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A Glance to Develop an Emotional-Persuasive Habit-Change Support Mobile Application for Heart Disease Patients (BeHabit)

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Abstract

Heart disease is stated as the world's biggest killer. The risk factors of this deadly disease are due to some bad habits such as being overweight, bad eating diet, smoking, assumption of alcohol, etc. Nevertheless, patients can live a healthy lifestyle if they have the proper guidance of persuasive-emotional featured technologies. In line with this, this study focuses on developing an emotional-persuasive habit-change support mobile application called BeHabit to improve heart disease patients' lifestyles. Persuasive-emotional features are two different features that are integrated with BeHabit to distinguish this application from the existing ones. The proposed system is designed, implemented, tested, and evaluated by 10 users. In conclusion, the users are satisfied to used BeHabit to change their bad habits. Emotional and persuasive features that are integrated into BeHabit are the key to help patients to change their bad habits. BeHabit and the integrated feature can be used as a guideline for healthcare developers and providers for the improvement of mHealth services.

Keywords: Heart disease, mHealth, Habit-change, Persuasive, Emotional features, Mood, Medical Information System.

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Introduction

The use of mHealth in the medical world has been a massive game-changer to the healthcare industry as patients have access to the latest and best reliable medical resources, treatments, good communication with doctors, and many more. Emerging mobile technology provides a platform for patients to be more aware of self-care, reduce hospitalization and mortality rates by 21% and 20% respectively (Clark et al., 2007). The rate of heart disease is relentlessly expanding and is becoming one of the biggest killers. Nonetheless, there are many ways to prevent heart disease by following good habits such as exercising 30 minutes a day on most days of the week, eating a healthy diet, maintaining an ideal weight, reduce stress, and many countless efforts that can be taken.

Nevertheless, persuasive-emotional features are two different technologies with each being researched individually. Persuasive technology is the study of computers known as Captology. It is the study of interactive technology that helps to change the user's habit. A study by (Fogg, 1998), has presented five perspectives on computers and persuasion where it is the primary research to emphasize further to understand more on persuasive computing. On the other hand, emotional technology is the new platform for further improvement in the artificial intelligence area where it measures biometric information to define emotion as a computation for different computer applications. Recently, there had an increase in demand for its application to various fields. In this scenario, emotionally featured technology is key to help patients to guide their emotions in a way so that they could change their bad habits.

The health habits of heart disease patients play a major role in mortality. Patients are advised to exercise regularly. According to medical experts, when it comes to exercising, it is different for heart disease patients as they should only maintain light exercise (Fuezeki et al., 2017). Hence, heart disease patients should be guided differently based on their lifestyle.

This paper firstly introduced some existing mobile health (mHealth) applications followed by the proposed emotional-persuasive habit-change support system with a mobile application which is called BeHabit. BeHabit is developed in June 2020 to assist heart disease patients to change their bad habits of exercise and mood to reduce further development of heart disease.

Problem Statement

Cardiovascular disease is the factor of death for 30% of all death worldwide and still resumes as the world's number one killer in industrialized countries (Ahmad et al., 2020; Keikhosrokiani et al., 2012). In recent many years, heart disease statistics had fallen over half in industrial nations such as Finland, the United States, Canada, Australia, New Zealand, France, and Japan. Unfortunately, heart disease cases in many non-industrial nations, including Malaysia, India, China, Korea, and other Asian nations are increasing (Cheng et al., 2005). The National Health and Morbidity Surveys (NHMS) have shown that the normal time of individuals who create heart disease in Malaysia is getting more youthful from year to year

(Lee et al., 2020). Therefore, more attention is required for heart disease patients in Malaysia. For instance, mobile health technologies can impact the health of a chronic disease patient (Keikhosrokiani et al., 2015; Nilsen et al., 2012). Having bad habits of diet, sleep, smoking, exercise, etc. might be the main cause of many diseases such as heart disease.

Many existing mobile applications provide a platform for heart disease patients mostly to record patient's activities; however, there is no current mobile application that can influence to change heart disease patients' bad habits by adding persuasive and emotional features. The lifestyle of heart disease patients is very different from a normal individual. A heart disease patient cannot perform vigorous physical activities, nor they should not have their heart rate beat faster than a certain rate. Therefore, this study aims to develop a mobile application called BeHabit to assist heart disease patients by implementing persuasive and emotional features as a motive to form a new healthy lifestyle. BeHabit guides patients to follow daily healthy routines as well as keeps track of the patient's moods and symptoms after each activity. It is programmed to suggest carrying out light physical activities as it is suggested by medical expertise (Fuezeki et al., 2017). BeHabit also provides a summary of the day to motivate the patients emotionally so that they will be enthusiastic to continue to live a healthy lifestyle. Besides, this application also helps the doctor to monitor their patients in real-time as well as provide prescriptions to their patients. As announced by World Health Organization, the cause of highest death from the year 2000 to 2019 are related to heart diseases (World Health Organization, 2020). Ischemic heart diseases have always been responsible for the highest cause of death.

The health habits of heart disease patients play a major role in mortality. Patients are advised to exercise regularly. According to medical experts, when it comes to exercising, it is different for heart disease patients as they should only maintain light exercise (MedlinePlus, 2019). Hence, heart disease patients should be guided differently based on their lifestyle. They should not follow regular healthcare mobile applications for guidance as they are for non-heart disease individuals. However, there are a few applications designed for heart disease patients but with some limitations.

Instant Heart Rate mobile application is designed to measure pulse accurately and heartbeat zone with the heart rate and health monitor after sleeping or during workouts & training. Instant Heart Rate doesn't require heart rate straps. It monitors blood circulation with accurate heart health monitors (like ECG or EKG). Functions similarly to pulse oximeters, detecting the change in your finger to provide accurate heartbeat measurements. It can measure the instant heart rate in less than 10 seconds. Most of the functions are in-app purchases and have limited functionalities (App Store, 2019a; Google Play, 2019b).

Cardiio helps to measure the user's pulse using a phone camera. This application will help users gain insights into how heart rate relates to fitness and endurance. It will also improve the user's fitness by building high-intensity circuit training exercises that will take around 7

minutes to complete. It keeps track of personal dashboards with history for daily, weekly, and monthly. This application is only available in iOS, and it has in-app purchases where most functionalities are limited to normal users (App Store, 2019b).

iCardio application helps users to keep track of runs, rides, and many activities related to cardio at the gym, daily step count, and activity all in one application. Users can add heart rates for more accuracy to count calories. The main motivation for this application is for users to lose weight. This application can also track workouts indoors and outdoors (App Store, 2019c; Google Play, 2019a).

In general, health care mobile applications are popular applications that exist in both android and iOS versions. Mobile applications as discussed are very useful and have become a good guidance system for anyone to lose weight or get into shape. However, they are not designed specifically for heart disease patients. Table 1 shows the comparisons of the existing projects to the BeHabit system.

Table 1. Strength and weakness in existing projects

Features	Instant Heart Rate	Cardiio	iCardio	BeHabit
Heart Rate at 24/7	No	No	Yes	Yes
Connects to smartwatch	No	No	Yes	Yes
Persuasion feature	Yes	Yes	Yes	Yes
Emotional feature	No	No	No	Yes
Designed for heart design patients	No	No	No	Yes
Consults doctor	No	No	No	Yes
Connects to Samsung Health	Yes	No	Yes	Yes

System Objectives

The objectives of this mobile application system are:

- To develop a mobile app for changing heart disease patient's habits to be healthier by adding persuasive features such as encouraging them to carry out suitable light physical activities, sending them motivational encouragements, and more which are discussed further in this report.
- To develop a mobile application for changing heart disease patient's habits to be healthier by adding emotional features synch as keeping track of patient's mood before and after they carry out an activity, display achievement of the day to encourage emotionally to pursuit their healthy habit, etc. which are explained in further details in this report.
- To develop a platform to send real-time patient information to the doctor and receive a doctor's prescription.

Proposed Solution

BeHabit system connects to Samsung Health with Samsung Smartwatch which retrieves data from Samsung Health Cloud. The smartwatch can provide more accurate data of the user such

as heart rate, calories, distance traveled, and step counts. Samsung Health platform is a useful tool as it provides centralized databased for developers to work on their projects. All information is retrievable from one Samsung account. BeHabit proposes a solution for heart diseases patient as this system analyses user heart rate in real-time and able to identify any abnormal changes. After the detection, the system automatically sends the user's abnormal maximum heart rate to the doctor as well as alerts the user in the application. The user can also communicate with the doctor by sending messages and retrieve prescriptions directly from their doctor. The system of BeHabit is shown in figure 1.

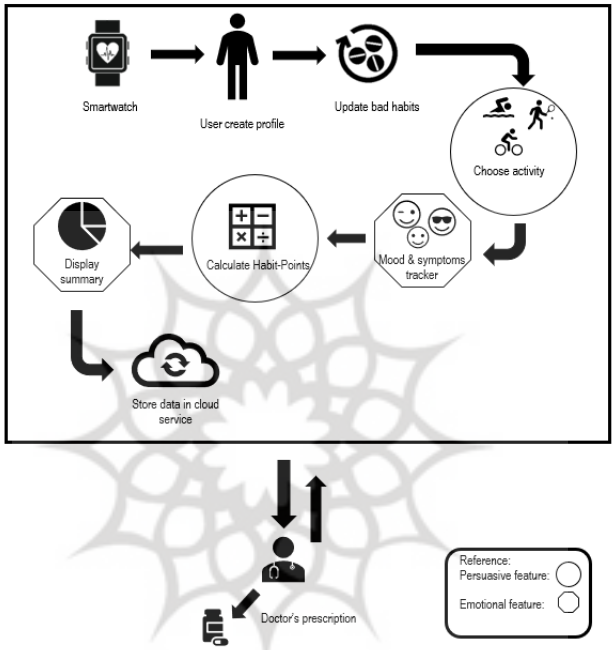

Figure 1. System flow for the proposed solution

Moreover, this system implements persuasive and emotional features to persuade patients for changing their bad habits. As for implementing persuasive features, the system applied a point collecting system known as Habit-Point. The BeHabit point is a technique to measure a user's activeness which is presented in Table 2. This feature will motivate users persuasively to improve their health by either increasing step count or carrying more activity. The system also sends users persuasive messages to complete their targeted achievements. Another persuasive feature in BeHabit is that the system will let the user choose an activity from some listed choices and the targeted minutes to complete is at most 30 minutes for each. At the end of the activity, the system will prompt praise to the user. More persuasive features are defined by (Lehto & Oinas-Kukkonen, 2011). BeHabit uses dialogue support, credibility support, and primary task to support the persuasion context. In short, an application should be appealing, pleasurable, memorable, and effective. Nevertheless, with the same ideology, BeHabit has implemented similar methods to emotionally affect the user.

Table 2. Habit-Points calculation

Habit-Points range	0 to 20	21 to 40	41 to 60	61 to 80	81 to 100
Remarks	Very bad	Bad	Average	Good	Excellent
Types of activity achieved	- 20% of the targeted step count - Preference of user mood	- 40% of the targeted step count - Preference of user mood	- 60% of the targeted step count - Preference of user mood	- 80% of the targeted step count - Preference of user mood	- 100% or more of the targeted step count - Preference of user mood

Moreover, the system keeps track of the user's mood before and after an activity. The system also keeps user symptoms if any after an activity. According to (Caldeira et al., 2018), mobile apps are developed for mood tracking in which the application features can be mapped into stages of mood tracking. Table 3 shows the stages to be implemented in the BeHabit system. For example, when the system prompts the user mood tracking form, it is a stage of preparation where it provides fundamental information on how to conduct mood tracking. Next, the system will show a range of emoticons, pictures, and texts to define how the user feels. This is a collection stage.

Table 3. Stages of Mood Tracking

STAGE	FEATURE	DESCRIPTION
PREPARATION	Instructions & explanation	Information about how to conduct mood tracking
COLLECTION	Interface for collecting mood data	Text, pictures, colors, emotions, etc
	Reminders	Reminders for users to log mood
REFLECTION	Visualizations	Graphs, tables, lists
ACTION	Recommendations	Further actions based on data, e.g., how to improve mood
	Sharing	Features for users to share or export data

The system will also notify users emotionally using motivational messages to improve user's emotional mentality. This feature is also a collection stage. Moreover, the system will display a summary of user activity. The main purpose of this feature is to emotionally motivate the user to keep up the work or to remind them to work out more which according to Table 3 which is at the reflection stage. Finally, the system will export user data to the doctor to be referred and receive a prescription to improve the user's health. System design, methodology, implementation, test, and user acceptance evaluation are summarized in this paper. Finally, concluding remarks and future works are added as well.

Methodology

System Development Methodology

The development methodology for this application is the Software Development Life Cycle (SDLC) methodology designed by (Keikhosrokiani, 2019a, 2019b, 2019c; Keikhosrokiani et al., 2018; Keikhosrokiani, Mustaffa, Zakaria, & Abdullah, 2019; Keikhosrokiani, Mustaffa, Zakaria, & Baharudin, 2019). SDLC is a framework that characterizes the various advances or procedures. The various steps involved in SDLC are modeling, assessment, design, and prototype as shown in figure 2. The SDLC can be applied to both hardware and software which will deliver high-quality products or services. This will guarantee the smooth running of the organizations.

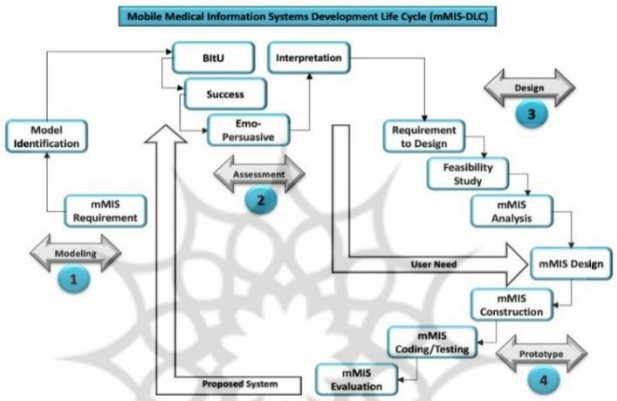

Figure 2. SDLC methodology of the project (Keikhosrokiani, 2019c)

Software Architecture

In this project, the software architecture illustrates in figure 3 below. End users will be using android mobile devices and connect to the internet via an access point. The mobile applications have access to the online database which is, in this case, Firebase and Samsung Health data through the Internet connection. However, the user's health data retrieved from Samsung Health are not stored nor stored in any database to ensure the user's confidentiality and data access control.

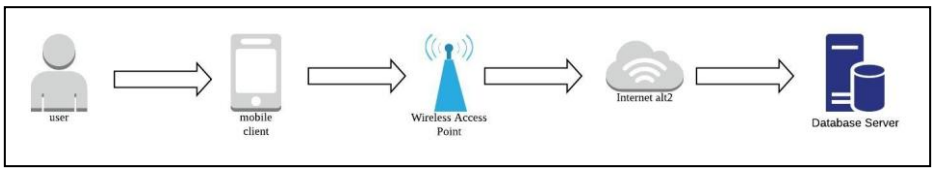

Figure 3. Software Architecture Design of the System

Use Case Diagram

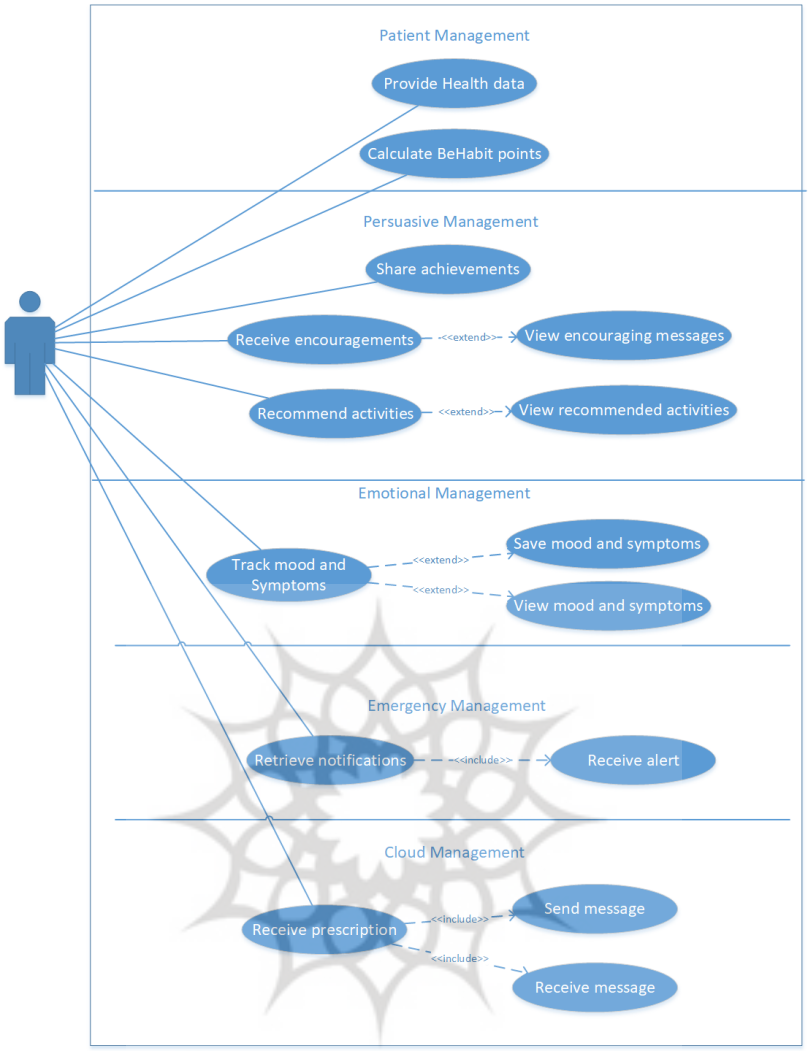

Figure 4. Use Case Diagram

Design Application Architecture Diagram

Application architecture design is divided into 3 layers, namely (1) the view layer, (2) the domain layer, and (3) the data layer. Each of the layers places a significant role in the overall architecture of the project.

The view layer is responsible for the interaction between the users and the system. The mobile application needs to be installed in a smartphone that is equipped with a stable cellular network with a GPS sensor. The application will be connected to the Internet via the gateway.

The domain layer is responsible for processing the data obtained from the view layer and pass it to API for data operation. The API implemented here is Google Firebase services, Samsung Health services, and YouTube API.

Finally, the data layer is responsible for storing and managing the data to be used in the application. The main database used in this system is the Firebase Real-Time database which

is a flexible scalable new SQL cloud database to store and think data for the client. The firebase database functions as online storage for the application to retrieve the basic information on the user. The firebase cloud messaging (FCM) Service is also used to send push notifications. The component in every layer needs to work together seemingly to ensure the application can perform at a desirable level.

Nonetheless, Samsung Health Data Store and Tracker Service have been responsible to provide a platform for sharing health data from users to Android phones. The health data and services are retrieved in real-time to the BeHabit system. Health data sharing is shared with the user's knowledge. Figure 5 shows the system architecture diagram.

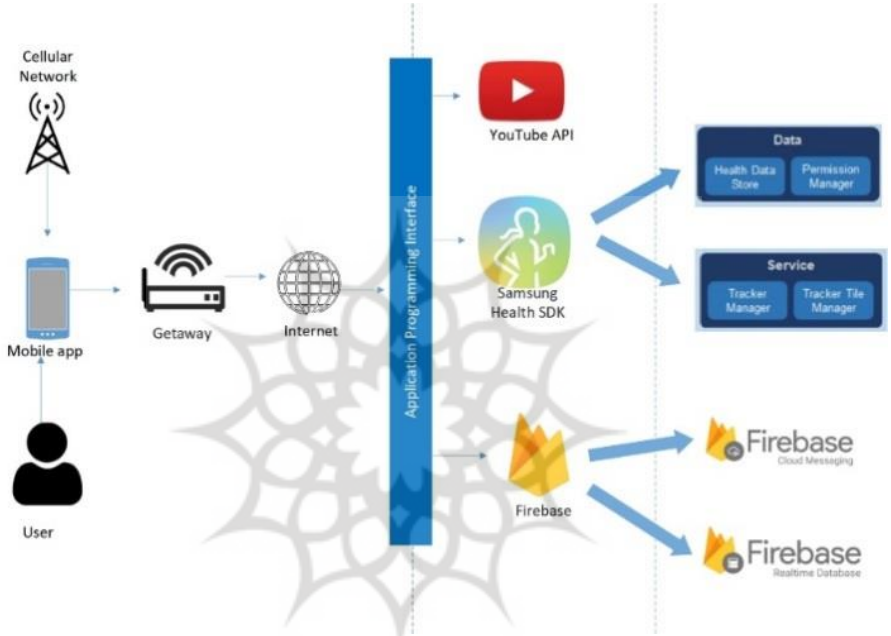

Figure 5. Use Case Diagram

Design Class Diagram

The class diagram shown in figure 6 below doesn't have an explicit type of relationship or association (such as one-to-one, one-to-many) between the classes. This is because this project implements Firebase as an online database which is a NoSQL database. The diagram shown in the figure is merely a relation between entities, showing information of the user, the doctor's prescription, user's symptoms, and emotions tracker, and information on the user's heart alert are all inside all main database of BeHabit system.

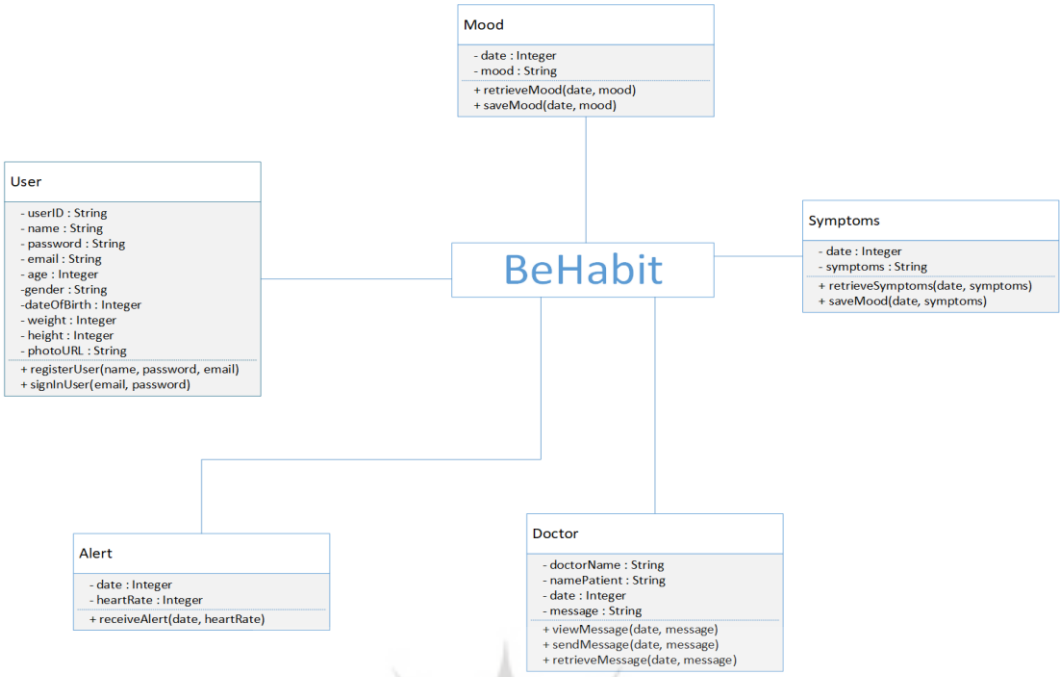

Figure 6. Class Diagram for BeHabit System

Detailed Sequence Diagram

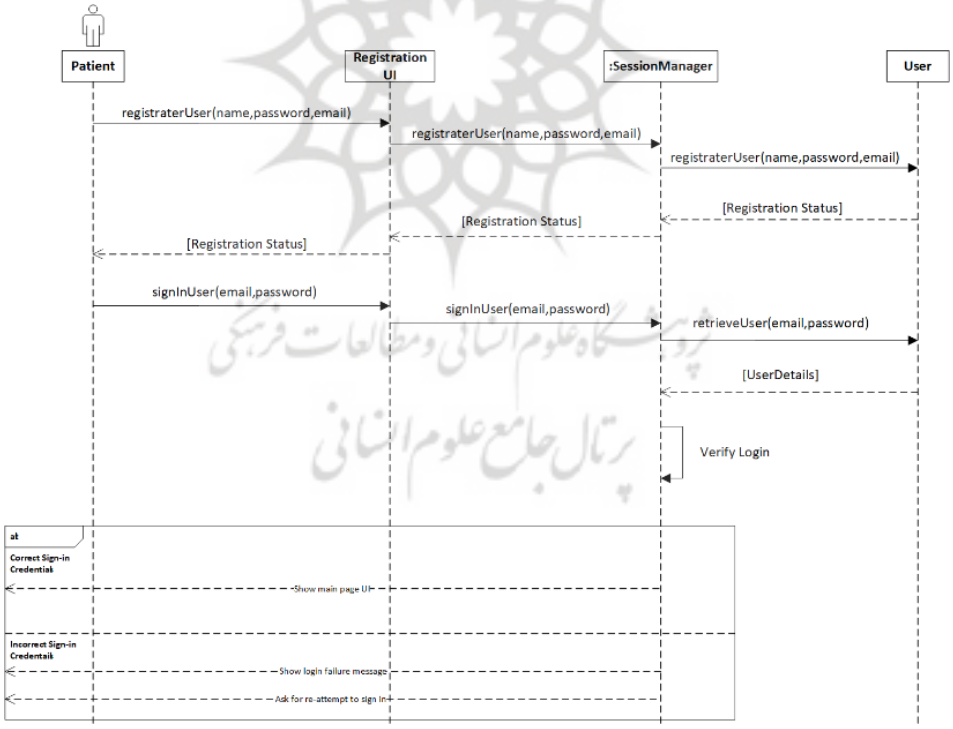

Figure 1. Detailed Sequence Diagram for New User Registration and Sign In

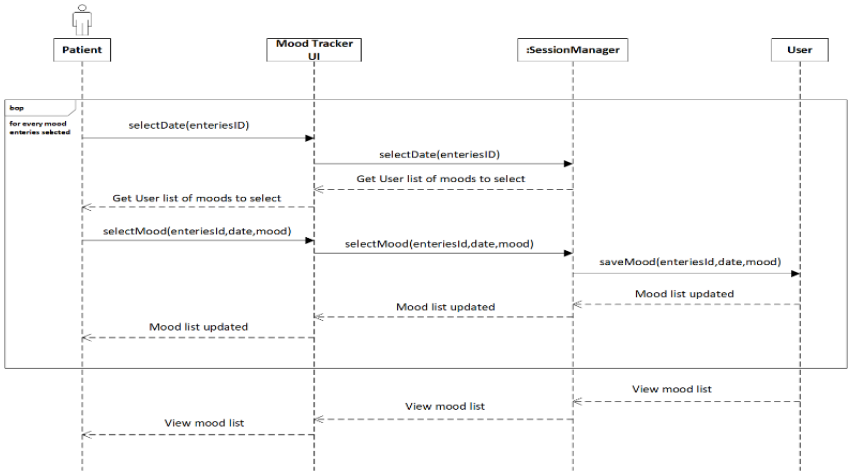

Figure 2. Detailed Sequence Diagram for Mood Tracker

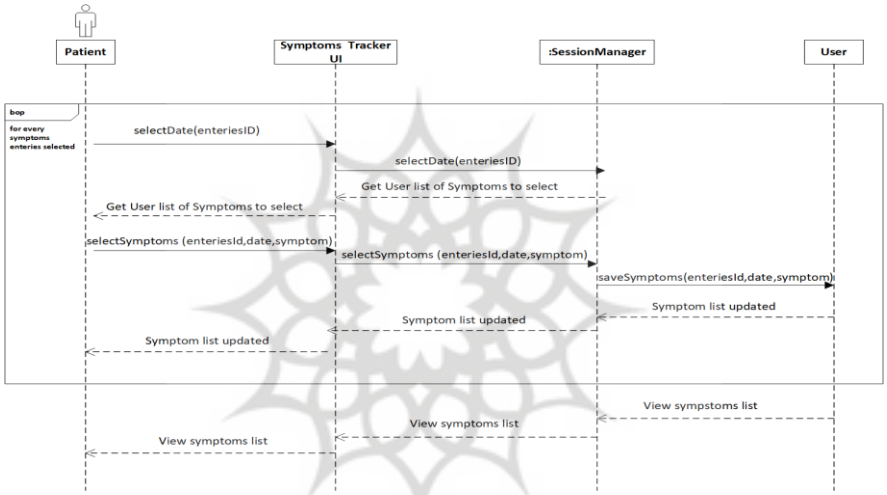

Figure 3. Detailed Sequence Diagram for Symptoms Tracker

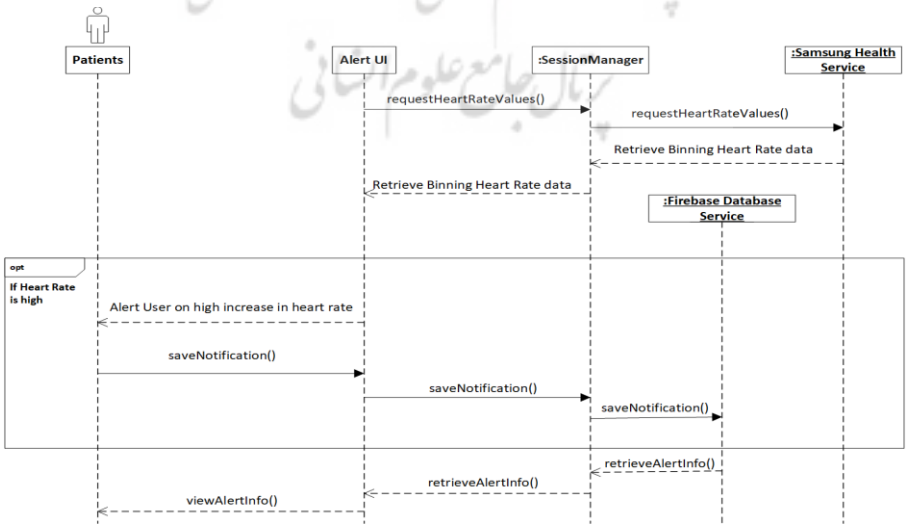

Figure 4. Detailed Sequence Diagram for Alert User

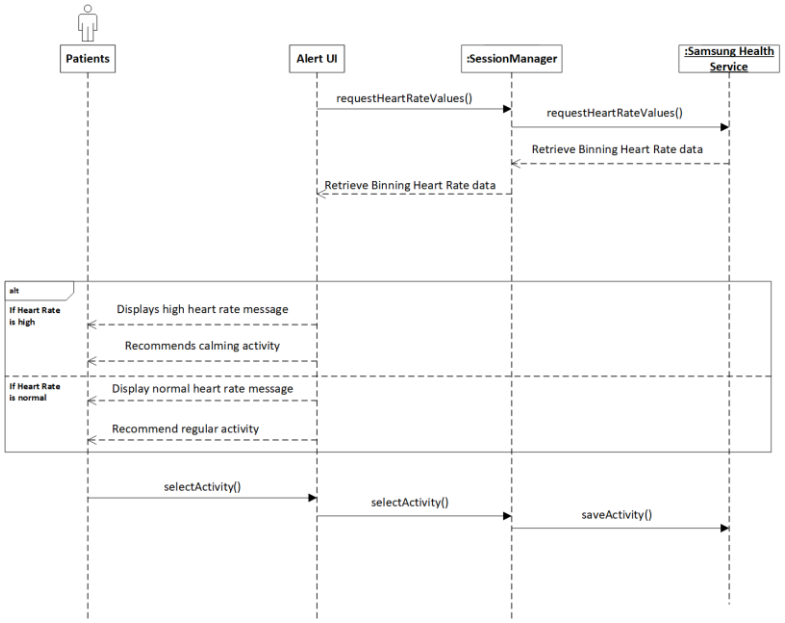

Figure 5. Detailed Sequence Diagram for Recommend Activity

System Implementation

System Requirement

There are some functional and non-functional requirements for developing BeHabit. According to Dr. Terzic, patients with heart disease should include themselves in rehabilitation (Gersh et al., 2009). Therefore, each user will be given different calculations based on their age. The system will mark the average maximum heart rate based on the table below according to the user's age when doing light, moderate, aerobic zone, and vigorous activity. Based on the functional requirements, the system should be able to retrieve real-time Samsung Health data and display them in an understandable user interface. It must provide an option for the user to view a history of health data. Furthermore, the user should be able to receive a push notification that contains a daily quote to encourage the user. The user can send messages to and receive from the doctor in real-time. The system provides a platform for users to track and view their moods. The system will check the user's heart rate if the user has the device to check it. The system displays helpful and encouraging tips to motivate users as a persuasive feature. It should recommend to the user the types of activity to carry out based on heart rate data User is also able to share their achievement of the week as well as month. Finally, it must notify the doctor and user in case of any abnormalities in the user's heart rate in real-time.

As for non-functional requirements, the mobile application is designed with a minimum SDK version API 24: Android 7.0 Nougat which is 100% compatible with all portable devices. Every user is required to sign into the system to access the functionalities of the mobile application in the line of protecting personal data. The user's health data is retrieved directly from the Samsung Health API and is not stored anywhere in the device to ensure the user's

confidentiality. The mobile application should be designed with a consistent graphical user interface that is user-friendly. The system always performs at an optimal level unless there is no Internet connection or have a failure in the online database. This requirement also always ensures system availability.

Algorithms, Pseudocode, APIs

In this section, only the operations that have more sophisticated procedures with the use of a specific library or APIs are discussed. The straightforward operation such as user sign-in, display encouraging tips, manage user profile, and more are considered as self-explanatory, thus it will not discuss in this section.

Recommend Activity

In recommendation activity, which is an implementation of the persuasive feature, the application retrieves binning heart rate data from Samsung Health data of the user. BeHabit has a built-in method to calculate the user's estimated heart rate at a vigorous level and compare the user's current heart rates with the value. The methods are called is onCalculateEstimatedHR() and onCompareHR(). Both methods are called when the user requests for activity recommendation. The calculation to identify the user's estimated heart rate value at vigorous value logic starts with converting the binning heart rate value into arrays and obtaining the user's age from the firebase database. The method compares the age and the arrays of heart rate with the estimated value. If the array of heart rate is less than the estimated value, then BeHabit will recommend regular activities to carry out. However, if there's any heart rate value in the array that exceeds the estimated value, then BeHabit will immediately recommend calming activities. The user can carry out the activity when the tap on the activity icon and the application links directly to the Samsung Health activity tracker.

Alert User

In alert user activity, the primary objective is to alert the user when the heart rate during exercise exceeds the estimated heart rate value. BeHabit uses the following table as a guide for detecting abnormal heart rates.

Table 5. Estimated heart rate at vigorous intensity by age

Heart Rate Zone	Vigorous Intensity	Maximum
Age range (years)	75-85%	100%
18 to 20	145-164 bpm	194 bpm
21 to 25	143-162	190
26 to 30	140-159	187
31 to 35	138-156	183
36 to 40	135-153	180
41 to 45	133-150	177
46 to 50	130-147	173
51 to 55	128-145	170
56 to 60	125-142	167
61 to 65	123-139	163
66 to 70	120-136	160
71 to 75	117-133	157
76 to 80	115-130	153

Firstly, the user's age is retrieved from the Firebase database. Secondly, BeHabit received binning heart rate data which is converted to arrays to check if there is any heart rate that exceeds the heart rate zone of vigorous-intensity and maximum. The method implemented here is called checkExerciseHeartRate() which returns either true or false. In a scenario where the method returns true, the notificationAlert() method will be triggered. This method will trigger sending out a notification to the user to inform the user immediately. Furthermore, the exceeded heart rate value will be pushed to the Firebase database. So, the user can view the heart rate values by data later in a list view.

Send/Receive Message to/from Doctor

BeHabit allows communication between user/patients and their respective doctors. The user can send a message to the doctor. The user has to select the Send message button which triggers the sendMessage() method. This method opens another layout to allow the user to write the message. When the user is done, he/she can tap on the send button. However, if the message is empty, the system will prompt the message when not the message will be pushed to the Firebase database. This message will later be received at the doctor's site and be displayed in the application. The system will also display messages received from the doctor site which is pushed in the Firebase database in the application.

Retrieve Current and Historical Health Data

BeHabit application is primarily dependent on Samsung Health SDK which provides Data and Services to Android API. The Samsung Health Data Store syncs data with the user's Samsung Account. The health data is retrieved from the Samsung Health Server that implements Rest API. For first-time users, BeHabit will request Rest API Oauth2 from the Samsung Health Server SDK. The users must approve the authentication to fully utilized BeHabit functionalities. Initially, health data service is required to be initialized and ensure health data store connection is connected. Next, it is vital to set the listener to retrieve the required health data to use. In this system, daily step count, heart rate, and exercise health data are retrieved. This activity implements a persuasive feature as it motivates the user to be more active.

Receive Daily Quotes

In this part, the system sends users inspirational daily quotes as persuasion features. Every day at 8 am, the user receives motivational quotes using Firebase Cloud Messaging. The system randomly selects a quote from a long list of quotes and triggers the quoteFCM() method to start. This method starts the service and sends out a daily quote to the user. Moreover, the user can view and share the quote in the application to other social media platforms.

Mood and Symptoms Tracker

The system tracks the user's mood and symptoms daily as emotional features. The user is required to select the date to enter entry for either mood or symptom. The system will trigger moodTrack() and symptomsTrack(). The user must select one mood or symptom and tap on the submit button. Next, the submitted information will be pushed to Firebase real-time database. The user can also view the submitted data in the application.

Calculate BeHabit Points

The main purpose of calculating BeHabit points is to identify the activeness and mental evaluation of the user. This point system is dependent on both the total steps taken by the user and the mood of the day. The system retrieves the health data and reads the user's input for symptoms. The implementation of BeHabit points applies persuasive features. The formula for BeHabit is shown below:

BeHabit points = ((Total steps/ target steps) * 0.5) + ((Mood value for the day/ Number of moods) * 0.5) (1)

User Interface Design

In the mobile application, the user interface and the layout are specified using XML file format. The main color used in this system user interface is blue. Blue is appeared to be livelier and more trustworthy compared to other primary colors. Therefore, this application is designed with various shades of blue color and choosing a correct and consistent color scheme using shapes allows achieving an attractive and integral mobile application design. Moreover, the consistent font size and font type on every interface in the mobile application are aiming to provide accessibility and user friendly for the user of the mobile application.

Database Design

Firebase Realtime Database has been used as the database throughput the implantation of this system. It is a flexible, scalable database for mobile application development. Firebase Realtime database stores and sync data with NoSQL cloud database. Therefore, it doesn't have an explicit relationship between each entity, and it does not represent in the table format. Instead, the data are stored in documents. Each document contains a set of key-value pairs. The database design will be visualized in the figure below.

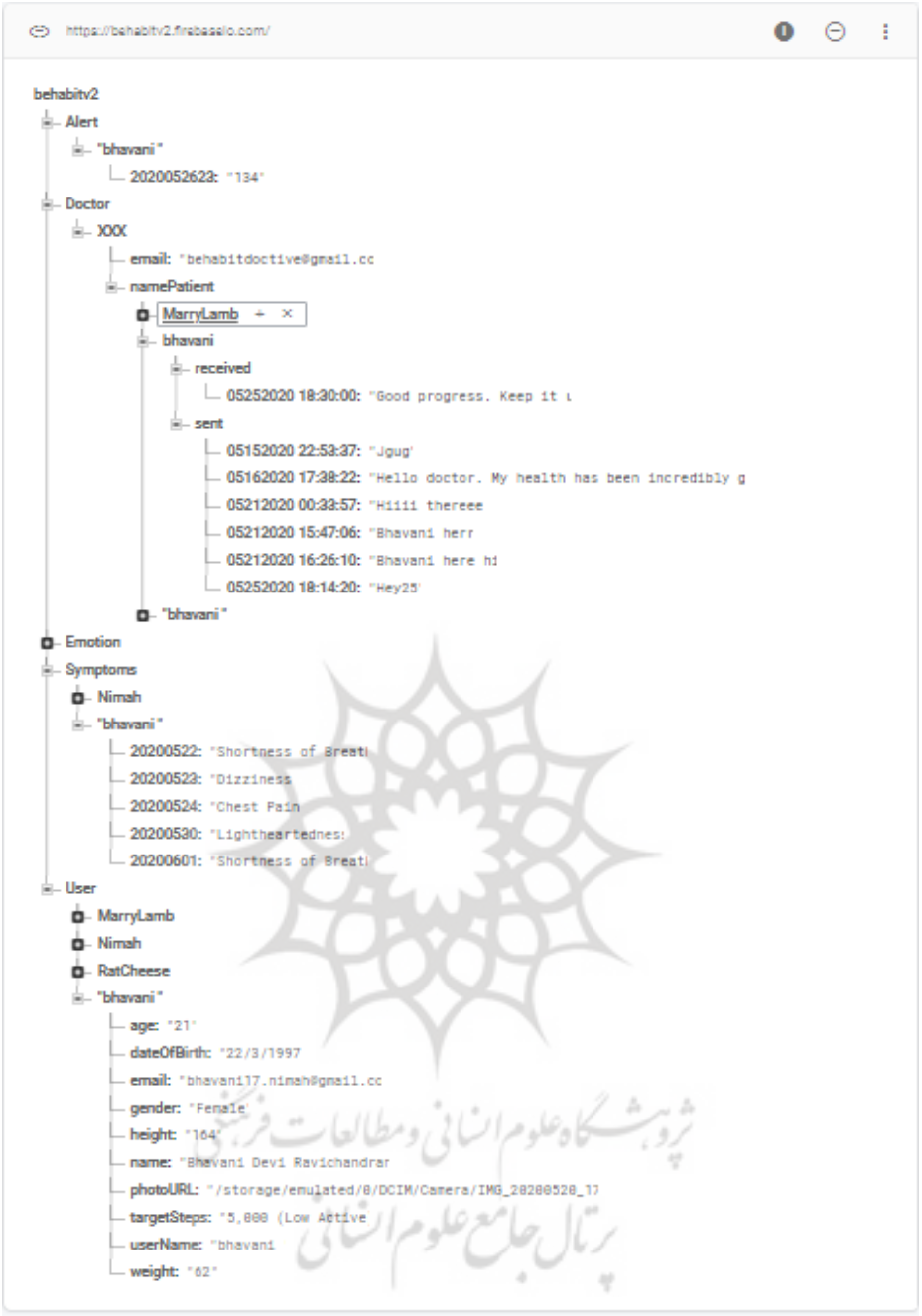

Figure 12. Database Design of Mobile Application User

Findings

Unit Testing

The unit testing defies the smallest units of code for its functionality. The purpose is to identify that each unit of the software performs as designed. Unit testing is very important because it can ensure the system runs seamlessly who starred in the Android application which uses Android Studio as the environment tools, unit testing is carried out on a method.

The functionality of a method is tested one by the other to minimize the error when methods are integrating to become a subsystem.

Integration Testing

Integration testing is a process of combining the units of code and carry out their testing process that will produce the result of combination functions correctly. The purpose of this level of testing is to expose faults in the interaction between integrated units. Integration testing provides a systematic technique for assembling a software system while conducting tests to uncover errors associated with interfacing. It can ensure the parameter, function, run-time Exceptions an incompatibility between the interactions of objects. In this application, the integration between the subsystems is important because we divided the work among different members. Integration testing needs to be carried out from time to time starting from the development of the project. It is advisable to carry out integration testing when every functionality of the subsystem is complete to ensure the efficiency of the implementation of the application.

System Testing and User Acceptance Evaluation

System testing is a level of software testing where complete and integrated software is tested. We performed system testing at the end of each iteration to ensure system compliance with the specific requirement. If that any error, immediate action needs to be done to fine-tune the system. In this project, an example of system testing carried out was the application system to ensure it can retrieve real-time data about the user's health data and process the data to calculate if the user is active or not.

Generally, user acceptance testing (UAT) on the system is carried when the system is integrated and completed (Keikhosrokiani, Mustaffa, Zakaria, & Baharudin, 2019; Keikhosrokiani et al., 2014). It is carried up by randomly selecting 10 users. This testing is carried out by first introducing all the available features to the respondent to make sure they understand the usage of each function implemented. After that, each of them we've given about 20 minutes. Next, the respondents are asked to fill up a questionnaire that consists of nine questions to find user satisfaction and acceptance of BeHabit.

After gathering all the responses, the results of UAT are analyzed Lastly, the result of UAT will be taken into consideration in future enhancement or development of the project. The summary of the UAT is shown below.

Table 6. User Acceptance Test (UAT) Result for BeHabit System

	Frequency	Percentage (%)
Q. 1 Are you considered healthy or diagnosed with any heart disease?		
Healthy	8	80
Not healthy	2	20
Maybe	0	0
Q. 2. How well were you satisfied with the features implemented in this application?		
Strongly unsatisfied	5	50

Unsatisfied	5	50
Moderate	0	0
Satisfied	0	0
Strongly satisfied	0	0
Q. 3. How well were you satisfied with the application usability?		
Strongly unsatisfied	5	50
Unsatisfied	5	50
Moderate	0	0
Satisfied	0	0
Strongly satisfied	0	0
Q. 4. How well will you recommend this application to your friends or family members?		
Will not recommend	7	70
Probably not recommend	3	30
Maybe recommend	0	0
Probably recommend	0	0
Will recommend	0	0
Q. 5. Did you encounter any errors or bugs when testing on this application?		
Yes	0	0
No	10	100
Maybe	0	0
Q. 6. Can you briefly describe the condition if you encounter errors or bugs during application testing?		
n/a	10	100
Q. 7. If the full version of this application happens to be available in the play store, will you download and use it to improve your health?		
Yes	8	80
No	0	0
Maybe	2	20
Q. 8. What are the features of this application you feel lacking something and can be further improved?		
Calorie intake tracker	3	30
Lack of information on stress test	2	20
Improve on BeHabit points and add more persuasive features	1	10
Add live chat with Doctor	3	30
Display more achievements	1	10
Q. 9. What is the feature of this application catching your attention at most?		
The exercises recommendation given according to the patient's heart condition	2	20
Attractive tips and UI	4	40
BeHabit Points and mood tracker	4	40

Figure 13 shows the user interfaces of the application. Generally, four pages are the Homepage, a History page, Mood and Symptoms tracker page, and Health Tips page. The user can access each by tapping at the bottom of the application. Moreover, the icons on the top bar of the application are Settings, Message, and Alert User interfaces.

In the Home page user interface, the user can view health data such as step counts, total distance, total calories burnt, heart rate, user speed, and heart rate during exercise, as well as Habit points. The application also allows users to share health data on social media platforms. Furthermore, the user can tap on the Exercise Recommendations button where the application evaluates the suitable activity to carry for the user.

The history page contains the user's history health data. The user can view an analysis of their health weekly and monthly through this same page. Next in the mood and symptoms tracker page, the user can view, add, and edit their data. On the Health Tips page, users can view quotes, health tips, and YouTube videos regarding health.

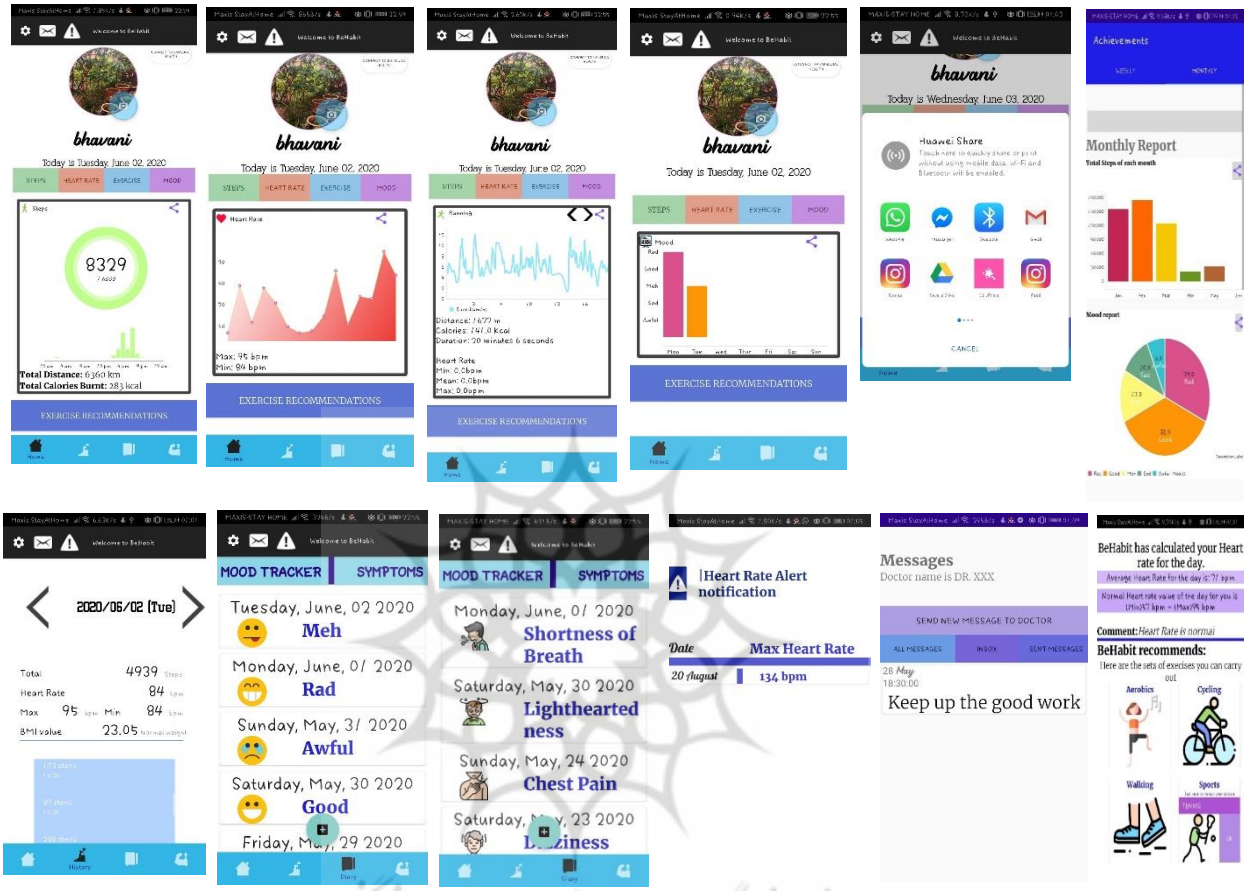

Figure 13. User Interfaces Designs of BeHabit application

Discussion

The system has successfully met all listed requirements in terms of performance, usability, security, user interface, and functionality. The application was released in a beta version for users to evaluate the criteria as mentioned so that the development team will notice the weakness of the system and make appropriate improvements to the application. The advantages of this system are it alerts the user by sending a notification when their heart rate is high and can be viewed later in the application as well as the users can view weekly and monthly achievements. The disadvantage of this system is that it cannot support offline mode. Nonetheless, the application has its strengths. The simple and friendly user interface, as well as the reliability and scalability of Cloud Real-time Database, are the highlight of the system. However, the system requires the Samsung Health application to run in the background.

Conclusion

The system with the BeHabit application has been developed successfully by meeting requirements to provide a platform for improving heart disease patients' lifestyles. BeHabit has equipped with a push notification that can alert the user when the heart rate increases as well as receive a prescription from the doctor. At the same time, the application benefits patients by providing emotional and persuasive feature implantation. The user can keep track of their daily mood from time to time and symptoms if there are any. All this information will be sent to the doctor's site to observe and provide prescriptions according to the individual user. The user can also send messages to the doctor if they wish to ask any questions or to update. The application provides a visual presentation of the user's health data. Moreover, the system can provide recommended activities to users according to their health and more. BeHabit was tested and evaluated by 10 users who were satisfied to use the app. Emotional and persuasive features are very important for changing bad habits. In the future, communication with a doctor should be improved. The system can increase usability to keep track of the user's other unhealthy habits such as smoking, diet, etc. Furthermore, a food intake tracking feature can be added to track of user's calorie intake. Finally, the Habit-Point calculation can be improved.

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Conflict of interest

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

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