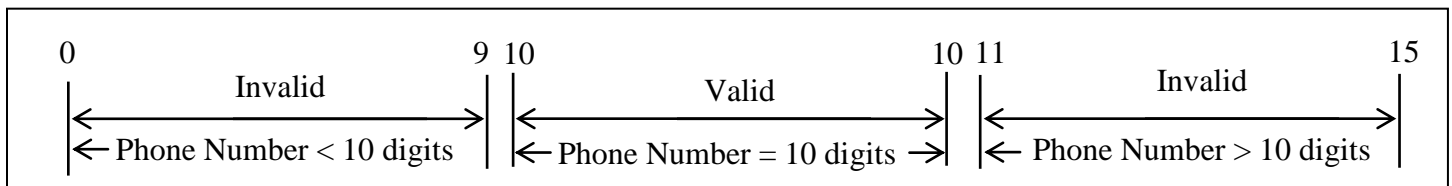
2. Boundary Value Analysis

Figure 5.2 Phone Number Boundary Value Analysis

EP1: 0 <= Phone Number <= 9 digits
EP2: Phone Number = 10 digits
EP3: 11<= Account Number <= 15 digits

No.	Test Condition	Test Coverage	Example of Test Data
1	Phone Num.= 0 digit	Phone Num.= 0 digits (Invalid)	No input
2	Phone Num. = 8 digits	Phone Num. = 8 digits (Invalid)	12345678
3	Phone Num. = 10 digits	Phone Num. = 10 digits (Valid)	0143094980
4	Phone Num. = 11 digits	Phone Num. = 11 digits (Invalid)	01430949801
5	Phone Num. = 15 digits	Phone Num. = 15 digits (Invalid)	014309498012345
6	Valid Phone Num.	Valid Phone Num. (Valid output)	0143094980
7	Invalid Phone Num.	Invalid Phone Num. (Invalid output)	-

Table 5.1 Phone Number Boundary Value Analysis Test Conditions and Coverage

3. Decision Table Testing

Test Condition ID	Test Condition
TCON-01-01	Valid input of phone number
TCON-01-02	Invalid input of phone number
TCON-01-03	Display error message, "Invalid Phone Number!"
TCON-01-04	Try again
TCON-01-05	Send message / Save phone number

Table 5.2 Input Verification Decision Table Test Conditions

Condition	TCOV-01-01	TCOV-01-02
Valid input of phone number	Y	N
Invalid input of phone number	N	Y
Output		
Display error message, "Invalid Phone Number!"	N	Y
Try again	N	Y
Send message / Save phone number	Y	N

Table 5.3 Input Verification Decision Table

4. Use Case Testing

Use Case ID	UC001	
Use Case	F001 Input Verification	
Purpose	To allow user to send message / save contact number	
Actor	User	
Trigger	User pick the "Send Message" function in the program	
Precondition	The application must be executed	
Scenario Name	**Step**	**Action**
Main Flow	1	User picks the function in the program.
	2	Application needs user to fill in the contact number
	3	User inputs the valid phone number.
	4	System checks the phone number.
	5	Application allow user to send message to that particular phone number / save the phone number
	6	Message is sent/ phone number saved.
	7	User ends session.
Alternate Flow – Invalid Account Number	1.1	User key in invalid phone number.
	1.2	System displays error message "Invalid Phone Number!".
	1.3	Back to Main Flow step 2.

Table 5.4 Input Verification Use Case Testing

5.1.4 Use Case Testing for System functions.

1. Route Tracking

Use Case ID	UC002	
Use Case	Route Tracking	
Purpose	To track user's current location and draw the route on map	
Actor	User	
Trigger	User pick the "WORKOUT" function in the program	
Precondition	The application must be executed. GPS signal must be turned on beforehand and prevent going indoor locations.	
Scenario Name	**Step**	**Action**
Main Flow	1	User picks the function in the program.
	2	User waits for the GPS signal until available
	3	User starts jogging
	4	System will track user's location
	5	System draws polyline on route which user has run
	6	User ends session.
Alternate Flow –	-	-

Table 5.5 Route Tracking Use Case Testing

2. Send Emergency message

Use Case ID	UC003	
Use Case	Send Emergency Message	
Purpose	Allow user to send out emergency message when necessary.	
Actor	User	
Trigger	User press on send message icon.	
Precondition	The device must have enough credit to send out message. There is coverage for mobile network.	
Scenario Name	**Step**	**Action**
Main Flow	1	User picks the function in the program.
	2	User insert phone number or use the last saved phone number.
	3	User chooses whether to edit the message content or not.
	4	Send message out.
	5	System sends the message to the assigned number.
	6	User ends session.
Alternate Flow – Invalid Phone Number	1.1	User key in invalid phone number
	1.2	System displays "Invalid Phone Number!"
	1.3	Back to Main flow step 2

Table 5.6 Send Emergency Message Use Case Testing

3. Save Workout

Use Case ID	UC004	
Use Case	Save Workout	
Purpose	Allow user to save their workouts.	
Actor	User	
Trigger	User presses on save button after finish working out.	
Precondition	-	
Scenario Name	**Step**	**Action**
Main Flow	1	User goes to workout
	2	User stop working out
	3	System will display workout information
	4	User saves workout
	5	System will save the workout information and store into database.
	6	User ends session.
Alternate Flow	-	-

Table 5.7 Save Workout Use Case Testing

4. Share workout to Social Network

Use Case ID	UC005	
Use Case	Share workout to Social Network	
Purpose	Allow user to share workout to Social Network.	
Actor	User	
Trigger	User press on Social networks icon and share.	
Precondition	The device must be connected to the Internet or can have access to the Social Network.	
Scenario Name	**Step**	**Action**
Main Flow	1	User picks the function in the program..
	2	Workout as usual.
	3	User stops working out.
	4	System will display workout information.
	5	User chooses to share the workout to its desired social network by pressing on the icons on the screen.
	6	User ends session.
Alternate Flow	1.1	User key in invalid phone number

Table 5.8 Share workout on Social Network Use Case Testing

5. Calculate BMI and aerobic fitness

Use Case ID	UC006	
Use Case	Calculate BMI and aerobic fitness	
Purpose	Allow user to calculate their BMI value and aerobic fitness.	
Actor	User	
Trigger	User presses on health calculator button	
Precondition	-	
Scenario Name	**Step**	**Action**
Main Flow	1	User goes into the health calculator
	2	User chooses between BMI calculator and VO2Max calculator
	3	User input information required with a seek bar available.
	4	System will process the data and generate the output
	5	System display the result/output onto the screen
	6	User ends session.
Alternate Flow	-	-

Table 5.9 Calculate BMI and aerobic fitness Use Case Testing

Chapter 6: CONCLUSION

6.1 Conclusion

In this project, the deliverable which is an application for the handheld device that works as a Health and Fitness application. The main function of the application is to keep track of user's workout and also allow users to send out emergency message if they are not feeling well and knowing that they are going to break down in the next moment. This could be able to save an individual's life if there is no one nearby the area, external help is definitely useful.

Clearly, the system aimed to help people which are keen to exercise but do not know where their capacity is. This application allows them to measure their fitness level and also aerobic capacity so that they can know where they should improve and that they will not over exercise. Also, the application will be able to keep track the user's workout record such as when he/she had went for a jog along with necessary information such as duration, distance travelled, top speed and also calories burnt in that particular workout. Users can use these records to see if they have improved from the previous workout.

Nonetheless, there are still some limitation and weaknesses in the system. Firstly, it might not be so efficient in term of power consumption because to get the exact location of the user, it needs to use the GPS in the device, mobile network and also internet connection in order to get a more accurate reading. Besides, as compare to other health and fitness application out there, there are still many functions are not available in the application such as music player, sharing URL of route jogged to social network, having its own network of users that can connect to each other and many more. However, basic functions are able to be provided in this project and the inability to provide the other functions are due to time constraints. It can surely be improved in the future.

As a conclusion, the system will definitely be able to help a person to exercise more effectively and also allow them to exercise with less worry because if anything comes up, emergency messages can be sent out together with the required information for further help.

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HEALTH MONITORING SYSTEM

BY

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1 A REPORT

SUBMITTED TO

Universiti Tunku Abdul Rahman

in partial fulfillment of the requirements

for the degree of

BACHELOR OF COMPUTER SCIENCE (HONS)

Faculty of Information and Communication Technology

(Perak Campus)