DEVELOPMENT OF PHYSICAL AND MENTAL HEALTHCARE APPLICATION

BY

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APPLICATION

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It is hereby certified that <u>Grace Lai Meng Huey</u> (ID No: <u>20ACB01861</u>) has completed this final year project entitled "<u>Development of Physical and Mental Healthcare Application</u>" under the supervision of <u>Ts Dr Chai Meei Tyng</u> (Supervisor) from the Department of <u>Computer Science</u>, Faculty of <u>Information and Communication Technology</u>, and <u>Mr Tan Chiang Kang @ Thang Chiang Kang</u> (Co-Supervisor) from the Department of <u>Computer Science</u>, Faculty of <u>Information and Communication Technology</u>.

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DECLARATION OF ORIGINALITY

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ABSTRACT

In this society, everyone may put less effort into maintaining their physical and mental health as their daily workload is increasing. They may not have such time to take care of their wellness and even worse that they ignore their own health. Some chronic diseases such as obesity and stroke as well as mental problems such as depression and anxiety keep increasing in these years due to poor nutrition, physical inactivity and staying in this stressful environment. However, there are only a few existing applications supporting both these aspects of health. Therefore, the project aims to develop mobile applications that integrates physical and mental health services to improve overall well-being. In order to meet the aim, this project is developed with two objectives which are to develop a mobile application that provides suitable workout and meal plan based on their information and goals and to propose an automatic mood detection to recognise user's emotion correctly. A user-friendly interface is developed in the application to ease the users to use the application. This project uses deep learning to propose automatic mood detection using a camera or photo from gallery and also use API call for creation of workout and dataset for creation of meal plan. These plans help to track calorie intake to ensure users maintain within the targeted number of calories that users can consume daily. The result captured from the mood detection will be tracked to study the patterns of the users over time. Other than that, the application will also include reminders to remind users to do something. In summary, the development of this physical and mental healthcare application improves people's health outcomes as it provides convenience and support in all aspects of health.

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LIST OF ABBREVIATIONS

API   Application Programming Interface

BMI   Body Mass Index

BMR   Basal MetabolicRate

CNN   Convolutional Neural Networks

COVID-19   Coronavirus Disease 2019

DBMS   Database Management System

FER 2013   Facial Emotion Recognition 2013

IDE   Integrated development environment

Chapter 1

Introduction

In introduction, we describe the background information, problem statement and motivation of our project, contributions and the outline of the thesis.

1.1   Background Information

Society depends on the physical and mental health outcomes and people will obtain a great impact based on their health. The rise in chronic illnesses such as heart disease and obesity has become a serious problem in recent years. Mental health conditions such as depression and stress also negatively affect people's quality of life. It can be caused by unhealthy diets, lack of physical activity, excessive use of alcohol and others. Therefore, a mobile application with both physical and mental healthcare is essential and useful for those who need it.

Furthermore, there is a need to create a digital platform that provides recommended physical and mental healthcare services. As seen in [1], the use of mHealth application, which is a mobile healthcare app, increases during the Coronavirus Disease 2019 (COVID-19) pandemic. To reduce the infection transmission, it promoted greater utilization of this type of healthcare mobile application for users to track their daily routine to regularly check for their health condition. Therefore, people staying in the house can use this plan to have some suitable workout and meal based on their data to achieve the goals and improve their health.

Despite the importance of physical and mental health, many people may face some obstacles to accessing healthcare services. For example, people may not be able to pay for the cost of healthcare services and time constraints can make it difficult for people to prioritise their physical and mental health [2]. A physical and mental healthcare that provides tracking of workout, meal and mood may help to reduce the cost of the healthcare. Thus, mood tracking is required to have accurate expressions of a person by introducing an automatic mood detection so that we can get the correct result. It tracks and determines the pattern of the data over time so that users can know their physical and mental condition.

This project studies on the topic of development of physical and mental healthcare mobile application. With the growing awareness of the interconnections between physical health and mental health, physical and mental healthcare is now highly focused and emphasised

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by people to maintain their healthy lifestyle. Studies [3], [4] have shown that physical activities can improve mental health in the way of reducing depression and anxiety as well as improving mood. On the other hand, poor physical health will lead to poor mental health, unintentionally affecting people's overall well-being negatively.

In this study, the physical and mental healthcare application will include the features such as suitable workout and meal plans and automatic mood detection using a camera or photo from gallery. Users can have a more accurate tracking of their progress and thus lead to improvement of their well-being. Reminders for medication and appointments are also offered to keep track of their health.

Overall, the development of the physical and mental healthcare application provides users the tool to keep track of their physical and mental health. It brings a comprehensive solution that promotes health conditions. It also gives convenience to those who are looking to improve their health to track their health.

1.1.1 Important Key Terms

Physical Fitness: The state of being physically healthy.

Mental Health: The emotional, psychological, and social well-being of an individual.

Wellness: The state of being in good health, both physically and mentally.

Health Tracking: The monitoring and recording of health-related data.

1.2 Problem Statement and Motivation

Nowadays, people not only care about their physical health but also start to concern themselves with their mental health in their stressful lives. As stated by World Health Organization (WHO) in [5], no matter what age group, regions and countries a person belongs to, everyone is vulnerable to risk factors that may lead to chronic diseases. Hence, comprehensive solutions to deal with physical and mental health needs are increasing. However, some of the existing healthcare applications only support for normal workout and meal plans to optimise their health and wellness which may not be suitable for every user to use the same plan as different people will have different preferences and goals. Chronic illnesses keep increasing these years particularly due to people in this current society having unhealthy diets, excessive alcohol and

tobacco use and lacking physical activities. Finding a suitable workout and meal plan is essential for everyone to increase effectiveness [6].

In fact, most of the health applications do not integrate physical healthcare services with mental healthcare services. A study [7] states that physical health has a potential and significant impact on mental health and vice versa. Physical and mental health services are closely interconnected to determine the health condition. This app aims to provide a convenient way for those who are busy with work to just use both the physical and mental healthcare functions in one application. It can help to track their daily physical activities, diets and also mental health to take care of their own health. Physical activities can improve mood as well as poor health condition may lead to depression and anxiety [3], [4].

Besides, healthcare applications that track the user's mood may be incorrect or insufficient to express the user's emotion by just using a limited amount of emojis. It is hard to determine their emotions if using this quick way to track the mood. Bias in reporting by users themselves leads to incomplete or inaccurate data. It may affect the correctness of the result for the determination of the user's health condition when analysing with other health indicators. Therefore, this app aims to provide an automatic mood detection to log and track their emotions daily. Mental health disorders are growing worse over time as stressful life events, environmental changes and others may affect their mental health. For example, during COVID-19 pandemic, global prevalence of depression and anxiety have risen by about 25%, stated by WHO [8] as most of them worry about being infected by the virus and the loss of income needed for their daily lives. It is needed for people to track their daily emotions so that they are able to discover any mental disorder. Using a limited amount of emojis is hard for people to recognise their specific emotional states. This is because it does not capture exactly the emotions and hence may cause any incorrect result.

1.3 Objectives

This project aims to provide a mobile application that integrates physical and mental health services. This application gives users a more comprehensive healthcare experience to improve health outcomes which helps to manage both physical and emotional health needs. Convenience is given to users to access both physical and mental healthcare services in one single application. Physical healthcare that is provided in the application is related to fitness

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and dieting. Mental healthcare such as mood tracking and enabling some reminders to users is also being implemented in the application to prevent users from getting depression and anxiety as well as ensure them to concentrate on their work with a reminder alerting them. Based on this aim, the thesis seeks the following objectives.

1) To develop a mobile application that provides recommended workout and meal plan based on their information and goals.

This application creates plans that provide guidance on fitness and nutrition. A recommended plan is created using user data by getting the exercises examples and meal examples from API. It is more attractive and effective for users to hit their targeted goals as well as the targeted muscle they want to get stronger. A variety of workouts and meals gains the user's interest so that they will stick to their plans. They can track their progress, motivating users to continue reaching their goals. Users may likely accomplish the goals as the plan given fits their needs and it is achievable by them. Inadvertently, the workout and meal plan can encourage users to form healthy habits with better choices on their daily workouts and diets even after they have achieved their goals. Therefore, a suitable plan is needed to promote physical and mental healthcare.

2) To propose an automatic mood detection to recognise user's emotion correctly.

Deep learning is used to implement this automatic mood recognition using a camera or photo from gallery by training a model to detect the mood. It helps to promote mental health as users may become more aware of their emotions using this tool to detect their mood correctly. It tracks the user's mood which at the same time, gives help for those who are having mood disorders but facing difficulties getting mental health services due to some personal issues. It improves the accuracy and reliability of mood tracking using deep learning as there is no bias on recognition of emotions.

1.4 Project Scope

The project scope is to develop an application that can improve physical and mental health. People who do not have such time or money may hope to have an application that can improve their wellness. There are a lot of physical healthcare mobile applications and mental healthcare mobile applications available in the current market. However, a limited number of mobile applications containing both physical and mental healthcare services can be found. Therefore, this project proposes a mobile app that includes integration of physical and mental healthcare in one single application. In the application, users will be provided with suggestions for workouts and meals and tracking their workouts and meals, mood tracking and also reminders.

Additionally, normal workout and meal plans provided in some health applications may not be suitable for everyone. When people think that the plan will not give any improvements for their health, they may start to quit the application and it may lead to health problems. Therefore, this project also includes an implementation of recommended workout and meal plans that suit the user's needs and goals. Collecting a user's targeted muscles that they hope to train, and their goals is the initial step of using the application so that a suggested plan can be created based on this data. Then, we get two API to retrieve the exercises examples and meal examples to find out which exercises are suitable for the user to maximise their advantages based on their data. It also offers tracking on these both plans.

This project develops a mobile application that implements automatic mood detection using a camera or photo from gallery so that users can have an accurate determination of their emotions. Firstly, we get the dataset that is to be included in the trained model. After that, we use the collected dataset to train a deep learning model and deploy to the application. After logging the mood, it will enable users to track their mood and receive feedback based on their emotional state so that they will realise their conditions.

1.5 Impact, Significance and Contribution

This project proposes a mobile application that contains integration of physical and mental healthcare which is unique and less available in the current market. The integration of physical activity and mental health tracking ensures people pay attention to their daily intake, physical activity and emotion so that they are able to improve their overall health and well-being. A

mobile application with these functions may give convenience to people without seeking these both types of healthcare services by switching between two different apps.

Moreover, this project contributes to a range of health and wellness outcomes by including support for users which suggests users for their recommended workout and meal plan to hit their targets. It is designed to improve health outcomes and have a greater sense of overall well-being. A suitable workout and meal plan based on user data is created due to the increased effectiveness of hitting their goals when compared to a one-size-fits-all approach. The suitable coaching for nutrition and exercise makes users stay engaged in their journey for good wellness. Users can have better nutrition which improves the management of health conditions such as diabetes using recommended meal plan while the workout gives users a better physical health condition. Reminders are also given in the application to ensure users get useful help to improve their health.

Furthermore, this project also contributes to mental healthcare by providing automatic mood detection using a camera or photo from gallery. Using a camera to take a photo of the user or taking photo from gallery can get the details of the facial expressions to receive correct data and information for analysis. The correctness for determination of mental states of users increases as there is no bias in logging the user's mood. It helps in early detection of mental health issues by tracking the pattern of their mood over time and thus avoid any delay in seeking medical attention to control the condition. The earlier the user goes for treatment, the higher the chance of recovery. It can help to improve health and also the quality of life for individuals by detecting and removing any mental health disorders like depression.

1.6   Report Organisation

The flow of this project is shown in the following chapters. First chapter is focusing on the problem statement, motivation, objectives, project scope, impact, significance and contribution. In Chapter 2, some related backgrounds are reviewed on this field of health-related mobile applications in the current market. Strengths and weaknesses of the applications are concluded in the table. Besides, in Chapter 3, the system development methodology is illustrated and the system design diagram as well as equations used. Then, Chapter 4 reports the system design of the developed mobile application. For example, system flowchart, system components specifications and system component's functionalities with a timeline chart.

Chapter 5 gives the system implementation along with hardware setup and software setup as well as system operation. Chapter 6 reports the system evaluation and result as well as the project challenges. Furthermore, Chapter 7 reports the summary of the project with the recommendations to improve the application.

Chapter 2

Literature Review

2.1 Existing Health Applications

There are a lot of available physical healthcare and mental healthcare applications in the market. MyFitnessPal [9], Lifesum [10], 7M Workout and 30 Day Fitness Challenge [11] are chosen to be reviewed as these apps are considered as physical healthcare applications. MyFitnessPal and Lifesum are both calorie tracking apps by logging user's meals to hit their fitness goals [12]. 30 Day Fitness Challenge and 7M Workout are both workout apps that provide daily exercises to users. On the other hand, MyTherapy [13], Medisafe [14], DailyBean and Daylio [15] which are mental healthcare applications, are being reviewed to understand the possible mental healthcare features. MyTherapy and Medisafe provide medication management that will track and give a reminder to users [16] while DailyBean and Daylio are both mental healthcare apps, logging the user's mood and tracking their patterns over time [17].

2.1.1 MyFitnessPal

MyFitnessPal is a health and fitness application that keeps track of diet, exercise and weight loss. It is a free health app to provide basic features in which a premium subscription to MyFitnessPal will provide users with additional features [18].

To use the app, it needs users to fill in some of the requirements. It allows users to select their targeted goal whether they wish to gain weight, maintain weight or lose weight so that users are able to customise their app experience. Therefore, users are also required to give their current weight, height and activity level for finding the most suitable number of calories that they can consume each day.

In [12, 18, 19], MyFitnessPal app provides calorie tracking features to monitor their diets. Number of calories that could be taken by users each day is calculated and specified. It tracks the calories in foods eaten by users but also the calories burned. The remaining number of calories will be shown to let users know that they still can consume how many calories so

that they will not overtake. In the premium features of this app, it also tracks protein, carbs and fat so that they can have a balanced diet.

Moreover, in [12], logging food throughout the day is offered using a barcode scanner or searching in a database for the food. Each food will be stated with the calorie and nutrient information so that users will not over consume the number of calories that can be taken. When adding food into the food diary, users can adjust the serving size and number of servings. However, if the food cannot be searched from the database, users may add the desired food that they wish to add to their own individual database. Users may enter the food name and nutrients accurately for easily tracking.

With the help of physical activities, users are not just controlling their diet to hit their goals. Hence, users can carry out some activities and track exercises using the app to mark down how many calories are burned from the activity [12, 18, 19]. If users find that the calories burned from exercise are different from the feedback of the cardio machine in the gym room, users can manually change the number of calories. Users can also enter the time for a cardio exercise, or the number of sets, reps and weight for an exercise. A report in excel format file can be generated to represent user's progress, meal level nutrition and exercise history. Figure 2.1 shows the section that include calorie tracking, food logging and workout tracking in this application.
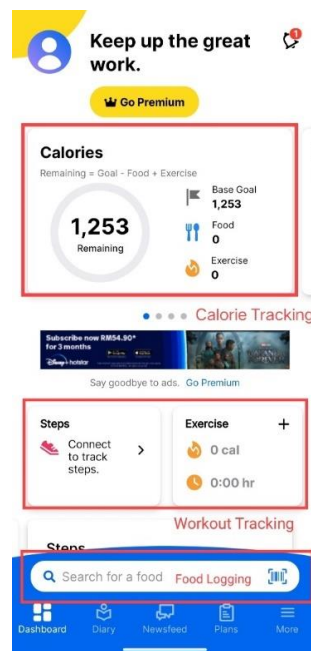
Figure 2.1 Dashboard section of MyFitnessPal app.

In addition, users can record their weight daily so that users can know whether they are working towards the goal in the right path. It will produce users a graph to show the weight changes over time for easy analysis.

Lastly, it offers a water consumption log to track user's drinks to help users stay hydrated [20]. If users set customisation to the daily water intake goal, the app will automatically give the minimum amount of water the user should drink. Users can choose the given amount of water or manually set the number of drinks in milliliter to add and track the water consumption. A reminder is used to ensure that users drink water regularly.

2.1.2   Lifesum

Lifesum is a food and exercise tracking app to help users to meet their goal to enjoy a healthy and balanced lifestyle. Users need to enter their personal data such as gender, age, weight and height and fitness goal when they are signing up to start their food and exercise journaling. It provides personalised plan that includes level of nutritional, workout habits and dietary needs with recommended amounts.

Lifesum tracks the calorie of food taken by users and creates a personalised meal plan [12] to users so that the user can get the insights to make healthier choices. The plan is created by calculating the calorie goal according to their own personal information entered and goal chosen. The plan contains all the requirements that the user must done daily in order to meet their goals. A well-planned number of calories that the user should take for a meal will be recommended by the app to prevent users from overtaking. A plenty of personalised meal plans can be selected by users to support dietary needs and restrictions such as allergies or any preferences. A simple overview of daily goals enables users to see more clearly on the amount of the calories which have been taken, burned and the remaining amount that can be taken [21]. Also, the gram of carbohydrates, protein and fat that the user has taken will be calculated according to the food on each meal and shows the user how many left he or she can consume.

Users can log food easily using a food database. On the other hand, if users hope to add a packaged food, they can just scan its barcode to find the item [21]. Users can see the food name, descriptions, the calories and portion size once they search for a food. For perfect matching the amount of food that users consume, it enables users to adjust the portion size. Adding custom food items could be used if the food item searched by users is not available.

When the number of calories for a meal exceeds or is equal to the specified amount, Lifesum will tell the users about it so that they can be aware of it. Users have the option to add the food item that users always eat as favourites and can be chosen quickly from a special list.

Lifesum offers a water consumption log feature to let users record the number of glasses they take within one day. Users are allowed to set water intake goals based on their weight, activity level and others. If users do not get enough drinks, it will remind users to stay on track on their water intake goals. Recommendations are given to users based on the water consumption data. Figure 2.2 is the section that contains calorie and food tracking and drink logging.
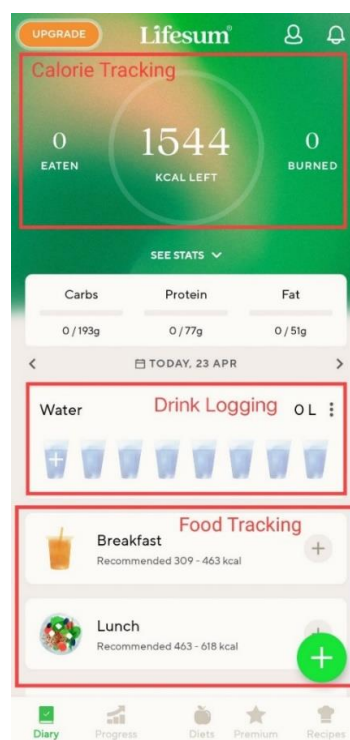
Figure 2.2 Diary section of Lifesum app.

Furthermore, it tracks exercises that are carried out by users [21]. Users could manually add their physical activity or link a compatible app to record the user's workout. Logging more details to the workout such as duration and intensity is more advised to do so. At the same time, it helps users to find out their own healthy habits as well as their progress towards their goals over time. Recommendations also will be given to users so that they can have more new kinds of exercises to keep their workout interesting.

2.1.3   7M Workout

7M Workout gives several categories of workouts to users such as beginner, classic, abs, sweat, Tabata and complete [22]. Figure 2.3 is the workout section that has these categories of exercise. All these workouts will have the same duration of work, but different numbers of calories are burnt as the level of the training workouts is different. Inside each workout, several exercises will be included. Users can see details of each exercise with description and even it uses YouTube integration to use video demonstrations so that users are performing and using the correct technique. When doing exercise, audio guidance is given to countdown the time without having users to look at the screen [23]. Users can skip or pause the exercise in case that they feel tired and have no energy to continue the exercise. Also, users can adjust the workout length based on their fitness level.
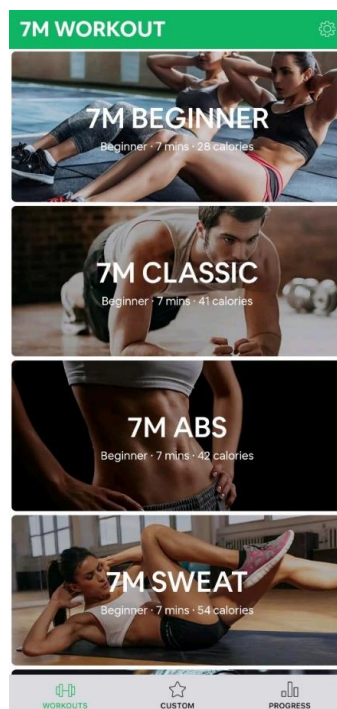
Figure 2.3 Workout section of 7M Workout app.

Additionally, it allows users to choose from a lot of workouts to build a custom workout based on their fitness goals [23]. Users need to pick three total body exercises, three lower body exercises, three upper body exercises and three core exercises. After that, they also can specify the number of times their workout will be repeated which is known as cycle. The time duration between two exercises can be set by users whether they wish to rest for 5 seconds, 10 seconds,

or 15 seconds. 7M Workout calculates the amount of time for the workout and the number of calories that can be burnt through this workout.

Moreover, the app helps to track the user's workout progress over time. Users can view the days they have done the workouts on a calendar [23] as well as the total number of workouts that have been done, total time duration and the total number of calories burnt. They also can view their current streak and best streak.

On the other hand, 7M Workout tracks weight by receiving weight and height input from the user to calculate his or her body mass index (BMI). In this app, there are only 4 groups to represent the BMI, which is underweight, healthy weight and overweight. The changes of weight over time are represented visually in graphs. Users can make a selection whether to view the graph in the form of week, month, year, or view all. It helps users to have a clear look on the graph.

Finally, 7M Workout also offers the reminder features to schedule reminders for their workouts. The reminder should be set with specific times and days so that they will not miss their workout. Users can set different reminders to different workouts so that they will not feel confused when they want to delete one of the reminders for the specific workout.

2.1.4   30 Day Fitness Challenge

Signing up for 30 Day Fitness Challenge app requires users to answer some questions about the goals, fitness level, gender, target muscle groups. This information will further lead to a personalised workout plan to the user so that the user can get the more effective plan to work towards goals [24].

30 Day Fitness Challenge app provides users a weekly meal plan for 30 days. It outlines all the foods for each meal every day. In the meal plan, there are a total of 4 meals such as breakfast, snack, lunch and dinner as well as two types of meal plan that is standard diet and vegetarian diet. Figure 2.4 shows that it also gives users the shopping list for every week in order to buy to make their daily meal [24]. After users have brought some ingredients, users need to tick the small box so that they will not forget which one has been brought. Once the user follows and finishes having their meals according to the plan, they are required to record it in the app.
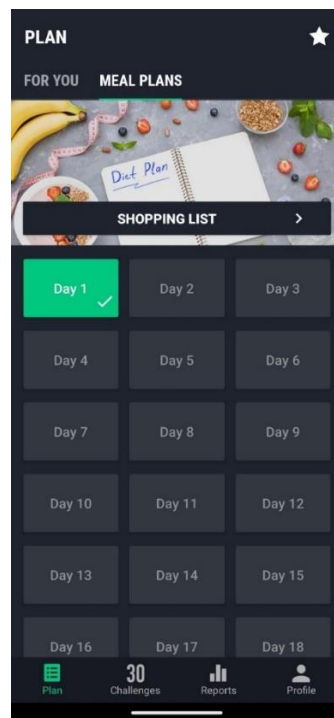
Figure 2.4 Plan section of 30 Day Fitness Challenge app.

In addition, 30 Day Fitness Challenge app provides a 30-day challenge program in which these challenges can come from different categories. Inside each challenge, it is separated into different levels which are easy, medium and hard levels. Users can pick the challenge to work it out. Users can carry out the exercise using a detailed description with animations showing the movements and also an audio guidance. Users have the options to skip or pause the exercise if they wish to stop for a while or stop the whole exercise.

Moreover, user can track daily workouts [11]. It also tracks the body measurements. There is a calendar showing the days that the user has done the workout. Under the calendar, there is a tab displaying the number of completed workouts, the number of calories burnt and the total duration of all the workouts. Users can further add their weight each day to make a record and the weight changes will be displayed in the form of a graph. With their weights recorded over time, it also helps to determine the highest and lowest weight of the user. It enables users to easily see the weight changes. 30 Day Fitness Challenge app also offers the BMI services. It helps users to determine whether they are severely underweight, underweight, healthy weight, overweight, moderately obese or very obese.

Finally, users can set a reminder to send a notification to themselves so that they will not miss out any workout or any meal any day and any time. Users have to set the day and time first when they want to get the reminder.

2.1.5 MyTherapy

MyTherapy acts as a medication reminder to prevent missed doses. It ensures that users will get the reminder to take their medicines on time especially for those medications that need to be consumed at specific time and even specific doses. They are free to set the reminder times, frequency and dosage to suit their needs and medication schedule. MyTherapy will alert users to refill a prescription when it is getting less [16]. At the same time, after taking the medicine, it will track their own progress over time showing the time that users take it. Figure 2.5 shows the medication section of this application.
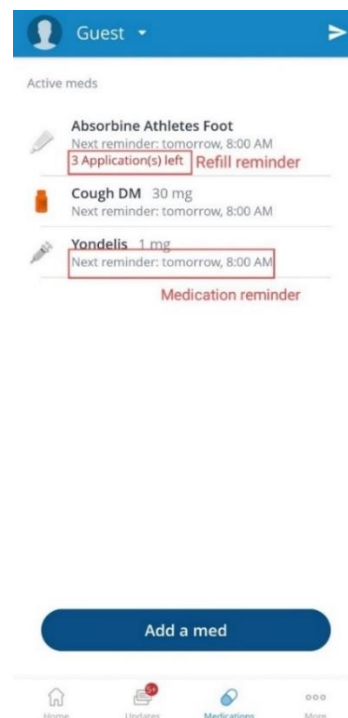
Figure 2.5 Medication section of MyTherapy app.

It also provides reminders for activities and measurements [16]. They can set the goal for their daily or weekly activities so that they can improve their health. After setting up the goals, users will get a reminder from MyTherapy to avoid users from forgetting to hit the goal. MyTherapy also offers measurement reminders to alert users to do regular checking of their health metrics to determine their health conditions.

Besides, users can track their symptoms and mood [16]. A wide range of symptoms such as headache, cramp and laryngitis as well as the mood at that situation can be searched through and added. The mood tracking will be displayed in calendar mode. MyTherapy also has the health metrics tracking which includes blood pressure, weight and others. According to the type of health metrics, users are needed to fill in the details of measurements. Users can add notes in order to track the progress. Apart from that, it offers activity tracking to track the workouts that users may do. They need to fill in the amount of time they have done the workout. By monitoring the activities, users will have an obvious improvement in physical fitness. For every tracking in the app, the date and time they add into the app have to be specified correctly to get an accurate result.

From all the tracking process, MyTherapy identifies the patterns that are related to their health over time to monitor their progress. When getting consultation from healthcare providers, users can show the tracking to healthcare providers. In this case, healthcare providers can get more clear and detailed information and the situation that the user is facing. It may contribute to healthcare providers to give a more accurate treatment decision that is highly effective.

Moreover, MyTherapy allows users to record upcoming doctor appointments. Users can set the date and time of the appointment as well as the location of the clinic or hospital. The date and time of the appointment helps MyTherapy to automatically determine the date and time for the reminder of the appointment. However, it is just a suggested reminder setting. Users can customise the reminders anytime. Also, users can record notes from the appointment.

Users can export their health journal as a portable document format (PDF) file that contains medications, measurements, activities and symptoms. Inside the file, it provides a visual representation for each content. Users can email this report to the doctor though the MyTherapy app. In the other way, users can print the report out so that they can share with the doctor [13], [16].

2.1.6   Medisafe

Firstly, users can do customisation when tracking a medication. They need to enter the name of the drug, the form of medication which means it is a pill, solution, injection or others as well as the strength. They also can specify how often the user should take the medication and what

time the medication should be taken so that it can send reminders to users. Additional medication instructions can be set to mark down the important points. As in this app, it provides a predefined instruction that can be added which is whether to take the medication after, while or before eating or it does not matter. Besides, users can set the treatment duration for the medication and set up refill reminders [25] by adding the number of doses available. Users are allowed to change the medication icon to their favourite icon. It helps to track the dosages at the same time the medication is created.

After adding a medication, Medisafe will send a notification to the users to remind them to take the medication if they forget to take [25]. They can choose to take the medication, skip it or snooze the reminder. However, if users still forget to take or record the medication, it will send a missed medication notification to a Medfriend [16]. Medfriend is a person who is a user of Medisafe and also who the user agrees to share the data with. Medfriend can monitor the user's medication management. Therefore, it reduces the possibility of the user forgetting to take medication. Figure 2.6 shows the adding medication content in Medisafe.
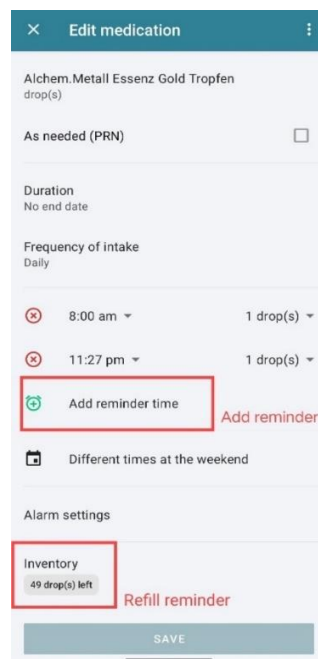
Figure 2.6 Add medication in Medisafe app.

In addition, a new doctor's details can be added by users before the doctor's details being used. Users can add new appointments inside the doctor information and medications that are given by the doctor. If users want to send the status report to the doctor [16], they just have to click the "Send Status Report" button and fill in the email address of the doctor and click 'Send". In this way, the report is sent to the doctor via email.

In Medisafe, users can add and track the appointments in which they should enter their doctor's details first. When adding an appointment, users can choose the doctor that has been added into the app who they wish to visit and select the time of the appointment. A reminder for the appointment can be set if they wish to do so. They can also add location and any additional notes into the appointment.

For health measurement tracking, Medisafe records and tracks body measurements over time such as blood pressure, weight, oxygen saturation (Sp02), body fat and others. Besides, Medisafe produces a report in the form of an excel format file in the app including the tracking of the medication and body measurements. As mentioned above, a status report can be sent to the doctor via email for letting the doctor get a deeper overview of the user's progress.

2.1.7   DailyBean

DailyBean is a simple app to record their daily lives easily. The first feature of this app is that users can track their mood over time by selecting one of the emojis to reflect their exact mood at that day. Users can choose from five different bean emojis in which each bean represents great, good, normal, bad and awful.

When choosing the bean to represent mood, users can add some specific categories [26] to represent the activities that make them have that kind of mood. The categories are distributed to 13 blocks accordingly. Additional blocks can be added and deleted and the categories for each block can be updated by users which enables users to create their own customised blocks. They have the option to hide the whole block which means that users will not be able to view the hidden block when they are adding the categories. Users also can record their sleep schedule, any note and any photo that users wish to share to represent that day when they are still filling in the details for the mood tracking. DailyBean enables users to backdate the information when they forgot to record it.

Once they confirm to log it, the bean will be marked on the monthly calendar for mood record [27]. As shown in Figure 2.7, the calendar is displayed with the emojis so that they can see easily. If they wish to view the details of a mood record that was made in the past, they can just click on the bean emoji and information will be shown under the calendar. Users are also allowed to see the entries for a month in the form of a timeline. If users want to view one of the bean emoji records, they can just choose the bean emoji from the upper left part of the

calendar and only the days that are recorded with this bean emoji will be displayed on the calendar.
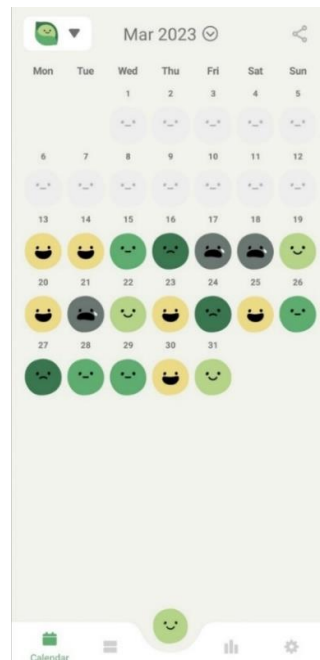
Figure 2.7 Calendar section of DailyBean app.

DailyBean provides some statistics on mood and activity tracking [27]. It is on a weekly or monthly basis showing the mood flow of the user over time. There is also a mood bar indicating the percentage of each mood being recorded. The icon ranking compares the icons that are used and recorded in the month with the last month of the corresponding month. It also can be tracked through different blocks. Sleep Analysis provides the statistics about the user's average waking time, bedtime and duration of sleep. Activity analysis checks the impact of activity on affecting the user's mood.

If users wish to get a reminder daily at constant specific time, they can turn on the reminder setting to enable the app to send notification to users. They can set the time for the reminder so that users will not forget to add their emotion for the day.

2.1.8   Daylio

First of all, users can use Daylio to track their mood [15, 28] to discover their emotional well-being. Daylio allows users to select their mood by rating their mood based on five emojis. The

rate of these five emojis goes from Rad, Good, Meh, Bad and Awful [29]. It enables users to simply select the emoji and they also can customise the mood options by changing emoji and name so that they can show their mood more accurately. Users can further describe their feelings at that moment such as what might be causing the mood by adding notes.

Second, activity tracking features are also provided by Daylio [15]. It is done after choosing the mood. There is a list of activities available to be chosen by users which each activity is under its own category. Categories such as social, food, sleep, hobbies and chores group the activities that are under the same type. Users are allowed to add more activities to each category if no activities stated in the category best describe the activity that users wish to add. If they want to add more details about the activities, they can choose to add notes to record it down. It offers a mood calendar or displays the entries in a list which users can view and log their mood and activity over time in a simple way.

Based on the mood and activities tracking, Daylio provides data analysis and insights to users. It provides users some detailed weekly, monthly or yearly statistics [28] to investigate their mood and activity patterns over time. Users are able to see the days they have logged their moods and activities by displaying it in a row. Also, they can see the mood chart that indicates which activities have an impact on your mood on a particular day. If users wish to see the number of each mood type, there is a mood count showing the number of entries for each mood emoji. Activity count and the number of days users have done their goal are included in the app to give more information to users. Daylio will detect the mood change patterns over time and provide insights into what might be causing the changes. Daylio displays the average daily mood in the form of a graph. It also calculates the average daily mood. It contains a Pixels chart that is only displayed in the yearly statistics. It enables users to see their full year mood by summarising all days in one chart. If users wish to get the statistic in PDF file, users need to subscribe to the premium version. Figure 2.8 is the calendar section of the Daylio app which contains mood calendar and mood count.
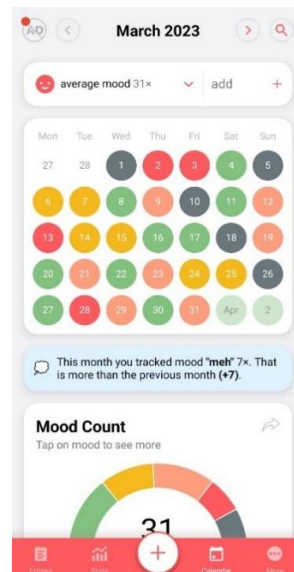
Figure 2.8 Calendar section of Daylio app.

Besides, users can also create and track a goal [15] to track important activities to build a habit. Users can set their goal by either picking from the challenge or creating from activity. If users pick goals from challenges, they still can further choose whether to select the suggested goals or create their own goal by themselves. Users are allowed to adjust repetition into weekly or daily. Weekly repetition may be set if users wish to accomplish the goal every week with a random day. It does not care about when the users do the goal but the number of times that they work out the activity per week should be the same with as number of times that has been set. Daily repetition enables users to choose any specific days during the week to finish the goal. Creating a goal from activities enables users to pick one of their activities and links to the goal which they can also set the start date to the past. Therefore, after creating their own goal, they can track their goal. Daylio will automatically tick their goal if users who create goal from activities add the related activities to track.

If users tend to set reminders to record their mood and activities every day, Daylio is the suitable app to give reminders to users. Also, to prevent users from forgetting to do the goal, it gives a reminder to remind users to work out for the goal.

2.2   Comparison of Existing Application with Proposed Application

Table 2.1 Comparison of physical healthcare applications with proposed app.

Features	Physical Healthcare Application				Proposed App
	MyFitnessPal	Lifesum	7M Workout	30 Day Fitness Challenge	
Workout Plan:					
Normal	✓		✓		
Personalised		✓		✓	✓
Meal Plan:					
Normal	✓			✓	
Personalised		✓			✓
Custom			✓		
Food Logging:					
Using barcode	✓	✓			
Using food database	✓	✓			✓
Type of Tracking:					
Calorie	✓	✓			✓
Exercise	✓	✓	✓	✓	✓
Body measurement	✓		✓	✓	
Water consumption	✓	✓			
Reminder:					
Workout			✓	✓	✓
Water consumption	✓	✓			

Table 2.2 Comparison of mental healthcare applications with proposed app.

Features	Mental Healthcare Application				Proposed App
	MyTherapy	Medisafe	DailyBean	Daylio	
Type of Tracking:					
Exercise	✓				✓
Body measurement	✓	✓			
Symptom	✓				
Medication	✓	✓			
Appointment	✓	✓			
Mood Tracking:					
Using camera or photo					✓
Manually add	✓		✓	✓	✓
Reminder:					
Workout	✓				✓
Body measurement	✓				
Mood logging			✓	✓	✓
Appointment	✓	✓			✓
Medication	✓	✓			✓
Refill drug	✓	✓			

2.3   Limitation of Existing Applications

According to the existing applications, most of the applications provide functions that are related to physical healthcare but with less mental healthcare functions or vice versa. In recent years, there has been an increasing recognition of the importance of mental healthcare. There has been a corresponding increase in the development of technology aimed at addressing mental health concerns. Therefore, a mobile application that has both physical and mental healthcare is important and essential to improve health.

Also, according to some of the existing systems, it does not offer a recommended meal and workout plan. Some of the applications only offer a normal plan which does not consider what the user needs and targets. A plan that is suitable for a particular person is important as it provides a tailored approach to health and fitness that is specific to an individual's needs and goals. It can lead to a more effective plan when compared to a normal plan, increased motivation from users to work towards their goals. It also reduces users from possible risk of injury as it takes into account their fitness level and experience.

Based on previous studies on the mood tracking, users are required to manually add the emojis for tracking their mood every day. In this situation, users may not be able to recognise their emotions correctly by just simply choosing from a limited amount of emojis. The simple representation of emotions using emojis may not be enough to capture correctly the actual human emotions. In addition, due to the user's subjective interpretation or preference, it may result in an inaccurate detection of mood as the user may choose the emojis without following their true mood.

Chapter 3
System Methodology/Approach

The project flow is split into several phases in the development. The phrases are project pre-development, data pre-processing, model training and prediction on test dataset. The models are then being deployed in the application.

3.1   System Development Methodology

There are several available system development methodologies, and each has their own pros and cons. The suitable system development methodology is Rapid Application Development (RAD). RAD enables fast and efficient implementation of application and brings closer to what is needed. It also ensures high quality of the application.

The methodology in RAD we use in developing this application is Phased Development methodology. Figure 3.1 [30] below shows how a phased development methodology works. It tends to produce a useful system and produce business value quickly. If having new requirements, it enables new generated requirements to be brought into the next system version. There are four general phases in RAD which are planning, analysis, design and implementation.

Firstly, in the planning phase, we identify the business value, project goals and the target users. Developing a project plan also involves a planning phase to outline the process of development and timelines. In the analysis phase, we gather requirements from potential users using questionnaires. Then, we analyse users' needs that they hope to include in the application. We break the requirements into several versions in which the first version of the application is the most important requirements.

After that, we create the system architecture, design the user interface, develop prototypes and even design the database. After that, the first version will be brought to the implementation phase. According to the design specifications, we code and test the version based on user feedback until the version meets the requirements. The next version will only be begun after the previous version is implemented.

After all system versions are well implemented, we integrate all the versions into and the application will be brought into maintenance to provide support such as fixing bugs, doing updates and others to the application.

In this project, dashboard module will be used and implemented in each version as it has included some information of each module. Firstly, the workout and meal plan module will be the first version of the system. Workout and meal plan that serve as the physical healthcare functions in this mobile application gives the fundamental way for us to represent the application. As for the second version of the application, mood recognition module and reminder module will be implemented in this stage to represent the mental healthcare feature which is also considered as one of the core functions in developing this mobile application. In the third version, the final implementation of dashboard module will be constructed to show the tracking, analysis and history of our activities in the past. After this, this mobile application will be fully presented and implemented.
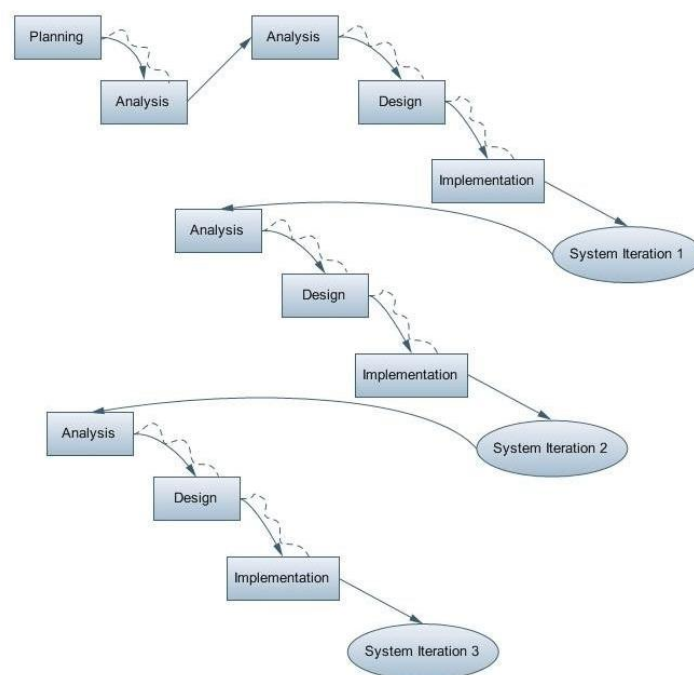
Figure 3.1 Phased development methodology [30]

CHAPTER 3

3.2 System Design Diagram/Equation

3.2.1 Equation

Basal Metabolic Rate (BMR) is the amount of energy used at rest in a neutral tempered, postabsorptive state. BMR is used to calculate daily calorie needs for weight management, providing the calories for create personalised plan.

Here is the format for BMR.

For Women:

$$BMR = \big(10 \times weight(kg)\big) + \big(6.25 \times height(cm)\big) - (5 \times age) - 161$$

For Men:

$$BMR = \big(10 \times weight(kg)\big) + \big(6.25 \times height(cm)\big) - (5 \times age) + 5$$

Number of daily macronutrient calories based on goal

For gain weight:

Carbohydrate = 0.6 × BMR

Protein = 0.2 × BMR

Fat = 0.2 × BMR

For maintain weight:

Carbohydrate = 0.4 × BMR

Protein = 0.3 × BMR

Fat = 0.3 × BMR

For lose weight:

Carbohydrate = 0.4 × BMR

Protein = 0.3 × BMR

Fat = 0.3 × BMR

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<u>For macronutrient calories based on the value above for each meal</u>

For breakfast, lunch, dinner:

Carbohydrate = 0.3 × Carbohydrate / 4

Protein = 0.3 × Carbohydrate / 4

Fat = 0.3 × Carbohydrate / 9

For snack:

Carbohydrate = 0.1 × Carbohydrate / 4

Protein = 0.1 × Carbohydrate / 4

Fat = 0.1 × Carbohydrate / 9

3.2.2 System Architecture Diagram

In this project, we use Firebase Spark plan to use the features provided in Firebase. First of all, Firebase Authentication is used to implement the registration, sign up, sign in and sign out module. The sign-in method used in this project is email address and password or using Google sign in, or Facebook sign in which is to authenticate the users before accessing the application. Firebase Realtime Database stores and retrieves the user data for the system if user is authenticated while Firebase Storage is used to store and get the images. Two Application Programming Interfaces (APIs) is used in this project to retrieve the necessary data for implementation of the modules. TensorFlow Lite model for emotion recognition is done and used in this project to predict the user's mood.
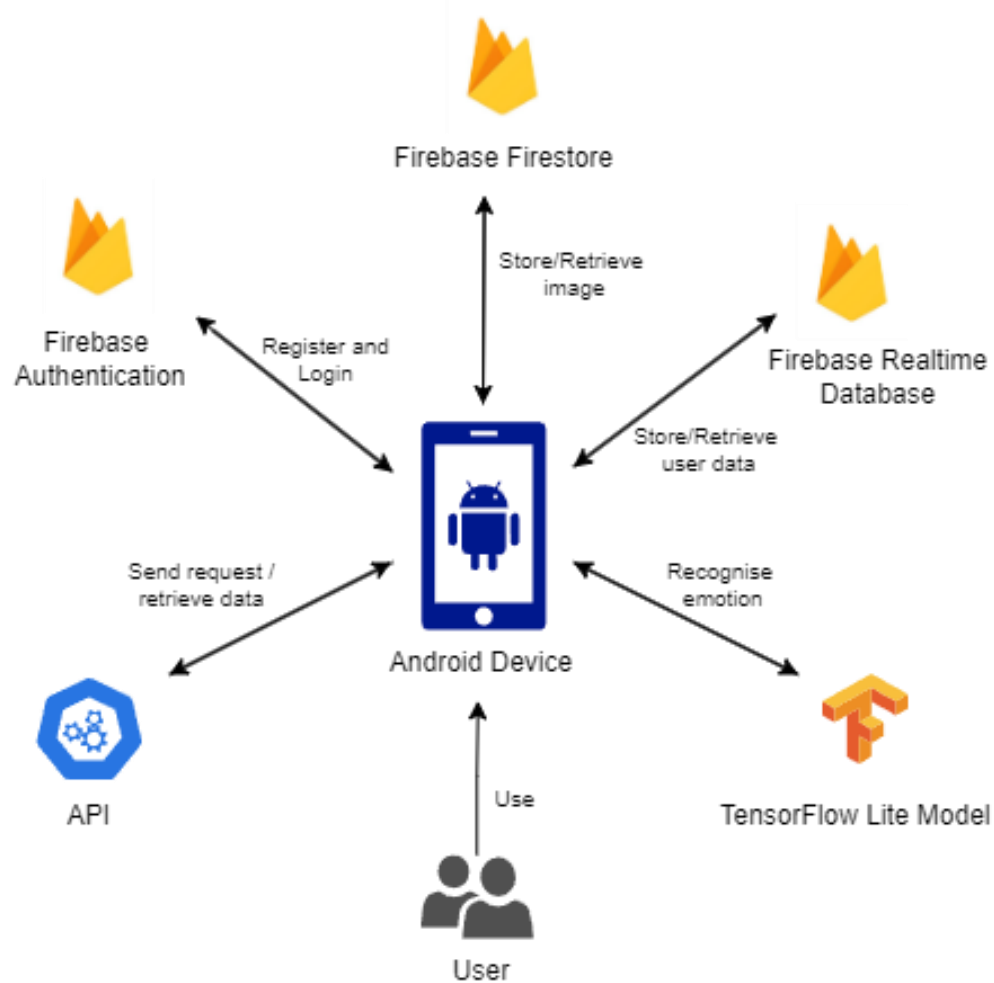
Figure 3.2.1 System architecture diagram

3.2.3 Use Case Diagram and Description

The use case diagram in Figure 3.2.2 below shows the interaction between application and user. A user that has no account before is only allowed to have access to register and login use cases. Otherwise, user will have all access to other use cases as well.
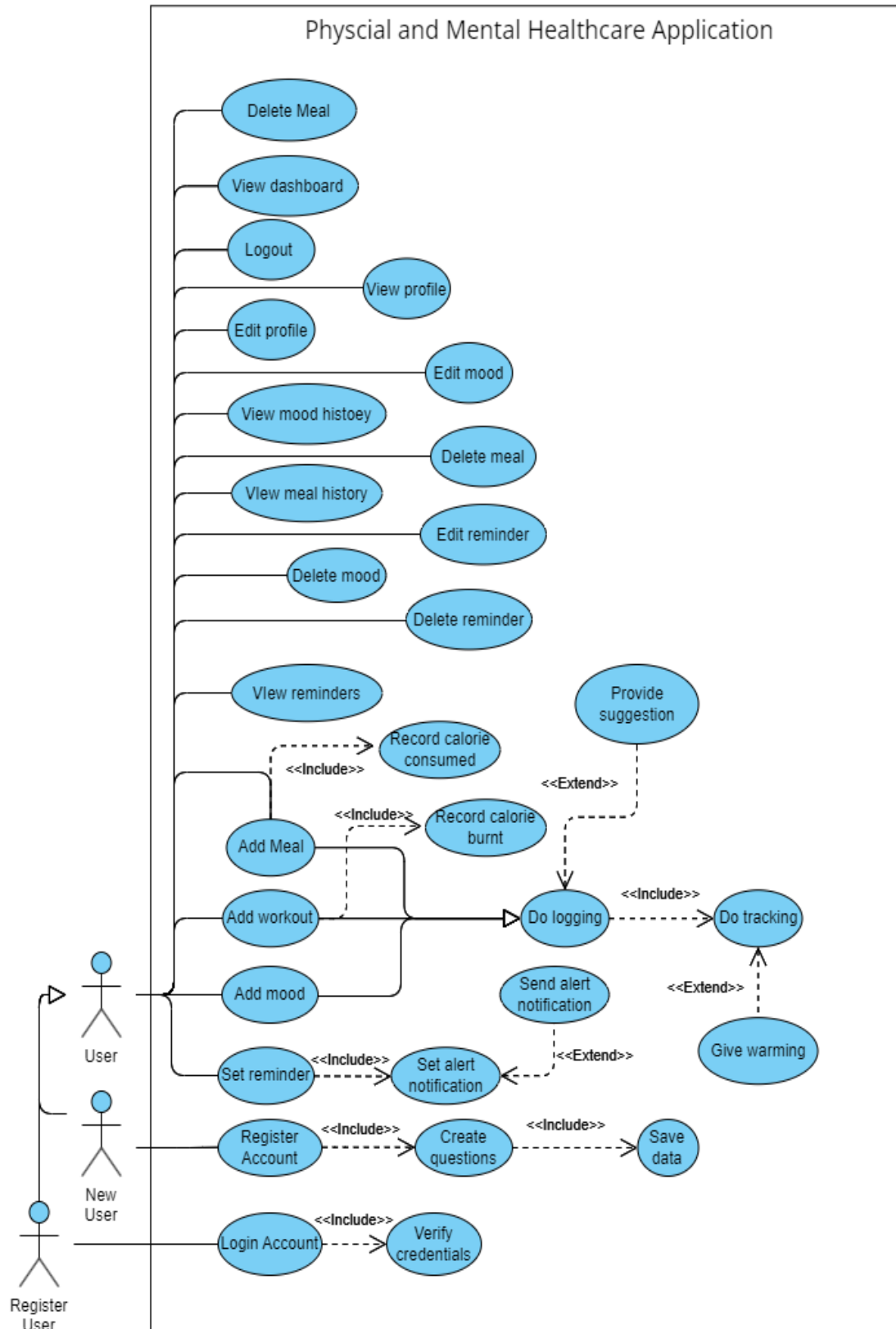
Figure 3.2.2 Use case diagram

3.2.4 Activity Diagram

i.   Login Module

User should enter email address or use Facebook or Google sign in method. Then, it will check whether the username and password are correct using Firebase Authentication. If it is correct, it will bring user to the next page, else it will show the error message and let user to input again. Figure 3.2.3 shows the Login activity diagram.
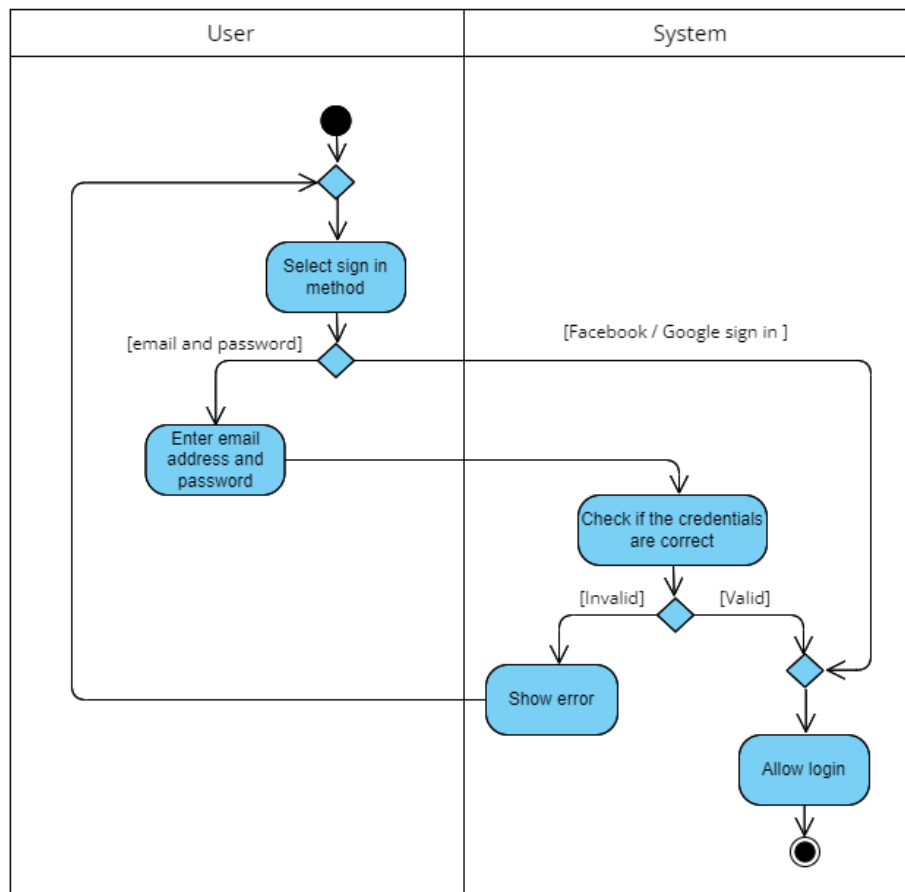
Figure 3.2.3 Activity diagram for login

ii.   **Register Module**

User must enter their email address and password in order to create a new account. The email address entered by user will be checked to make sure that there is no duplication of email address. If duplication is found, error message will be shown and let the user to re-enter the email address again. If all is well, a questionnaire will be created, and user must answer it in order to continue use the application. The targeted daily number of calories will be displayed, and all the information taken from the questionnaire will be stored together with calories into the database. Figure 3.2.4 shows the register activity diagram.
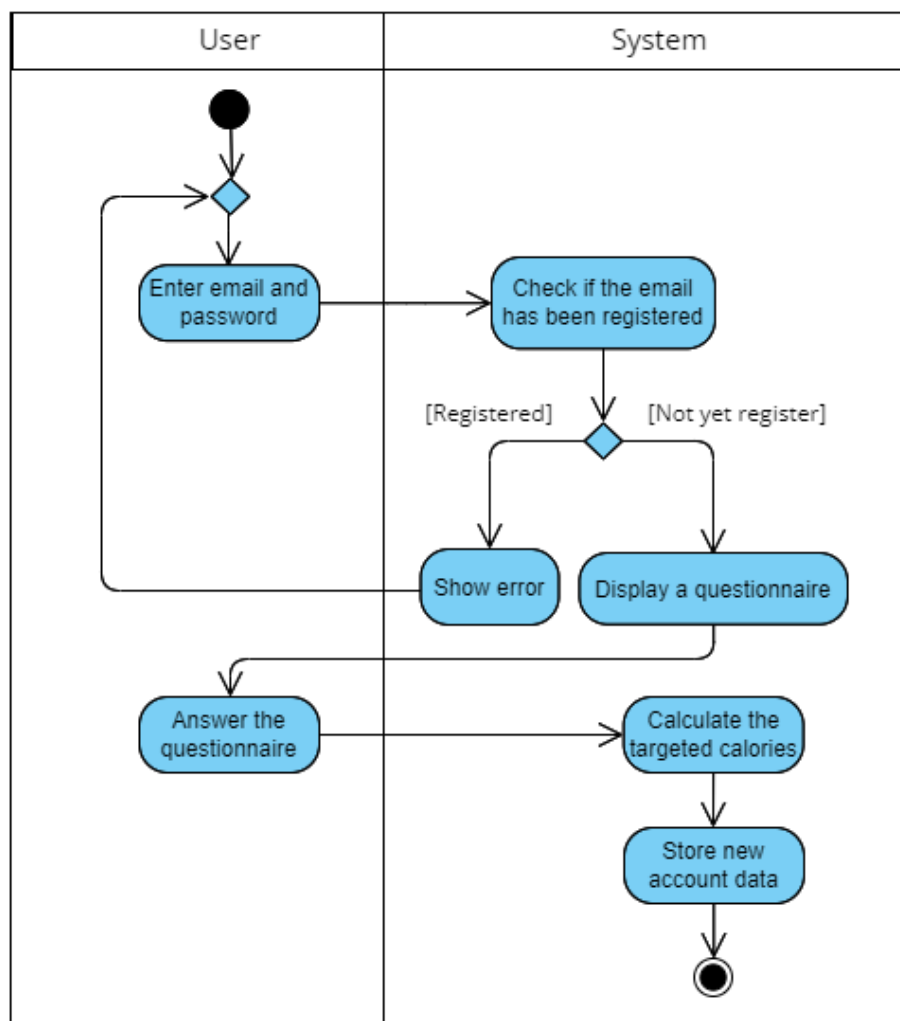
Figure 3.2.4 Activity diagram for register

iii. Profile Module

When user enter the Profile module, it will display all the user data related to the user that has been stored when answering the questionnaire. User is allowed to edit or update the information and all the details will be updated to the database. Figure 3.2.5 shows the profile activity diagram.
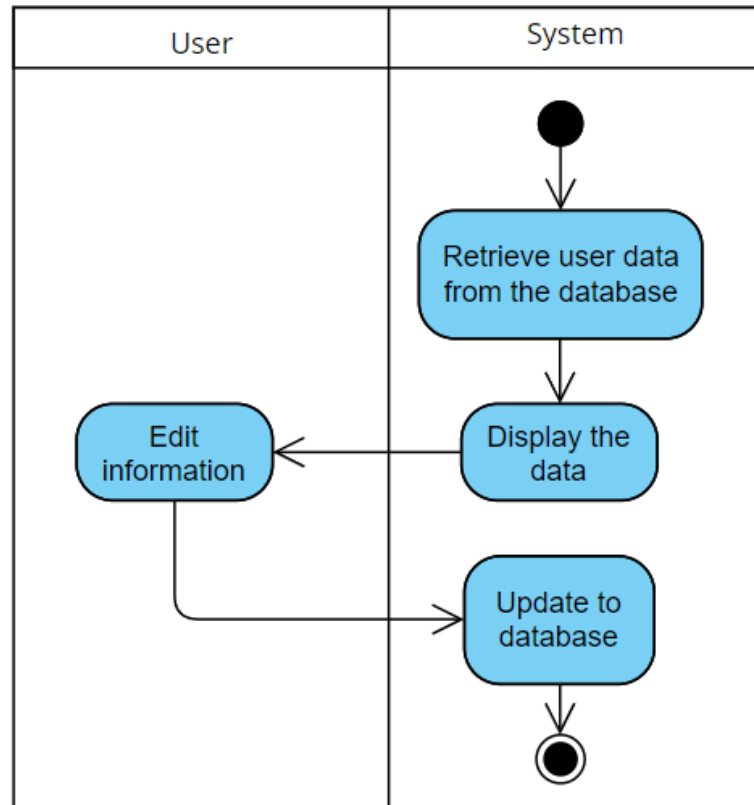
Figure 3.2.5 Activity diagram for profile

iv. **Workout Module**

User selects the workout set related to their target muscles that they want to train, then a list of exercises will be retrieved and displayed. When user selects one of the exercises and has completed it, a number of calories burned will be calculated and store the data in the database. The calories burned will further be used for tracking. Figure 3.2.6 shows the workout activity diagram.
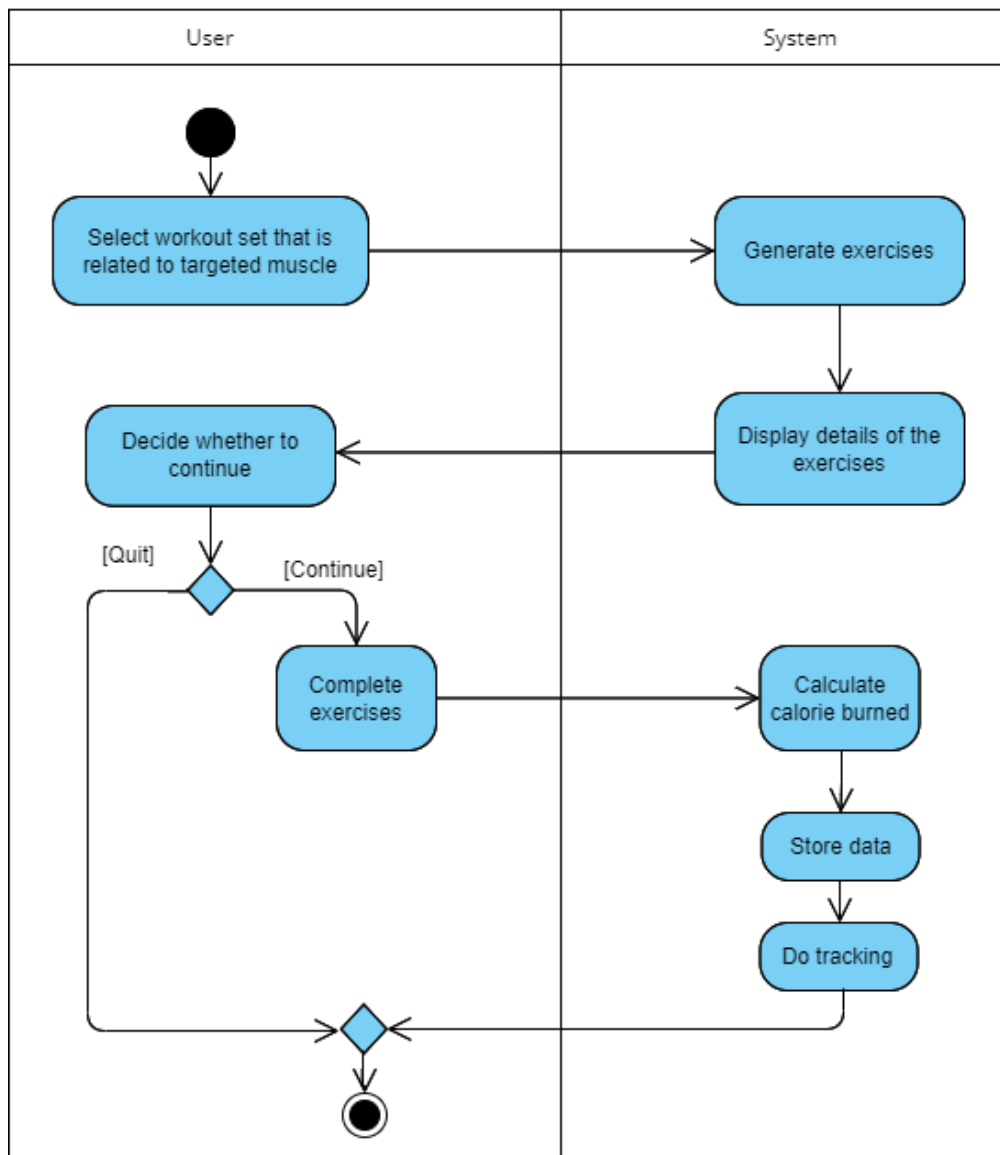
Figure 3.2.6 Activity diagram for workout

v. Diet Module

If user wants to add a new meal, a list of meal type will be displayed, and user can choose one of them. System will calculate the calories allowed for this meal type and display the food accordingly. When user selects the food and add it to the Save Meal list, user can review the saved meal in a page and when user confirms to consume the food, system will store the food details to the database and direct user to the Meal History. User also can straight to move to view the history. Figure 3.2.7 shows the diet activity diagram.
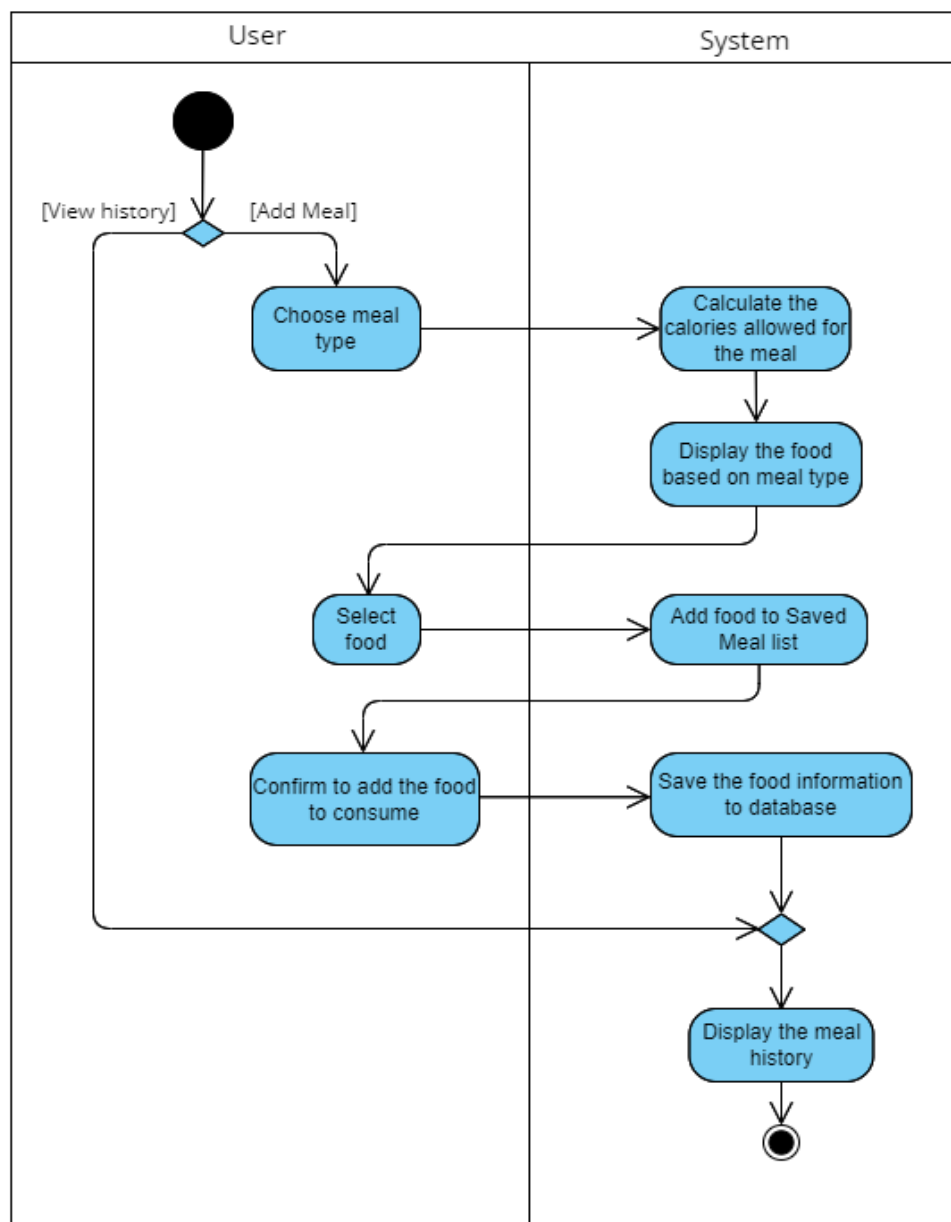
Figure 3.2.7 Activity diagram for diet

vi.   Mood Module

If user wants to edit or delete the mood records, all the changed data will be updated to database. Also, if user hopes to add a new mood record, user has the option to choose the insertion method such as using icon and the emotion recognition. When user selects gallery or camera, it will switch to the upload or capture a photo and send for recognition. It will first detect the face and start to make predictions. All the data that need to be saved is stored in the database. Meanwhile, it will also check the average score of the mood. If it is lower than 2, it will display a list of music and when user selects the music name, it will navigate user to the YouTube app to listen to the music. Figure 3.2.8 shows the mood activity diagram.
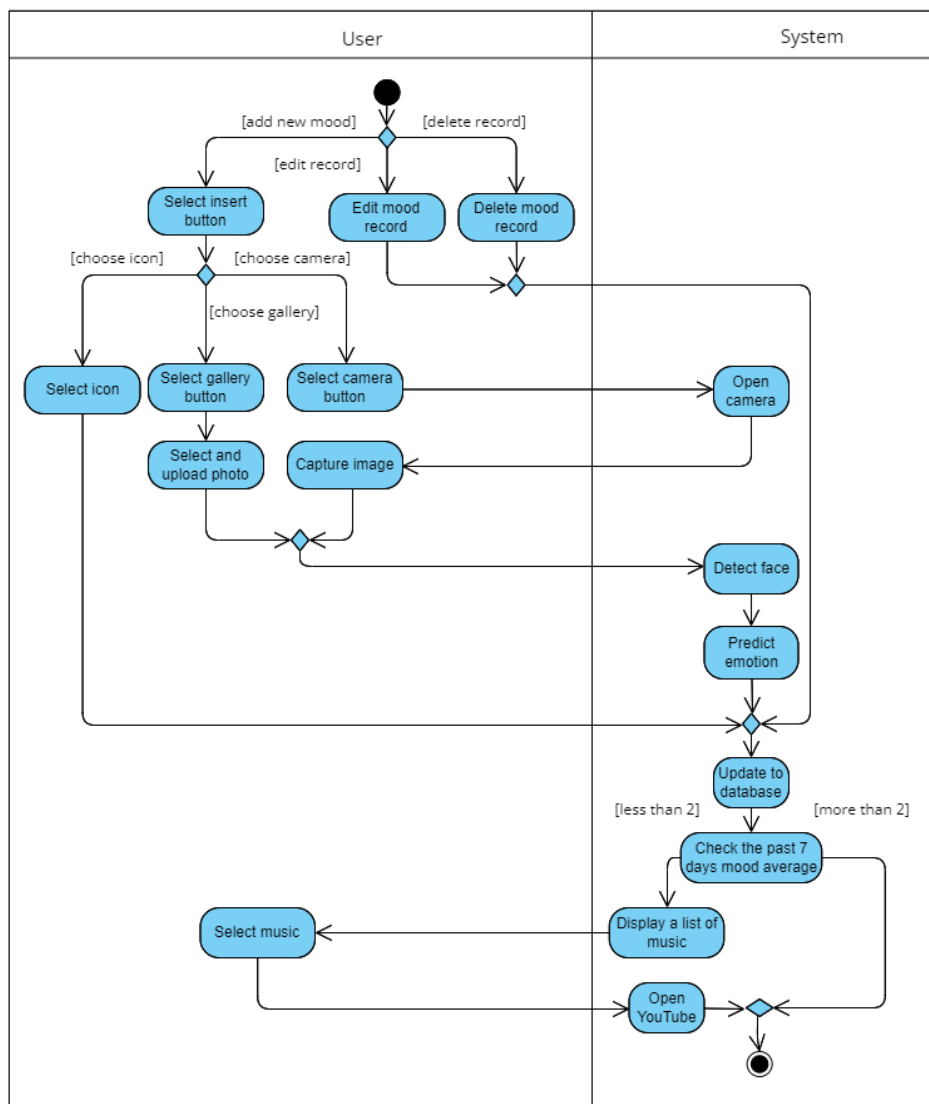
Figure 3.2.8 Activity diagram for mood

vii.   Reminder Module

User can choose to add, edit or delete a reminder. User should enter the details for user to set the notification alert. After confirming to add, edit or delete a reminder, all the added or changed data will be updated or stored in the local storage. It will then check whether the time is reached. If it has reached the time set, a notification alert will be popped out, else it will keep checking until the time is reached. Figure 3.2.9 shows the reminder activity diagram.
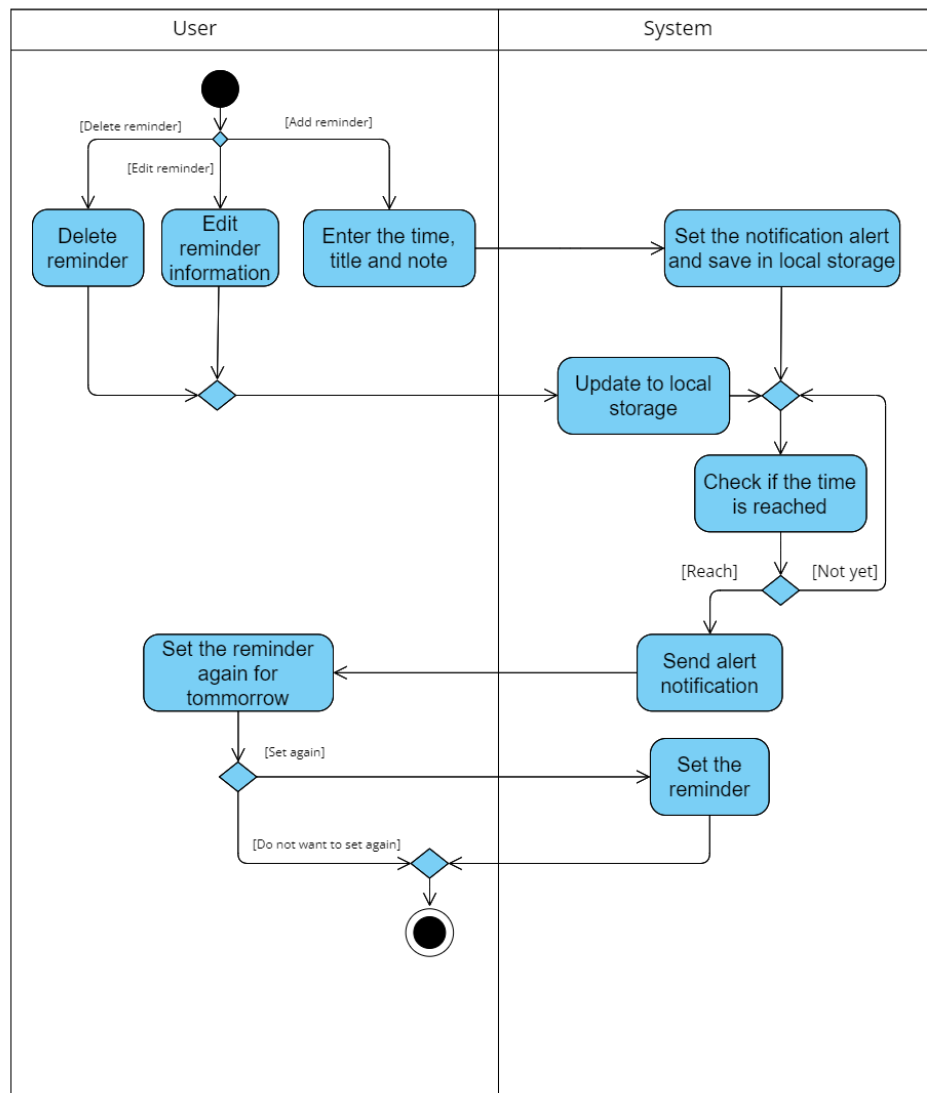
Figure 3.2.9 Activity diagram for reminder

Chapter 4
System Design

4.1 System Flowchart

As shown in Figure, user needs to register an account before they can use. Then, it will navigate user to login. If he or she is a new user, user will be navigated to answer a questionnaire and bring user to Dashboard. If not, user will be brought to Dashboard. After that, user can view the dashboard once the user is authenticated. User is able to update user profile once user hopes to change the goal, target muscle or others. User still have another four modules in this application. When user chooses the workout module, he or she need to select an exercise and calorie will be recorded after completing the workout. When user chooses the diet module, user is able to view the meal history and add the meal for today. User also can delete the meal history record. Calorie will be recorded as well. Furthermore, if user selects the mood module, user has the option to view, edit, delete and add the mood record. When inserting a new record, user can choose to use either icon, camera or photo to log the mood. At the end, when user could use the reminder module to add, delete, edit and view reminders. If user has no things to do with the application, user can quit the application or choose to logout.
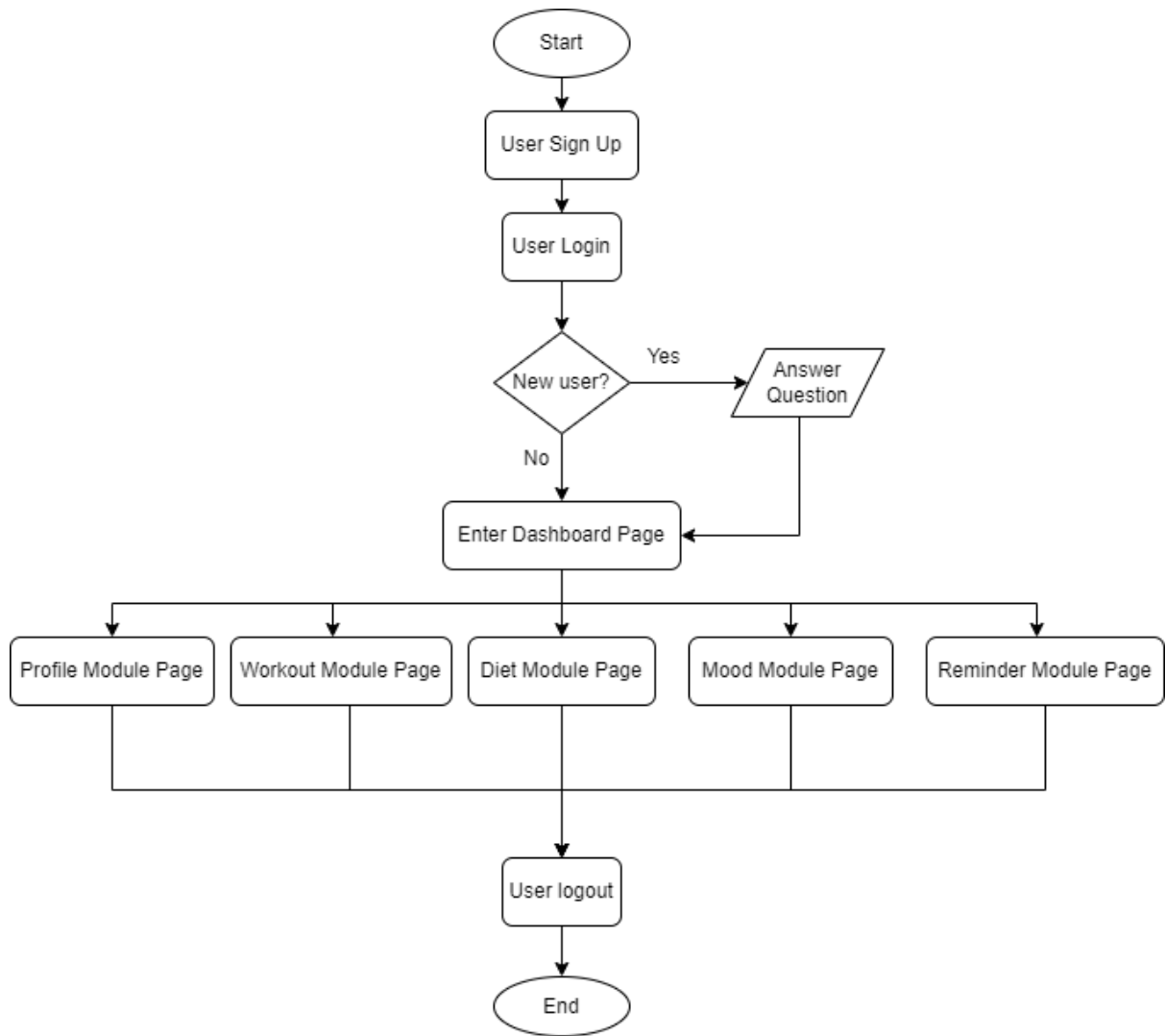
Figure 4.1 System Flowchart

CHAPTER 4

4.2　System Components Specifications

Table 4.1 System functions

Function ID	Function	Description
F001	Splash screen	To display the logo and name of the application.
F002	Sign in	To login to the application.
F003	Sign up	To create a new account.
F004	View dashboard	To see the overall information of calorie and mood counts for today and also the past days.
F005	View profile	To see the personal information.
F006	Edit profile	To change the personal information.
F007	Add workout	To view and add the exercise that has been done.
F008	Add meal	To add a new meal for today.
F009	View meal history	To view the meal records that have been added before
F010	Delete meal	To delete the meal that has been added before.
F011	View mood history	To view the mood records that have been added before.
F012	Add mood	To add a new mood record for today.
F013	Delete mood	To delete the mood records that been added before.
F014	Edit mood	To update the information in the mood record.
F015	View reminders	To view the reminders that has been set before.
F016	Set reminder	To set a notification alert to remind user for something.
F017	Delete reminder	To delete the reminder.
F018	Edit reminder	To update the details of the reminder.
F019	Bottom navigation bar	To ease the navigation between each module.
F020	Floating button	To provide short cut to add new record.

4.3   System Component's Functionality

4.3.1   Login and Register Module

Firebase Authentication will be used to authenticate the user. If user has no account, user has to register a new account in order to use this application. After registering, user will be brought to a questionnaire and answer it to get the user's personal details and other data that is required to use in this application. After that, it will calculate the daily calorie needed for user. If user is authenticated, it will bring user to the dashboard module.

4.3.2   Dashboard Module

User is able to view an overview of their calorie intake, calorie burned, and mood counts for the current day and also the past days, allowing user to track progress over time and make informed decisions about user's health and well-being.

4.3.3   Workout Module

To create the recommended workout plan and meal plan accordingly, we first gather information about the user through questionnaires in the application to understand their goals, and targeted muscle as well as their age, weight, height before they start to use the application. A recommended workout plan is created using user data by getting the exercises examples and meal examples from API call. The data will be used to find out the workouts that are based on their targeted muscles. We subscribe the ExercisDB on RapidAPI and get the API key to construct the HTTP request to the API endpoints. After successfully receive a response from the API, we parse the needed data and obtain a curated list of exercises. User can choose which set he or she want to take and after completing the set, calorie burned will be recorded in the database, contributing to the user's overall activity tracking and progress monitoring.

4.3.4   Diet Module

As for meal plan, we first calculate the remaining calorie that the user still can consume. Then, we break down the calorie for each meal and each macronutrients calorie. This calculation takes into account factors such as the user's basal metabolic rate and desired rate of weight loss, gain or maintenance. After deciding on a calorie goal for the day, we break it down into meals, taking into account things like breakfast, lunch, dinner and snacks. The number of calories in

each meal is carefully calculated so that the user feels nourished and satisfied but remains within their daily calorie limit. To ensure a healthy and balanced diet, we also carefully distribute the reserved calories between macronutrients such as proteins, fats and carbohydrates. We use the Edamam API to make it easier to choose foods that are appropriate while staying under the recommended calorie and macronutrient restrictions. The food will be displayed and let the user to choose it. Adding a meal will record the calories of the food. If user is having meal that exceeds the remaining allowable calories, it will alert the user that this meal will exceed the allowed calories.

4.3.5   Mood Module

An automatic mood detection will be proposed in the app. It can be done by using deep learning algorithm. Firstly, we collect a dataset of images of people. We get the prepared dataset which is Facial Emotion Recognition 2013 (FER 2013) dataset [31] which has labels indicating their emotion represented by each image. We just want the four categories of image, which are happy, sad, neutral and angry. After that, we use the collected dataset to train a deep learning model which is a Convolutional Neural Networks (CNN) model based on the dataset using a supervised learning approach. Once the model is trained, it can be integrated into the app. When a user takes a picture using the camera or select photo from the gallery in the app, the input image will be sent to the Mediapipe framework first to preprocesss the image. The image will be cropped out to take the face appeared in the image using the pre-trained face detection model in Mediapipe framework. We refer to the documentation and some resources to modify the codes given in the Mediapipe guideline to take the position and size of the frame of the face detected. Then, the image will be sent to the model to analyse the facial expression in the image and predict the user's mood. Otherwise, user is also allowed to add the mood records directly using icon as well. When logging mood record, used will be determined by the system to check their past 7 days moods and get the average score. If user is determined in low mood, user will be asked whether want to listen to some music to relax.

4.3.6   Reminder Module

It is a module for users to input their reminder so that they will not miss out on something that they should do. For example, reminder for mood, meal and workout logging. They can set the time that the users think they might be free at that time so that they will remember. Moreover,

the user can set time to take the medication. Also, users are allowed to set a reminder for the time and place of an appointment to visit the doctor. Users can choose which time period they use for reminders so they can schedule them around the times they plan to be available. With this adaptive scheduling feature, users can reduce the likelihood of forgetting important tasks by strategically planning their day and allocating time for necessary activities.

4.3.7 Profile Module

User is allowed to update their profile which means that user can change their target muscles to train, goal or others based on their condition they want. Target calories will be recalculated with BMR and saved to the database.

4.4 Timeline
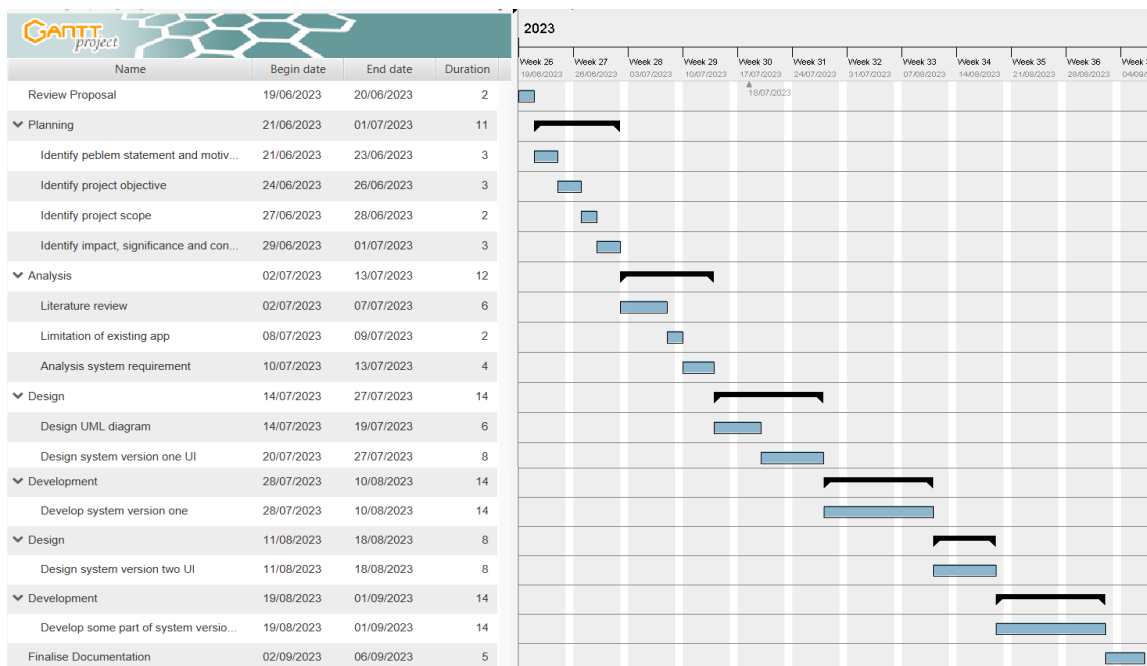
Figure 4.2 Gantt chart diagram for FYP 1
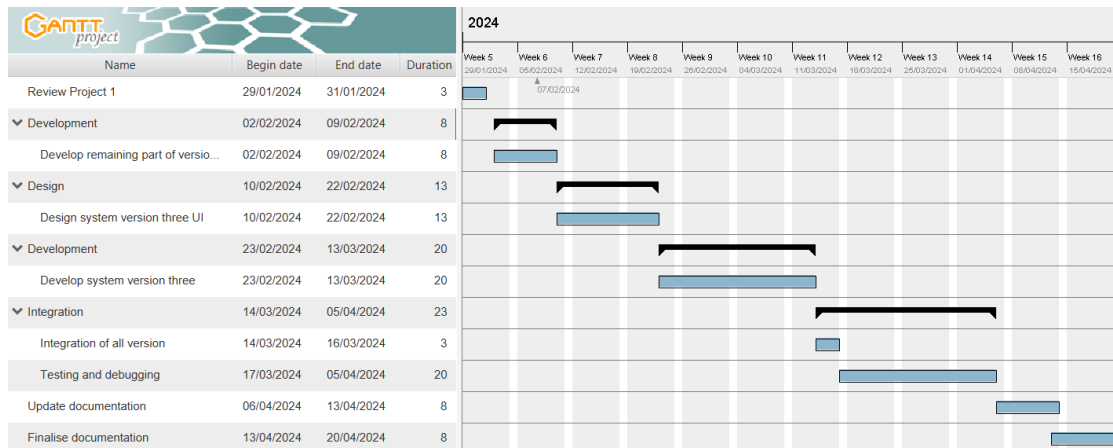
Figure 4.3 Gantt chart diagram for FYP 2

Chapter 5

System Implementation

5.1 Hardware Setup

There are two hardware used in this project which are computer and android mobile device. A computer is issued to develop software, testing and debugging the mobile application. Training a model for mood detection need a computer to build these models. Table 5.1 is the specifications of the laptop being used for this project. A mobile device is used for testing the application's user interface and functionality in a real-world environment and deploying this physical and mental healthcare application. At the same time, it also can find out performance issues that may occur. Table 5.2 is the specification of the Android handphone used.

Table 5.1 Specifications of laptop.

Description	Specifications
Model	Lenovo IdeaPad S340
Processor	AMD Ryzen 5 3500U
Operating System	Windows 11
Graphic	AMD Radeon Vega 8 Graphics
Memory	12GB DDR4 RAM
Storage	256 SSD + 1TB HDD

Table 5.2 Specifications of Android handphone.

Description	Specifications
Model	Vivo Y77 5G
Processor	Dimensity 810
Operating System	Funtouch OS 13.0
Graphic	AMD Radeon Vega 8 Graphics
RAM	8GB
Storage	256 GB

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In order to use actual device to run the application, we should set up the basic setting in the phone first. Go to the software information, click on the "Build number" for several times as shown as Figure 5.1 below. After that, go to the developer options, click on the USB debugging to allow debug mode.
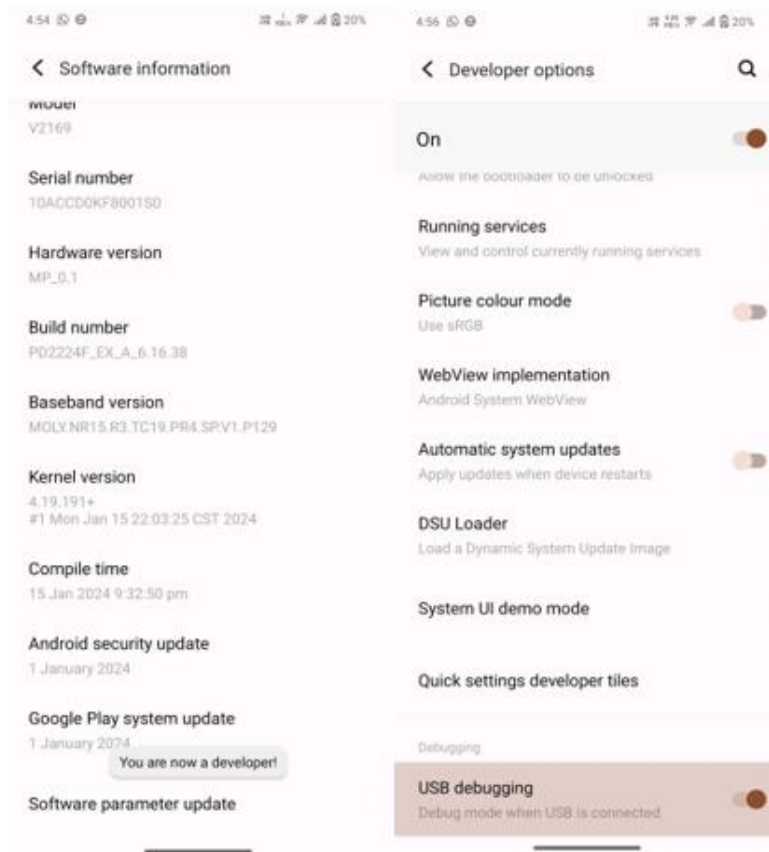
Figure 5.1 Hardware setup

5.2 Software Setup

Before starting to develop the application, some software are required to be installed and downloaded in the computer so that we can working on it.

i. **Integrated Development Environment (IDE)**

IDE that is used in this mobile application development is Android Studio. Since we are developing an Android application, Android Studio is the official IDE for development. It provides regular Android platform updates to the application. It also gives a lot of tools and features to spend up and ease the development of the application. Android Studio supports multiple programming languages. It also provides many third-

party libraries and tools so that we can use it for consuming APIs, machine learning, deep learning and user interface design.

ii.   **Programming Language**

Java is used to develop mobile application as Java is a platform-independent language. It allows us to run the same code on different platforms without modifying the code. Java also allows us to write modular and reusable code by creating classes and objects. Java Virtual Machine (JVM) performs bytecode verification before executing the code to ensure the code is not malicious.

iii.   **Database Management System (DBMS)**

In order to store the user data generated by the application, Firebase Realtime Database is used. It can deal with large numbers of user data such as profiles and progress information. Firebase Storage is also used to store the images while Firebase Authentication is used to streamline the creation of robust authentication systems to enhance user sign-in and onboarding experiences effortlessly.

iv.   **MediaPipe**

Google's Mediapipe framework is tailored for creating multimodal applications. It provides a lot of pretrained machine learning models related to human body parts. One of the pretrained train required for this project is the face detection model.

v.   **Google Colab**

Colab is a hosted Jupyter Notebook service. It aids in providing free access to processing resources like GPUs and TPUs without the need for setup. Since we need to train an emotion expression model, GPUs are quite important to involve in this project. Therefore, Colab is well suited to deep learning.

5.3   Setting and Configuration

To start a new project, click on the "Empty Activity" shown in Figure 5.3.1.
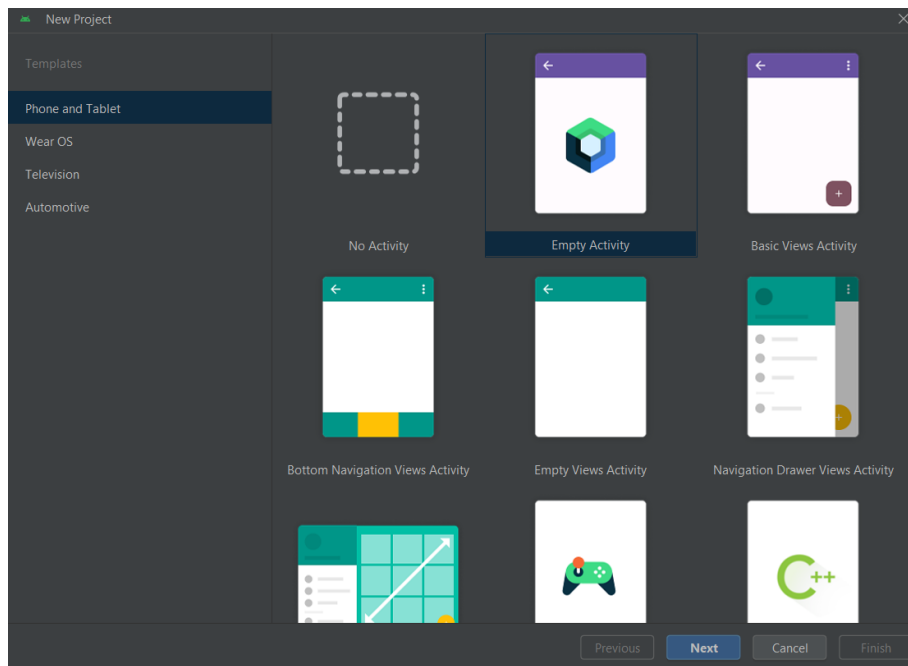
Figure 5.3.1 Start of new Android project

After that, set the language to Java and API 24("Nougat") was set for minimum SDK to run the application. Finish button is clicked to generate a new project as shown Figure 5.3.2.
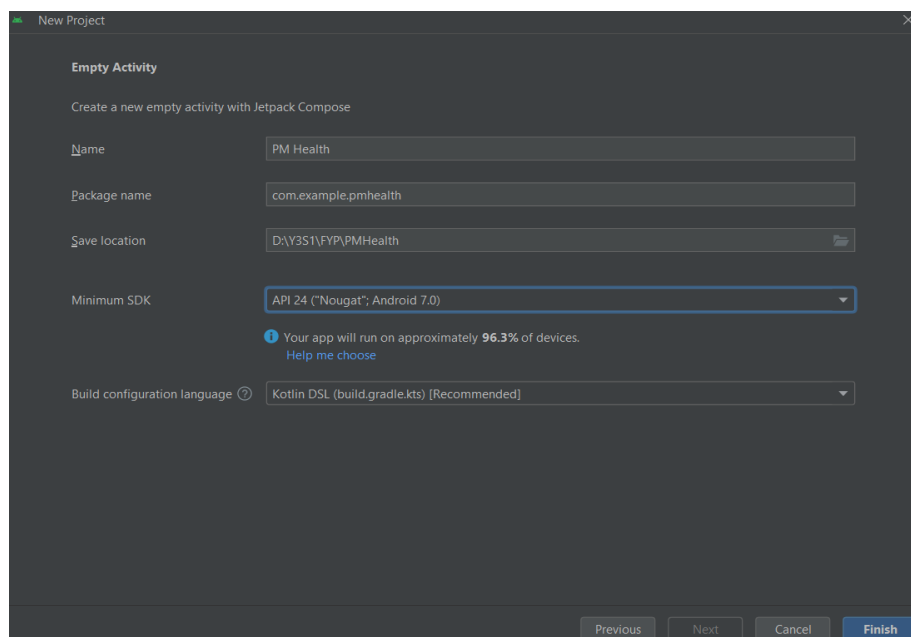
Figure 5.3.2 Setting of new Android project

To run the project on an actual device, open the device manager in Android Studio. Connect the phone with computer using a USB cable. A dialog will be popped up and click on the Allow button. At the end, the name of actual device will be shown as in Figure 5.3.3 and choose it.
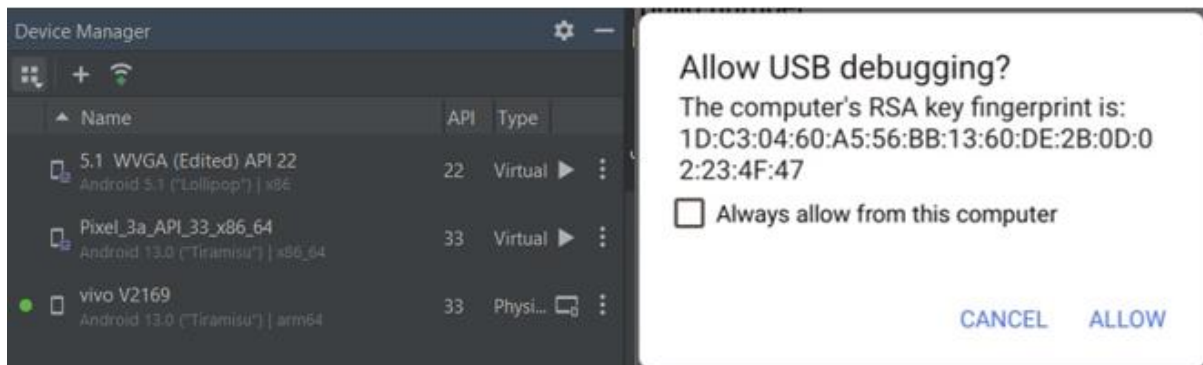
Figure 5.3.3 Connect to mobile device

5.3.1 Firebase

In order to use the Firebase Authentication, Firebase Storage and Firebase Realtime Database, we register an account in Firebase Console and add the Firebase SDK to the app. As shown in the Figure 5.3.4, we create a new project.
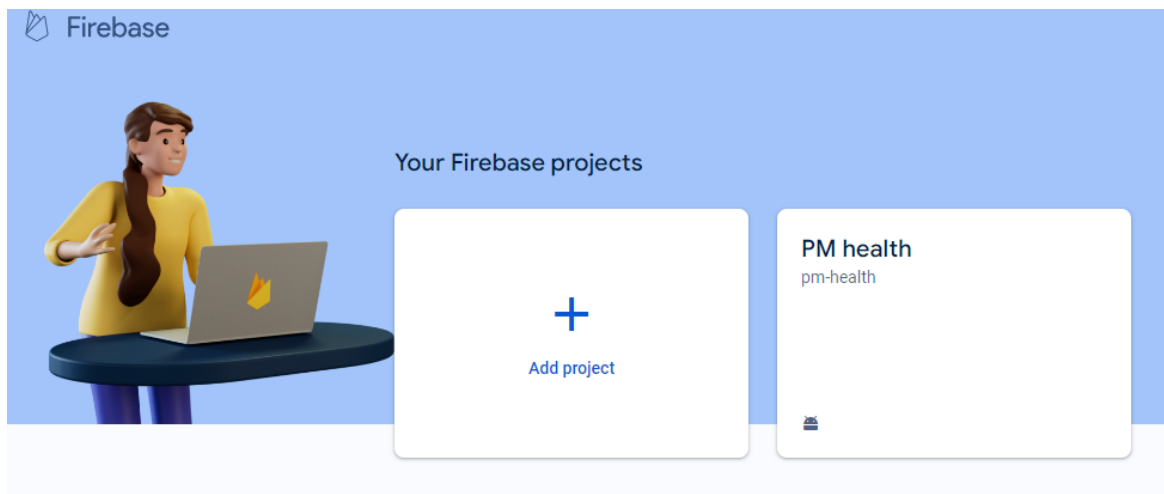
Figure 5.3.4 Create new Firebase project

Next, we set up the Firebase Authentication service. We choose the sign-in method that we want to use as shown in the Figure 5.3.5.
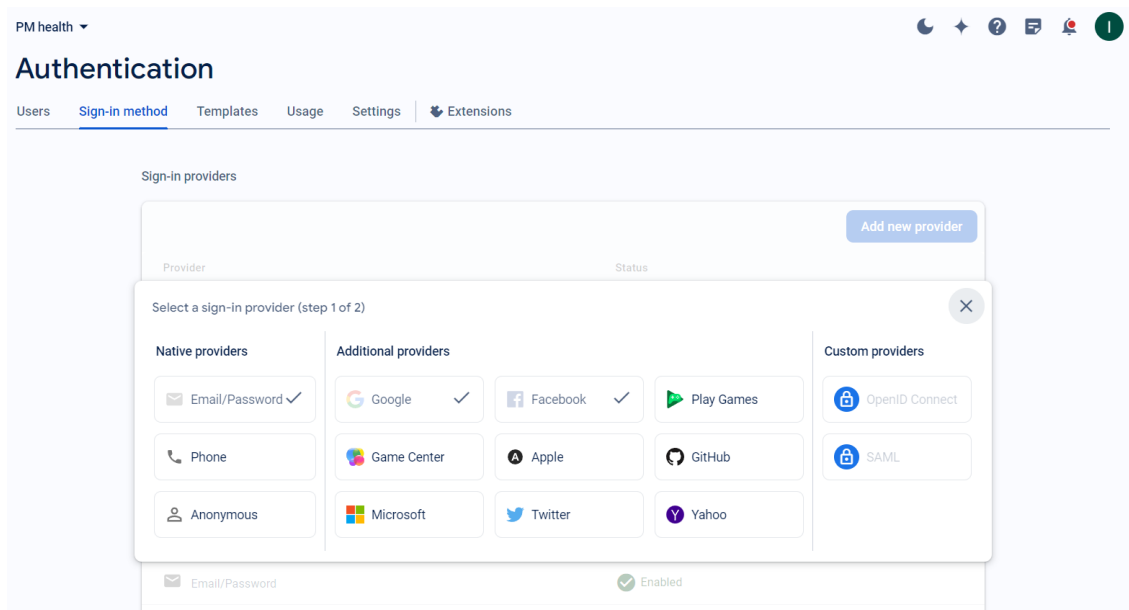
Figure 5.3.5 Sign in method

After that, we create a database in Firebase Realtime Database. First, we set the Realtime Database Location shown in Figure 5.3.6 and set the security rules to Locked Mode in Figure 5.3.7. After setting up the database, update the security rules of the database as shown in Figure 5.3.8 to ensure the permission for reading or writing data.
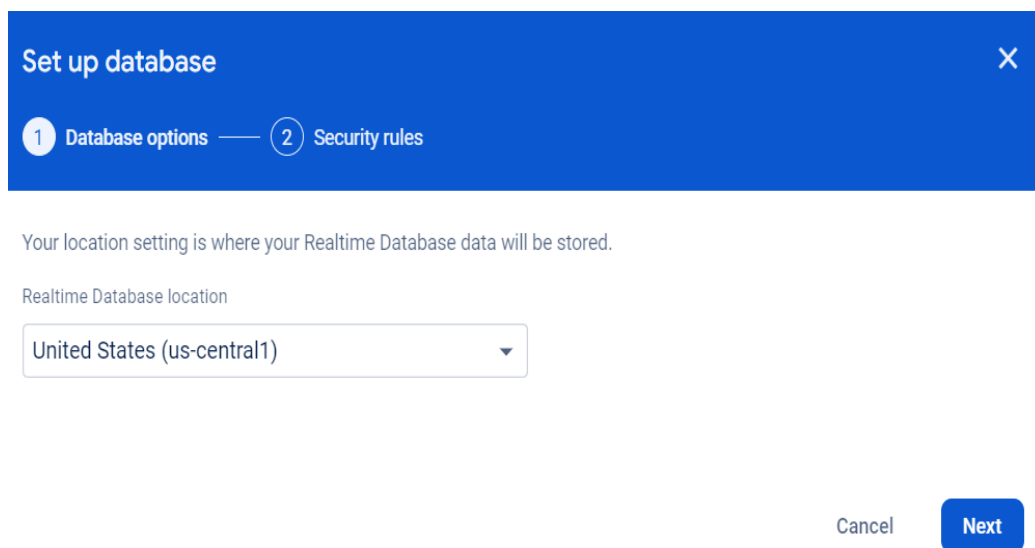
Figure 5.3.6 Set Realtime Database location
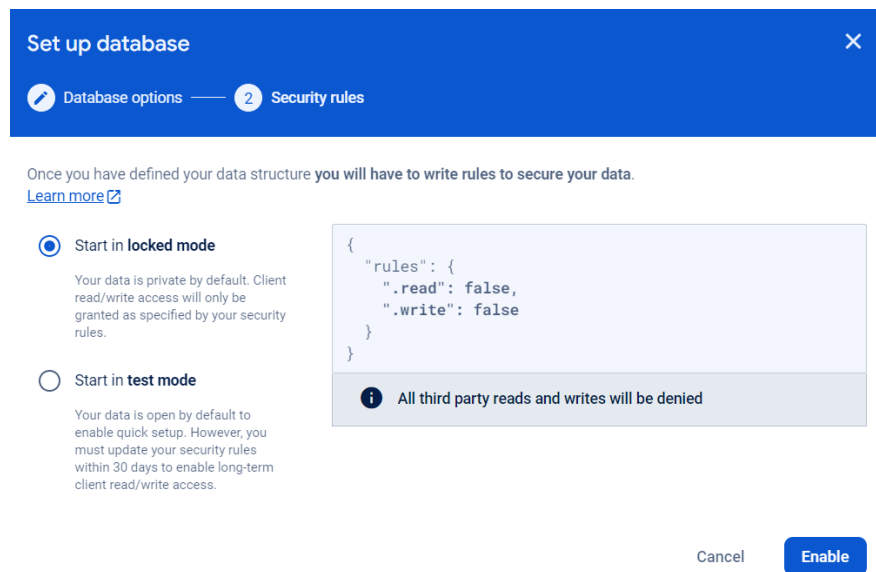
Figure 5.3.7 Set the security rules for database

Figure 5.3.8 Update security rule for Realtime Database

Next, we create a Cloud Storage in Firebase Storage. We set the secures rule to test mode shown in Figure 5.3.9 and Cloud Storage Location to "asia-south1" shown in Figure 5.3.10. After creating, we update again the security rules for the Cloud Storage created in Figure 5.3.11.
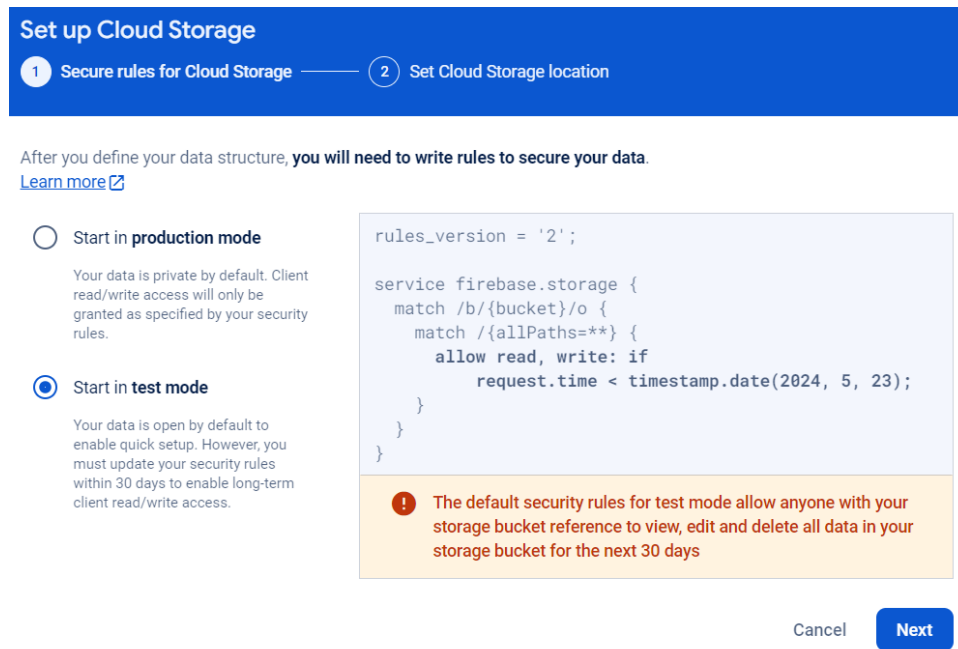
Figure 5.3.9 Create Cloud Storage
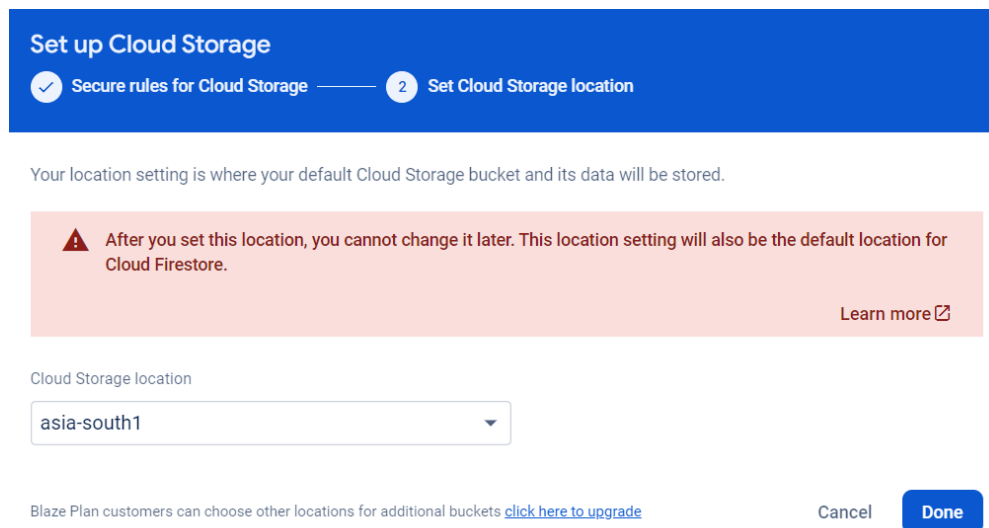
Figure 5.3.10 Set Cloud Storage location

```
1   rules_version = '2';
2
3   service firebase.storage {
4     match /b/{bucket}/o {
5
6       // Allow read access to images only if the user is authenticated
7       match /FoodImages/{allImages=**} {
8         allow read: if request.auth != null;
9         allow write: if request.auth != null && request.resource.size < 10 * 1024 * 1024;
10      }
11
12      // Allow read access to other resources (like metadata) without authentication
13      match /{allPaths=**} {
14        allow read;
15      }
16    }
17  }
18
```

Figure 5.3.11 Update security rules for Cloud Storage

To connect all the services required from the Firebase to the Android studio, as shown in Figure 5.3.12, chose the "Tools" in the Android Studio and select "Firebase". Then, we connect the application to Firebase, and add the Software Development Kit (SDK) to the application.
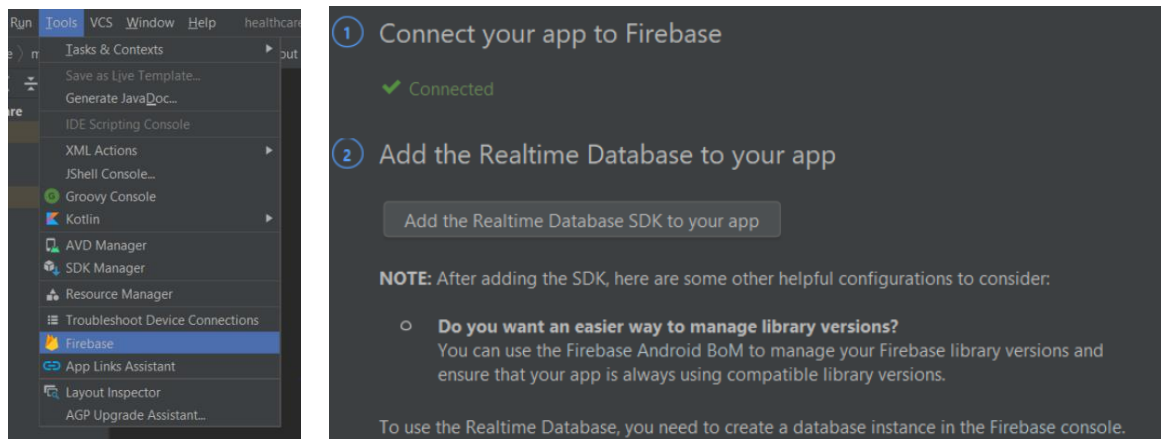
Figure 5.3.12 Connect Android Studio to Firebase

5.4 System Operation (with Screenshot)

5.4.1 Splash Screen

Figure 5.4.1 shows the splash screen when user enters the application. It shows the logo and the name of the application. After that, if the existing user has not logout before, then it will navigate to Dashboard page. Else, it will navigate user to Login page.

Figure 5.4.1 Splash screen

5.4.2 Login and Registration

For those who have logout their accounts, the user should login again. If he or she is a new user, then user can choose to sign up using email or Facebook and Google account. Figure 5.4.2 shows the login and register page for user to sign up and login. It will check if the email is already be taken which it will not allow user to create duplicated accounts. It will also check if the user is a new user or an existing user which existing user will be navigated to the Dashboard page while new user will be navigated to answer a series of questions. Figure shows that user chooses the Google sign in method.
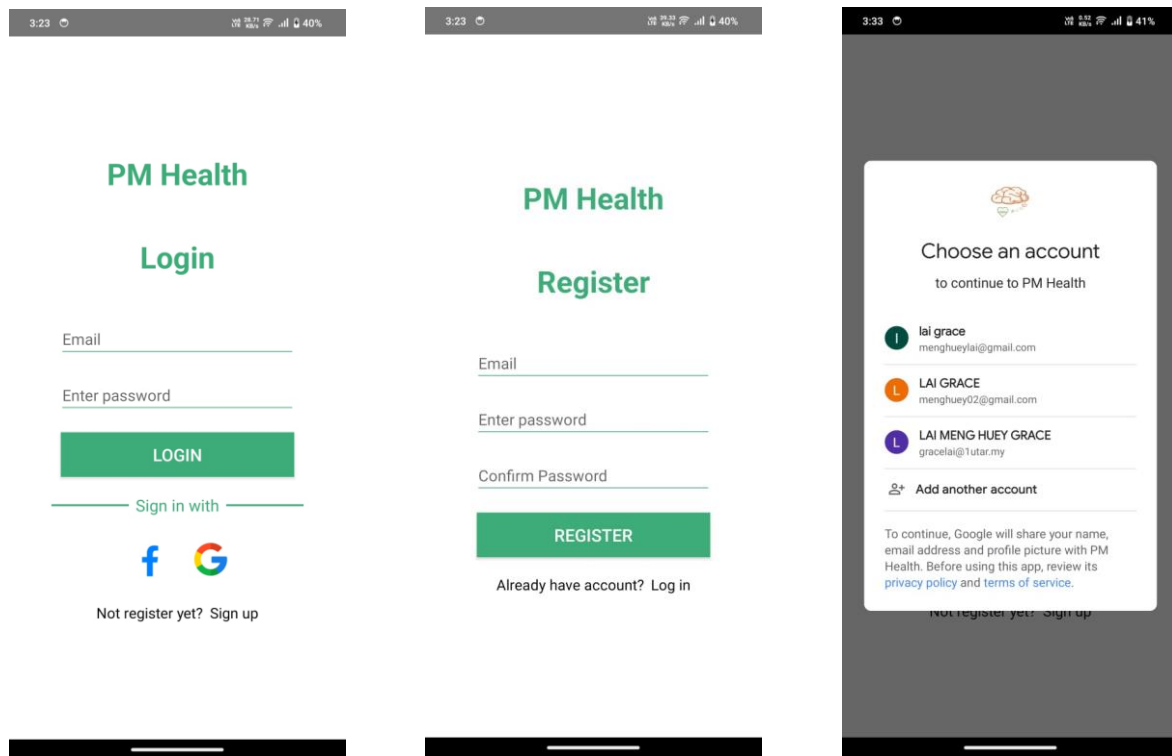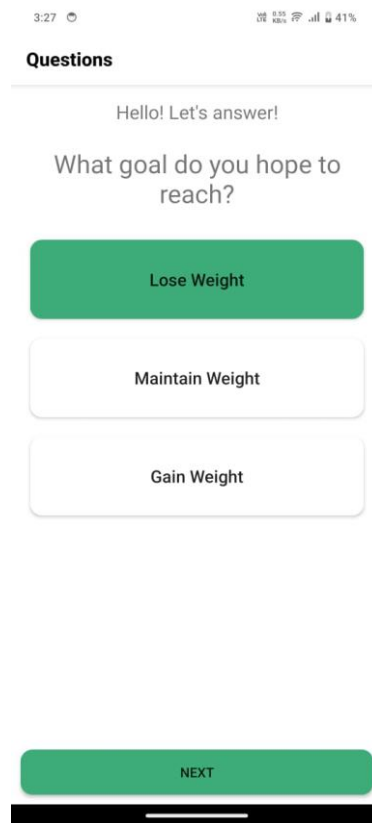
Figure 5.4.2 Login and registration page

5.4.3 Questionnaire

If a user is the first-time user, the user will be asked to answer the questions which are collected for creating recommendations on workouts and meal plan. The data will be used to calculate the daily calorie needed by the user and also find out the workouts that are based on their targeted muscles. The answers chosen by the user will be stored in the Firebase Realtime Database for further usage and tracking. Figure 5.4.3 shows the questionnaire page of one of the questions. After answering the questionnaire, it will bring user to the dashboard page.

Figure 5.4.3 Questionnaire page

5.4.4 Dashboard

As shown in Figure 5.4.4 below, user can have a look on their daily calorie allowed to consume. We retrieve the data from the database and calculate it. It will show how many calories have been left as well as the carbohydrates, protein and fat throughout the day. User also can view the calorie that has been burned due to work out or has been consumed. Furthermore, calorie consumed for each meal type are also shown. User also can view the calorie burned by workout and also the mood counts about how many records user had made. It is allowed user to click on these six boxes to add new record. However, user is restricted to adding new records for all modules that occurred only today.
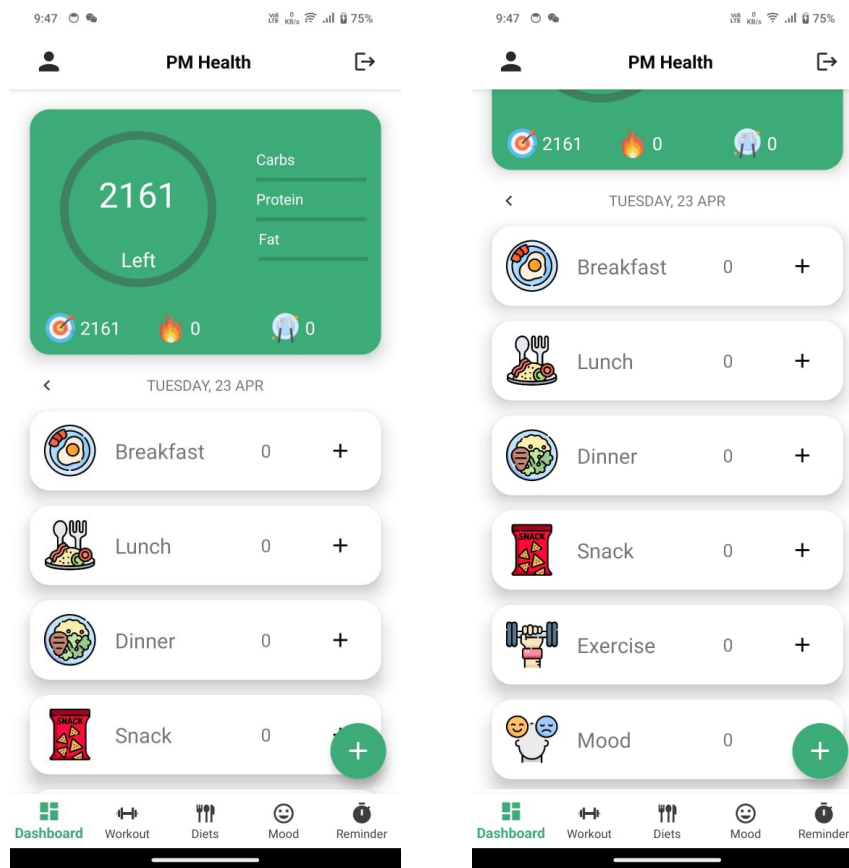
Figure 5.4.4 Dashboard page

Besides, user is given the option to view all past day's records shown as Figure 5.4.5. User can swap to left and right or click the arrows to view the history. If user hopes to logout, can click the logout icon at the right side of the bar. On the other hand, if user wants to update their information details, user can click the person icon at the left side of the bar. It will navigate user to Profile page.
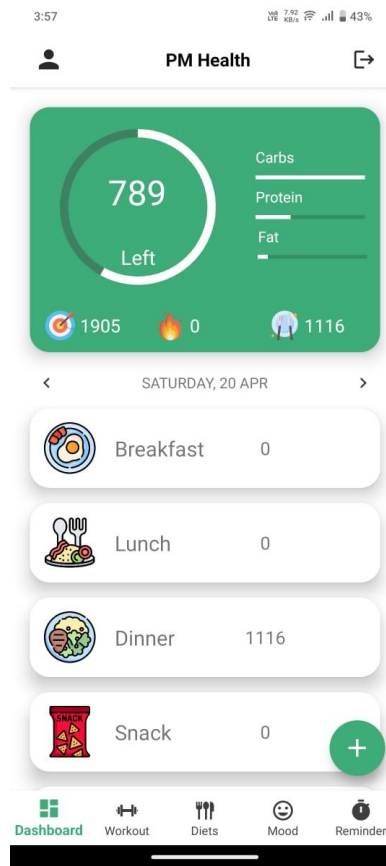
Figure 5.4.5 Dashboard page for past day

5.4.5   Profile

In this page, it will display the information of the user as well as the body parts and the area that user hopes to train as shown in Figure 5.4.6. In order to provide personalised plan, this page is mainly for user to update their information details like weight and height to restructure the plans. After editing, user should press the save button to update the data to the database and will navigate back to Dashboard page.

Figure 5.4.6 Profile page

5.4.6 Workout

When user click the workout section in the navigation bar or the floating button, it will bring user to Workout page. Exercises are distributed to the user according to the targeted muscles that the user selected. Then, distribute the workouts into several groups with each group containing three to four workouts. Each exercise consists of three sets, and each set involves twelve repetitions. For finishing one of the groups, user will gain a calorie burned according to their weight and duration and the calories value will be saved to database and updated the calories burnt in dashboard. Figure 5.4.7 and Figure 5.4.8 shows the screenshot of workout page and exercise and dashboard page.
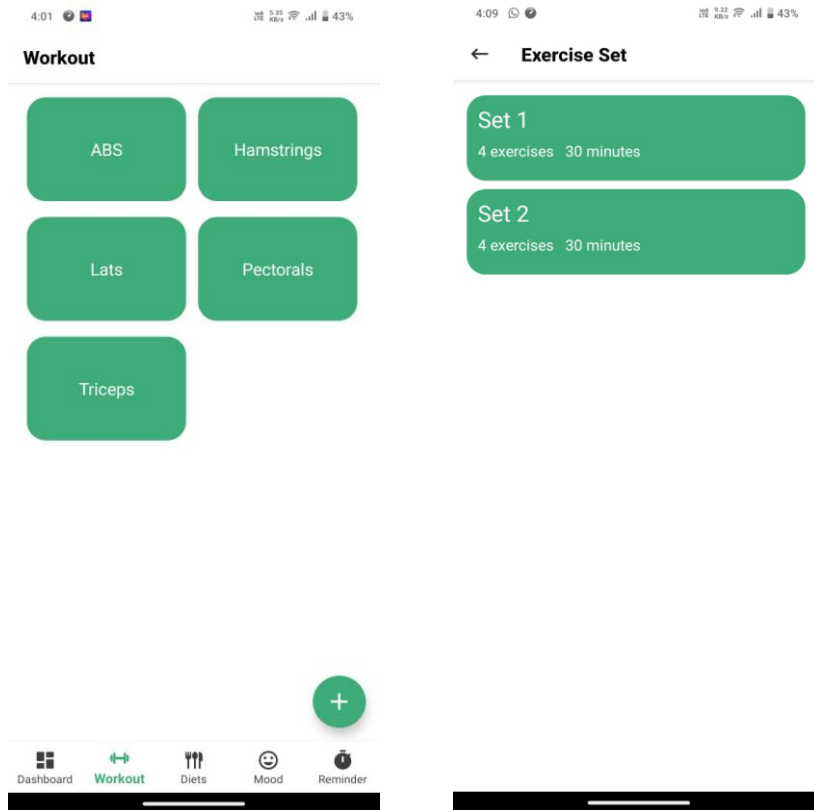
Figure 5.4.7 Workout page
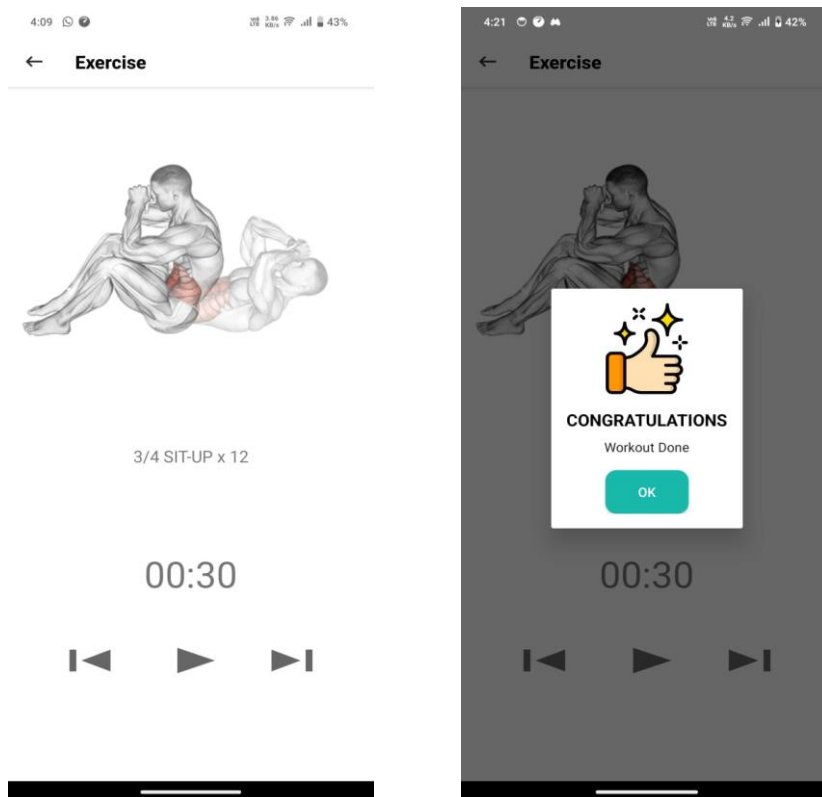
Figure 5.4.8 Exercise page

5.4.7 Meal

Nevertheless, if user hopes to go to Diets page, user can click on the Diets section in the navigation bar or the floating button. After that, it will show four selections as shown in Figure 5.4.9 for user to choose which meal type that they want to view.
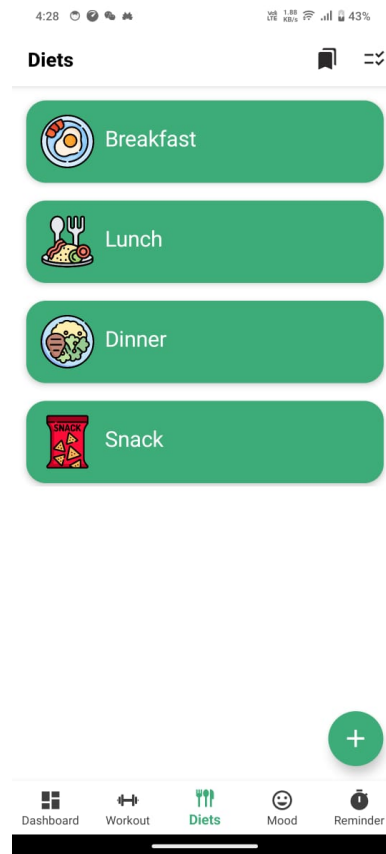
Figure 5.4.9 Diet page

For example, after the user clicks on the breakfast menu, it will display some food with name and image as shown in Figure 5.4.10 below. If user chooses one of the foods, it will pop up a dialog with the food name, food image and the calorie that the food contains. Clicking on the Add button will place the food information into the database and close the dialog while clicking on the Cancel button will lead to dialog dismiss.
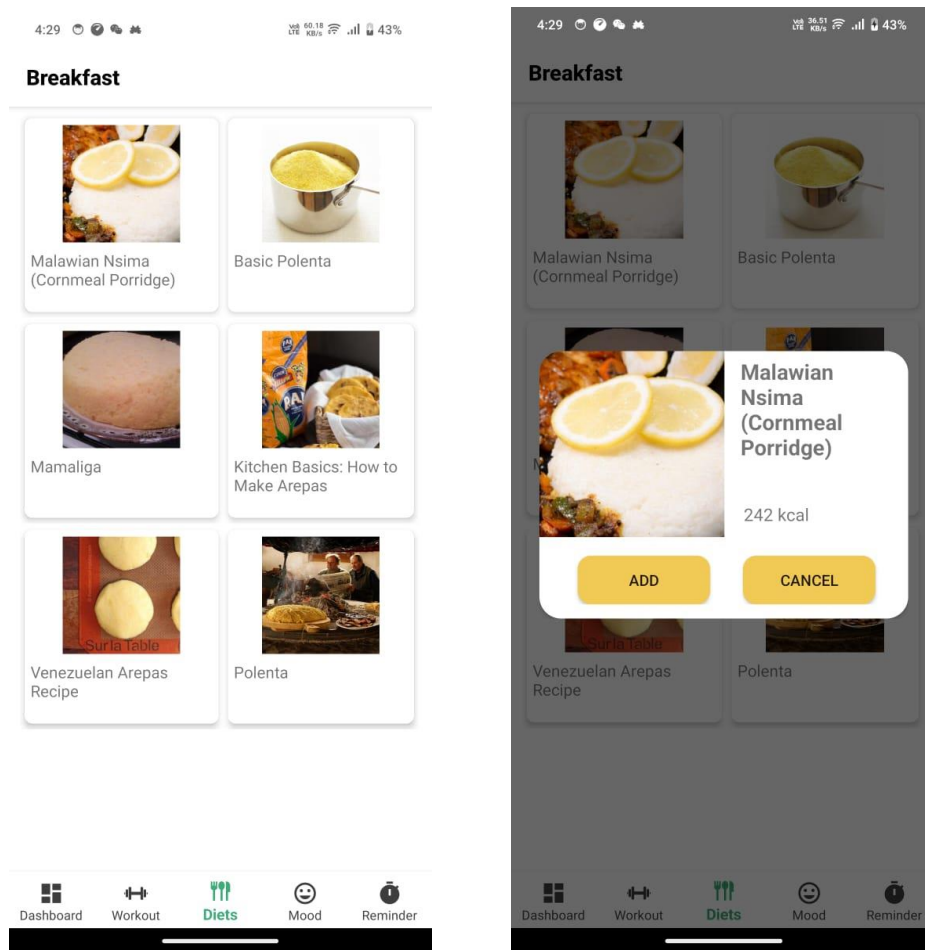
Figure 5.4.10 Meal plan page

If user confirms that wants to add the food as the diets today, user can click on the first icon at the action bar. It will lead the user to a page that shows all the food added today shown in Figure 5.4.11.
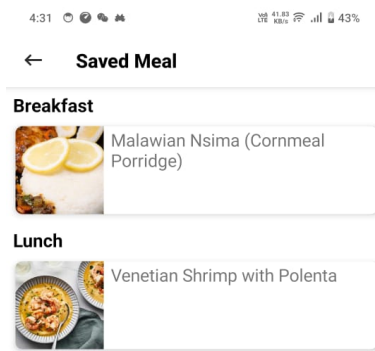
Figure 5.4.11 Saved meal page

When user clicks on the food, it will navigate user to a page containing all the food information such as carbohydrates, fat, protein and ingredients as shown in Figure 5.4.12. Clicking on Cancel button will remove the food from the favourite meal. Apart from that, user must click the Add button to make a confirmation that user really consumed this meal if they want, and user will be brought to the Diet History page.
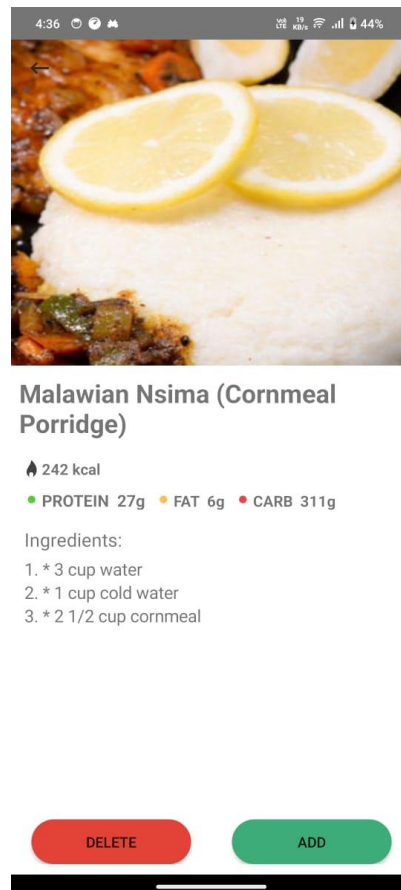
Figure 5.4.12 Meal details page

In this page shown in Figure 5.4.13, it will display all the food that have been taken before. When user hopes to view more details, click on it and it will show out. User can delete a food by clicking the Delete button and the food information will be removed from database. To add on, it will recalculate the calorie that can be consumed by user for each meal type. For example, user is always left with more calories if they had their workouts. Therefore, the calories allowed for each meal will be different from the initial targeted calories.
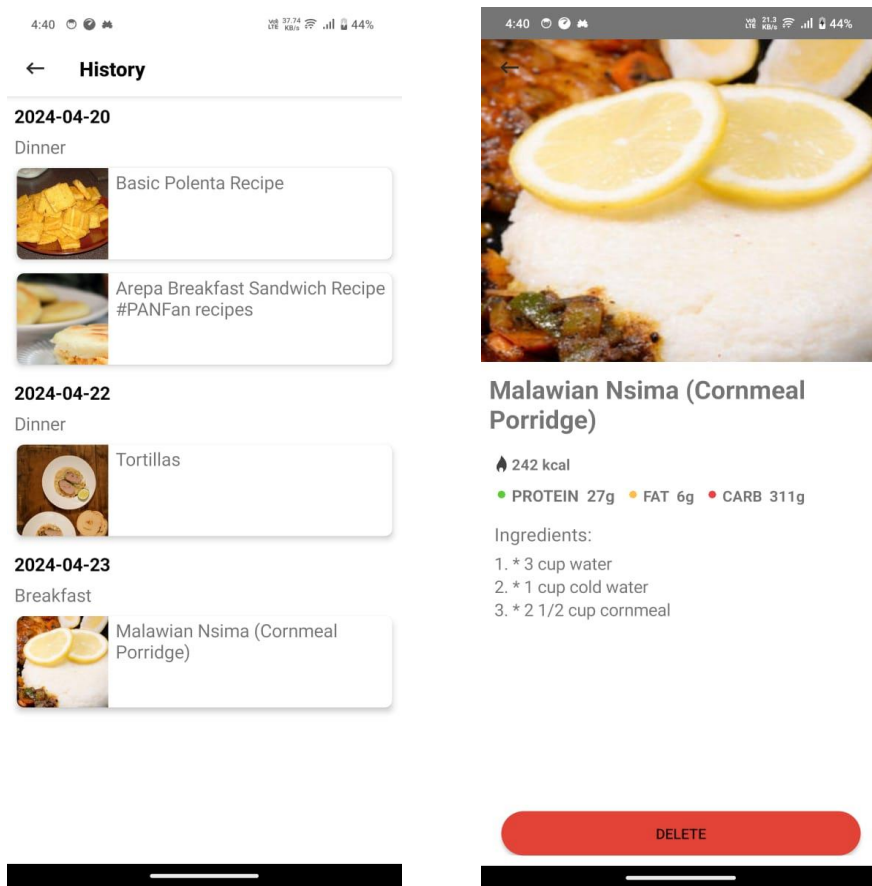
Figure 5.4.13 Meal history and details page

5.4.8   Mood

Clicking on the mood section in the navigation bar or the floating button, it will lead user to the Mood page. A calendar is provided for user to choose which day user wants to view or add. Then, the mood count will display the total number of mood count for that particular date and also count for each remotion. If user wants to add a new record for the date, user can click on the box showing the mood count at the bottom as shown in Figure 5.4.14 and it will navigate user to the history for the date.
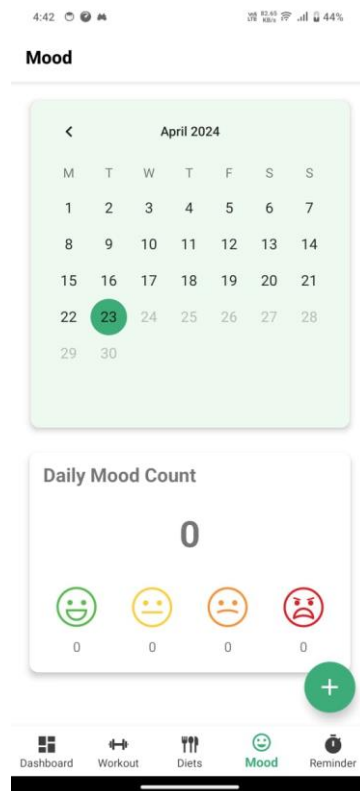
Figure 5.4.14 Mood page

In this history page, user can view all the mood records which as the mood and the time created this new record. User can click on the button if user is planning to add a new record. A pop-up dialog box is shown such as what in Figure 5.4.15 for user to select which method they prefer.
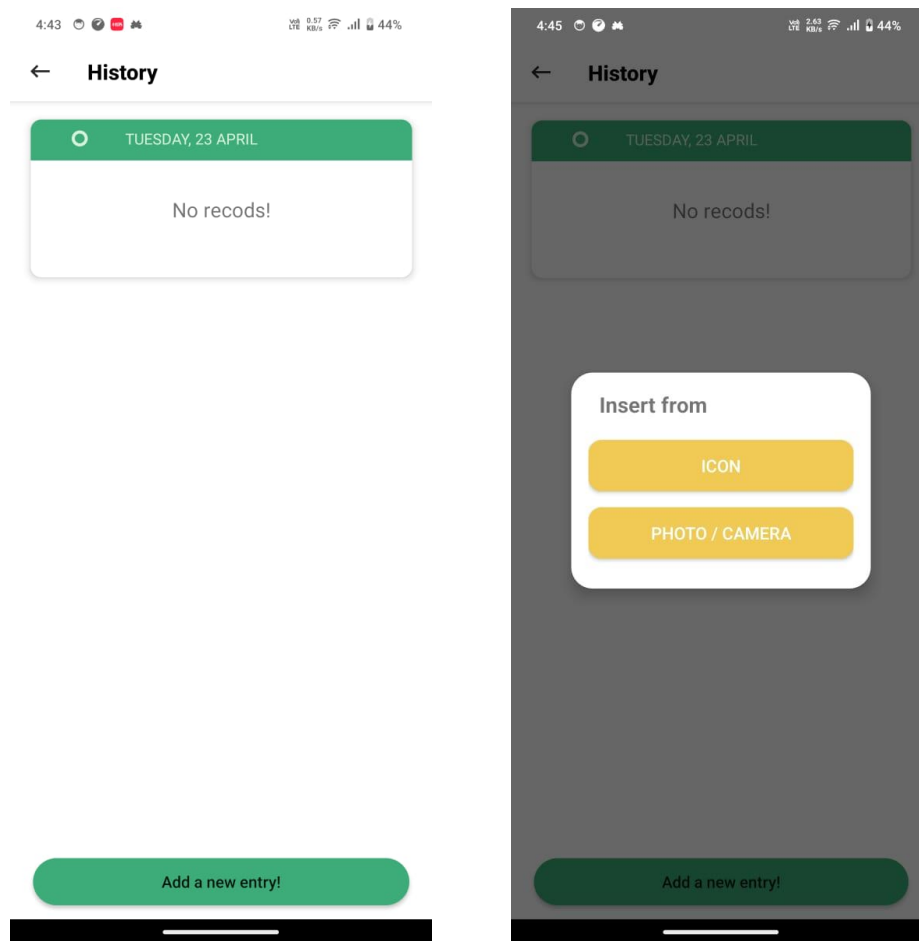
Figure 5.4.15 Mood history page

If user prefer to use the emoji icon, then user should click on the first button. As what we can see from Figure 5.4.16, user can then change the time and select the emoji icon that represents their mood at that time. After that, click the button and will navigate user to a page that having the note field for user to take note. After all is well, user can click the button below to insert a new record to the database.
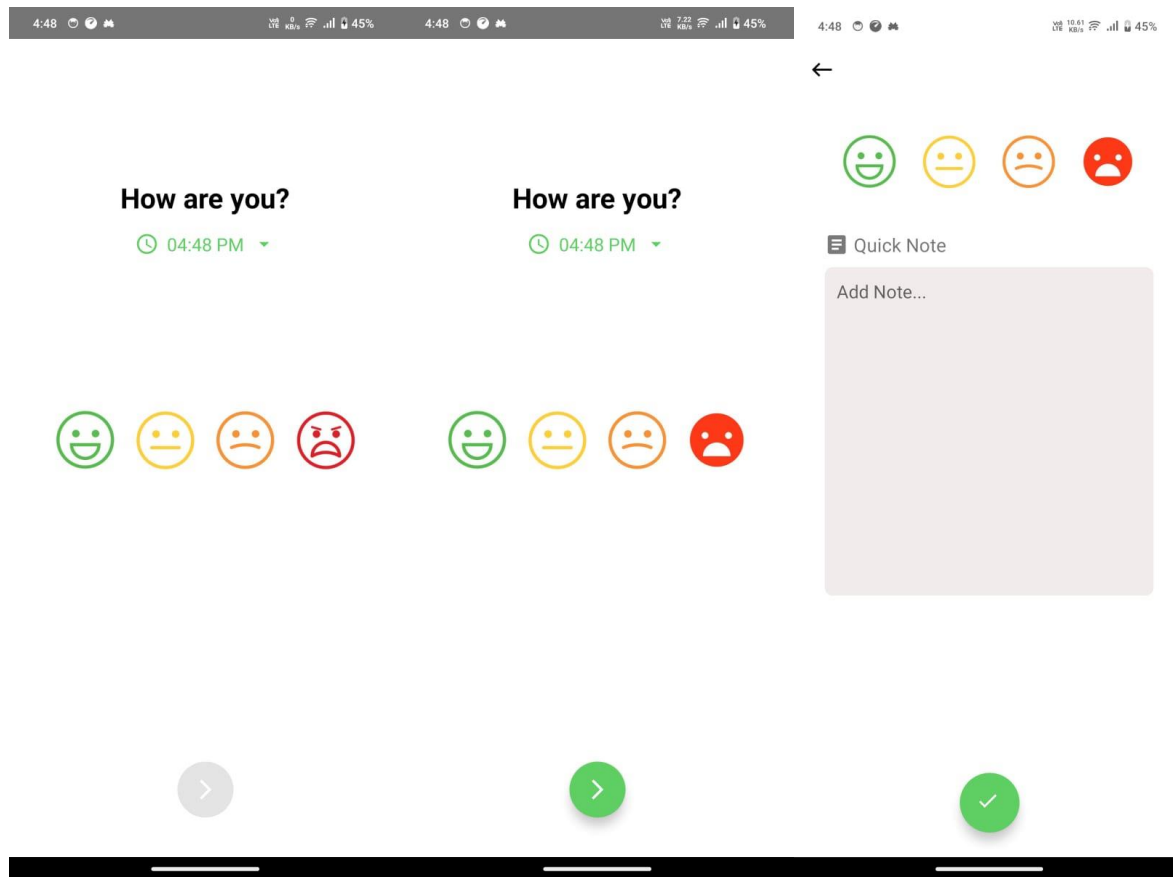
Figure 5.4.16 Add new mood page

Also, if user prefers to use the camera or photo to recognise emotions, user can click on the second button, a page will be shown out for user to use photo from the gallery or take from camera as shown in Figure 5.4.17. For recognising from photo, click the floating button and it will let the user to select which photo. Else, user can click the Camera tab and it will let the user to make an emotion recognition using camera. From both methods, the photo will be used to recognise emotion after that and navigate user to a page showing the emotion detection and having a note input field. Same as previously, user can click the button to confirm the mood added. However, emotion recognition is just allowed for today insertion which it is denied for user to insert using camera for past days as shown in Figure 5.4.17.
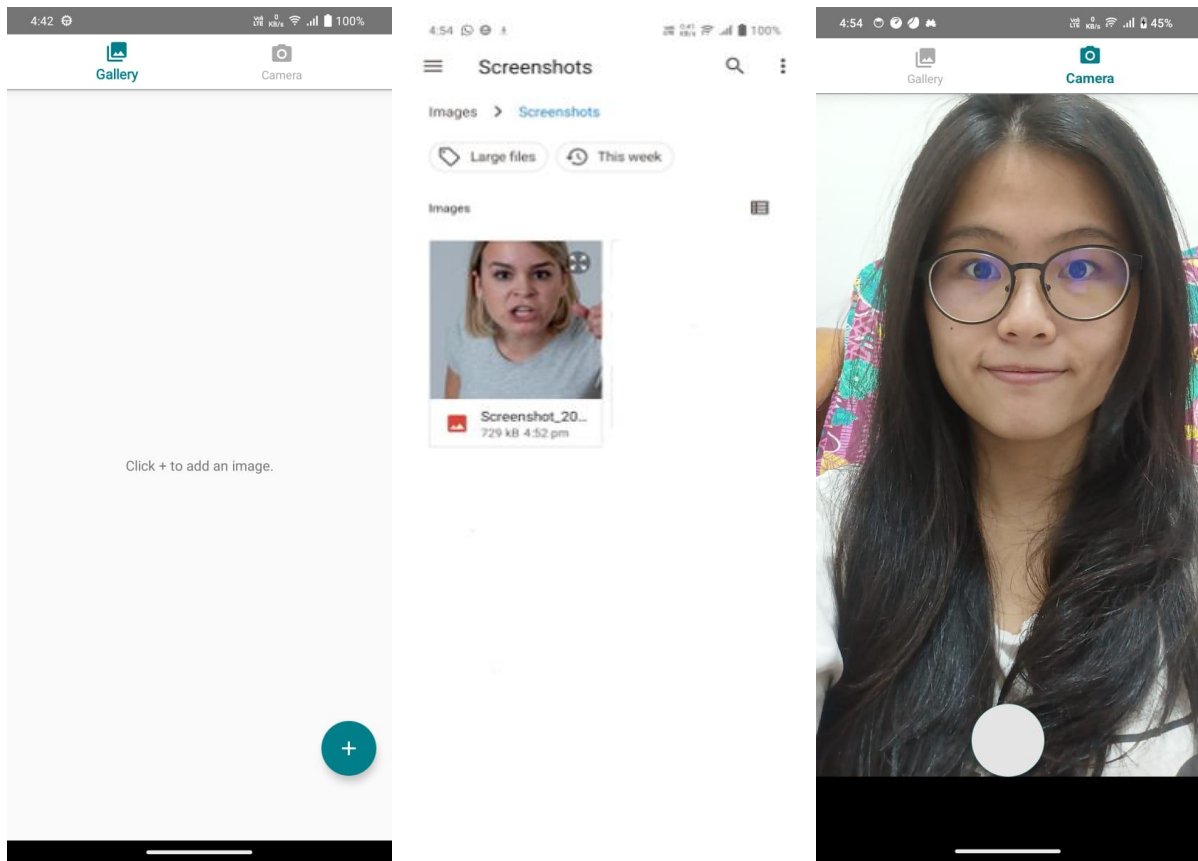
Figure 5.4.17 Mood recognition page

In addition, when adding a new record for mood, it will calculate the average of the past seven days mood records together with the new record. If the average is lower or equal to 2, then a dialog in Figure 5.4.18 will be popped out. It will ask user whether user wants to have some music to appease themselves. If so, it will bring user to a list of music or songs and user can select them, bringing them again to the YouTube app to listen to the music. Else, the process of the mood insertion is considered finish and bring user back to the mood home page.
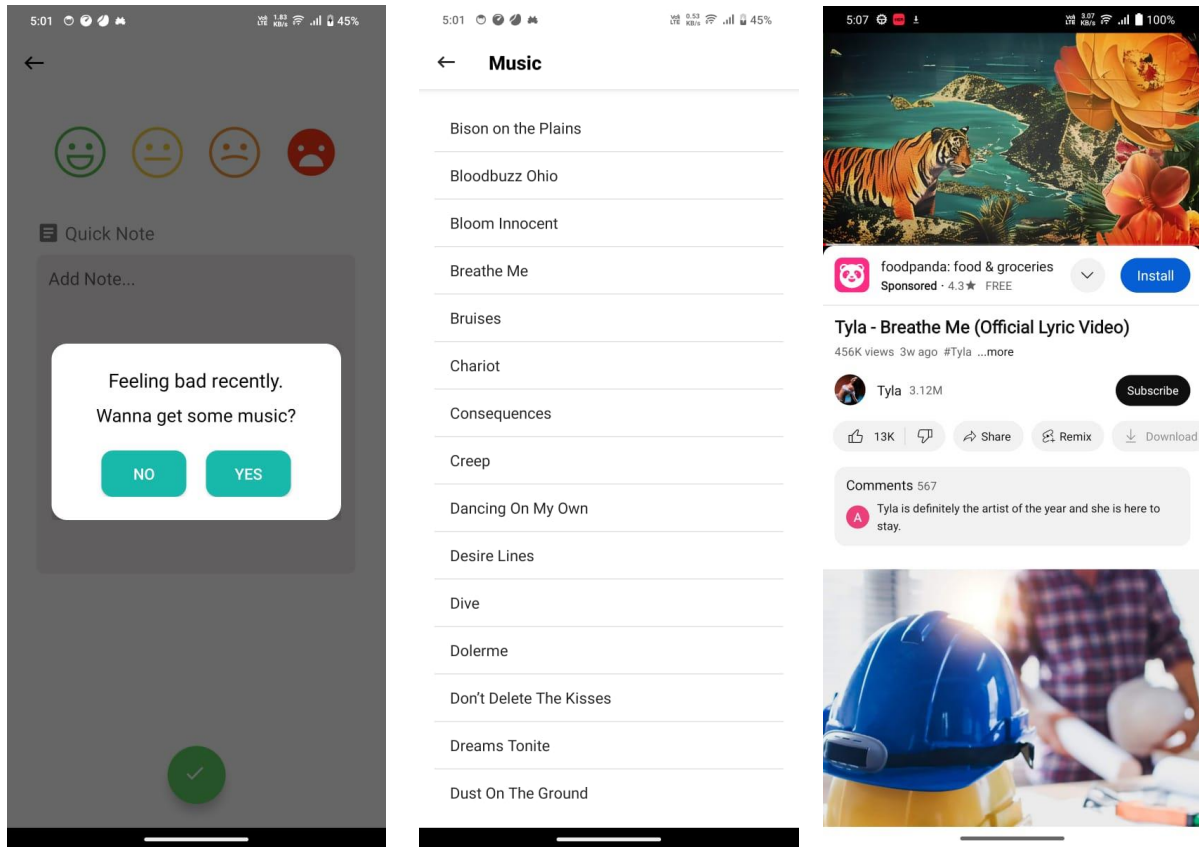
Figure 5.4.18 Music recommendation page

Also, user is given the option to view back the details of the mood records by clicking the mood record that user wants to view. It will bring user to the page in Figure 5.4.19 below. User edits the mood selection and change the note as well as deletes the mood record.
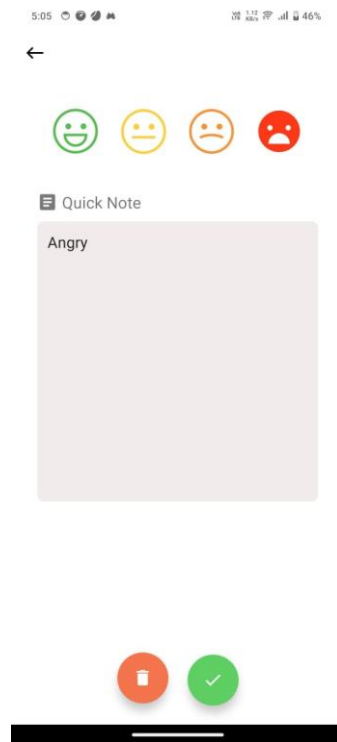
Figure 5.4.19 Mood history details page

5.4.9   Reminder

We also provide a reminder function for user to set a notification alert for anything. Hence, user can choose the reminder section in the navigation bar or the floating button which will bring user to the reminder page shown in Figure 5.4.20. It will display all the notification alert that have been set before or still using. A switch toggle is provided for each reminder so that user can cancel or set the alert again without creating a new reminder. User also can delete the reminder by long pressing on the reminder and click the Delete button. The reminder record will be deleted and unset the alert.
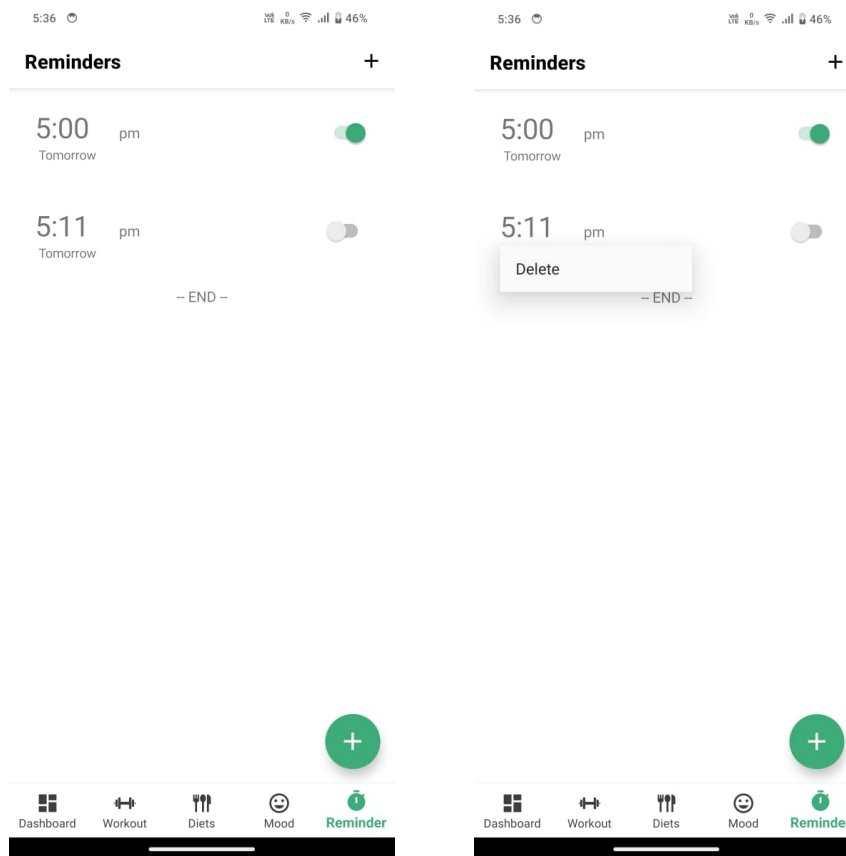
Figure 5.4.20 Reminder page

However, as shown in the Figure above, there is still an Add icon at the action bar for user to click and navigation to the next page to add a new reminder which as shown in Figure 5.4.21, user can enter the title, time and note for this reminder. For input the note, user can either directly key in the details or click on the microphone for the functionality of voice input or speech recognition. User says what he or she wants to jot down, and the spoken words are then translated into text. By clicking on the Set Alarm button, the reminder is set. It will pop out the notification alert when the time set is reached shown in Figure 5.4.21.
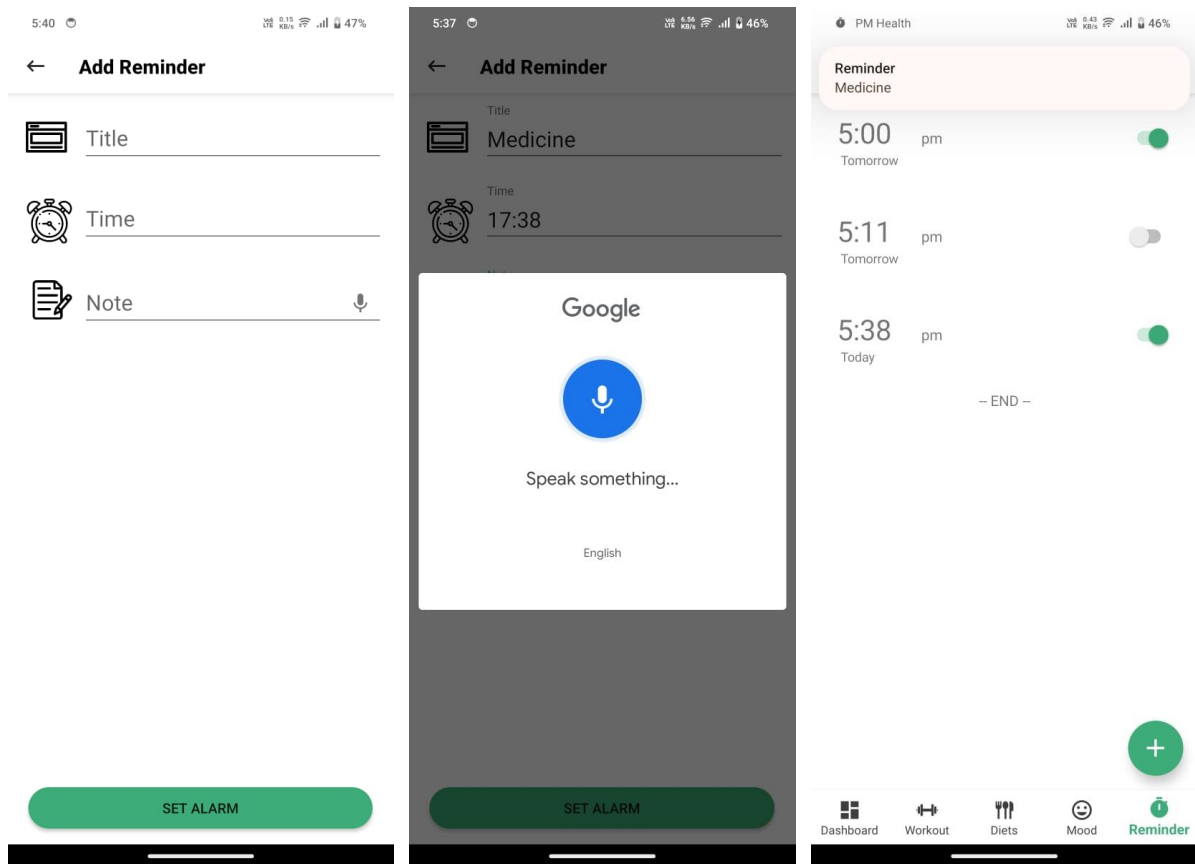
Figure 5.4.21 Add reminder page

As shown in Figure 5.4.22, user is allowed to press on notification alert, and it will display the details of the particular reminder but not allow user to edit it. User is just allowed to set the reminder again for tomorrow at the same time.
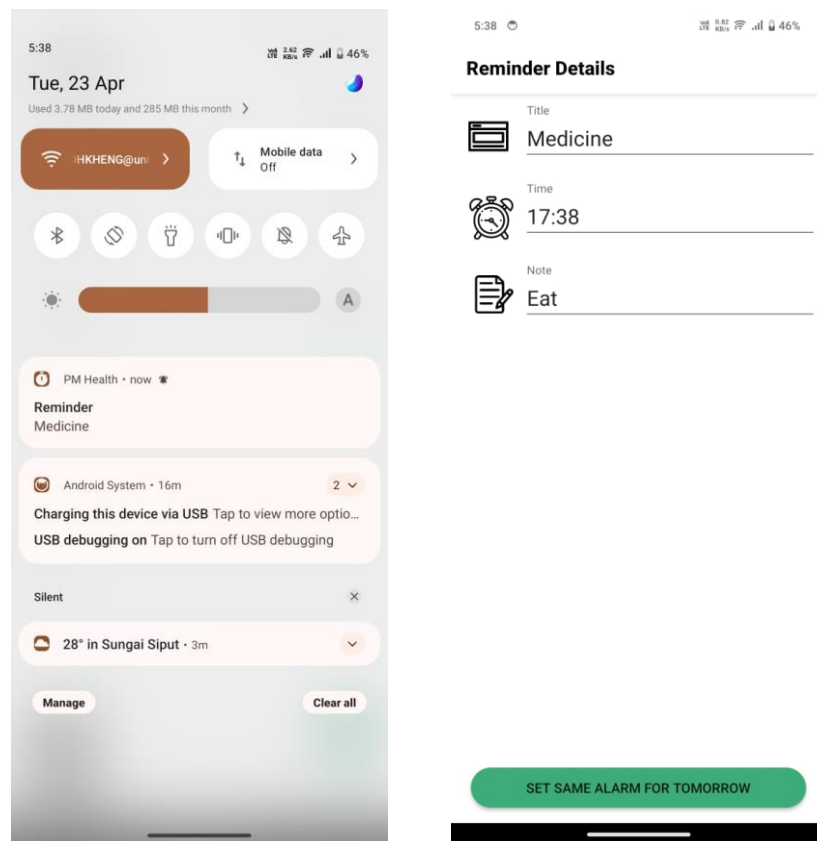
Figure 5.4.22 Notification alert page

5.5   Implementation Issues and Challenges

In order to develop this application, we need to use Android Studio. However, we are lacking knowledge on how to use the Android Studio as we do not learn about it before. We tried hard to search from online to get some ideas and knowledge to use the IDE before taking the course for learning the mobile development so that we are able to finish the work on time.

For using Firebase authentication and Realtime Database used, we faced the challenges that we need to take time to study and learn the configuration for them. A well-designed database is important for developing the application as it needs to store the user information and data and also retrieve data when needed.

Apart from that, we are lacking knowledge on the integration of third-party API and hence it also takes time to learn about it. API is quite important in this project to get the exercises and also the food. One of the most critical issues was that the organization updates

its API and causes the API unable to work in the application. We spent time to study the problem and solved it accordingly.

Moreover, when trying to integrate Mediapipe frameworks, there was having a problem that not much information for use to teach us how to integrate the Mediapipe framework into Android Studio. We can just refer to the documentation and the source code found on the official page. In order to understand the code, we spent a lot of time to discover it. Since we are required to find out the position and the size of frame of the face detected, we need to find out the related code and add codes to get the frame size and position. We then used the information to crop out the image and take the input for recognition.

Besides, the integration of the TensorFlow Lite model is quite challenging. Mode is firstly built in Python using Google Colab and save the model in TensorFlow Lite format. This model should be integrated into the Android Studio so that we are able to use it for recognition. For mentioned above, we need to preprocess the cropped image to match the input format of the model and also the output format. Time was spent to discover the integration part.

The last challenging issue was to discover how the reminder services work in the background. To ensure the reminder works well without error, some testing was required to understand the behaviors of the alarm manager service.

5.6   Concluding Remark

To conclude, this application is tailored to provide a platform for user to enhance their health. By using laptop, mobile devices and Android Studio as well as the software such as Firebase Authentication, Firebase Realtime Database and Firebase Authentication, all the modules are implemented smoothly. Integrating a model for emotion recognition in the application helps to enhance the user experience. Including workout and meal plan, mood tracking and the reminder function, it gives user a better way to manage their physical and mental health. Even there was a series of problem when developing, we are able to solve it according. In short, it helps users to achieve their goal, causing a healthier life.

Chapter 6

System Evaluation and Discussion

6.1 System Testing and Performance Metrics

Use case testing, which is the way we use to identify test cases that cover the application. Each action that can be taken by a user will be tested to ensure the performance of the application. Functionalities are assessed to ensure they align with intended objectives and user expectations.

Sign in and sign up will be validated to make sure that the input is valid as well as to ensure that user is having an account to use the application. Also, testing on insertion, update, deletion or retrieval of data from the database will be performed. Some recommendations provided in the application will also be tested to ensure everything is well-going.

6.2 Testing Setup and Result

6.2.1 Splash Screen Testing

Table 6.1 Splash screen test case

Splash Screen Test Case			
Use Case: Splash Screen			
Function ID: F001			
Date Created: 20/4/2024			
Role: User			
Test Action	**Expected Result**	**Actual Result**	**Pass/Fail**
User launches the application	System displays splash screen when launching	System displays splash screen when launching	Pass

6.2.2 Sign In Testing

Table 6.2 Sign in test case

Sign In Test Case			
Use Case: Sign in			
Function ID: F002			
Date Created: 20/4/2024			
Role: User			
Test Action	**Expected Result**	**Actual Result**	**Pass/Fail**
User does not enter email or password or both.	System shows the message "Please enter your credentials".	System shows the message "Please enter your credentials".	Pass
User enters incorrect email or password.	System shows the message "Invalid email or password".	System shows the message "Invalid email or password".	Pass
User enters email and password correctly.	System validates the credentials and direct user to Dashboard Page.	System validates the credentials and direct user to Dashboard Page.	Pass
User chooses the "Sign up" link.	System directs user to a Register Page.	System directs user to a Register Page.	Pass
User chooses the Facebook or Google icon.	System will create a new account and direct user to answer a questionnaire if it is a new user, else it will validate and direct user to a Dashboard Page.	System will create a new account and direct user to answer a questionnaire if it is a new user, else it will validate and direct user to a Dashboard Page.	Pass

6.2.3 Sign Up Testing

Table 6.3 Sign up test case

Sign Up Test Case			
Use Case: Sign up			
Function ID: F003			
Date Created: 20/4/2024			
Role: User			
Test Action	**Expected Result**	**Actual Result**	**Pass/Fail**
User does not enter any credentials, or just enters email.	System shows the message "Please add your credentials".	System shows the message "Please add your credentials".	Pass
User enters email and either one of the passwords or confirm password field.	System shows the message "Both passwords are not same".	System shows the message "Both passwords are not same".	Pass
User enters all the credentials but password field and confirm password field are different value.	System shows the message "Both passwords are not same".	System shows the message "Both passwords are not same".	Pass
User enters all the credentials but the password or confirm password or both are not more than five digits.	System shows the message "The given password is invalid [Password should be at least 6 characters]".	System shows the message "The given password is invalid [Password should be at least 6 characters]".	Pass

User enters all the credentials and the password and confirm password are same value, but the email format is invalid.	System shows the message "The email address is badly formatted".	System shows the message "The email address is badly formatted".	Pass
User enters all the credentials correctly.	System redirects user to answer a questionnaire.	System redirects user to answer a questionnaire.	Pass
User chooses the "Log in" link.	System redirects user to a Login Page.	System redirects user to a Login Page.	Pass

6.2.4 View Dashboard Testing

Table 6.4 View dashboard test case

View Dashboard Test Case			
Use Case: View dashboard			
Function ID: F004			
Date Created: 20/4/2024			
Role: User			
Test Action	**Expected Result**	**Actual Result**	**Pass/Fail**
User is being navigated to Dashboard page.	System displays the calories, carbohydrates, proteins and fat left, the daily calories targeted, calories burnt, calories consumed, calories consumed for each meal, calories burnt for exercises and mood count. All this information is according to a chosen date.	System displays the calories, carbohydrates, proteins and fat left, the daily calories targeted, calories burnt, calories consumed, calories consumed for each meal, calories burnt for exercises and mood count. All this information is according to a chosen date.	Pass

User selects the person icon.	System navigates user to a Profile page.	System navigates user to a Profile page.	Pass
User selects the logout icon.	System brings user to a Login page and user account has been logout.	System brings user to a Login page and user account has been logout.	Pass
User changes the date by scroll left or right or clicks the arrow buttons.	System displays information based on the date chosen.	System displays information based on the date chosen.	Pass
User clicks on the area box of the meal type if the date is today.	System redirects user to a Saved Meal page.	System redirects user to a Saved Meal page.	Pass
User clicks on the exercise area box if the date is today.	System redirects user to a Workout page.	System redirects user to a Workout page.	Pass
User clicks on the mood count area box if the date is today.	System redirects user to a Mood History page.	System redirects user to a Mood History page.	Pass

6.2.5 View Profile Testing

Table 6.5 View profile test case

View Profile Test Case			
Use Case: View Profile			
Function ID: F005			
Date Created: 20/4/2024			
Role: User			
Test Action	**Expected Result**	**Actual Result**	**Pass/Fail**
User is being navigated to Profile page.	System retrieves the necessary user data from database and displays.	System retrieves the necessary user data from database and displays.	Pass

6.2.6 Edit Profile Testing

Table 6.6 Edit profile test case

Edit Profile Test Case			
Use Case: Edit profile			
Function ID: F006			
Date Created: 20/4/2024			
Role: User			
Test Action	**Expected Result**	**Actual Result**	**Pass/Fail**
User edits the value of the input fields.	The chosen or edited value will be displayed accordingly.	The chosen or edited value will be displayed accordingly.	Pass
User clicks the Save button.	System saves the information details to the database.	System saves the information details to the database.	Pass

6.2.7 Add Workout Testing

Table 6.7 Add workout test case

Add Workout Test Case			
Use Case: Add workout			
Function ID: F007			
Date Created: 20/4/2024			
Role: User			
Test Action	**Expected Result**	**Actual Result**	**Pass/Fail**
User is being navigated to Workout page.	System displays the targeted muscle names.	System displays the targeted muscle names.	Pass
User selects one of the targeted muscle names.	System shows a list of exercises.	System shows a list of exercises.	Pass
User selects one of the exercises.	System displays the exercise GIFs.	System displays the exercise GIFs.	Pass

User selects the pause button.	Timer will be stopped.	Timer will be stopped.	Pass
User selects the previous button.	System displays the previous exercise GIF.	System displays the previous exercise GIF.	Pass
User selects the next button.	System displays the next exercise GIF.	System displays the next exercise GIF.	Pass
User completes the exercise.	System calculates the calories burnt and stores it in the database.	System calculates the calories burnt and stores it in the database.	Pass

6.2.8 Add Meal Testing

Table 6.8 Add meal test case

Add Meal Test Case			
Use Case: Add meal			
Function ID: F008			
Date Created: 20/4/2024			
Role: User			
Test Action	**Expected Result**	**Actual Result**	**Pass/Fail**
User is being navigated to Diet page.	System displays four categories of meals.	System displays four categories of meals.	Pass
User clicks on one of the meal types.	System displays all the foods related to the meal type selected with images and name according to user's number of calories allowed to consumed daily for the specific meal.	System displays all the foods related to the meal type selected with images and name according to user's number of calories allowed to consumed daily for the specific meal.	Pass
User selects one of the foods.	A dialog will be popped out, showing the food image, name and number	A dialog will be popped out, showing the food image, name and number	Pass

	of calories. It also contains two buttons.	of calories. It also contains two buttons.	
User selects the cancel button from the dialog.	The dialog disappears.	The dialog disappears.	Pass
User selects the add button from the dialog.	The food selected will be saved to database for recording the meal saved and the dialog disappear.	The food selected will be saved to database for recording the meal saved and the dialog disappear.	Pass
User clicks on the first icon in the action bar from the Diet page.	System displays all the foods saved according to the meal type for today only in the Saved Meal page.	System displays all the foods saved according to the meal type for today only in the Saved Meal page.	Pass
User selects one of the foods from the Saved Meal page.	System displays the information of the food chosen such as the food image, name, number of calories, carbohydrates, proteins and fats as well as ingredients.	System displays the information of the food chosen such as the food image, name, number of calories, carbohydrates, proteins and fats as well as ingredients.	Pass
User selects the add button	The food information is being saved into the database and it will be used to calculate the number of calories, carbohydrates, protein and fat consumed.	The food information is being saved into the database and it will be used to calculate the number of calories, carbohydrates, protein and fat consumed.	Pass
User selects the delete button.	System deletes the food information from the database, and it will not be shown anymore.	System deletes the food information from the database, and it will not be shown anymore.	Pass

6.2.9 View Meal History Testing

Table 6.9 View meal history test case

View Meal History Test Case			
Use Case: View meal history			
Function ID: F009			
Date Created: 20/4/2024			
Role: User			
Test Action	**Expected Result**	**Actual Result**	**Pass/Fail**
User clicks on the second icon in the action bar from the Diet page.	System displays all the foods that had been consumed before in sequence of date.	System displays all the foods that had been consumed before in sequence of date.	Pass
User selects one of the meal records.	System displays the information of the selected meal such as the food image, name, number of calories, carbohydrates, proteins and fats as well as ingredients.	System displays the information of the selected meal such as the food image, name, number of calories, carbohydrates, proteins and fats as well as ingredients.	Pass

6.2.10 Delete Meal Testing

Table 6.10 Delete meal test case

Delete Meal Test Case			
Use Case: Delete meal			
Function ID: F010			
Date Created: 20/4/2024			
Role: User			
Test Action	**Expected Result**	**Actual Result**	**Pass/Fail**
User selects the delete button in the Meal History Details page.	System deletes the related food record from the database and recalculate the number of calories, carbohydrates, protein and fats consumed.	System deletes the related food record from the database and recalculate the number of calories, carbohydrates, protein and fats consumed.	Pass

6.2.11 View Mood History Testing

Table 6.11 View mood history test case

View Mood History Test Case			
Use Case: View mood history			
Function ID: F011			
Date Created: 20/4/2024			
Role: User			
Test Action	**Expected Result**	**Actual Result**	**Pass/Fail**
User is being navigated to Mood page.	System shows a calendar and the mood count for today.	System shows a calendar and the mood count for today.	Pass
User selects a date.	System displays the mood count for the date chosen.	System displays the mood count for the date chosen.	Pass

User clicks on the mood count box.	System navigates user to a Mood History page.	System displays all the mood records according to the date chosen.	Pass
User clicks on a specific mood record.	System directs user to a Mood Details page.	System directs user to a Mood Details page.	Pass

6.2.12 Add Mood Testing

Table 6.12 Add mood test case

Add Mood Test Case			
Use Case: Add mood			
Function ID: F012			
Date Created: 20/4/2024			
Role: User			
Test Action	**Expected Result**	**Actual Result**	**Pass/Fail**
User clicks on a "Add a new entry!" button in the Mood History page.	System pops out a dialog showing the method to insert a new mood record.	System pops out a dialog showing the method to insert a new mood record.	Pass
User selects the Icon button.	System directs user to a New Mood page.	System directs user to a New Mood page.	Pass
User selects the Photo/Camera button.	System brings user to an Emotion Recognition page.	System brings user to an Emotion Recognition page.	Pass
User selects the Gallery button in Emotion Recognition page.	System displays a plus button for user to choose and upload photo from phone's gallery.	System displays a plus button for user to choose and upload photo from phone's gallery.	Pass
User has finished upload the photo.	System sends the photo for recognition and navigates user to New Mood page with result if everything runs well.	System sends the photo for recognition and navigates user to New Mood page	Pass

		with result if everything runs well.	
User selects the Camera button in Emotion Recognition page.	System starts the phone's front camera.	System starts the phone's front camera.	Pass
User clicks the round button in the camera fragment.	System captures the photo and sends the photo for recognition and navigates user to Add Details Page with result.	System captures the photo and sends the photo for recognition and navigates user to Add Details Page with result.	Pass
More than one face is detected on the photo.	System shows the message "Only allowed for one face in one photo".	System shows the message "Only allowed for one face in one photo".	Pass
No face is detected on the photo.	System shows the message "No face detected".	System shows the message "No face detected".	Pass
User is being navigated to New Mood page.	System shows the result directly from the recognition if user chooses the Photo/Camera method, else it just displays the icons for user to choose.	System shows the result directly from the recognition if user chooses the Photo/Camera method, else it just displays the icons for user to choose.	Pass
User selects the time.	The time will be updated according to what user set.	The time will be updated according to what user set.	Pass
User selects the round button.	System will show the input fields and a mark icon button.	System will show the input fields and a mark icon button.	Pass
User enters the details about the mood.	The information will be updated according to what user set.	The information will be updated according to what user set.	Pass
User clicks on the mark icon button.	The details set will be saved into database. System also will display a dialog if user is	The details set will be saved into database. System also will display a dialog if	Pass

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	detected under bad mood for the past 7 days to let user choose whether user wants to listen to some music.	user is detected under bad mood for the past 7 days to let user choose whether user wants to listen to some music.	
User clicks on the yes button in the dialog.	System shows a list of music to let user choose which he or she wants.	System shows a list of music to let user choose which he or she wants.	Pass
User selects one of the music.	System navigates user to the YouTube app to listen to the music.	System navigates user to the YouTube app to listen to the music.	Pass
User clicks on the no button in the dialog.	The dialog disappears and brings user back to the Mood page.	The dialog disappears and brings user back to the Mood page.	Pass

6.2.13 Delete Mood Testing

Table 6.13 Delete mood test case

Delete Mood Test Case			
Use Case: Delete mood			
Function ID: F013			
Date Created: 20/4/2024			
Role: User			
Test Action	**Expected Result**	**Actual Result**	**Pass/Fail**
User clicks on the dustbin icon button in the New Mood Page.	The specific record will be deleted from database.	The specific record will be deleted from database.	Pass

6.2.14 Edit Mood Testing

Table 6.14 Edit mood test case

Edit Mood Test Case			
Use Case: Edit mood			
Function ID: F014			
Date Created: 20/4/2024			
Role: User			
Test Action	**Expected Result**	**Actual Result**	**Pass/Fail**
User is being navigated to Mood Details page	System shows the details about the mood records, a button with dustbin icon and a mark icon button.	System shows the details about the mood records, a button with dustbin icon and a mark icon button.	Pass
User enters the details about the mood.	The information will be updated according to what user set.	The information will be updated according to what user set.	Pass
User clicks on the dustbin icon button.	The specific record will be deleted from database.	The specific record will be deleted from database.	Pass
User clicks on the mark icon button.	The details set will be saved into database. System also will display a dialog if user is detected under bad mood for the past 7 days to let user choose whether user wants to listen to some music.	The details set will be saved into database. System also will display a dialog if user is detected under bad mood for the past 7 days to let user choose whether user wants to listen to some music.	Pass

6.2.15 View Reminders Testing

Table 6.15 View reminders test case

View Reminders Test Case			
Use Case: View reminders			
Function ID: F015			
Date Created: 20/4/2024			
Role: User			
Test Action	**Expected Result**	**Actual Result**	**Pass/Fail**
User is being navigated to Reminder page.	System displays all the reminders that has been set before.	System displays all the reminders that has been set before.	Pass
User selects the plus icon in the action bar.	System directs user to a Reminder Setup page.	System directs user to a Reminder Setup page.	Pass
User clicks on a reminder record.	System redirects user to a Reminder Details page.	System redirects user to a Reminder Details page.	Pass

6.2.16 Set Reminder Testing

Table 6.16 Set reminder test case

Set Reminder Test Case			
Use Case: Set reminder			
Function ID: F016			
Date Created: 20/4/2024			
Role: User			
Test Action	**Expected Result**	**Actual Result**	**Pass/Fail**
User enters the details.	System displays the values accordingly.	System displays the values accordingly.	Pass
User clicks on the microphone icon.	System performs speech to text function to record what user wants to note.	System performs speech to text function to record what user wants to note.	Pass

User clicks on the set alarm button.	System sets a new notification alert according to the time set.	System sets a new notification alert according to the time set.	Pass

6.2.17 Edit Reminder Testing

Table 6.17 Edit reminder test case

Edit Reminder Test Case			
Use Case: Edit reminder			
Function ID: F017			
Date Created: 20/4/2024			
Role: User			
Test Action	**Expected Result**	**Actual Result**	**Pass/Fail**
User is being navigated to Reminder Details page.	System displays the specific reminder details such as title, time and note.	System displays the specific reminder details such as title, time and note.	Pass
User edits the value of the input fields.	The chosen or edited value will be displayed accordingly.	The chosen or edited value will be displayed accordingly.	Pass
User clicks on the microphone icon.	System performs speech to text function to record what user wants to note.	System performs speech to text function to record what user wants to note.	Pass
User clicks on the update alarm button.	System updates the specific notification alert according to the time set.	System updates the specific notification alert according to the time set.	Pass
User turns on the switch of a reminder in the Reminder Page.	System sets again the notification alert for the specific reminder.	System sets again the notification alert for the specific reminder.	Pass
User turns off the switch of a reminder in the Reminder Page.	System cancels the notification alert for the specific reminder.	System cancels the notification alert for the specific reminder.	Pass

6.2.18 Delete Reminder Testing

Table 6.18 Delete reminder test case

Delete Reminder Test Case			
Use Case: Delete reminder			
Function ID: F018			
Date Created: 20/4/2024			
Role: User			
Test Action	**Expected Result**	**Actual Result**	**Pass/Fail**
User long presses a reminder in the Reminder page.	System displays a delete selection.	System displays a delete selection.	Pass
User chooses the delete selection.	System deletes the reminder records from the local preferences and cancels notification alert for the specific reminder.	System deletes the reminder records from the local preferences and cancels notification alert for the specific reminder.	Pass

6.2.19 Bottom Navigation Bar

Table 6.19 Bottom navigation bar test case

Bottom Navigation Bar Test Case			
Use Case: Bottom Navigation Bar			
Function ID: F019			
Date Created: 20/4/2024			
Role: User			
Test Action	**Expected Result**	**Actual Result**	**Pass/Fail**
User clicks on the Dashboard button.	User will be brought to the Dashboard page.	User will be brought to the Dashboard page.	Pass

User clicks on the Workout button.	User will be brought to the Workout page.	User will be brought to the Workout page.	Pass
User clicks on the Diet button.	User will be brought to the Diet page.	User will be brought to the Diet page.	Pass
User clicks on the Mood button.	User will be brought to the Mood page.	User will be brought to the Mood page.	Pass
User clicks on the Reminder button.	User will be brought to the Reminder page.	User will be brought to the Reminder page.	Pass

6.2.20 Floating Button

Table 6.20 Floating button test case

Floating Button Test Case			
Use Case: Floating button			
Function ID: F020			
Date Created: 20/4/2024			
Role: User			
Test Action	**Expected Result**	**Actual Result**	**Pass/Fail**
User clicks on the floating button with plus icon.	System changes the plus icon to cross icon and displays other four floating buttons.	System changes the plus icon to cross icon and displays other four floating buttons.	Pass
User clicks on the first floating button.	System brings user to the reminder page.	System brings user to the reminder page.	Pass
User clicks on the second floating button.	System brings user to the Mood page.	System brings user to the Mood page.	Pass
User clicks on the third floating button.	System brings user to the Diet page.	System brings user to the Diet page.	Pass
User clicks on the first floating button.	System brings user to the Workout page.	System brings user to the Workout page.	Pass

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User clicks on the floating button with cross icon.	Four of the floating buttons above disappear and the cross icon is changed to plus icon.	Four of the floating buttons above disappear and the cross icon is changed to plus icon.	Pass

6.3 Project Challenges

Challenge faced during the project was managing the complexity of integrating multiple software components and hardware platforms. To use the Firebase Realtime Database, Firebase Authentication and Firebase Storage in Android mobile devices and laptops, we need a comprehensive planning to ensure everything run well and is able to take the data from the database. The project became even more difficult when diagnosing and debugging problems resulting from the interaction between different components was required especially when integrating the Mediapipe framework and modify the output. Problem in using the model also arose due to the output and input format of the model.

6.4 Objectives Evaluation

The first objective in this project is to develop a mobile application that provides recommended workout and meal plan based on their information and goals and it has been achieved. This application creates plans that provide guidance on fitness and nutrition. A recommended plan is created using user data by getting the exercises examples and meal examples from API. For the workout module, exercises will be recommended based on the target muscles user hopes to train and the calories burned will be recorded. Calories burned will be involved in calculation to determine the meal suggestion. By calculating the daily calories for each meal, user can get a more comprehensive suggestion for their diets. The calories intake for each meal will be logged and recalculate the calories to ensure that calorie used to find the next meal has been reduced as well. In short, this objective is reached to enhance the user experience.

The second objective is to propose an automatic mood detection to recognise user's emotion correctly and it has been successfully developed. Deep learning is used to implement this automatic mood recognition using a camera or photo from gallery by training a model to detect the mood. It helps to promote mental health as users may become more aware of their emotions using this tool to detect their mood correctly. It tracks the user's mood which at the

same time, gives help for those who are having mood disorders but facing difficulties getting mental health services due to some personal issues. It improves the accuracy and reliability of mood tracking using deep learning as there is no bias on recognition of emotions. Some music recommendations are provided for the user to relax if user is detected to be always in low mood in past 7 days.

In summary, each of the objectives outlined at the project's outset has undergone rigorous evaluation, resulting in the confirmation of their successful achievement. We have ensured that every aspect of our project aligns with its intended goals and delivers the desired outcomes. This comprehensive evaluation process has provided valuable insights into the effectiveness of the project to meet the objectives to help users to improve their physical and mental health.

6.5   Concluding Remark

In conclusion, use case testing is used to measure the performance of this application to ensure that the application meets the requirements. The use case testing involves assessing and confirming that all system functionalities perform as intended. These experiments have shown really pleasing findings, precisely matching our anticipated outcomes. This reinforces the application's robustness and unwavering quality, providing assurance about its ability to properly satisfy customer demands.

Chapter 7

Conclusion and Recommendation

7.1 Conclusion

Everyone has the risk to have any chronic diseases even though they are young. Chronic illnesses keep increasing these years particularly due to people having unhealthy diets, excessive alcohol and tobacco use and lacking physical activities. Hence, comprehensive solution to deal with physical and mental health needs is increasing. Some of the existing healthcare applications only focus on normal workout and meal plans for taking care of their health and wellness. However, it is actually insufficient to just use the normal plan that may not be suitable to the user. Finding a suitable workout and meal plan is essential for everyone to increase effectiveness.

Besides, most of the health applications do not integrate physical healthcare services with mental healthcare services. Both are closely interconnected to determine the health condition. Integration of both services is implemented and is used for tracking their daily physical activities, diets and also mental health to take care of their own health. This application creates plans that provide guidance on fitness and nutrition. A recommended plan is created using user data by getting the exercises examples and meal examples from API call. It is more attractive and effective for users to hit their targeted goals as well as the targeted muscle they want to get stronger.

Finally, healthcare applications that track the user's mood may be incorrect or insufficient to express the user's emotion by just using a limited amount of emojis. Bias in reporting by users leads to incomplete or inaccurate data. It may affect the correctness of the result for the determination of the user's health condition. Therefore, this app aims to provide an automatic mood detection to log and track their emotions daily. Deep learning is used to implement this automatic mood detection using a camera or photo from gallery by training a model to recognise the user's mood. It identifies the patterns that result in negative impact on their mental health. It also improves the accuracy and reliability of mood tracking using deep learning as there is no bias on recognition of emotions.

In conclusion, integration of physical and mental healthcare features into one application with workout and meal recommendation as well as mood recognition. Physical healthcare that is provided in the application is related to fitness and dieting. Mental healthcare such as mood tracking and enabling some reminders to users is also being implemented in the application.

7.2   Recommendation

To provide a more comprehensive application, an interactive chatbot designed to offer advice on low mood can engage users in meaningful conversations, providing personalized support and coping strategies tailored to their emotional well-being. Moreover, when integrated with wearable fitness devices, it can significantly enhance workout tracking capabilities, offering users real-time insights into their physical activity levels and progress. Furthermore, by incorporating the largest workout and diet database, users gain access to a broader range of options for improved workout routines and meal suggestions, enriching their fitness journey. Besides, adding the function to generate daily and monthly reports not only aids in user improvement but also facilitates sharing vital health data with healthcare professionals. This feature not only enhances user accountability but also enables informed discussions with doctors regarding progress and potential adjustments to fitness and dietary regimens.

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FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S3	Study week no.: 2
Student Name & ID: Grace Lai Meng Huey 2001861	
Supervisor: Ts Dr Chai Meei Tyng	
Project Title: Development of Physical and Mental Healthcare Application	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

Reviewed FYP1 and found the suitable API for meal plan.

2. WORK TO BE DONE

Continue to implement the diet module.

3. PROBLEMS ENCOUNTERED

Hard to find a suitable API.

4. SELF EVALUATION OF THE PROGRESS

Tasks were completed within expected timeframe.

_____
Supervisor's signature

_____
Student's signature

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FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S3	Study week no.: 4
Student Name & ID: Grace Lai Meng Huey 2001861	
Supervisor: Ts Dr Chai Meei Tyng	
Project Title: Development of Physical and Mental Healthcare Application	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

Diet module was done and discovered the emotion recognition model.
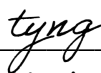
2. WORK TO BE DONE

Start to train the model.

3. PROBLEMS ENCOUNTERED

Faced some problems to work with the API and the calculation of correct number of calories allowed to consume.

4. SELF EVALUATION OF THE PROGRESS

Tasks were completed within expected timeframe.

_____
Supervisor's signature

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Student's signature

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FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S3	Study week no.: 6
Student Name & ID: Grace Lai Meng Huey 2001861	
Supervisor: Ts Dr Chai Meei Tyng	
Project Title: Development of Physical and Mental Healthcare Application	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

Model was trained and saved in TensorFlow Lite format.

2. WORK TO BE DONE

Integrate the model into Android Studio and complete the mood module.

3. PROBLEMS ENCOUNTERED

Trying hard to discover the model structure and preprocess the data.

4. SELF EVALUATION OF THE PROGRESS

Has to study more on training a model.

_____
Supervisor's signature

_____
Student's signature

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FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S3	Study week no.: 8
Student Name & ID: Grace Lai Meng Huey 2001861	
Supervisor: Ts Dr Chai Meei Tyng	
Project Title: Development of Physical and Mental Healthcare Application	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

Integration of model was done and used to get the result. Hence mood module was done.

2. WORK TO BE DONE

Finish the reminder module and improve the UI.

3. PROBLEMS ENCOUNTERED

Faced difficulty when integrating the model as need to preprocess the input in the Android Studio and use correct data type to get the output as well. Also, Mediapipe framework was used and need to study the framework to crop the detected face from the image to act as the input of the model.

4. SELF EVALUATION OF THE PROGRESS

Tasks were completed within expected timeframe.

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tyng
Supervisor's signature

_____
Student's signature

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FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S3	**Study week no.: 10**
Student Name & ID: Grace Lai Meng Huey 2001861	
Supervisor: Ts Dr Chai Meei Tyng	
Project Title: Development of Physical and Mental Healthcare Application	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

Reminder module was completed and UI was also improved. Solved some problems found.

2. WORK TO BE DONE

Do testing and start to do the report.

3. PROBLEMS ENCOUNTERED

API used for meal plan is updated and need to solve it.

4. SELF EVALUATION OF THE PROGRESS

Tasks were completed within expected timeframe.

_____
Supervisor's signature

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Student's signature

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FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S3	Study week no.: 12
Student Name & ID: Grace Lai Meng Huey 2001861	
Supervisor: Ts Dr Chai Meei Tyng	
Project Title: Development of Physical and Mental Healthcare Application	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

All the module was work expectedly and completed the report.

2. WORK TO BE DONE

Finalise the report and submit.

3. PROBLEMS ENCOUNTERED

No problem encountered.

4. SELF EVALUATION OF THE PROGRESS

Tasks were completed within expected timeframe.

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Supervisor's signature

_____
Student's signature

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Full Name(s) of Candidate(s)	Grace Lai Meng Huey
ID Number(s)	2001861
Programme / Course	CS
Title of Final Year Project	Development of Physical and Mental Healthcare Application

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Based on the above results, I hereby declare that I am satisfied with the originality of the Final Year Project Report submitted by my student(s) as named above.

_____ *tyng* _____   _____

Signature of Supervisor   Signature of Co-Supervisor

Name: __Chai Meei Tyng__   Name: _____

Date: __26/04/2024__   Date: _____

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UNIVERSITI TUNKU ABDUL RAHMAN

FACULTY OF INFORMATION & COMMUNICATION TECHNOLOGY
(KAMPAR CAMPUS)
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Student Name	Grace Lai Meng Huey
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