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Digital Health Companion

In partial fulfilment of the requirements for the degree of

Bachelor of Science in Information Technology

Supervisor: DR. GHULAM MUSTAFA

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Bahria University, Lahore Campus

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C e r t i f i c a t e

We accept the work contained in the report titled

"Digital Health Companion"

written by

Ahsan Nawaz Bhatti

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as a confirmation to the required standard for the partial fulfilment of the degree of Bachelor of Science in Information Technology.

Approved by:

Supervisor: DR. GHULAM MUSTAFA

_____ (Signature)

June 14, 2022

DECLARATION

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

Enrolment	Name	Signature
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Date: June 14, 2022

Specially dedicated to
my beloved grandmother, mother, and father
(Ahsan Nawaz Bhatti)
my beloved grandmother, mother, and father
(Muhammad Ali)

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We would like to thank everyone who had contributed to the successful completion of this project. We would like to express our gratitude to our research supervisor, Dr Ghulam Mustafa for his invaluable advice, guidance, and his enormous patience throughout the development of the research.

In addition, we would also like to express our gratitude to our loving parent and friends who had helped and given us encouragement.

AHSAN NAWAZ BHATTI
MUHAMMAD ALI

Digital Health Companion

ABSTRACT

Digital Health Companion is a cross platform application which can be used to help people visualize their health data. We aim to track health data on daily basis and then visualize the data. The application regulates this data and tell the user if he/she is on the right track and help them to maintain a healthy lifestyle. Companion Apps have a potential to revolutionize how health care is perceived by public. This pandemic has opened a huge space in the digital health market. Now more than ever, people have become conscious about keeping a good and healthy immune system. Most Health apps fail because they overwhelm the user with statistics and numerical data. The user feels annoyed because the applications fail to help user realize their health situation and ultimately, they delete the application because they do not find it useful.

Our objective is to penetrate this space in the market by creating a digital companion with interactive features. We aim to create a mobile application which helps the user in regulating their health on daily basis by visualizing the data in a manner which is intelligent and interactive. We visualize the health data using various animations, for example, if the user has a high heart rate, the animation will visualize it in a manner which will alert the user about their condition.

TABLE OF CONTENTS

CHAPTERS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS / ABBREVIATIONS

AFL	Flutter
FB	Firebase
DT	Dart
SRS	Software Requirements Specification
ERD	Entity-Relationship Diagram
AR	Architectural Diagram
UML	Unified Modelling Language
JSON	JavaScript Object Notation
DM	Domain Model
SD	Sequence Diagram
FDD	Feature-Driven Development
APK	Android Application Package
IOS	IPhone Operating System
DHC	Digital Health Companion

CHAPTER 1

1 INTRODUCTION

1.1 Background

As we have gone through the pandemic, we have realized about the survival of the fittest. Those who have a better metabolism and have keep themselves in shape have a better chance of surviving such viral outbreaks. This pandemic has opened a huge space in the digital health market. Now more than ever, people have become conscious about keeping a good and healthy immune system. Most Health apps fail because they overwhelm the user with statistics and numerical data. The user feels annoyed because the applications fail to help user realize their health situation and ultimately, they delete the application because they do not find it useful.

We aim to create a mobile application which helps the user in regulating their health on daily basis by visualizing the data in a manner which is intelligent and interactive. We visualize the health data using various animations, for example, if the user has a high heart rate, the animation visualizes it in a manner which will alert the user about their condition.[1]

1.2 Problem Statements

According to statistics, people usually delete a health companion app within 8 days after installation[2]. This is because of the overwhelming UX/UI of these apps. They frustrate the user by presenting them with overwhelming numeric data which is difficult for the user to understand. The main reason why most of these apps don't do well is that they fail to help users understand their health data. Too many numbers which can overwhelm the user. Our target was to visualize this data and create an app which is intelligent and interactive. It can keep a track of your BMI, steps, regulate your Heart rate, stress level and Caloric Intake. We collect some basic data on initial signup and record it in order to help the application work well. This record will help the application to keep your health in check. This is done via interactive animations. The app has an avatar which acts as your friendly companion. The avatar is smart and interactive. It is able to detect give recommendations based on data collected on daily basis. It also manages all of the above-mentioned features with various animations for each scenario to give a more interactive feeling. Initially we have used sensors which are present in mobiles or wearables to get the data needed such as gyro (steps), Infrared (BPM & Stress). In optional scope we plan to use external sensors with our app to get different types of data such as BP, Sugar etc.

1.3 Aims and Objectives

The objectives of this project include:

- To facilitate user to understand health condition with the help of avatars.[3]
- To facilitate user to record their health condition and alert them on daily or weekly basis.
- To provide users with suggestions based on health condition.
- To help users keep and maintain their health records.

1.4 Scope of Project

What: The problem addressed was the unavailability of a health companion app which can perform to the standards without the user being overwhelmed by the numbers. There is no app which visualizes the data and interacts with the user in a manner which will persuade him/her to maintain a health regime.

Why: This pandemic has now more than ever, made people self-aware regarding their health. People have become more self-conscious. This has created an opportunity in the market which can be capitalized. We can seize this opportunity by providing a Health Companion App which caters to the general public needs regarding the health regulation and tries to deliver what these apps normally fail to deliver i.e., an interactive and smart companion with friendly UI.

How: We have created a cross platform mobile application with animated avatars created in Rive. We created the basic application in Flutter which will perform the basic functionalities.[4]

Following is the list of features for the application:

- Health Regulatory App
  - Heartbeat
  - Stress
  - Steps
  - Food
  - Exercise
  - Daily Activity
- Animated Avatar

CHAPTER 2

2 SOFTWARE REQUIREMENTS SPECIFICATION

2.1 Overall Description

Digital Health Companion is a Mobile based application therefore front-end, and back-end will be developed in Android Studio. The final application is cross platform meaning it works on both android and IOS. Our development approach was feature-driven development in which first we built an overall model then built a feature list and then we planned, designed, and developed by feature.

2.1.1 User Classes and Characteristics

The application acts as your personal data manager thus features only a single user i.e., the person who install's the app for their own use.

a) User

The user can perform the following activities.

- Sign-in
- Measure Heartbeat
- Calculate BMI
- Measure Steps
- Measure nutrients.
- Exercise
- Measure Daily Activity

2.1.2 Operating Environment

The operating environment for the Digital Health Companion is as listed below.

- Android/IOS Mobile Phone
- Android 7.1/IOS 9
- Gyro
- Stable Internet Connection

2.2 Other Non-Functional Requirements

The non-functional requirements of the Digital Health Companion are given below.

2.2.1 Security Requirements

The login system should be secured to protect your health data

2.2.2 Software Quality Attributes

- **Reliability**

  The models have been trained on multiple datasets to improve the prediction correctness. [5]

- **Availability**

  The system is available across multiple platforms and can be accessed by users on any of them.

- **Portability**

  Users can log on to the system anywhere at any time.

2.3 Software Requirements Chart

The following table has the software requirements.

ID	Priority	Type	Description
DHC - R1	High	Functional	Login
DHC - R2	High	Functional	Register new user
DHC - R3	High	Functional	Measure Heartbeat using camera
DHC - R4	High	Functional	Count Steps using Gyro
DHC - R5	Medium	Functional	Measure Calories Burned
DHC - R6	Medium	Functional	Macros Calculations(kcal)
DHC - R7	Medium	Functional	Keep Track of water intake
DHC - R8	Medium	Functional	Exercise
DHC - R9	High	Functional	Measure health condition
DHC - R10	High	Functional	Avatar to visualize above functionalities
DHC - R11	High	Functional	Medicine Track

Table 1.1: Software Requirements Chart

CHAPTER 3

3 DESIGN AND METHODOLOGY

3.1 Diagrams

This chapter provides an overview of the Digital Health Companion design. The overall view of the system is provided by the system architectural design. Developers and clients will be able to examine and check the design plan of the project. This Chapter includes the following objects.

- Use case diagrams.
- Sequence Diagrams.
- Entity relationship diagram
- Activity Diagram
- Class Diagram
- Domain Diagram

3.2 Use case Diagrams

3.2.1.1 System Use case

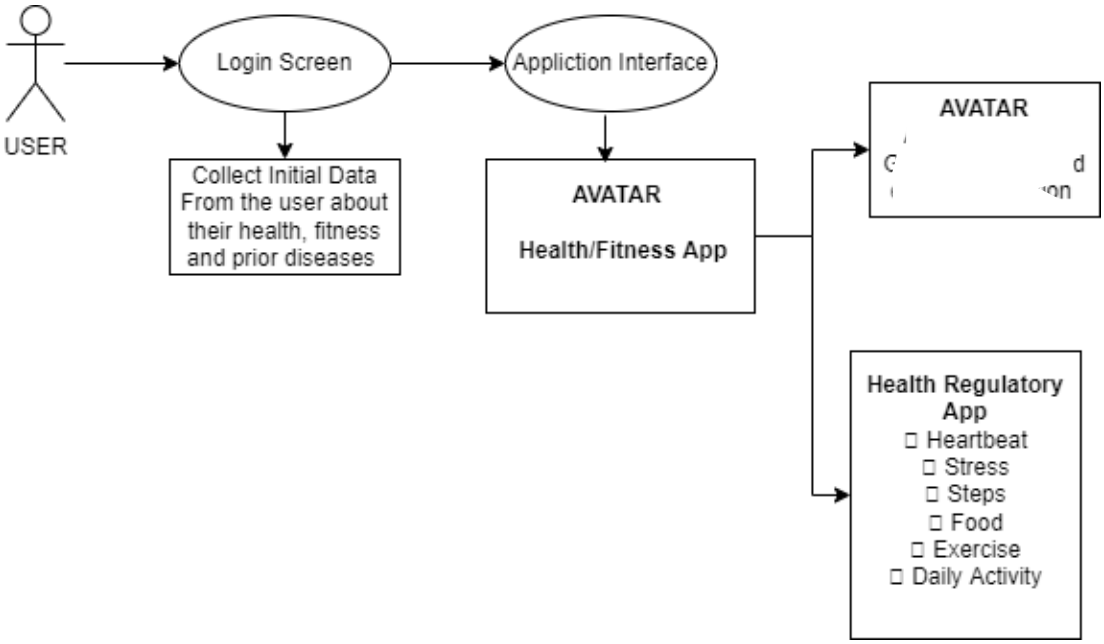

Figure 3. 1: System use case

Figure 3. 2: System user

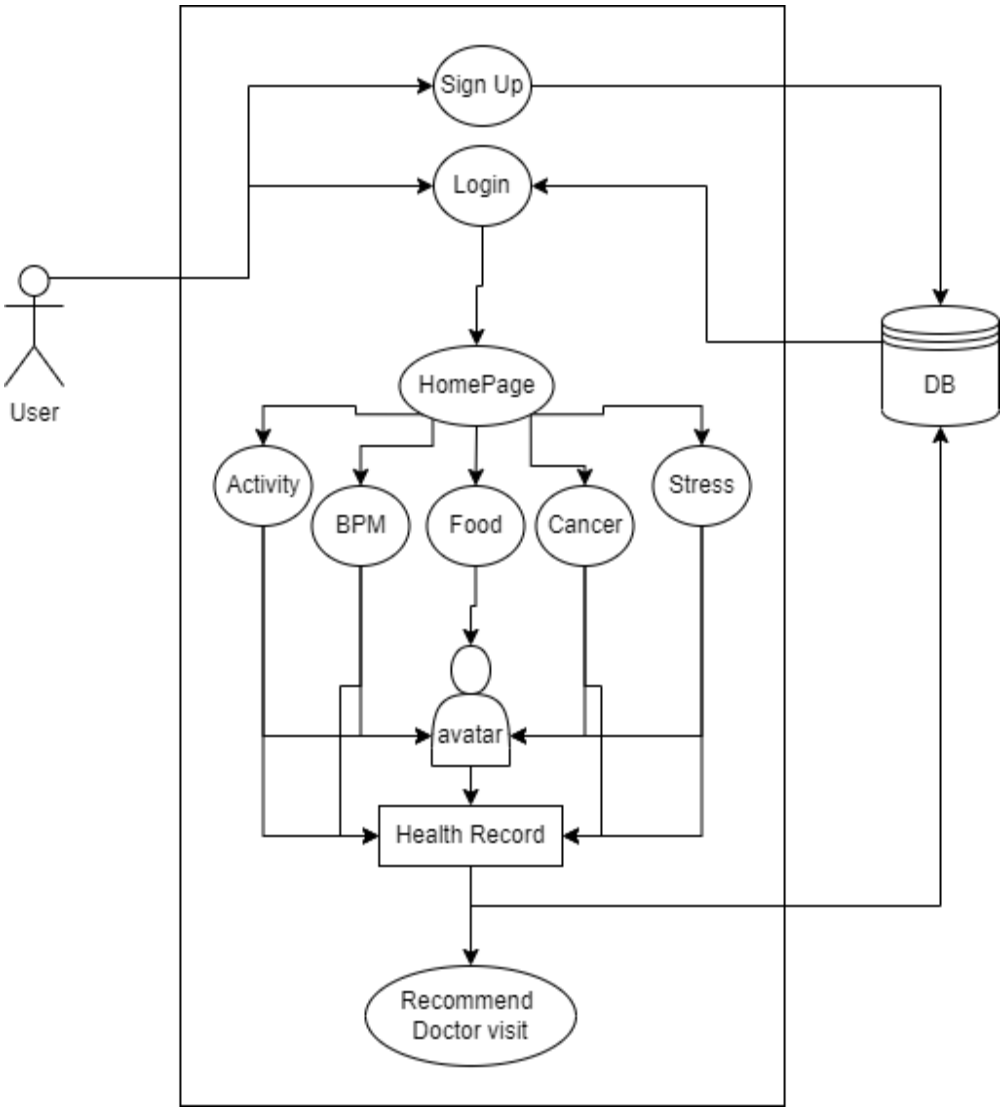

Figure 3. 3: System Flow

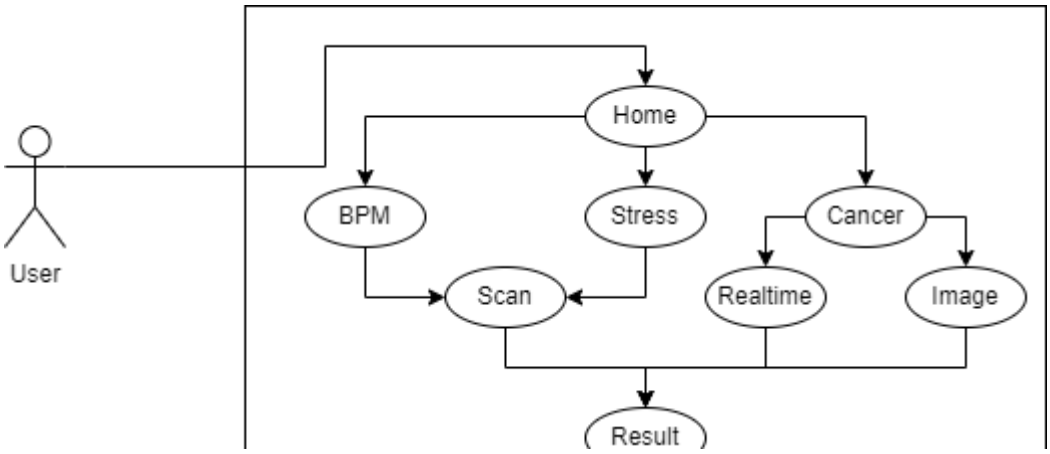

Figure 3. 4: BPM & Stress Model

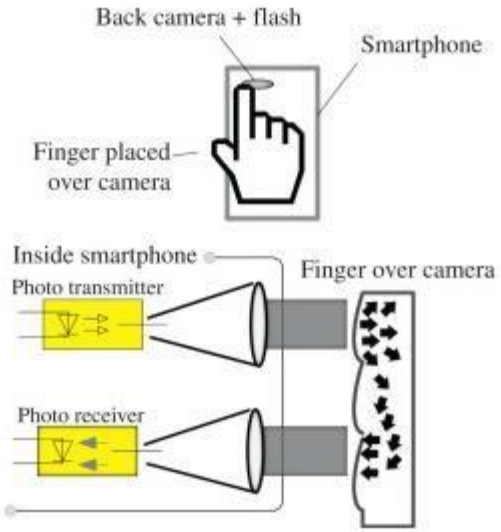

Figure 3. 5: Detection using camera sensors

This figure shows the flow of application that how the user interacts with application's Features. For example, user uses camera and flash to scan their finger for BPM by placing it on the camera module of the mobile.

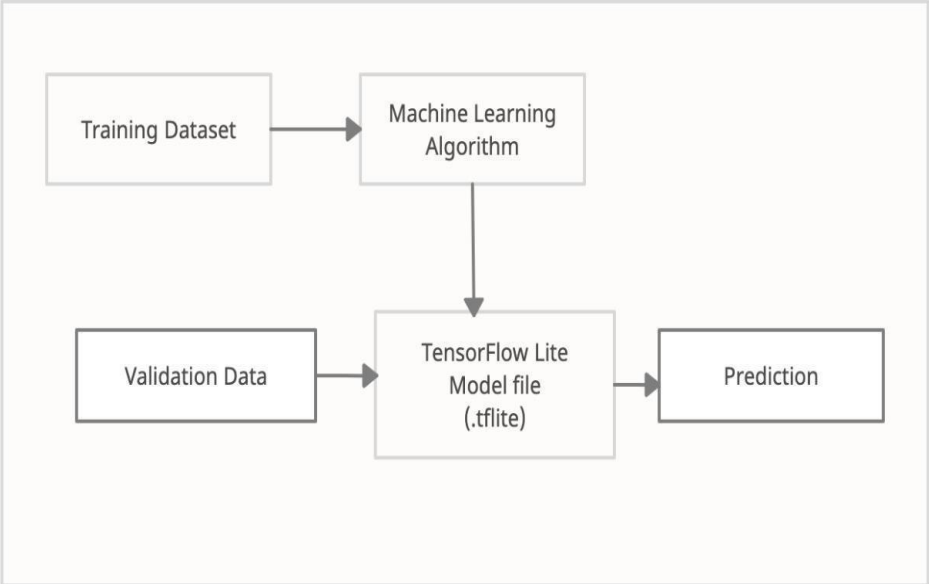

Figure 3. 6: Use Case of Image Classification

This figure shows how the application uses the TensorFlow machine learning to train the dataset which is then used for detection.

3.2.1 Create profile (U1)

	Name	Create profile
1.	**Use-case-ID**	U1
2.	**Objective**	Users will always login with their username and password
3.	**Priority**	High
4.	**1st Actor**	Will be User
5.	**Goal**	To create a new profile.
6.	**Pre-conditions**	User is viewing the login screen of the system
7.	**Post-conditions**	System displays the home screen
8.	**Flow of Events**	1. Users enter his personal information and press submit butt 1. The user fills up his personal information and submits it. 2. The system checks to see whether a user with the same ID already exists. 3. The system generates a new page containing the user's data and shows it as the user's home page.
8.1	**Basic flow**	After success creates profile user go to login page U3.
9.	**Flow of Events for Extension (Alternate** Scenario**):**	No alternate flow must sign up to proceed further.
10.	**Use case**	No other use case use

Table 3. 1: Create Profile-U1

3.2.2 User Sign in (U2)

	Name	**User Sign in**
1.	**Use-Case ID**	U2
2.	**Objective**	The user will sign in with the credentials.
3.	**Priority**	High
4.	**Source**	Database
5.	**Actors**	User
6.	**Flow of Events**	Open Application Enter Sign in Enter Username and Password Click on Sign-in Button
6.1.	**Basic Flow**	After successful sign-in user will go to U3
6.2.	**Alternate Flow(s)**	No alternate flow, User must sign-in to proceed further
6.3.	**Exception Flow(s)**	Invalid Username Invalid Password
7.	**Includes**	U1
8.	**Preconditions**	must sign up
9.	**Post conditions**	Taken to Homepage
10.	**Notes/Issues**	If the User will sign-in with the right credentials no problem will occur

Table 3. 2:Sign In-U2

3.2.3 Homepage (U3)

	Name	Homepage
1.	**Use-Case ID**	U3
2.	**Objective**	In this use case, user can view the main area of our app and access features from there.
3.	**Priority**	High
4.	**Source**	User
5.	**Actors**	User
6.	**Flow of Events**	Sign-in to and view application home screen with all the available features
6.1	**Basic Flow**	After successful sign-in Administrator can go to any of succeeding flows.
6.2	**Alternate Flow(s)**	No alternate flow
6.3	**Exception Flow(s)**	No exception flow
7.	**Includes**	No other use case includes
8.	**Preconditions**	User must be signed in to perform U3
9.	**Post conditions**	Health status can be checked.
10.	**Notes/Issues**	Provide Accurate data

Table 3. 3: Homepage-U3

3.3 Detect heart rate (U4)

	Name	Detect/predict heart rate
1.	**Use-Case ID**	U4
2.	**Objective**	User will be able to measure BPM
3.	**Priority**	High
4.	**Source**	User is the main source of this use case User cares most about this functionality
5.	**Actors**	User
6.	**Flow of Events**	Login select option from the homepage Place finger on the back camera
6.1	**Basic Flow**	Users predict result
6.2	**Alternate Flow(s)**	No alternate flow
6.3	**Exception Flow(s)**	No exception flow
7.	**Includes**	Use case U3
8.	**Preconditions**	None
9.	**Post conditions**	Can check his health condition
10.	**Notes/Issues**	No

Table 3. 4: Heart rate Detection-U4

3.4 Detect/predict Stress (U5)

	Name	Detect/predict Stress
1.	**Use-Case ID**	U5
2.	**Objective**	User will be able to measure stress
3.	**Priority**	High
4.	**Source**	User is the main source of this use case
5.	**Actors**	User
6.	**Flow of Events**	None
6.1	**Basic Flow**	Users predict result
6.2	**Alternate Flow(s)**	No alternate flow
6.3	**Exception Flow(s)**	No exception flow
7.	**Includes**	Use case U3
8.	**Preconditions**	None
9.	**Post conditions**	Can check his health condition
10.	**Notes/Issues**	None

Table 3. 5: Stress Detection-U5

3.5 Import dataset (U6)

	Name	Import dataset
1.	**Use-Case ID**	U6
2.	**Objective**	Help user to manage a healthy lifestyle routine by providing them with exercises
3.	**Priority**	High
4.	**Source**	User
5.	**Actors**	User
6.	**Flow of Events**	No flow of events includes
6.1	**Basic Flow**	No basic flow
6.2	**Alternate Flow(s)**	No alternate flow
6.3	**Exception Flow(s)**	No exceptional flow
7.	**Includes**	No Includes
8.	**Preconditions**	No preconditions
9.	**Post conditions**	Admin train dataset
10.	**Notes/Issues**	None

Table 3. 6: Exercise Module-U6

3.6 Train dataset (U7)

	Name	Train dataset
1.	**Use-Case ID**	U7
2.	**Objective**	Help user manage their daily caloric intake.
3.	**Priority**	High
4.	**Source**	user
5.	**Actors**	user
6.	**Flow of Events**	Open food tab Generate caloric intake Help manage weight
6.1	**Basic Flow**	No basic flow
6.2	**Alternate Flow(s)**	No alternate flow, the admin must sign-in to proceed further
6.3	**Exception Flow(s)**	Missed meals
7.	**Includes**	No other use case
8.	**Preconditions**	No preconditions
9.	**Post conditions**	No post condition
10.	**Notes/Issues**	None

Table 3. 7: Use case Caloric Intake-U7

3.7 Classification (U8)

	Name	Classification
1.	**Use-Case ID**	U8
2.	**Objective**	Recommend Doctor visit to user based on health condition
3.	**Priority**	High
4.	**Source**	User
5.	**Actors**	User
6.	**Flow of Events**	Keep regular Data
6.1	**Basic Flow**	Set reminders for medicinal intake and get notified on set time
6.2	**Alternate Flow(s)**	No alternate flow.
6.3	**Exception Flow(s)**	Accurate data should be entered
7.	**Includes**	Use case U4
8.	**Preconditions**	Medicine must be added
9.	**Post conditions**	Notification generated.
10.	**Notes/Issues**	If time is not set correctly the alarm might not go off.

Table 3. 8: Use case of recommendation-U8

3.8 Avatars (U9)

	Name	Avatars
1.	**Use-Case ID**	U9
2.	**Objective**	show condition of user by actions
3.	**Priority**	medium
4.	**Source**	Result
5.	**Actors**	Animated avatars
6.	**Flow of Events**	login
6.1	**Basic Flow**	None
6.2	**Alternate Flow(s)**	No alternate flow
6.3	**Exception Flow(s)**	Accurate data should be entered
7.	**Includes**	None
8.	**Preconditions**	None
9.	**Post conditions**	No post condition
10.	**Notes/Issues**	None

Table 3. 9: Use case of Avatars-U9

3.9 Entity Relationship Diagram

ERD

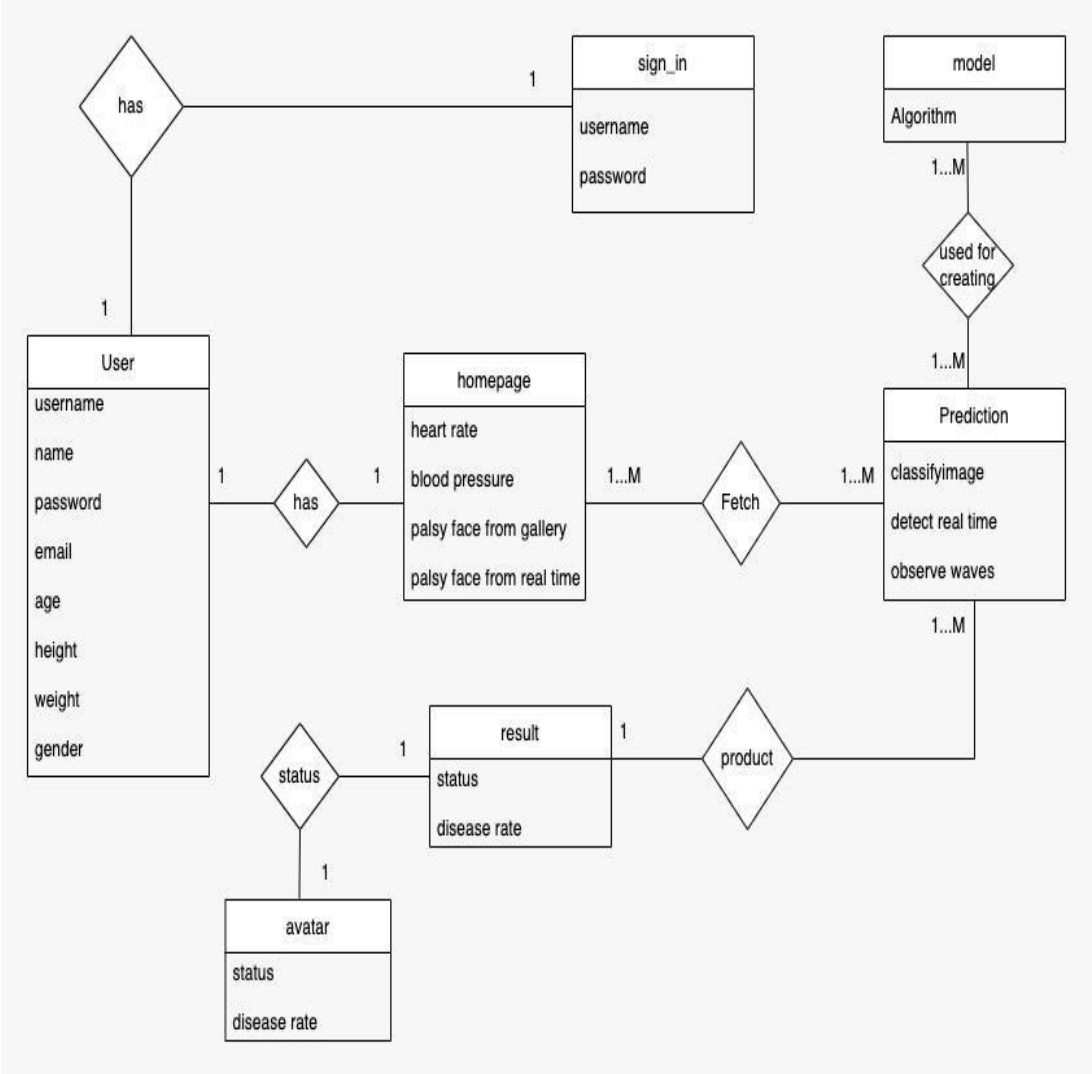

Figure 3. 7: ERD

This figure shows the ERD of the application and that how the detection proceeds and avatars show action based on the result in the application.

3.10 Sequence Diagrams

3.10.1 Sequence diagram of Create profile

The Following is the sequence diagram:

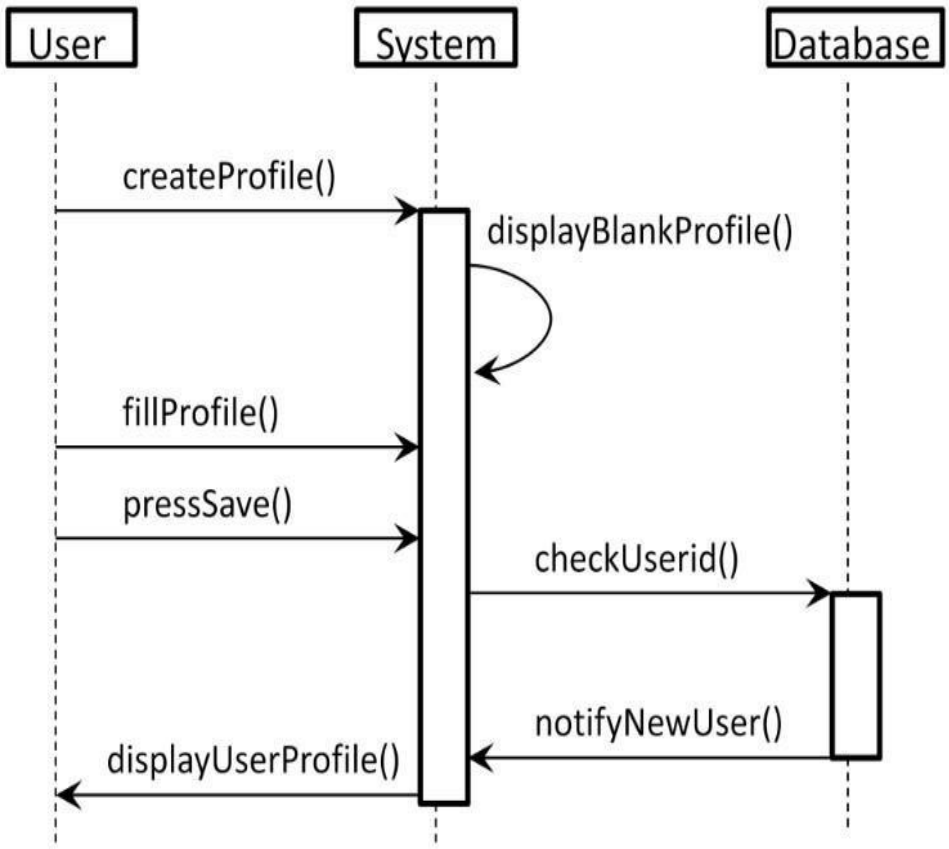

Figure 3. 8: Sequence Diagram of User Profile

Figure shows the sequence diagram of user profile creation process. Initially user signs up and the information is stored in the database so that whenever he/she sign in on a new device their health data can be fetched.

3.10.2 Sequence diagram of Sign in

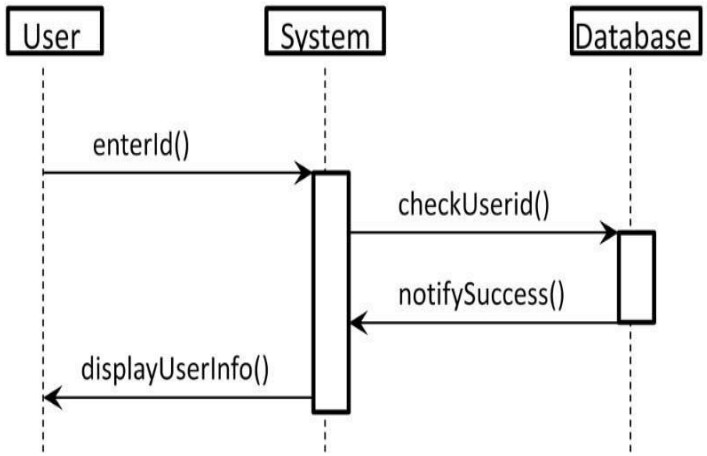

Figure 3. 9: Sequence diagram of Sign In

This figure shows the Sequence diagram of the Sign in process that how the upon a sign in request, the application first verifies the credentials with those in the DB.

3.11 Activity Diagram

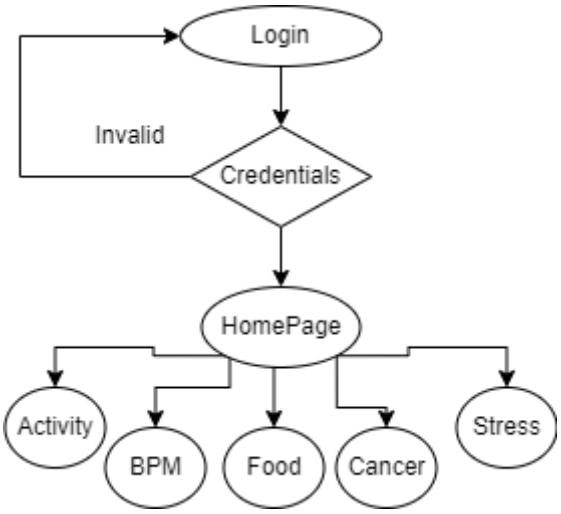

Figure 3. 10: Activity Diagram of Mobile application

This activity diagram shows the basic login activity of the application that how the user first needs login successfully to use the application.

3.11.1 Activity Diagram of Image classification model

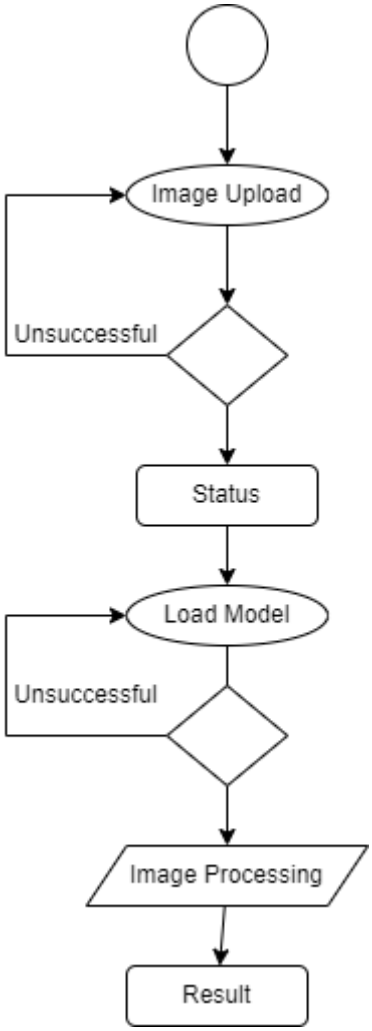

Figure 3. 11: Activity Diagram of Image classification model

This figure shows process of disease detection using image processing

3.12 Class Diagram

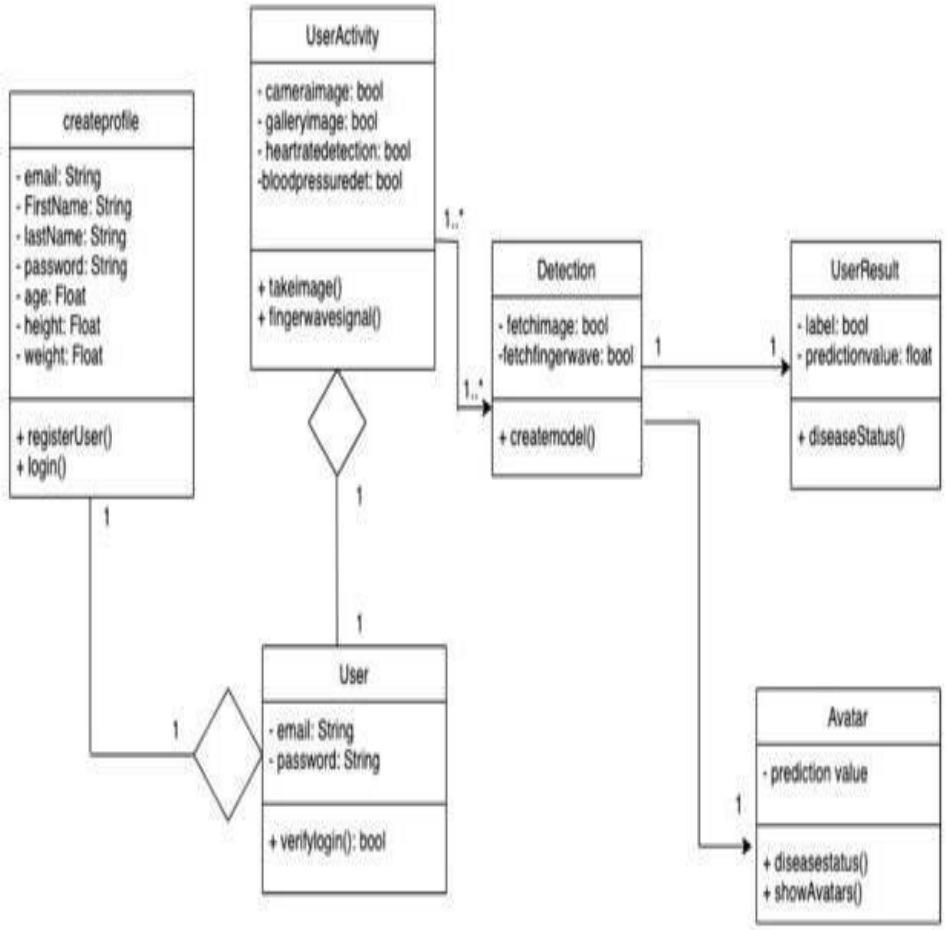

Figure 3. 12:Class Diagram

Figure 10 shows the class diagram of the application and shows the main functionality of the application.

3.13 Domain Diagram

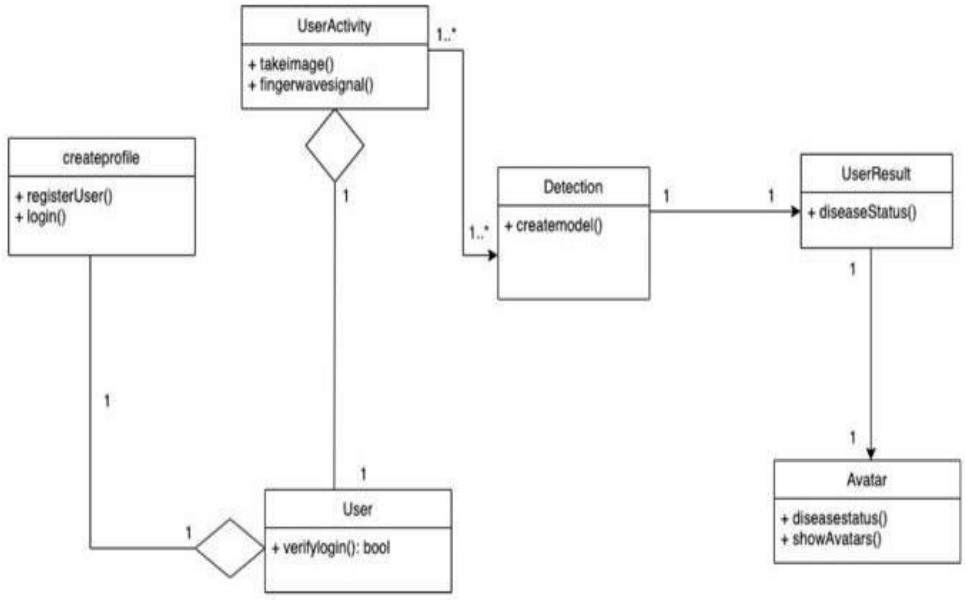

Figure 3. 13: Domain Diagram

Figure shows the main functionality of the application like user profile, detection and avatar, user result.

3.14 Methodology

The methodology which we will use for this project is Feature Driven Development. We will work our way through the various stages of FDD SDLC to develop our final product:

The steps of FDD that will be considered in our project are under following:

Step 1– Develop an overall model: This is the first step of FDD, in this initial scope of the project will be decided as it will decide what the project is and what function.

Step 2 – Build a feature list: This is the second step of FDD, in this provide the basis for the next steps. At this stage we will find the features by inspecting the model.

Step 3 – plan by features: this third stage is particularly important. In this, we start planning the planning the project. Count all the intentions gathering in the earlier stages. Documents will give time to the completion of each module. Use Gannt chart and another chart for this.

Step 4– design by feature: At this stage further accuracy is needed as a system is somehow designed according to the feature. Configuration diagram will be created for each module so if there is any functionality error it can be replaced.

Step 5 – build by feature: this is the final stage where the technological section arises in working and after that one step after another feature will be developed. And after its completion, the project will be tested and debugged.

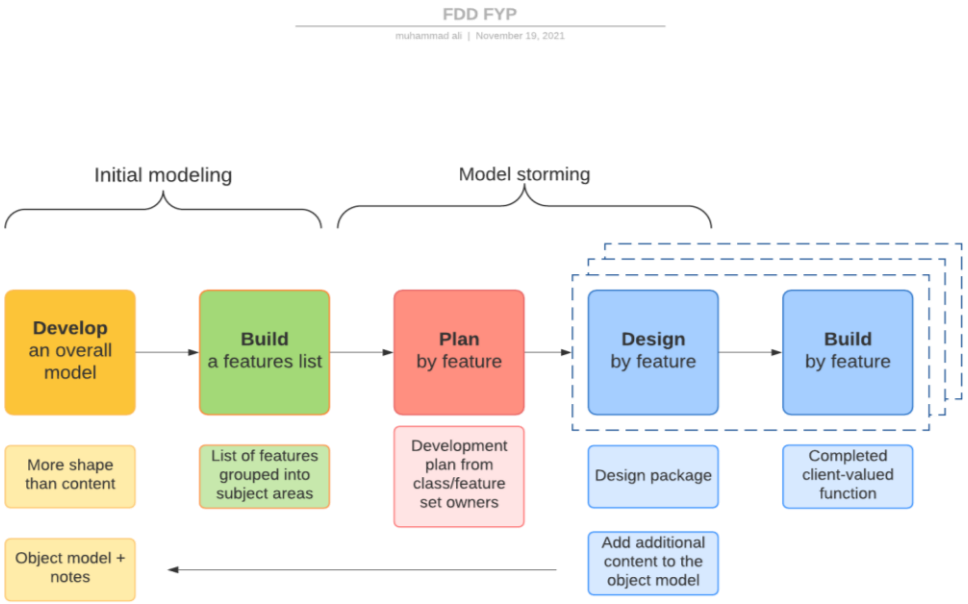

Figure 3. 14:FDD Flow

CHAPTER 4

4 IMPLMENTATION

4.1 Camera Sensors

Use the camera sensors which is built-in android phones to detect the Blood pressure and heart rate place the index finger on the back camera to check the status of blood pressure and heart rate.

4.2 Avatars

We have used animated Avatars which will make the application more user friendly and easier to understand. [3]

4.3 Tools and Technologies

The tools and technologies used in this application are under following: -

4.3.1 Flutter

Flutter is an open-source software created by google to develop beautiful and fast-moving UIs. It is used to create cross-platform apps from a single codebase for Android, iOS, Linux, macOS, Windows, Google Fuchsia, and the web. It utilizes Dart as its base language to wite code. Flutter allows you to create fast and dynamic UIs.

4.3.2 Android Studio

Android Studio is an integrated development environment for developing the android apps. Use XML for the front end and Java for a backend which integrated the train Model, camera sensors, Avatars, and results.

4.5.3 Rive

Rive is a platform which allows you to create interactive animations based to dynamic state machines which modify the animation based on given state of the variable

CHAPTER 5

5 USER MANUAL

5.1 Splash Screen

Figure 5. 1: Splash Screen

Fig shows when user open the app sees the Splash Screen on which sees the application name icon related to application.

5.2 Exersice screen

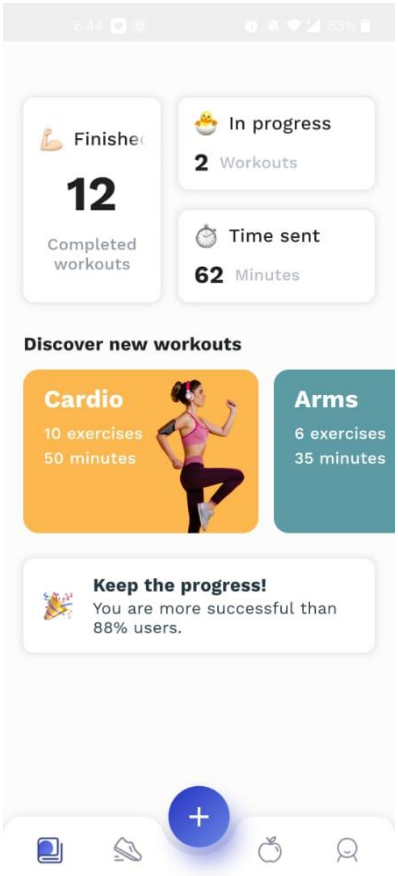

Figure 5. 2: Exercise Screen

Fig the main exercise/yoga screen for the user

5.3 Signup Info Screen

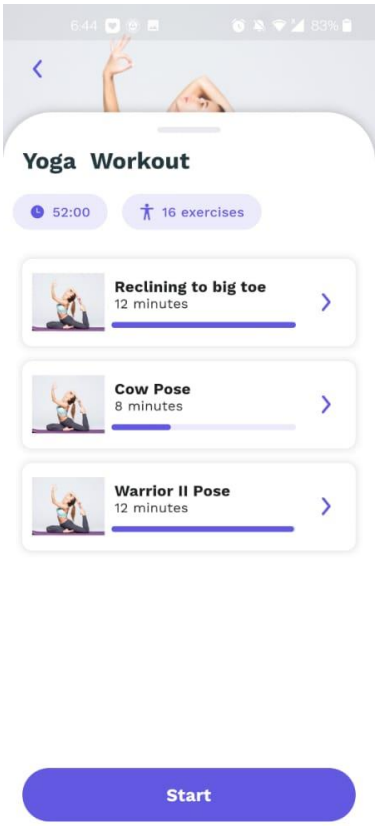

Figure 5. 3:Select Exercise screen

User can select a workout/yoga of their choice and then

5.4 Exersice Info Screen

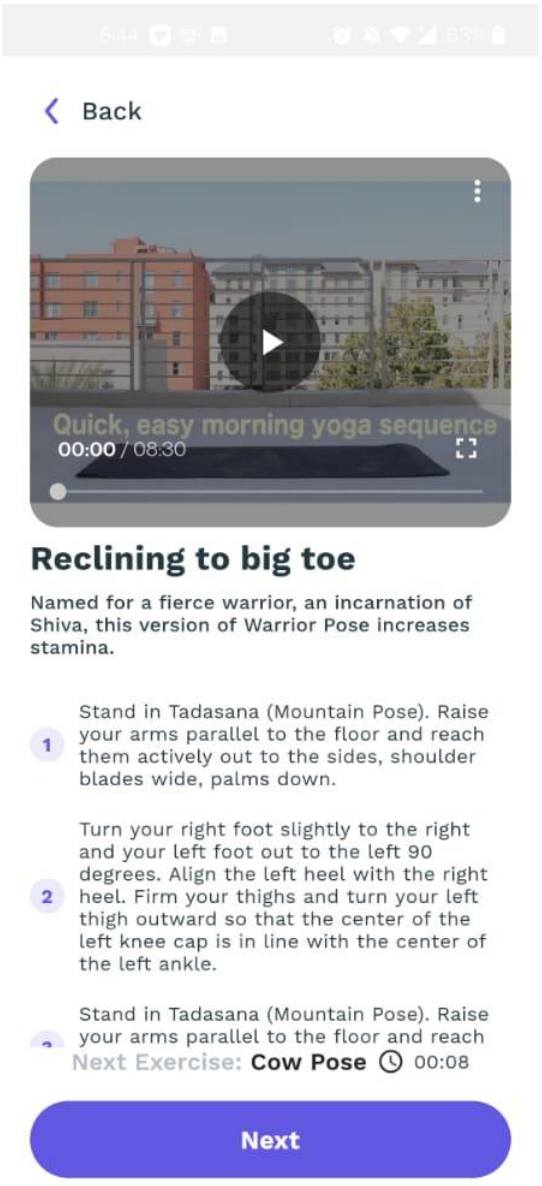

Figure 5. 4: Info Screen

This screen serves as a guide for what the user has to do

5.5 Steps and Calories burnt

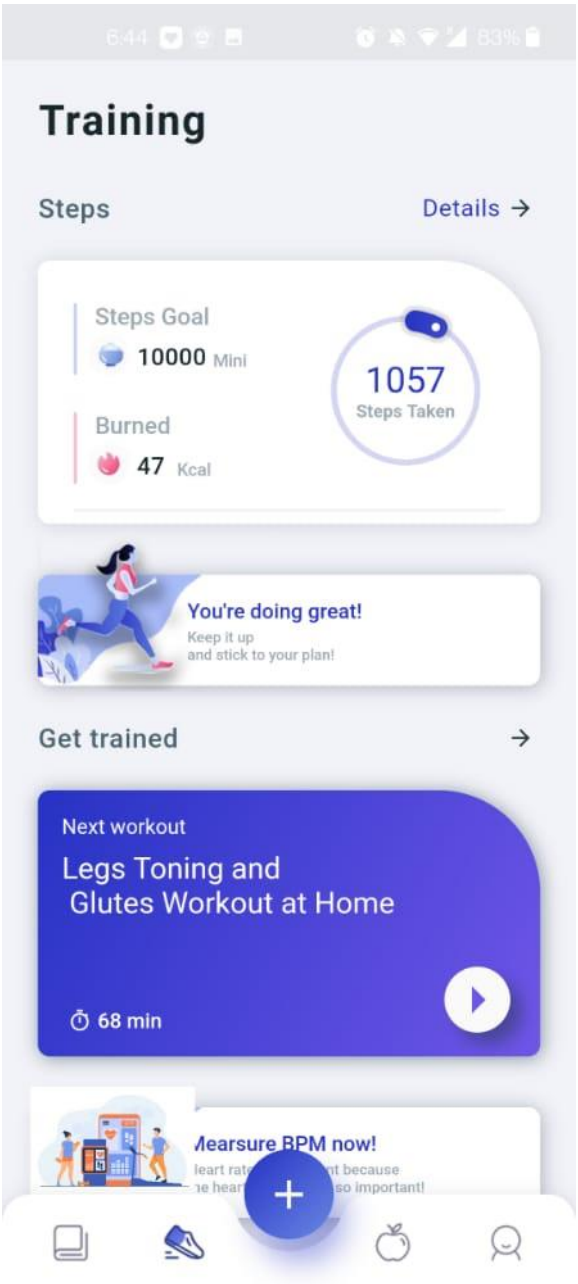

Figure 5. 5: Caloric Intake Page

Fig 18 Shows the user how to how many steps they have taken and how many calories they have burnt.

5.6 Water Intake Page

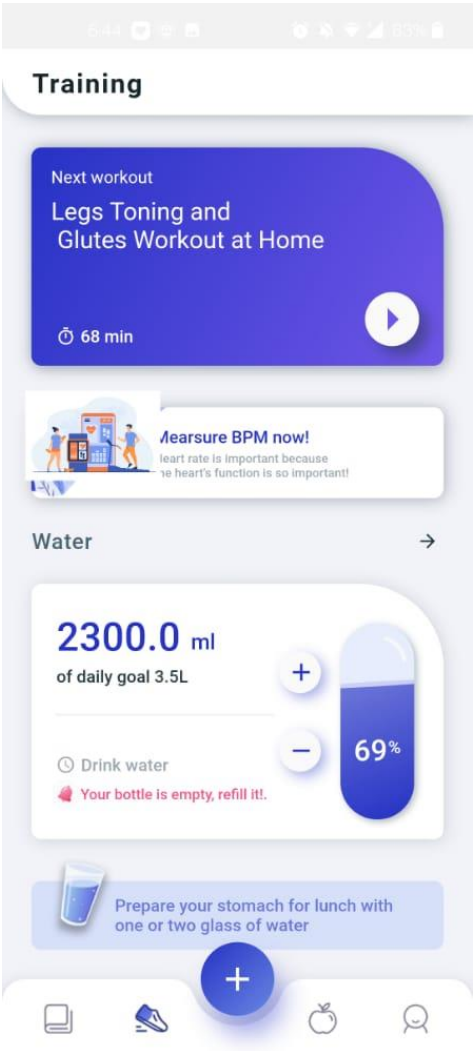

Figure 5. 6: Create Meal Page

Help the user keep track of their water intake

.

5.7 Macro Calculator Info Screen

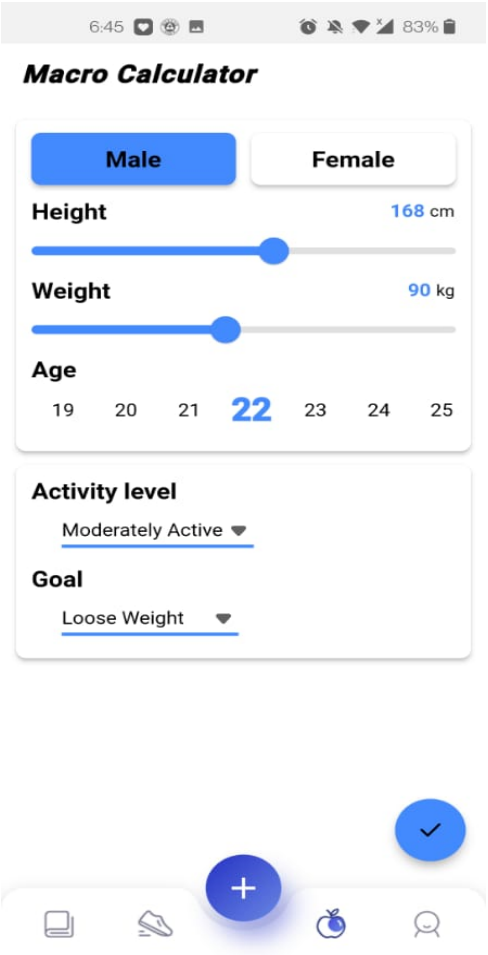

Figure 5. 7: User provides inputs

Help the user keep track of macro nutrients.

5.8 Macro details

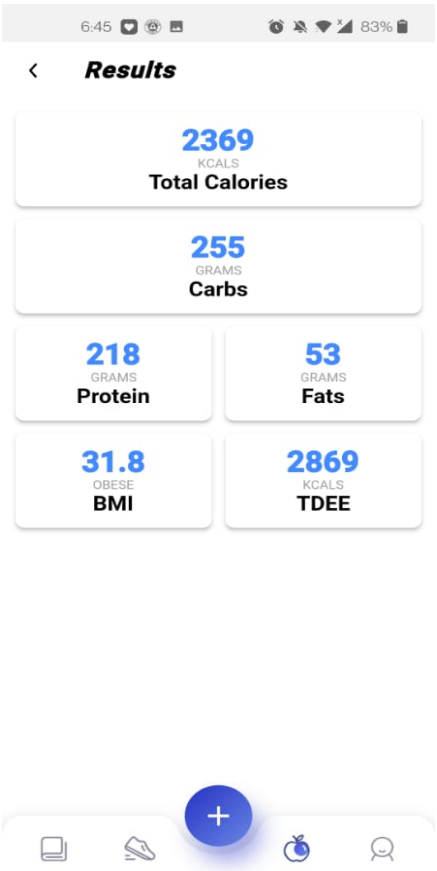

Figure 5. 8: Details of the macros

Fig provides user details about how many macro nutrients they require for their goal.

5.9 Medicine Reminder

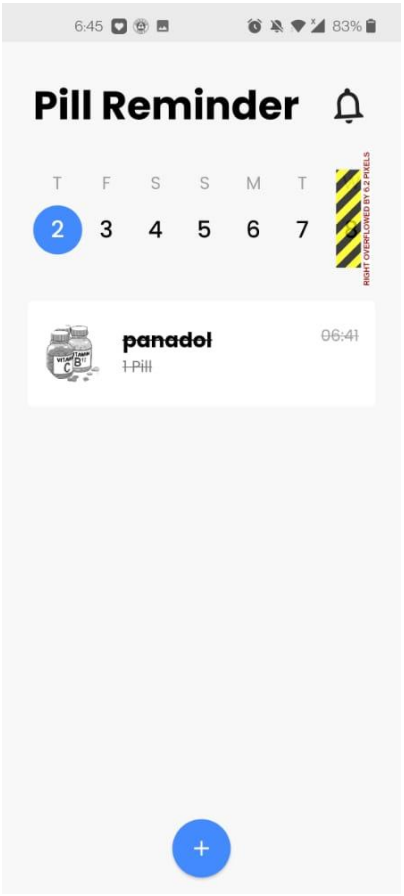

Figure 5. 9: Medicine Journal

Figure shows a journal screen for user to keep track of their medical intake

5.10 Adding a Medicine Reminder

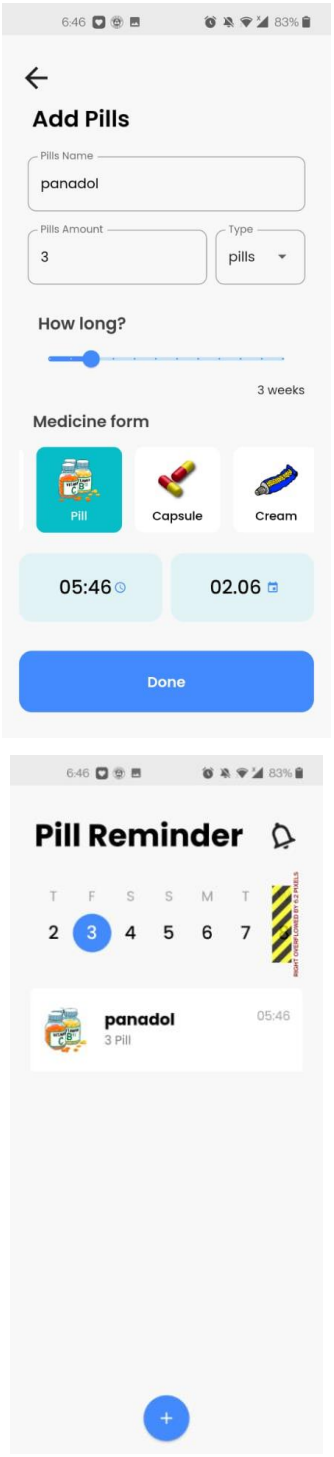

Figure 5. 10:Reminder Being Added

Shows the user adding a medicine reminder.

CHAPTER 6

6 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This pandemic has been an eye opener for everyone. Now more than every it has become crucial to maintain a healthy immune system so that your body can be prepared for the worst. Digital health companion is an application which allows the user to better understand their health data by creating dynamic visualizations of that data. This application helps the user in regulating and maintaining a healthy lifestyle. Users can keep track of their caloric intake, maintain water intake, keep a track of steps count, get medication reminders. The user will be able to measure BMI and BPM. The Application features dynamic graphics and avatar to help users get a better understanding of their health data.

6.2 Limitations

Currently the ML based modules cannot be integrated due to flutter because the tflite dependencies have depreciated for flutter v2 until further notice. Due to this many AI models based on CNN and KNN, like melanoma detection, diabetic retinopathy etc cannot be implemented until Flutter v3 announces new dependencies.

6.3 Recommendations & Future Use

This application covers a drop in the ocean that is the potential a mobile phone possesses in the field of medicine. Now a days the limitation barriers on technology have been pushed backed and everything is available on the palm of your hand. The features we are currently utilizing can be improved upon and added upon in order to create a much more functional and dynamic application.

In future we can add multiple modules like skin lesion detection which include diseases like psoriasis, acne, and melanoma. We can also add further diseases like diabetic retinopathy etc. We will also work towards improving the animation and graphics system in order to create a much more interactive and customizable UI.[6]

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