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IOT Based Smart Health Monitoring System

Bachelor of Science in Information Technology

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Certificate

We accept the work contained in the report titled “IOT Based Smart Health Monitoring System”, written by Mr.Hamza Habib Rao AND Muhammad Nabeel Arshad as a confirmation to the required standard for the partial fulfillment of the degree of Bachelor of Science in Information Technology.

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Abstract

The increasing trend of ageing populations across all over the world in recent years, has led to complex health issues, including the increase of heartbeat, less sleep time and less number of steps taken and rise in hospital and clinical services expenditures. Health monitoring is playing an important role in maintaining health for individuals, specifically for the elderly or people with heartbeat, less oxygen saturation, less sleep time and less number of steps taken. It can reduce hospitalization and increase the quality of life. Traditional health monitoring methods are difficult and time-consuming for all parties involved. These models will be insufficient to meet the need of medical services in our society. There has been a demand for developing efficient healthcare solutions which help to decrease the pressure on hospital systems and healthcare providers. This improves the quality of care as well as having a part in reducing healthcare costs by keeping patients out of hospitals for routine care. IoT is promising for developing remote healthcare monitoring systems. IoT applications provide a paradigm for connecting real and virtual entities, allowing them to interact, share information, and make choices in concert. In recent years, IoT-based applications in the medical field have drawn substantial attention of researchers and technologists. Our study proposes an IoT Tiered Architecture (IoTTA) for developing holistic and integrated sensor data-to-real-time clinical feedback applications. Health monitoring technologies based on the Internet of Things (IoT) are now potentially extremely valuable for elderly people. This research presents an IoT-based system that is a real-time health monitoring system that uses the patients' measured values of body statistics (such as (bpm) heart rate, total steps count, how many miles will be covered, and how many calories burned), which are the most important measurements required for critical care. This system uses an IoT-based system with a watch sensor to detect these signals and displays them on an application screen that indicates the patient's heart rate, total steps count, distance travelled, and calories burned. It can be simply synchronized with a mobile application for immediate access. IoT-based products might be beneficial to elderly patients in terms of saving lives. Smart health monitoring system is a IOT based application that we have developed. In this project our IoT device is Fitbit smart watch because we will fetch the data from a watch through its sensor. It will provide following statistics data from watch sensor such as steps count, bpm (beats per minute), calories burned, miles covered, user name, battery life, device name. These are all the data are fetch through Fitbit Api's. All the data to be fetch from Fitbit server. By this, our application provide watch statistic to the patient. This application have some feature where patient can take advantages from it like medical description patient will upload its medical description which was given by its doctor. This description can be uploaded via a mobile camera or export image from its phone gallery. Patient can check their health status by entering their following credentials. Patient can save their health status and can refer to its specif

doctor. Patient can also see their watch statistic in graph foam. Graph will help patient in monitoring their health on daily basis. Their is set target feature in this application where patient can be set their target on a daily basis which help's patient to maintain their good health. In this application there is a doctor module where doctor can be sign up and then login into the account. After login into the account doctor will see its patient health status, patient health graph and patient log. In this module doctor can be recommend its medical advice to their patients. And can easily monitor their patient health with the help of graph. In this application there is nutritionist where nutritionist can suggest their diet plan to their patient if it is required. Login will be required for the nutritionist where it can see weekly data of their patient and can suggest health diet tips to their patient. This product might be beneficial for the elder patient and also those patient who needs monitoring on the daily basis.

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"Unity is strength... when there is teamwork and collaboration, wonderful things can be achieved."

Mattie Stepanek

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Chapter 1

Introduction

Smart health monitoring system is a IOT based application that we have developed. In this application user will be able to see its watch statistics. Before seeing the health, statistics user must have to wear a Fitbit watch. After wearing a watch user must make a Fitbit account if it does not make it the application can not access the watch data. The data will come from Fitbit server through token. This token is provided from Fitbit developer account. For generating a token, it is mandatory to register developer account. All the data to be fetch from Fitbit server through internet. In this application some Fitbit APIs are required to get data from watch. In this application there is two major module one is patient side module and the second one is doctor side module. In this application patient side module have some features with their functionality. In this app there is medical description facility is available for the patient where patient can upload its description in text foam as well as in image foam. Image can be taken from mobile camera and can also export image from mobile gallery its all depend upon patient choice. In this app you can see set remainder feature is available where patient can set their mealtime and medicine time on a specific time which was provided by the patient. In this app there is check health status and previous health status functionality is available where patient can check its health status and this health status will also refer to doctor. In this app you can see nutrition diet manual page which is by default available for the patients where patients can take help from this page. On the other hand, there is a doctor module where doctor must register in our application through sign up process. After registration doctor can be log in in our application at any time. In this application doctor can see its patient health status. Doctor has a choice to recommend any medical advice to its patient if its needed. Otherwise, it can see their patient health status. We built the app in Android Studio utilising Flutter and the Dart programming language, as well as several APIs. Our app is built using the flutter Framework, which lets it to run on any Android device. We will create the application in such a way that it is simple to use.

1.1 Problem Description

Today, it's tough to get to the doctor because of the temperature or a pandemic, and people struggle to keep to their doctor prescription. Doctors occasionally ask patients to show them whatever medications they've been prescribed previously, or to show them when and who diagnosed them earlier. There is chance of losing the hand-held reports. Chance of losing previous medical records and medical reports. There is diet nutrition manual is available in hand-held book. There is difficult way for any patient to convey a daily health status record to its specific doctor. Patients will forget to take medicine on time. They were also forgotten to take meal on time. Some patients require daily care, and it is impossible to visit the hospital every day.

1.2 Project Objectives

This project's major purpose is to enable customers to virtualize products in their homes or wherever they are physically convenient. This application allows users to get medical advice about their health from the comfort of their own homes. Our main objective is to help people to check their health status through mobile application where they can see or view previous week health status record about their Beats per minute, chest pain because if you go physically to the hospital then it will consume too much time of an individual. We focused on on-patients who were in desperate need of monitoring. We built this software for non-monitoring people to save their time and money. We created this software so patient may stay informed about his health without having to travel to the hospital every day. They can get information about their health status from the doctor at their own homes.

1.3 Project Scope

The main scope of this application is to determine user health through various modules. Our scope revolves around the health monitoring. This project seeks to fill a gap in the market by developing a tool that assists both users and providers in personalizing the healthcare experience with the objective of improving overall health and wellness. This system provides an interface enabling access to a patient portal, doctor portal, BPM monitoring, etc. In addition, notifications or alert messages will be utilized to ensure patient health and wellness. This application also provided facility to the doctors where doctors registered their account and manage their patient's health time to time. This application offers a complete set of features designed to provide an efficient and effective means to achieve optimal health and wellness in the most user-friendly format possible.

1.4 Methodology

The laptop, smart watch and mobile phone are required for this project; the app will be programmed on the laptop, Pc and executed on the mobile phone. The application will relate to smart watch through internet. The main working of this project is to diagnosis beats per minute (BPM), Check Health Status, check how much miles to be covered and total step count. Sensor available in the smart watch which helps to detect the BPM, step count, miles, calories burn. The reading that comes from the sensor that is in the smart watch. Smart watch will send the data to the application and the application show the stats of user health.

1.4.1 Watch Statistics Interface

In our project, user data statistics will be displayed, such as how far a user will travel in a single day. On the primary screen, the user's BPM and calories will be displayed. Fitbit's server will be the source of all stats. This information can only be obtained by using the internet. To obtain data from a server, the user must first wear a watch, after which the data will be transferred to a Fitbit server, which will then give the user with data on our application. Additionally, users must update data on the Fitbit original application, then it will transfer data to the Fitbit server.

1.4.2 Check Health Status

In our project we are providing check health status facility to the user. This facility will be provided according to user data. If the user reports health is not good, it will show message to the user which is according to user data. Health status will be generated based on user data the data will be entered by the user is beats per minute (BPM), chest pain. These two data will be mandatory for the user, if the user did not enter the data, then application will not predict it's health. On the other hand, in this module user have a choice to mark the following check boxes (Smoker, Diabetes, Headache). These check boxes are optional if the user is suffering from these issues, it would be marked by the user otherwise this module will generate the user health based on BPM and Chest Pain. Message will be generated in the emergency if user BPM, Chest Pain suddenly goes higher, then BPM and Chest Pain control message will be provided to the patient.

1.4.3 Refer Health Status to Doctor

In our application we are providing facility to user to send its health record to its personal doctor. In this module user predict their health status as above mention in check health status, then after predicting it, user have a choice to send its health status to its personal doctor. It will depend upon user choice. User can only share their health status with those doctors who are registered in our application. If the doctor is not registered, then it would be shown blank to a user. If the doctor is registered in our application, then there is a list of doctors available where user can send their health status to its specific doctor.

1.4.4 Nutrition Diet

In our application there's a nutrition diet plan is available for the user. In our application nutrition diet plan helps the user to set their diet according to user choice. Users see diet manual which is by default available in our application.

1.4.5 Set Reminder Notification

In our application there is a set reminder notification facility for the users. Where user can facilitate with this feature. In this feature user can be set their mealtime and medicine time also. This feature also helps those patients who wants to take medicine on time. User can set their reminder according to it's time. Time would be set according to hour and minute. If the time is matched according to the user, it will generate a notification on screen bar as well as when screen is off. This notification will generate on the daily basis until the user delete the reminder.

1.4.6 Medical Description

In this application we are providing medical description module, where user can be entering their medical description like medicines and tests. In this feature user can also be safe their hand-held reports by capturing pictures of reports from mobile camera. In this feature user can also export report or images from gallery in this module. Only images can be export in this module.

1.4.7 Health Status History

In this application there is history of patient health status. This status only shown when the user use check health status module. In this module it saves user health status record which was generated by the user by using check health status module. In this module user can be see their health status history with date and time which was generated by the check health status module. By using this feature user can save their medical history time by time and can also show to the doctor. This feature can be saved manual paperwork of patient and can be maintained patient records time by time.

1.4.8 Doctor Panel Main Page

In our application there is another panel which was available for doctors only. In this panel only doctors can be registered their account in this application. If the doctor is new in this application, doctor firstly must register their account and then login into the application. After logging into the doctors panel, doctors can be seen their patients list, where doctors can be facilitating their patients through providing their medical descriptions. This medical description also sent to their patients by the doctors.

1.4.9 Check Patient Health Status

In this doctor panel doctor can be seen their patient's health status. This health status should be sent by the patient. If the patient sends its health status to its specific doctor, then its health status will be shown to only their specific doctor. Only specific doctor can see their patient health status, all doctors have no authority to check patients' health status. If the user did not send its health status to its doctor, then no status will be shown to the doctor.

1.4.10 Providing Medical Recommendation to Patients

In this module doctor can be provide their medical facility to their patients. In this module it gets the health status record from patient and provide recommendation facility to the doctor, where doctor can be recommending their medical instance in description form. After giving their medical facility to their patient it will goes back to the patient panel. In this module both doctor and patient save their medical recommendations or record which was given by the doctor.

1.4.11 Patient Statistics Graph

This graph will be provided to the patient side where patient can see their watch statistics in graph foam. This graph will assist the patient in daily health monitoring. Daily data will be generated for this graph. The graph will be produced using the current date. Additionally, the doctor and nutritionist will receive this graph so they may easily keep tabs on their patients' health.

Chapter 2

Literature Review

The main process, research into health requests is immovable among the different requests of IOT. Healthcare requests generally reflect close attention to IOT techniques thanks to cost savings, easy interpretation, and recovery of patient's personal satisfaction. This paper helps to imagine how IOT is incorporated into complex health care procedures. The "Mobile Healthcare Management System (HMS)" is one in all the most IOT apps that link the web to mobile sensors, people, clinicians, networks and other connected devices. The failed method, the IOT-based smart HMS, has made it possible for clinicians to observe their patients in remote areas on an ongoing basis the web of Things work with many technologies such as wireless sensor network (WSN) communicate with each other via Coap, 6LoWPAN, REST, etc. protocols such as radio frequency data, smart mobile inventions, and wireless sensor networks. The IOT European Research Cluster (IECR) project concept. IOT is an infrastructure that links everyone, wherever, wherever and wherever to all or any facilities, flexibly, through connectivity and networking. It's seen as a groundbreaking development with several improvements over the years. The IOT came as a revolutionary idea, which was implemented during a smart world with a sort of rational energy efficient technology. "IOT has become a significant focus of health, energy, the environment, public protection, food and water access, connectivity, manufacturing so on and far more in numerous areas of social use.

Biggest advantages of IOT in healthcare is a reduction in maintenance burden, followed by an increase opportunity for health care. The addition of a personal and online Health Care network is great learn from experience and expect that mobile communications and technology in general kill will lead to the development of cloud-based healthcare services. IOT has been offered as a major platform for neural consciousness monitoring. For effective monitoring equipment is not available, a much higher risk may occur. Technologies like IOT be played here. The patient's best concern is such caution. Some sensors are used to Detailed patient analysis. Caregivers can provide complete health care device. Increased monitoring of IOT devices commonly used by patients with disabilities is needed.

Monitoring strategies, using sensors, were collected to maintain the patient's constant physical movement is transferred there to the caregiver.
[1] Healthcare app that a allow patients and adults to live independently. IoT sensors are used during this time to diagnose and re-evaluate their health condition and send alerts in illegal cases. The IOT device itself will appropriately advise the patient when other minor problems detected. The sections below cover various applications of IOT in health care.
IOT has been defined as the main distributor of healthcare systems as one of the IOT the most important uses. Help provide people with better health care anytime and anywhere regions by removing geographical, temporal and other barriers while increasing their coverage and effective at the same time. The IOT medical revolution is a reality and therefore fair, affordable care provides high-quality care to everyone. These applications generate a large amount of Sensor data must be properly processed for monitoring and manipulation. Cloud computing, through it Foundations is a promising approach t efficient knowledge processing in the medical field. Further work on security issues related to various implementation stages need to be completed.[2]

2.0.1 IoT-Based Smart Health Monitoring System for COVID-19

With the commencement of the COVID-19 pandemic, social distancing and quarantine are becoming essential practices in the world. IoT health monitoring systems prevent frequent visits to doctors and meetings between patients and medical professionals. However, many individuals require regular health monitoring and observation through medical staff. They have used technology to simplify patient life for early diagnosis and treatment in the suggested work. The Internet of Things (IoT) is being used to create a smart health monitoring system that can track a person's temperature, heart rate, blood pressure, and oxygen saturation.
This approach is useful in rural or village situations where neighbouring clinics may communicate with city hospitals on the medical problems of their patients. However, the IoT system will notify the doctor or physician in the event that any changes in the patient's health based on standard values take place. The measurements of heart rate, patient body temperature, and SPO2 had maximum relative errors of 2.89 percent, 3.03 percent, and 1.05 percent, respectively.
These values were equivalent to those of commercial health monitoring systems. This IoT-based health monitoring device makes it simple for doctors to get real-time data. High-speed internet access enables the system to continuously check the parameters. Additionally, the cloud platform enables data storage so that earlier measurements may be accessed soon. This approach would aid in the early detection and treatment of certain COVID-19 patients.[3]

2.0.2 IoT-Based Smart Health Monitoring System for COVID-19 Patients

The COVID-19 epidemic is currently one of the biggest worldwide problems facing health agencies. More than 56.4 million persons have been verified to be SARS-COV-2 infected globally as of November 19, 2020, and more than 1.35 million have died as a result of the coronavirus, demonstrating the rise of COVID-19 cases globally. As of November 21, 2020, there were 445,281 confirmed COVID-19 infections in Bangladesh, and there had been 6350 coronavirus fatalities. Patients with COVID-19 experience a variety of symptoms, including fever, breathlessness, a drop in oxygen saturation, dry cough, nausea, vomiting, sore throat, headache, loss of taste and smell, bodily discomfort, and an irregular heartbeat. High temperature, poor oxygen saturation, and irregular pulse rate are among the signs that are regarded as dangerous. Hypoxemia and hypoxia are each brought on by low oxygen saturation levels and shortness of breath, respectively.

Patients with hypoxemia and heart rate issues have a lower probability of surviving. Patients may fail to notice hypoxemia and an accelerating pulse, and as a result, they pass away without obtaining the appropriate care. As a result, it's critical that COVID-19 patients are kept up to date on all aspects of their health, particularly their body temperature, heart rate, and oxygen saturation (SpO2). It is increasingly important for people to get regular medical checks as they get older.

IoT-based arrangements might be advantageous to people for routine health exams because it may be time-consuming and challenging for most people to acquire doctor's visits. IoT technology has emerged as a crucial invention with multiple uses. It specifically refers to any physical device system that acquires and exchanges data across wireless networks without the involvement of a person. Every nation (including Bangladesh) struggles to provide patients with the right care due to a marked rise in active COVID-19cases during the second wave. The simplest indicators of a person's health are their pulse rate and body temperature.

The number of pulses per minute is the pulse rate, commonly referred to as the beat rate. For ordinary people, the normal pulse rate lies between 60 and 100 beats per minute. Adult males and girls have resting pulse rates that are around 70 and 75 bpm, respectively. [4]Typically, the pulse rates of women above the age of 12 are greater than those of men. However, COVID-19 patients' abnormal pulse rates necessitate the assistance of an emergency medical assistant. The internal body temperature of a healthy adult fluctuates between 97.8°F (36.5°C) and 99°F (37.2°C) depending on a number of variables, including gender, eating habits, and environmental temperature. A change in body temperature may be caused by a number of conditions, including influenza, low-temperature hypothermia, and other illnesses. Fever is a frequent sign of numerous disorders, including COVID-19, thus it's important to take regular temperature readings. In COVID-19 individuals, oxygen saturation is also a crucial component. [5]The usual range of the human body's oxygen saturation (SpO2) is 95 to 100 percent. Recently, many instruments have been employed to measure these variables. For instance, most nations have commercial access to fingertip pulse oximeters, which are used to gauge SpO2 and pulse rate. The deluxe handheld pulse oximeter, which costs around 299 USD and measures SpO2 and heart rate, is also offered commercially. A wrist-worn pulse oximeter that measures SpO2 and heart rate is available over the counter. Like the devices listed above, this one lacks functionality for measuring body temperature. The wrist-worn pulse oximeter is pricey, coming in at USD 179. [6]The market today offers both analogue and digital thermometers, although the majority of them are pricey. The earlier-mentioned gadgets are not IoT-based. Some of them display values, but getting measurements from various devices is difficult. As a result, it might be challenging for a doctor in Bangladesh to get updates from every patient at once. Patients with severe symptoms of COVID-19 are in need of immediate monitoring. Patients can now obtain COVID-19 therapy using their mobile phones at home thanks to technology.[7] The system, in which its only a hardware prototype was created, is based on cloud computing and the Arduino Uno. However, there are no statistics from actual testing. A heart rate monitoring system based on a mobile application was shown in. In this system, a pulse rate sensor was used to measure the patient's pulse rate, and Arduino was used to analyse the results. The Android application received the measured information. There were only a few sensors employed in the research. Different IoT-based wireless health monitoring systems have been presented by various authors. However, it appears that IoT-based smart devices for combining temperature, heart rate, and SpO2 measurements for COVID-19 patients have not yet been introduced. [8]The major goal of this study is to create and put into use a unique Internet of Things-based smart health monitoring system for COVID-19 patients based on body temperature, pulse, and oxygen saturation levels. Through a mobile application, the device may provide measured values for a person's body temperature, oxygen saturation level, and pulse rate, enabling the patient to seek medical assistance even if the specialist is not physically there.[9] A clinician needs the patient's pulse rate and oxygen saturation level in order to treat a COVID-19 patient. Our suggested approach would allow individuals to tell doctors about their medical issues. Patients with COVID-19, as well as individuals with other illnesses including chronic obstructive pulmonary disease (COPD) and asthma, can benefit from this device. COPD contributed to 5

Chapter 3

Requirement Specifications

3.1 Existing System

The members of our group have attempted to search for a mobile application that is connected to our idea, which is an IOT smart health monitoring system; however, there are currently no such applications available in Pakistan. On the other hand, there are a number of fitness tracking applications that are available, but these applications only provide the user with the ability to track their fitness. These applications did not do any sort of health monitoring on the user. There are several applications that are currently on the market that are simply concerned with user fitness and health, and these applications are related to health. They do not give any other services besides exercise, monitoring of the user's heart beat and blood pressure, monitoring of the user's step count, and monitoring of the user's calorie burn. These applications will be responsible for providing these data. They also do not offer any kind of medical facility to the patient in which they can assist both the patient and the doctor. Additionally, these applications do not display their users' health statistics in the form of a graph foam, nor do they offer any kind of medical service to their users. These are the problems we have with the current system. As a result, the suggested system will address all of these concerns.

3.2 Proposed System

After conducting some research, we came to the conclusion that dedicated health monitoring applications for managing patient health (such as how many calories will be burned, how many miles will be covered, manage heart rate, and medical recommendations) in an effective and centralised manner do not exist on the market. This was our conclusion after discovering that there is no gap in the market, also known as a market opportunity. Our application provides the user with watch data that show the number of calories burned, the total number of steps taken, the heart rate monitoring, and the amount of miles that will be covered. Within this application is a patient dashboard, which provides the patient with access to the following modules for patient facilitation. The following are the different modules: (such as description, set reminder, nutrition diet, check health status, health history, details of an application, history, set targets). In the system that is being suggested, there is a notification for an alert that is based on a push notification. This notification is triggered in the event that photographs are uploaded into the description module, and it sets the medicine time in the set reminder module. The user will receive notifications whenever they utilise these modules, so it is important that they do so. It is the job of the doctor to inspect the patient whenever the patient requests him to do so. However, with the assistance of this app, the doctor is able to more properly analyse the patient's condition and then prescribe medication that is suitable for the patient. When the patient asks for a diet plan, the same role will be applied to the nutrition. He can simply request the nutrition, and then he will see an overall view about the patient's condition, such as how many calories he consumes or how many steps he takes. This role will also be applied to the nutrition. The rate at which his heart beats, after which he will provide him with a diet plan that he can adhere to.

3.3 Requirement Specification

3.3.1 Software Requirements

The software requirements for this project are:
1. Android Studio.
2. Flutter.
3. Dart Language.
4. Firebase.
5. Fitbit Server.

3.3.2 Hardware Requirements

The hardware requirement for this system are:
1. Fast internet connection.
2. Personal computer or laptop.
3. Fitbit smart watch.

3.3.3 Functional Requirement

The user will see three user interfaces after opening our mobile application: one for the patient, one for the doctor, and one for the nutritionist. In our system, users have the option of going anywhere within a single application. However, if the user wants to go to the doctor module, he or she must first register with our system. After registering for our doctor panel module, he or she will be sent to a new screen where they may view their patient's health state and, if necessary, give medical advise. Nutritionists, on the other hand, recommend food plans to patients based on their health data (such as calories burn, total steps covered, heart rate monitoring, total miles patient have been covered). The patient will be given a diet plan based on these criteria. Finally, in the patient module, patients may view their watch statistics on their main page before proceeding to their dashboard page, where they can view and use features such as (description, set remainder, nutrition diet, check health status, health history and so on). If a patient wants, he or she can communicate information about their health to their doctor. And also check medical advice which is provided by the doctor.

1. **Patient Panel**

   In this panel patient can see their health statistics details. The health statistics are patient step count, how much they travelled, how much its calories burn, how much is maximum and minimum BPM of patient. In this panel there is patient dashboard where patient can add its medical description, patient can add its remainder, patient can check its health status, where patient can save their health status history and patient can check their doctor recommendations about their health in health status history, patient can check nutrition diet manual, and last patient can exit from the application.

2. **Doctor Login**

   To access the application, doctor must have a valid email address and a password. If the email and password is wrong doctor will not log-in in the application.

3. **Doctor Dashboard**

   Users can also utilise this feature to access the doctor panel. This panel is only for physicians, and it allows them to manage their patients appropriately. The doctor will be able to see the patient's health status after logging in. And, if the doctor really wants, then doctor will convey his or her advice to the patient.

4. **Set Remainder Notification**

   The user has the option of configuring their medication handbook in accordance with their physician's prescription. The user may customize their instructions by specifying a certain time. This manual will send a notification to the user reminding them to take their prescription at the time specified.

5. **Check Health Status**

   This function provides the user with medicine and some tips which the user may use. In this function patient will enter its bpm, chest pain and some other credential then it will generate a message to the patient.

6. **Generate Health Status**

   This feature enables users to build their own health report. Their health report will be generated based on their bpm (beats per minute), chest pain, smoker, diabetes, and headache. To generate a report patient must enter these credentials. Patients send this report to its specific doctor.

7. **Nutrition Diet**

   This feature will show the patient a nutrition diet manual. This diet manual is included by default in the application, allowing patients to benefit from it. And also patient can see suggested diet plan which is provided by the nutritionist.

8. **Medical Description**

   In this feature patient can upload its medical description where the patient may describe their medical condition, including medications and testing. This function also allows patient to save their hand-held reports by taking images of them with their mobile camera. In this module, patient may also export reports or photographs from the gallery. Only images can be export in this module.

9. **History**

   In this feature patient can see its statistics in graph foam. Following graphs will be provided to the patient (such as calories graph, minimum heart rate graph, maximum heart rate graph, step graph, miles covered graph).

10. **Set Targets**

    This module allows patients to create daily attainable goals that will help them maintain their good health. The following goals can be set for the patient: (calorie burn target, minimum heart rate, maximum heart rate, total steps target, miles target). Achievable will be displayed on the patient's statistics page if they meet their goals as planned.

11. **Nutritionist**

    With this feature, nutritionists will be able to get weekly data of their patients' health statistics. Following statistics will be shown to the nutritionist such as (calories burn, steps taken, miles covered, maximum and minimum heart rate) All of the facts will be grouped by date and presented to the nutritionist in numerical form. Where a nutritionist may quickly provide a diet plan based on their data.

3.4 Non-Functional Requirements

Non-functional requirements are extra requirements that improve the system's usability and performance. These are not required but are essential to accomplish the primary functionality. A list of all the important non-functional requirements for running/using the application is shown below.

1. **Usability**

   The application is prepared with the availability criterion in mind. This graphical user interface is made simple by the presence of clear and beautiful buttons. A suitable colour scheme was utilized to enhance the application's usability.

2. **Security**

   Access to the system is restricted to registered users. Only authorized users will be able to access the application. The user's data will be handled securely.

3. **Performance**

   The program will immediately begin processing all the data.

4. **Portability**

   The application runs on Android. Therefore, it is platform-independent and mobile device-independent.

5. **Efficiency**

   The program will use less resources from the user device and will have a fast response time.

6. **Robustness**

   Consistency will be maintained throughout the application.

3.5 System Overview and Scope

It enables the user to keep a daily, weekly, or monthly track of their health. Additionally, this technology enables users to communicate with their physicians through this application. The user will get a report on their health data, which they may also share to their doctor. In this application, the user may organize their medication handbook by time and date, which benefits the user's health. This application provides a medicine facility to the user, allowing them to benefit from the application. The software product is an IoT-based smart health monitoring system. The technology will be used to priorities patients' and senior citizens' blood pressures and to assign physicians. Doctors also utilize this technology to check their patients' health. Our focus is on health monitoring forecasts. This project aims to address a market need by creating a tool that supports both consumers and providers in customizing the healthcare experience with the goal of enhancing overall health and wellbeing.

3.6 Use Cases

3.6.1 IOT Based Smart Health Monitoring System Application Use Case

This is the application use case diagram which show overall structure of the application. There are three major module of the application one is patient, second one is nutritionist, third one is doctor. In patient module patient can access some feature (such as medical description, check health status, health history, graph, set targets etc). There is doctor module where doctor can registered in the application and login into the system to facilitate its patient. as shown in table **??** and figure 3.1.

Table 3.1: IOT Based Smart Health Monitoring System Use Case

USE CASE NAME	IOT Based Smart Health Monitoring System.
Description	This use case enables users to access the specific module they choose. The user can choose how he or she wishes to use the module. The user will be forwarded to the following page after successfully entering the main page.
Actor	Patient, Nutritionist, Doctor.
Precondition	User must open the application.
Post condition	The system will take you to the appropriate page.

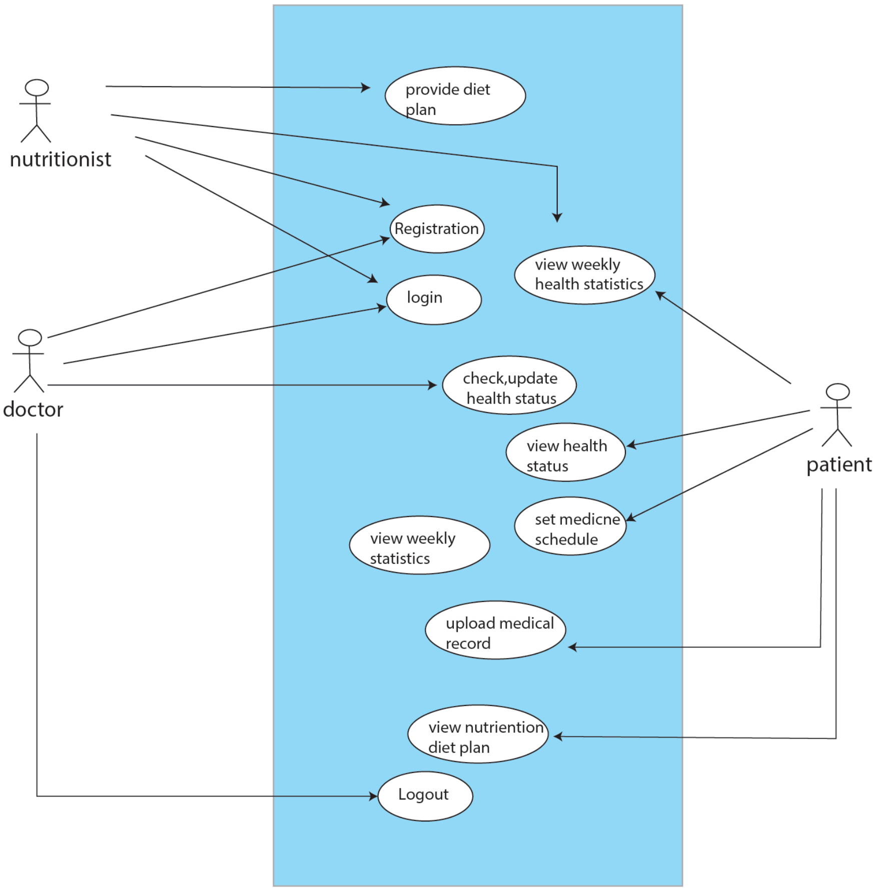


Figure 3.1: IOT Based Smart Health Monitoring System

3.6.2 Patient Dashboard Use Case

This is a module that allows patients to view certain functions. The patient can provide a description of their medicine as well as a snapshot using the camera. A photo that has previously been exported from the gallery can also be uploaded by the patient. Patients may also use the app to monitor their health by entering their BPM, chest pain, and other details. Patients can also go to the nutrition diet page for a range of healthy eating suggestions. The following use case is depicted in table 3.2 and figure 3.2

Table 3.2: Patient Dashboard Use Case

USE CASE NAME	Patient Dashboard.
Description	The following functionalities are available to patients in this use case (such as medical description, check health status, nutrition diet, health status history, graph etc).
Actor	Patient.
Precondition	Click on the specific feature.
Post condition	The system navigates to the desired page..

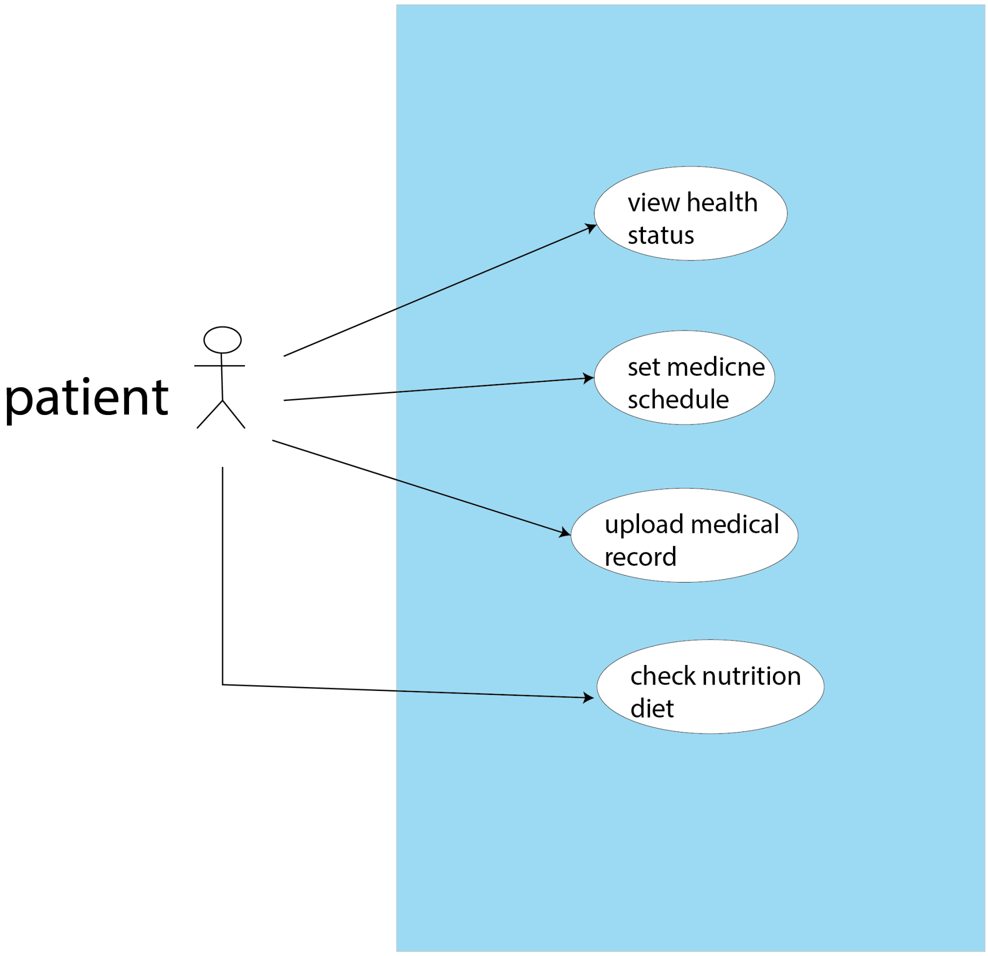


Figure 3.2: Patient Dashboard Use case Diagram

3.6.3 Medical Description Use Case

This is a patient-facing module where the patient enters their medical information. The medical information will be entered in two formats: one in image foam and the other in text foam. Patients may submit their medical information in both text and photo foam. The patient may also save images from the gallery and submit them to their medical records. As shown in table 3.3 and figure 3.3

Table 3.3: Medical Description Use Case

USE CASE NAME	Medical Description.
Description	User press “Add medical Description” button. The user fills in the essential information. The user fills in the essential information. The user clicks the "Save Medical Description" button.
Actor	Patient.
Precondition	Patient must be enter into the medical description page.
Post condition	Patient will be saved their medical description.

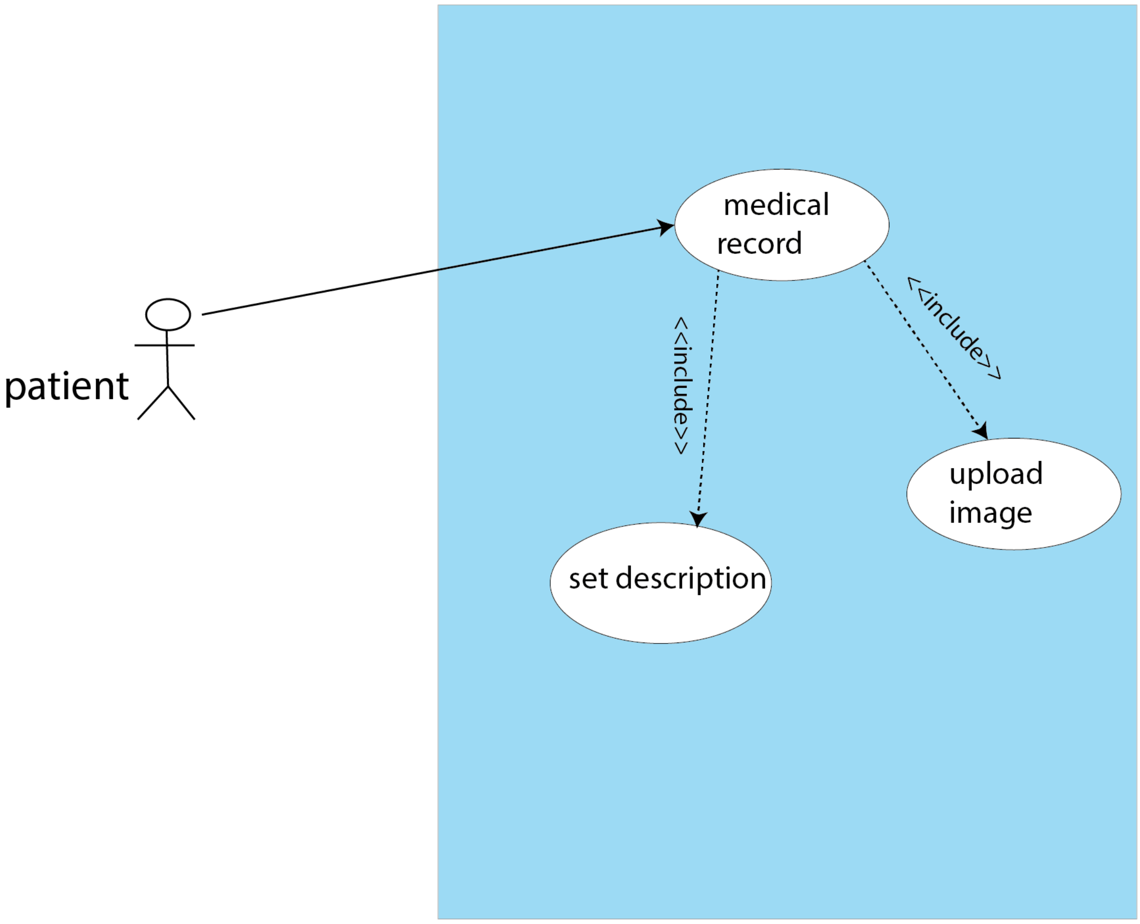


Figure 3.3: Medical Description Use case Diagram

3.6.4 Check Health Status Use Case

As shown in table 3.4 and figure **??** below. It's a patient-facing module that allows patients to monitor their health condition. The patient must input their BPM, Chest Pain, and other credentials in this section. It will not reveal the user's health condition until the credential is filled out. BPM is required, and chest pain and other credentials are only transient. When a patient enters these details, a message foam will be generated with their current health condition.

Table 3.4: Check Health Status Use Case

USE CASE NAME	Check Health Status
Description	User press "Check health status" button. The user will see the following essential page where user have to fulfil it. The user clicks the "Generate Report" button.
Actor	Patient.
Precondition	Health status function performed successfully.
Post condition	The system displays the health status message.

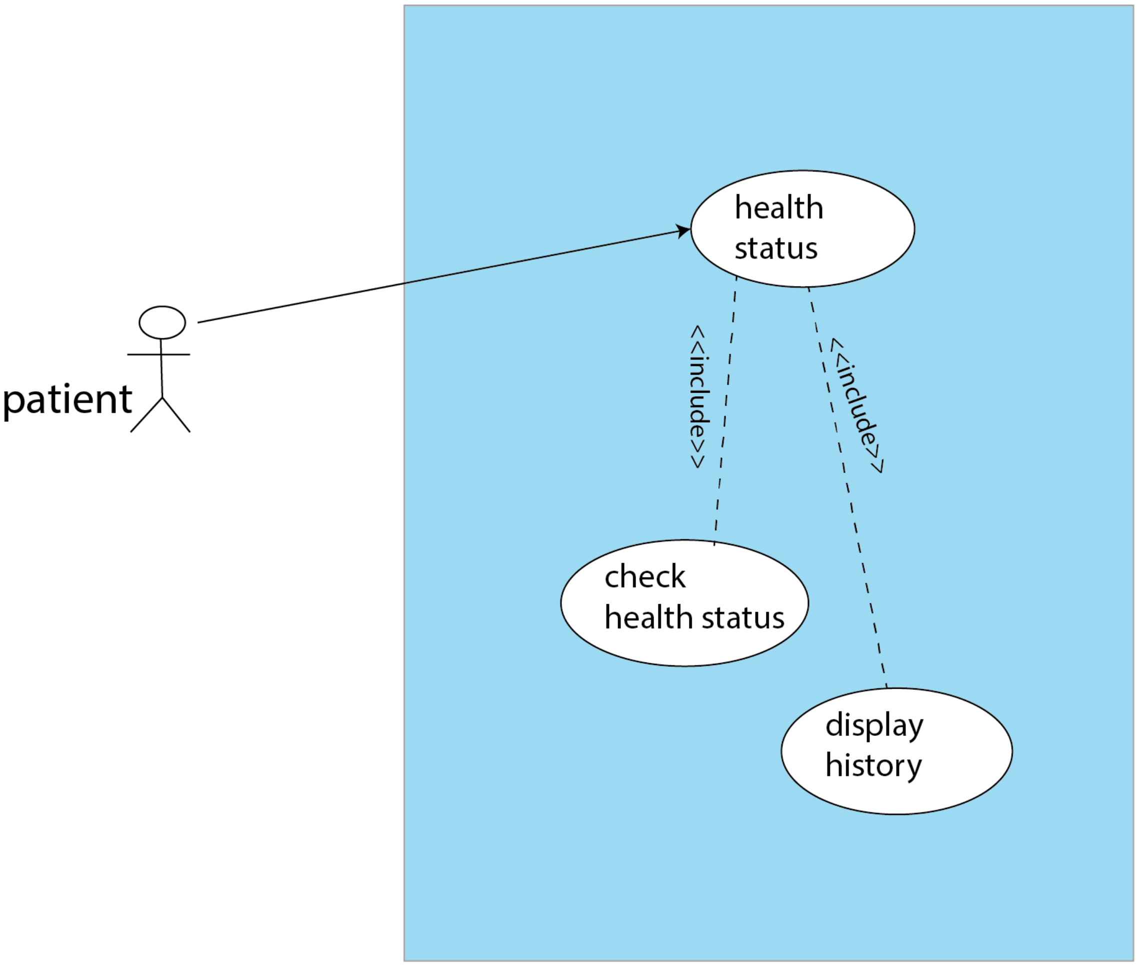


Figure 3.4: Check Health Status Use case Diagram

3.6.5 Set Remainder Use Case

As shown in table 3.5 and figure 3.5. This is a module that sends you set reminder notifications. It's a patient-facing module that allows patients to set their meals and medicine timing based on the current time. The patient must set the hour and minute; if the hour and minute are not provided, the alert notification will not be issued. There is a descriptive text box in this module where the patient enters its medicine. This medicine will be shown in notification foam.

Table 3.5: Set Reminder Use Case

USE CASE NAME	Set Reminder
Description	This use case allows patient to set their reminder according to their time the keyword user has entered in the form of number.
Actor	Patient.
Precondition	• Patient must enter time in 24 hour format. • Patient must enter the description.
Post condition	Patient will saved their description successfully.

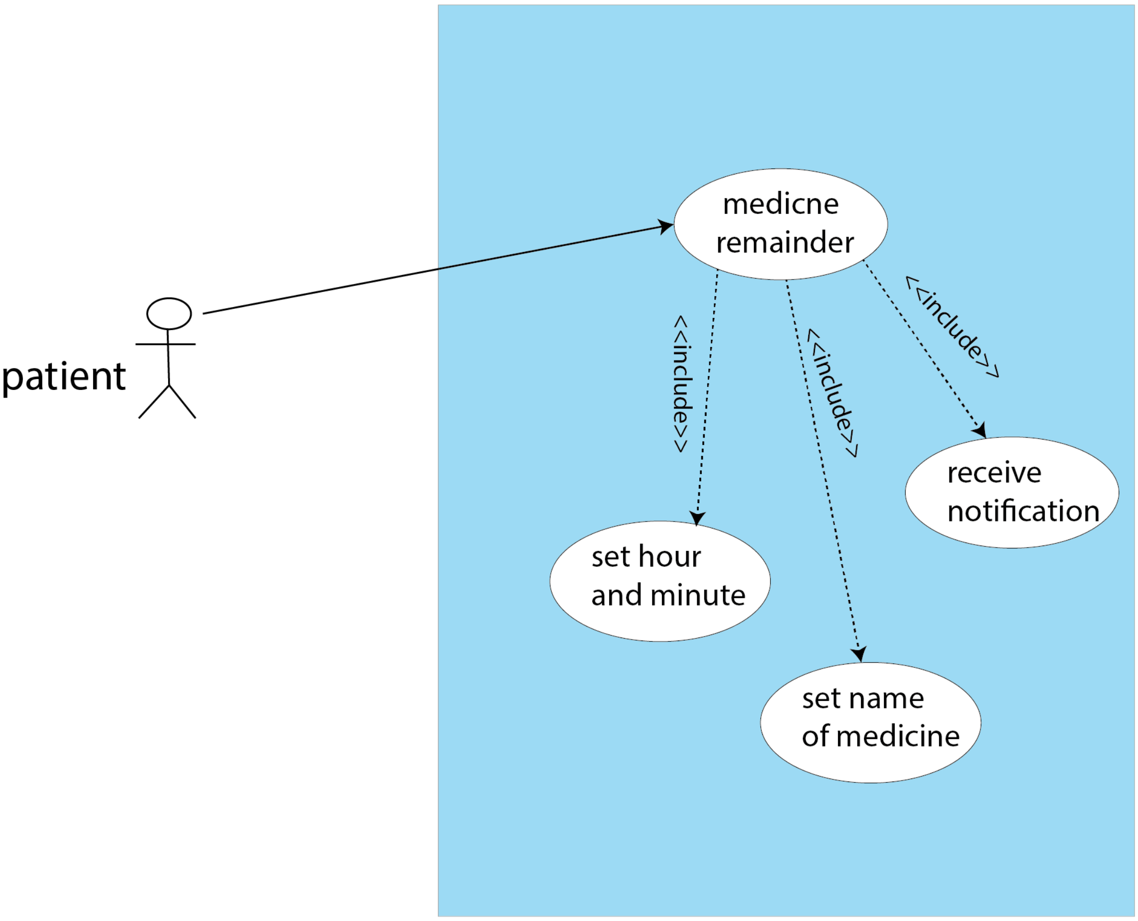


Figure 3.5: Set Reminder Use Case Diagram

3.6.6 Nutritionist Use Case

Nutritionist can be registered their account in the application. After successfully registration it will login into the system. After login into the system it can see patient weekly data and also view weekly health statistics. And also suggest diet plan according to patient health statistics. Following use case is depicted in table 3.6 and figure 3.6

Table 3.6: Nutritionist Use Case

USE CASE NAME	Nutritionist
Description	This use case allows nutritionist to registered their account. After registration it will login into the system where nutritionist can see their patient health statistics and suggest diet plan according to their health statistics.
Actor	Nutritionist.
Precondition	• Nutritionist must Login. • Nutritionist suggest the diet plan according to patient health statistics.
Post condition	Successfully suggested.

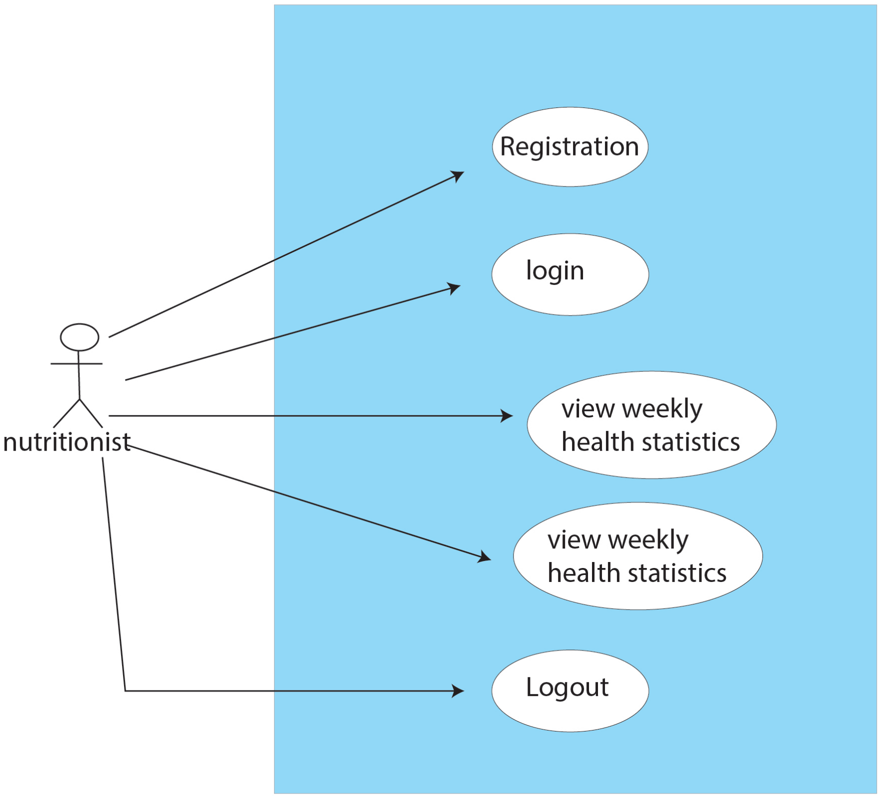


Figure 3.6: Nutritionists Use Case Diagram

3.6.7 Doctor Module Use Case

In this module, the doctor must create an account in the application. After completing the registration process, the doctor will authorize the application and examine the patient's health status. If the doctor finds it necessary, the doctor will examine the patient's health state and offer feedback or any medication recommendations to the patient. If the doctor thinks it unnecessary, the doctor will examine the patient and manage it accordingly. The doctor will then logout or leave the application. Following use case is depicted in table 3.7 and figure 3.7

Table 3.7: Doctor Module Use Case

USE CASE NAME	Doctor Module
Description	This use case allows doctor to register their account in the application and after registration it will login into the system where it can their patient health status. Doctor can be suggest any medical advice to their patient if it needed.
Actor	Doctor.
Precondition	• Doctor must be Logged in. • Doctor can see their patient health status. • Doctor can be advice to their patients.
Post condition	None.

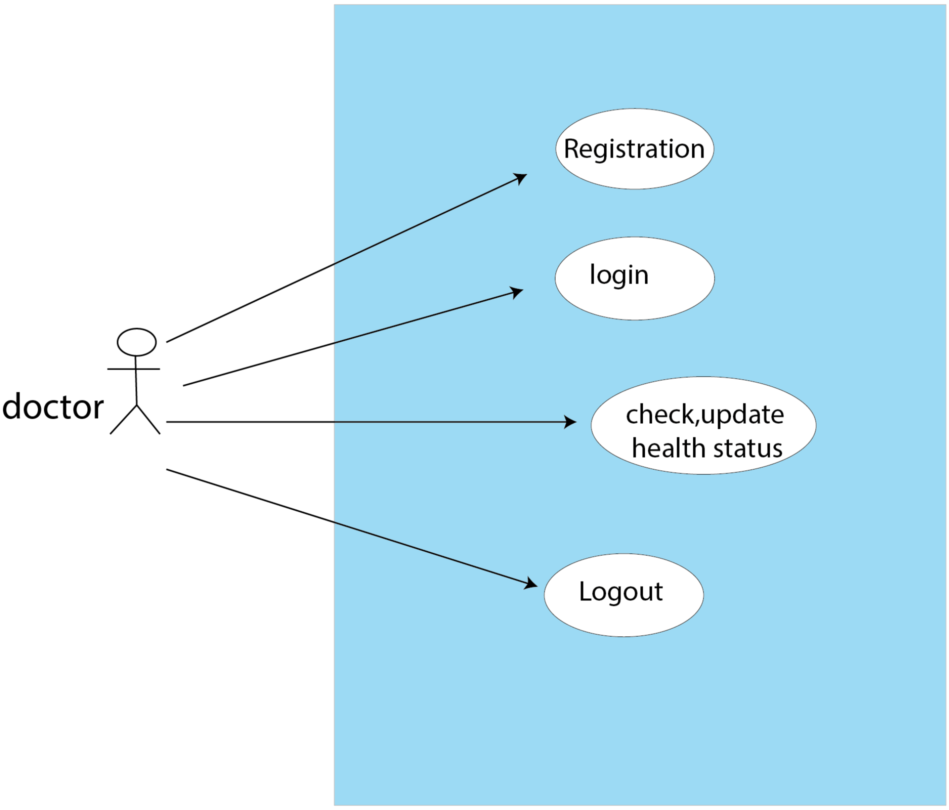


Figure 3.7: Doctor Use Case Diagram

Chapter 4

Design

In systems design, we define the structure of a system's architecture, its components, its modules, its interfaces, and its data. The following sections make up this chapter:

4.1 System Architecture design

In the following figure 4.1 IOT smart health monitoring system architecture is shown in which Data is fetch from internet and stored in Database and then transfer to further module.The application interacts with a number of distinct subsystems. First and foremost, we are focusing on Android as our primary implementation platform. The UI and backend control [backend like connections to the database such that using [real time database and firebase database] will be based on Flutter and Dart core libraries. We only use one type of database for database storage, authentication, and management: no relational database or NoSQL database (Firebase as a Database services like Cloud Storage, Cloud Firestore, Firebase RealTime-Database as well as Firebase Authentication [Auth]).

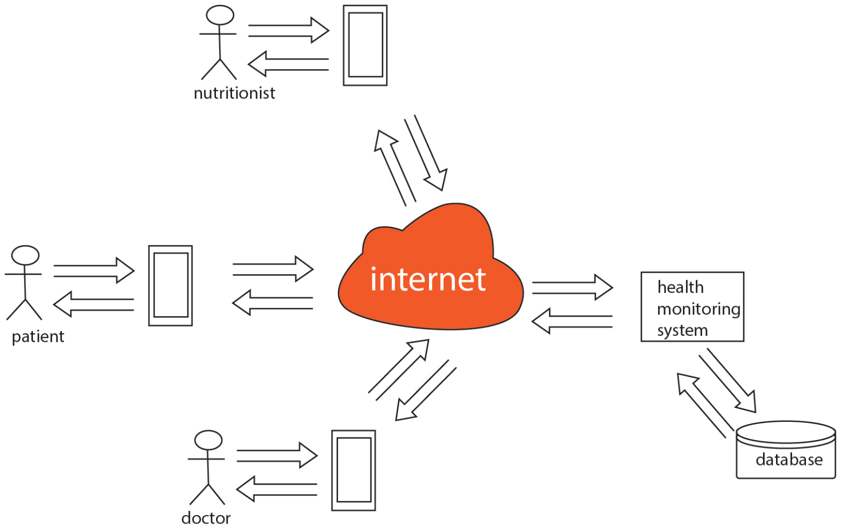


Figure 4.1: System Architecture

4.2 Design Methodology of IOT Based Smart Health Monitoring System

Incremental software development model is being used in this system. Incremental model consists of these steps:

1. Planning
2. Requirement
3. Analysis and Design
4. Implementation
5. Testing
6. Evaluation
7. Deployment

following figure 4.2 shows the design methodology of IOT Based Smart Health Monitoring System.

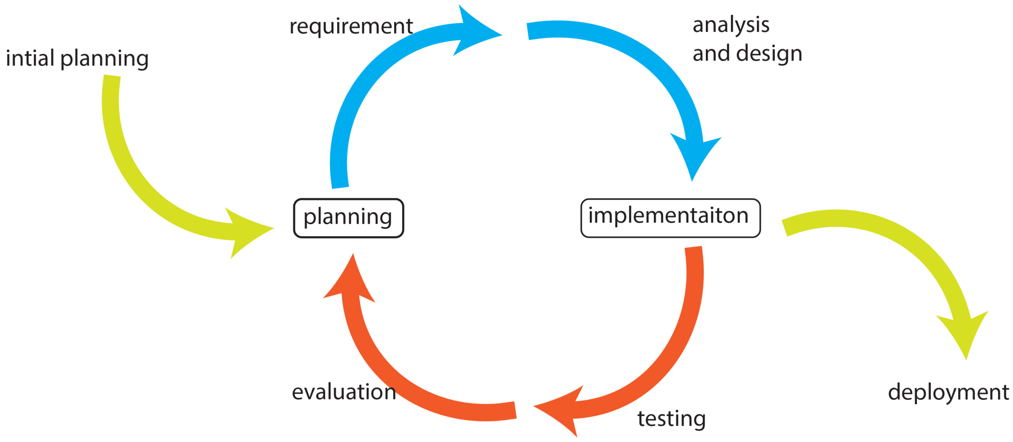


Figure 4.2: Incremental Model

4.2.1 Activity Diagrams

4.2.1.1 Health Activity Diagram

When a patient enters into the system, they can view their health statistics, which include their heart rate, steps taken, calories burned, and the distance travelled. This is the whole list of data retrieved from the Fitbit server. First, the watch sends data to the Fitbit server, and then it sends data to the application as shown in the figure 4.3.

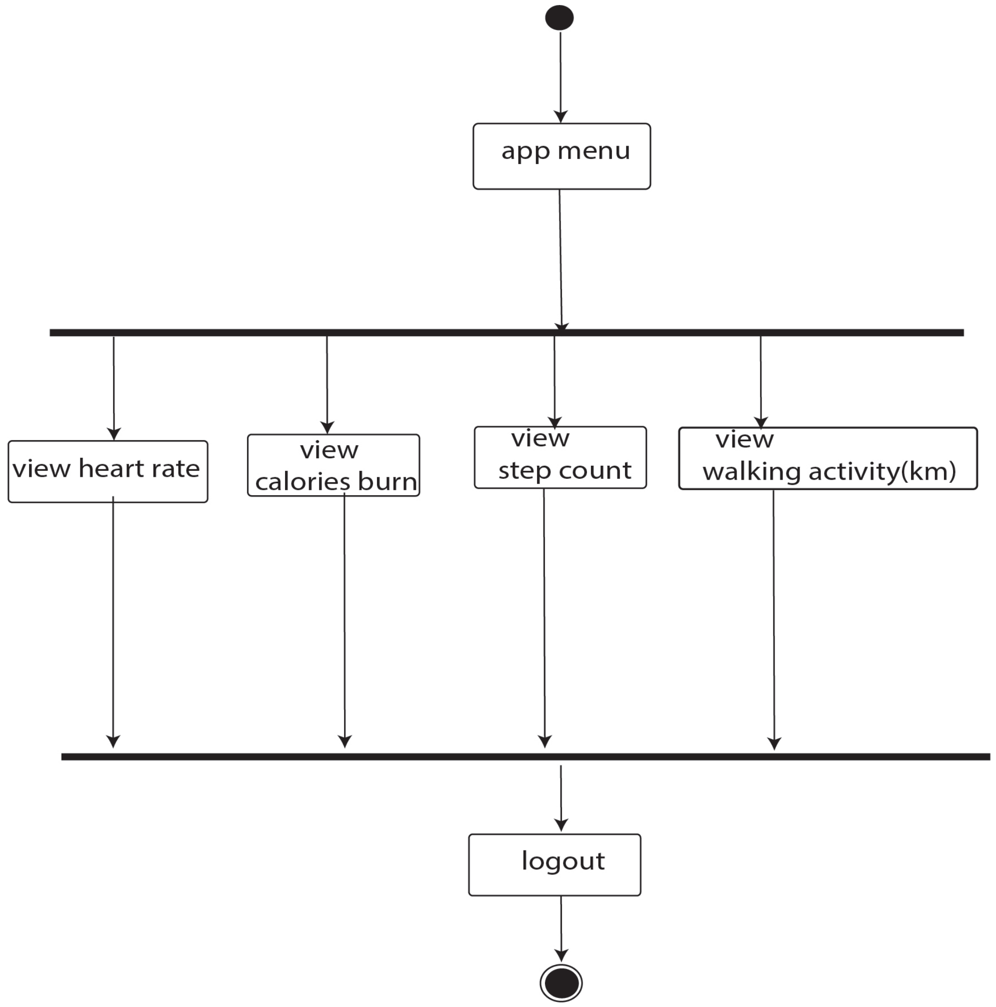


Figure 4.3: Health Activity Diagram

4.2.1.2 Set Reminder Activity Diagram

As shown in figure 4.4 The patient will add his or her medicine and lunch time according to his or her preferences. Only the time format will be used to set the reminder.

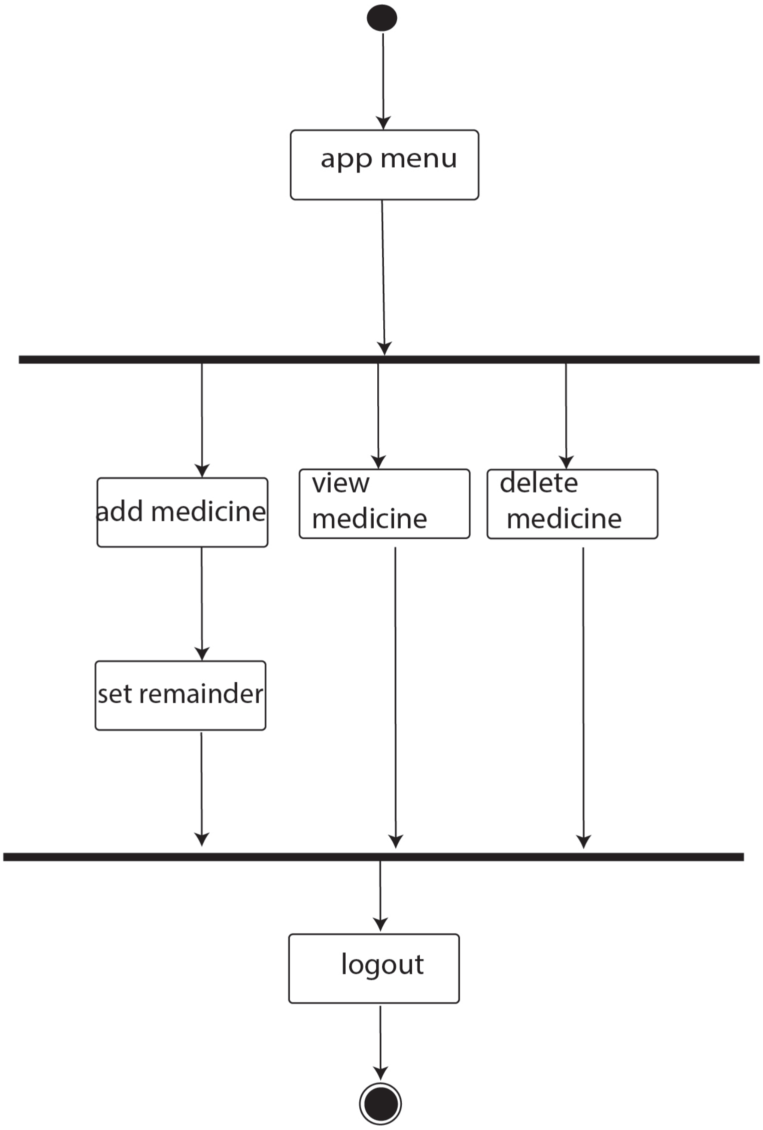


Figure 4.4: Set Reminder Activity Diagram

4.2.1.3 Medical Description Activity Diagram

This module allows the patient to post their hand-held report by taking a picture with their phone. In addition, the patient can export images from his or her phone's gallery. Patient can delete its description if he/she wants. figure as shown below 4.5.

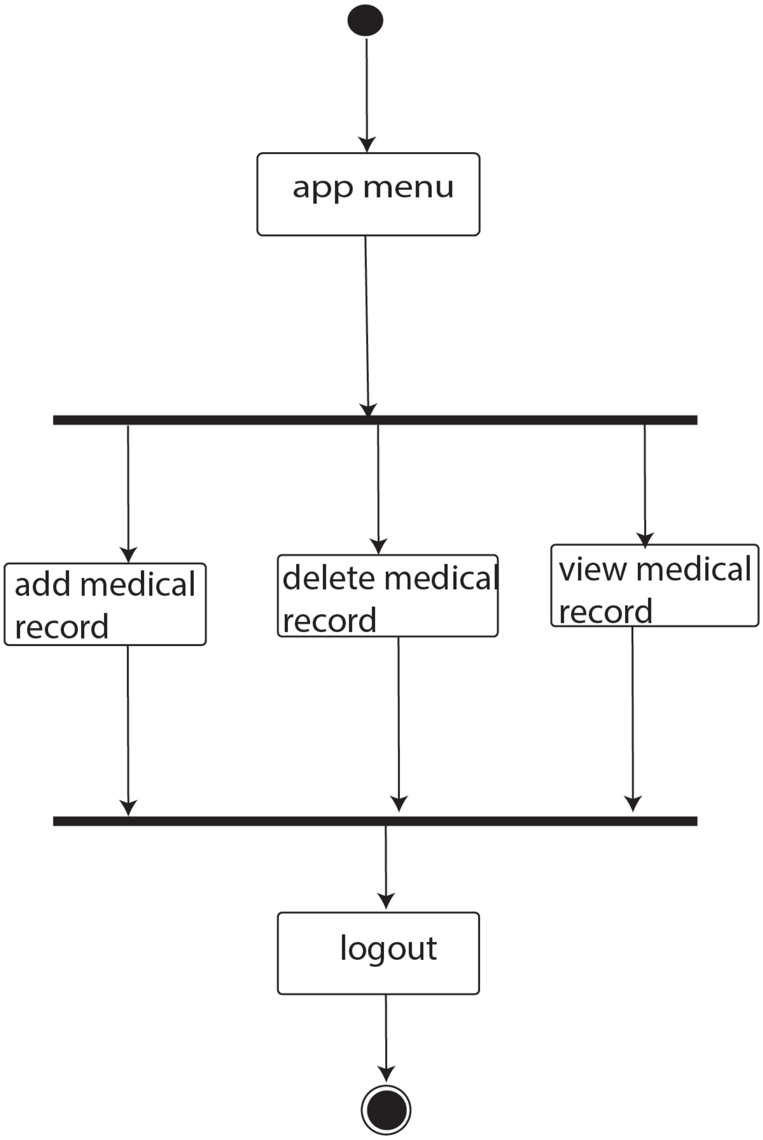


Figure 4.5: Medical Description Activity Diagram

4.2.1.4 Doctor Module Activity Diagram

In this module, the doctor will enter into the application and examine the patient's health status. The doctor will examine the patient's health state and offer feedback or any medication recommendations to the patient. The doctor will examine the patient and manage it accordingly. The doctor will logout or leave the application. as shown in figure 4.6.

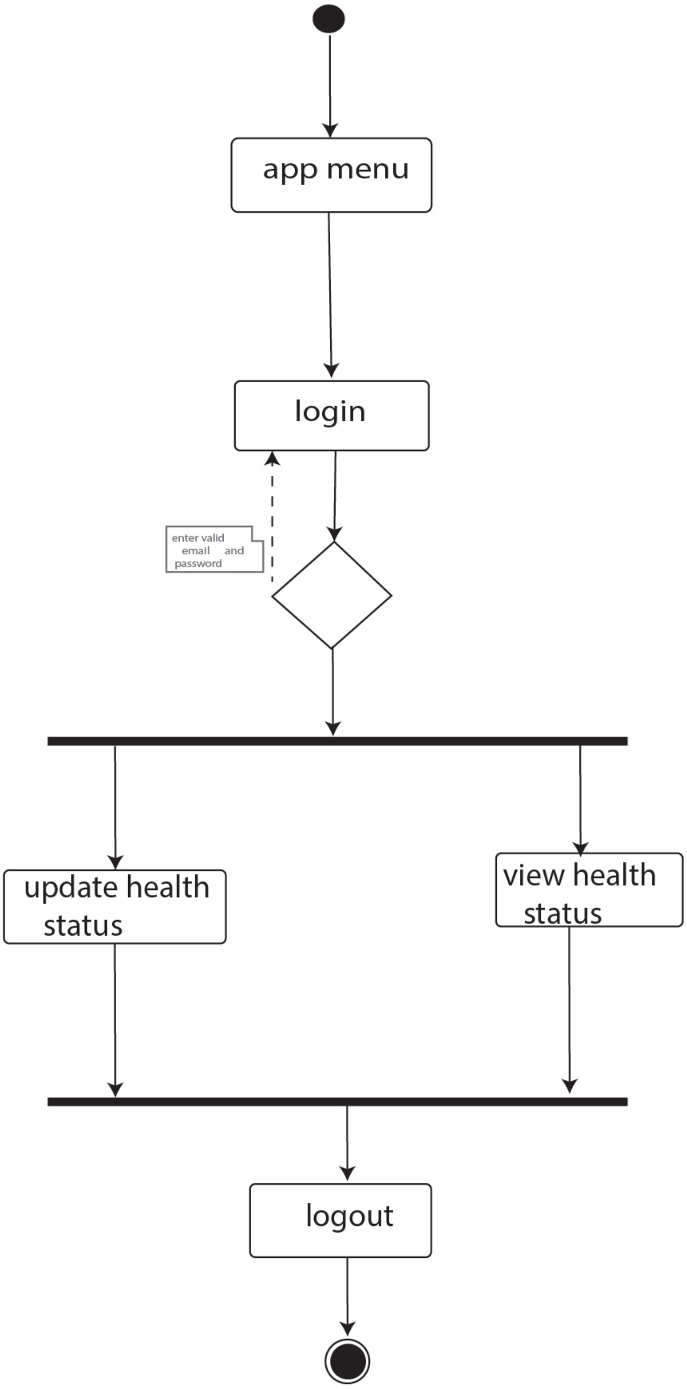


Figure 4.6: Doctor Module Activity Diagram

4.2.1.5 Nutritionist Activity Diagram

In this module nutritionist will login into the account. In this module nutritionist can see its patient health statistics. Health statistics will be provided in weekly foam. Where nutritionist can easily figure out the perfect diet plan for the patient where it can easily suggest to their patients as shown in figure 4.7.

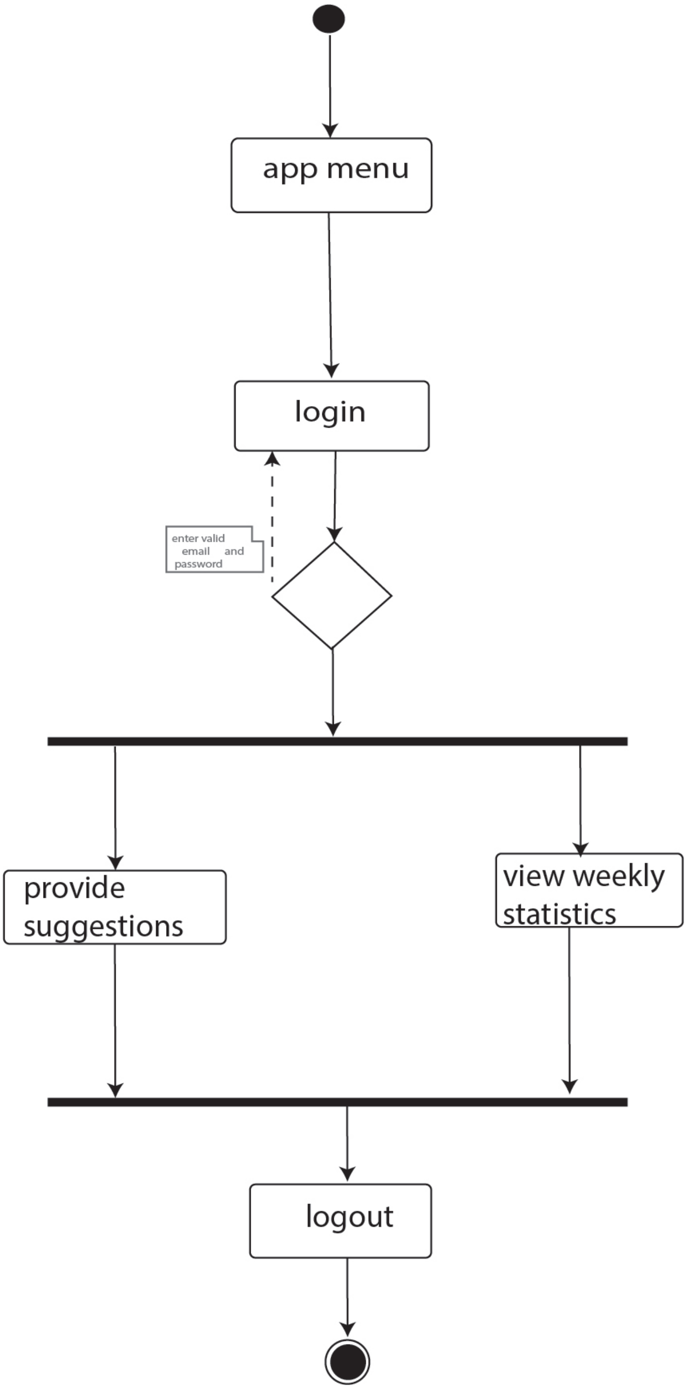


Figure 4.7: Nutritionist User Activity Diagram

4.2.2 Sequence Diagrams

4.2.2.1 Doctor Module Sequence Diagram

Figure Given below 4.8 is showing how a user will login into the application. After login into the system doctor can see its profile details and see their patient health status. Doctor can check its patient health status and can suggest medical advice to their patient. following the sequence as depicted in the diagram.

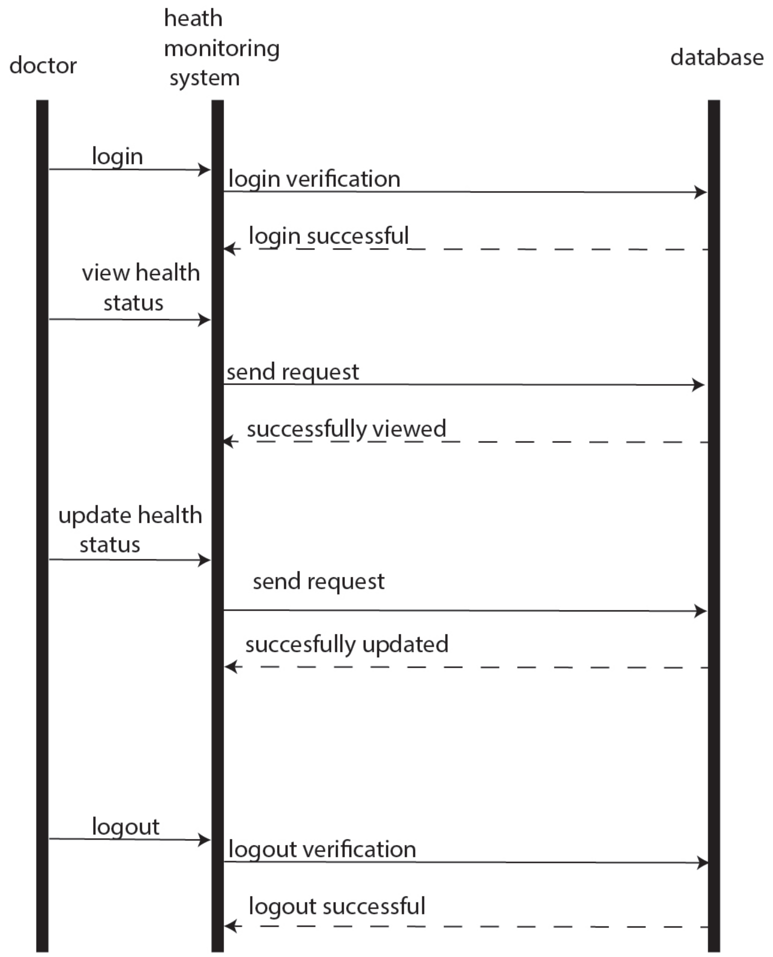


Figure 4.8: Doctor Module Sequence Diagram

4.2.2.2 Nutritionist Sequence Diagram

In the Sequence Diagram given below 4.9 the nutritionist will log in to their account. Nutritionists can view their patients' health statistics in this area. The patient weekly health statistics will be display on the nutritionist screen. Where nutritionists can quickly work out the optimal food plan for their patients.

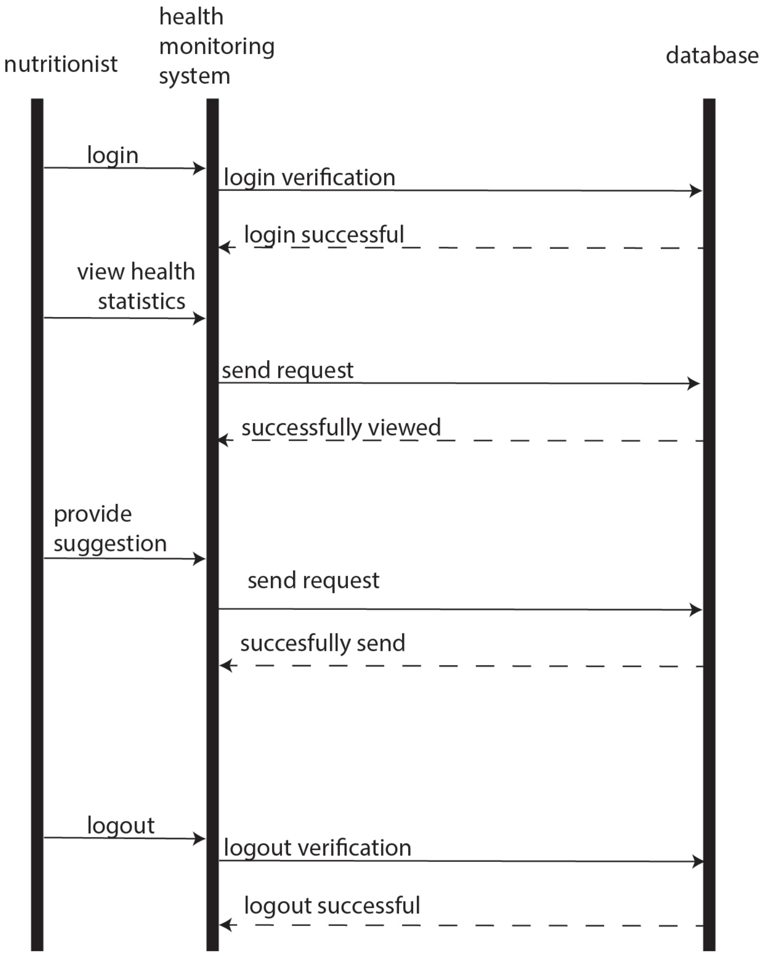


Figure 4.9: Nutritionist Sequence Diagram

4.2.2.3 Patient side Sequence Diagram

This is a patient-facing module that allows them to observe certain functions. By utilizing the camera, the patient may submit a description of their drug along with a photo. The patient can also upload a photo that was already exported from the gallery. Patients can also check their health condition by inputting their BPM, chest pain, and other information as shown in figure 4.10.

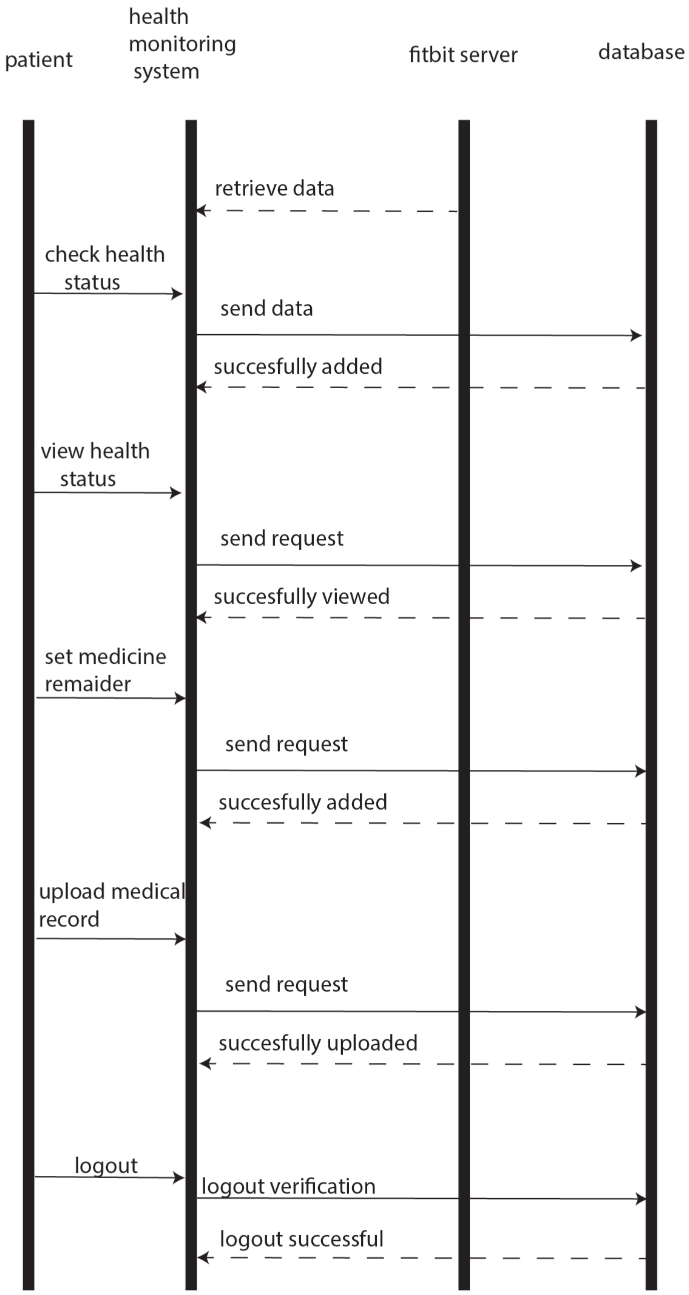


Figure 4.10: Patient Sequence Diagram

4.2.2.4 ERD Scheme Diagram

As shown in the figure 4.11 Schema of firebase diagram

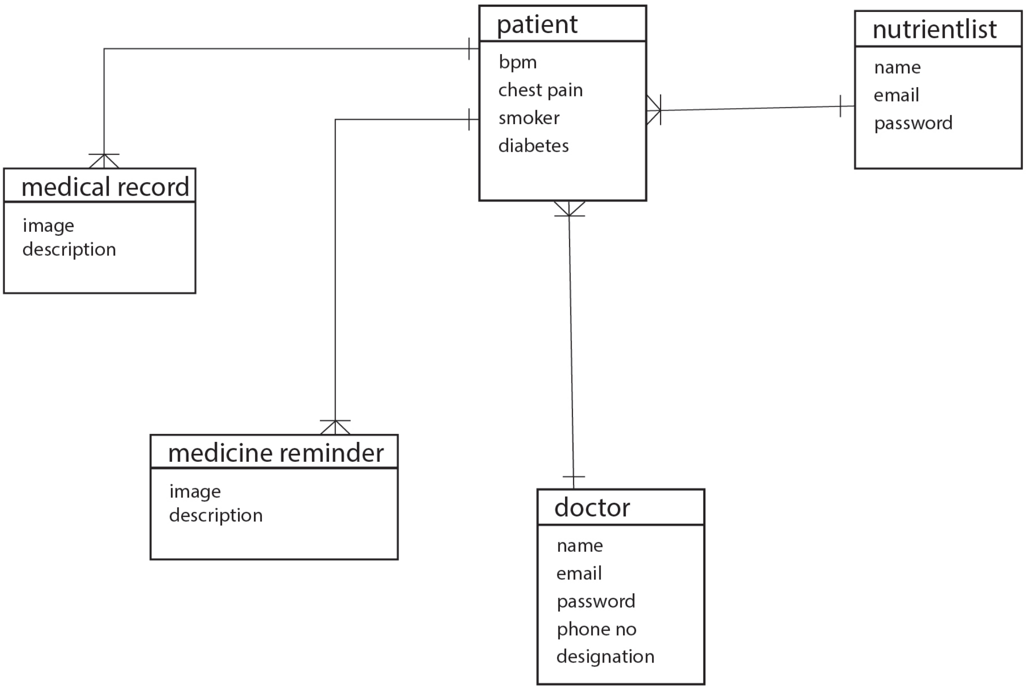


Figure 4.11: Firebase Schema Sequence Diagram

4.3 Class diagram

The following figure 4.12 is the Database design used for IOT based smart health monitoring system. It is showing all the attributes and their relation with each other.

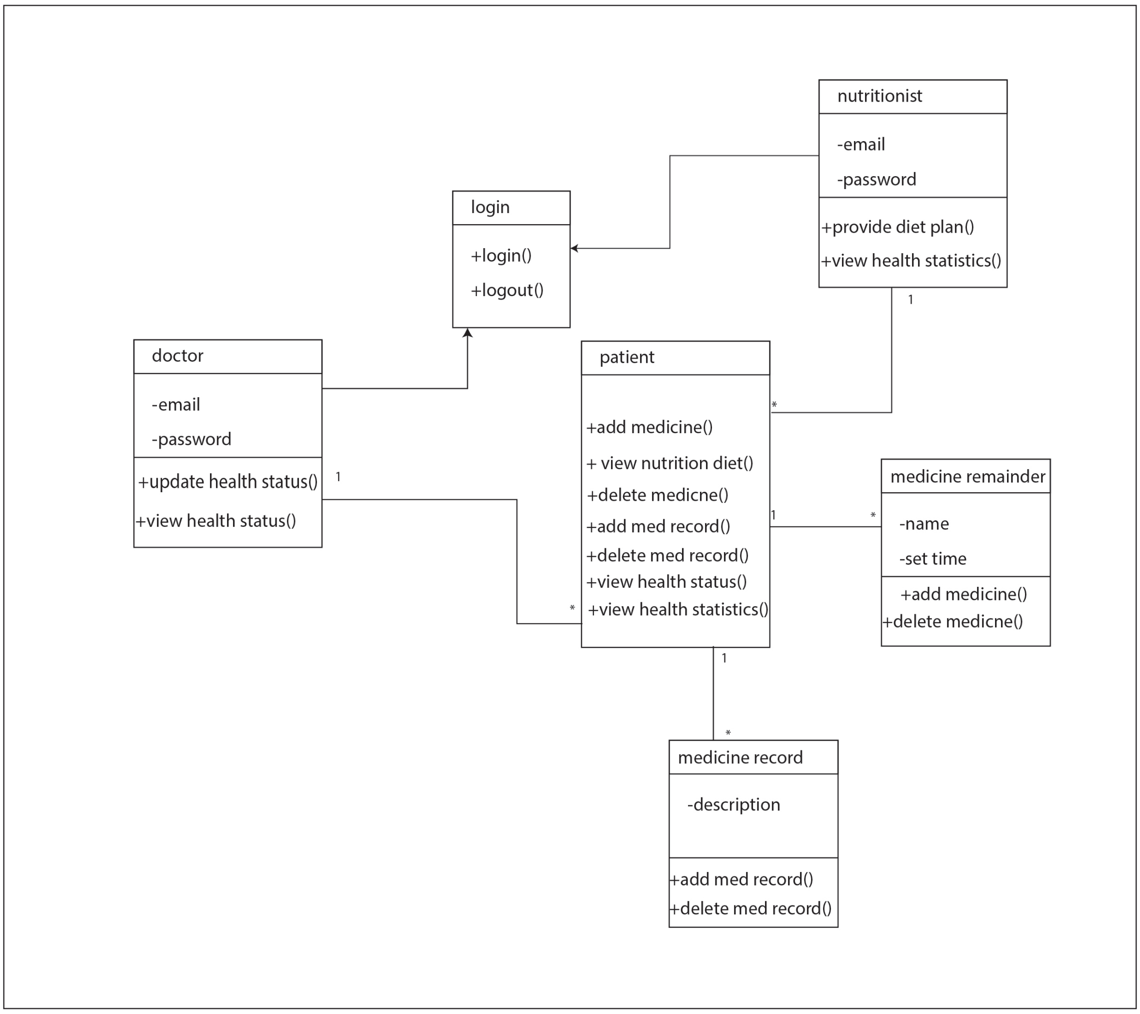
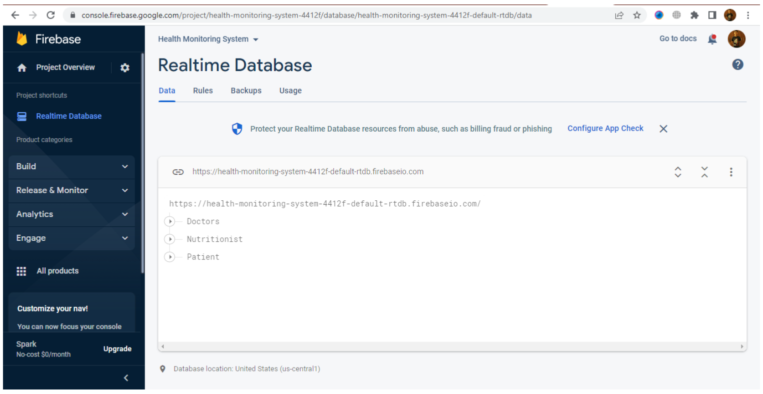


Figure 4.12: Class Diagram

4.4 Database Design



Realtime Database

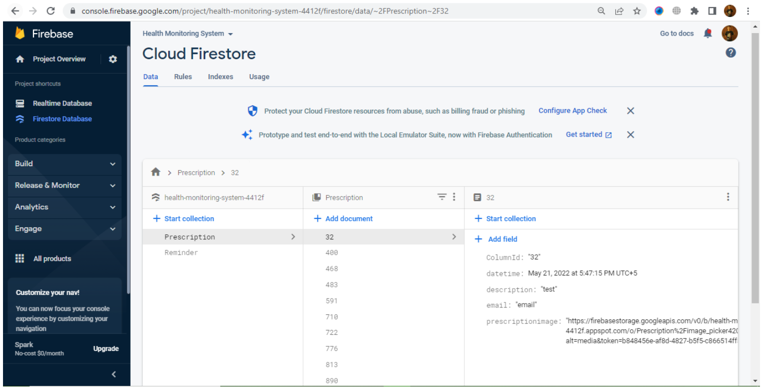
Protect your Realtime Database resources from abuse, such as billing fraud or phishing

https://health-monitoring-system-4412f-default-rtdb.firebaseio.com

```
https://health-monitoring-system-4412f-default-rtdb.firebaseio.com/
  Doctors
  Nutritionist
  Patient
```

Database location: United States (us-central1)

Figure 4.13: Realtime Database



Cloud Firestore

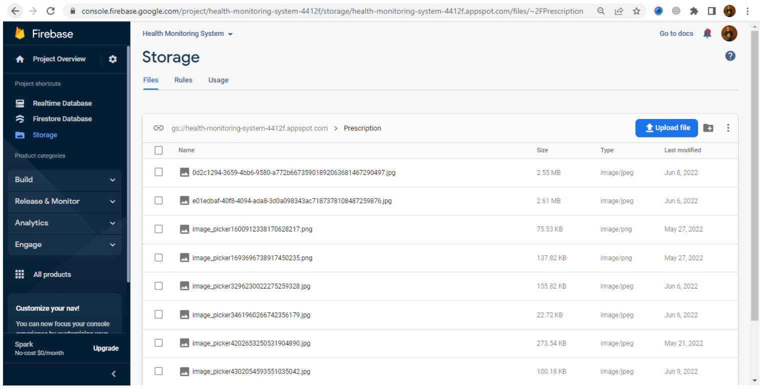
Protect your Cloud Firestore resources from abuse, such as billing fraud or phishing

Prototype and test end-to-end with the Local Emulator Suite, now with Firebase Authentication

Prescription > 32

health-monitoring-system-4412f	Prescription	32
Prescription	32	ColumnId: "32"
Reminder	400	datetime: May 21, 2022 at 5:47:15 PM UTC+5
	468	description: "test"
	483	email: "email"
	591	prescriptionimage: "https://firebasestorage.googleapis.com/v0/b/health-m 4412f.appspot.com/o/Prescription%2Fimage_picker42(alt=media&token=b848456e-af8d-4827-b5f5-c866514ff
	710	
	722	
	776	
	813	
	890	

Figure 4.14: Firestore Database



Storage

gs://health-monitoring-system-4412f.appspot.com > Prescription

□	Name	Size	Type	Last modified
□	0d2c1294-3659-4bb6-9580-a772b6673590189206368 1467290497.jpg	2.55 MB	image/jpeg	Jun 8, 2022
□	e01edbaf-40f8-4094-ada8-3d0a098343ac7187378108487259876.jpg	2.61 MB	image/jpeg	Jun 6, 2022
□	image_picker1600912338170628217.png	75.53 KB	image/png	May 27, 2022
□	image_picker1693696738917450235.png	137.82 KB	image/png	May 27, 2022
□	image_picker3296230022275259328.jpg	155.82 KB	image/jpeg	Jun 6, 2022
□	image_picker3461960266742356179.jpg	22.72 KB	image/jpeg	Jun 6, 2022
□	image_picker4202653250531904890.jpg	273.54 KB	image/jpeg	May 21, 2022
□	image_picker4302054593551035042.jpg	100.18 KB	image/jpeg	Jun 9, 2022

Figure 4.15: Firebase Storage

4.5 GUI Design of IOT Based Smart Health Monitoring Systemk

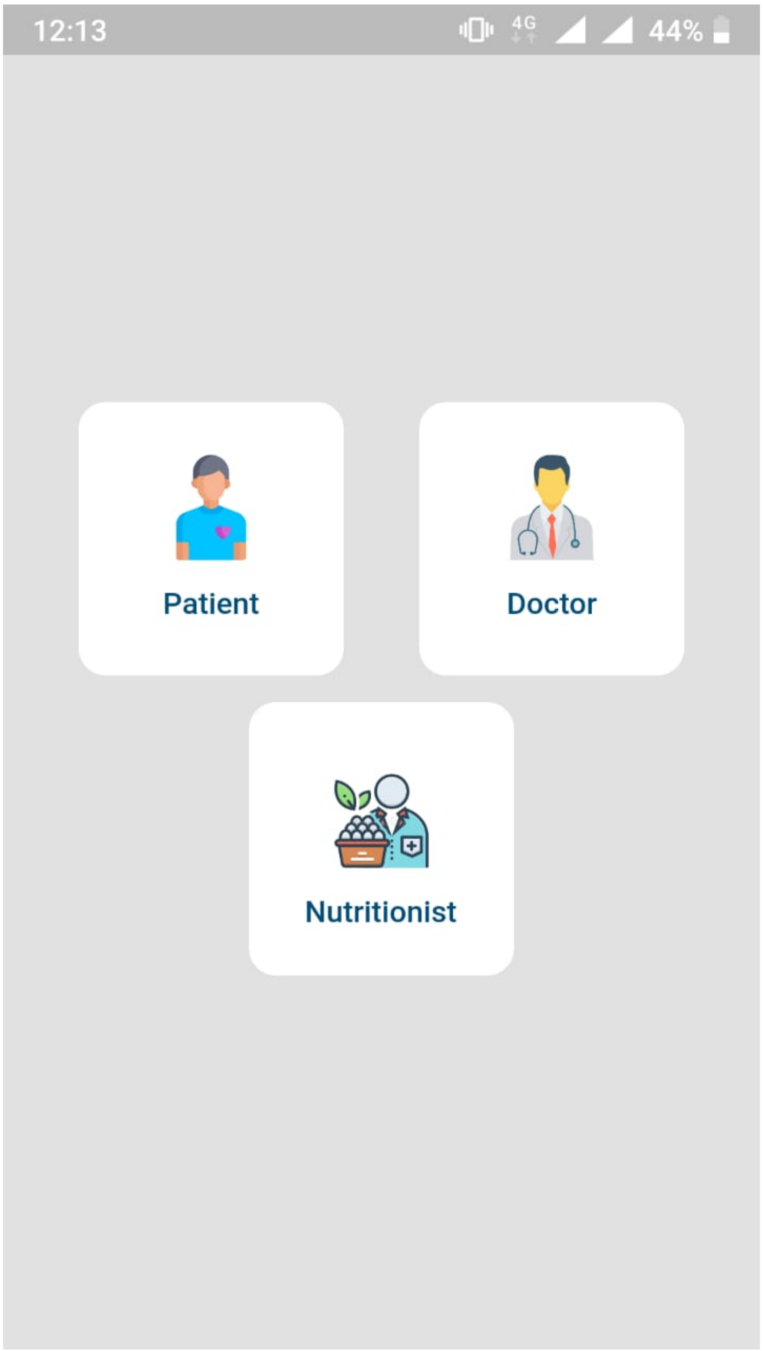
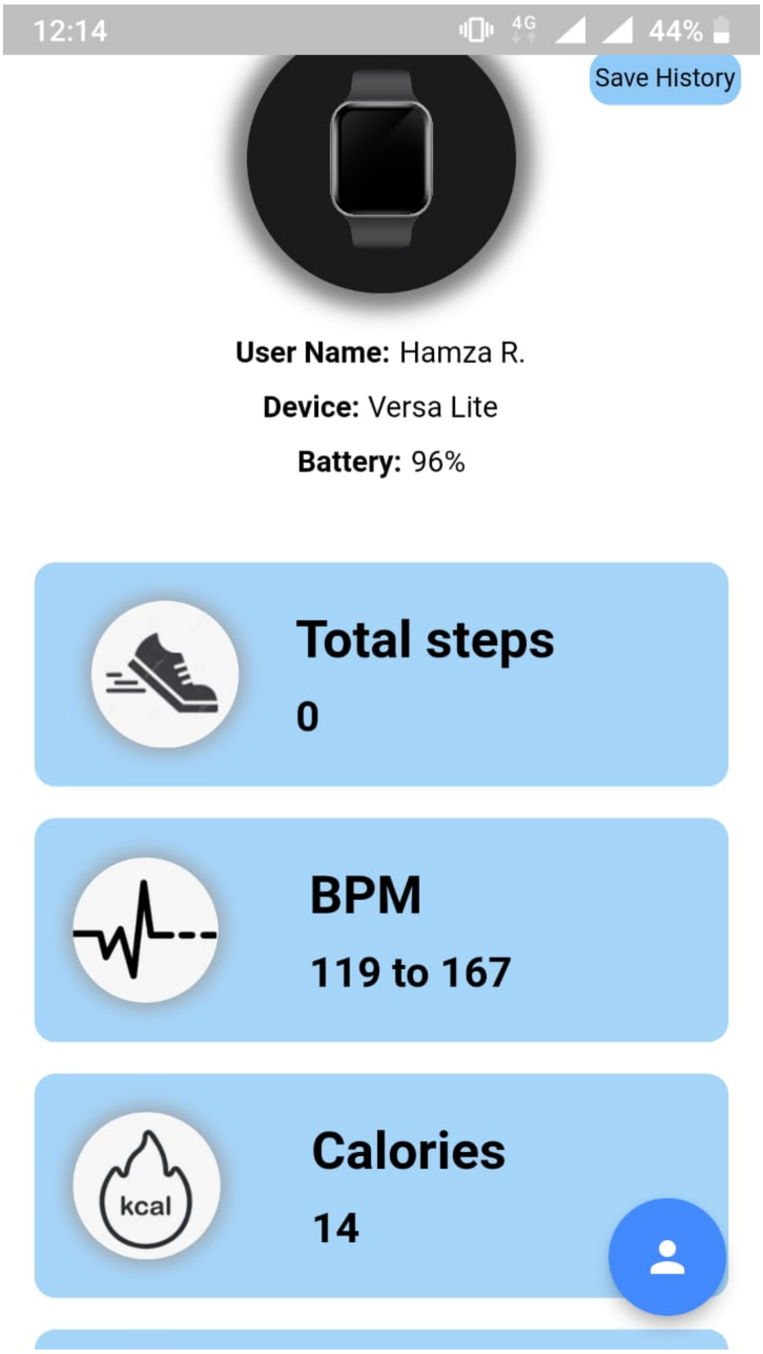


Figure 4.16: Application Main Page



User Name: Hamza R.

Device: Versa Lite

Battery: 96%

Total steps
0

BPM
119 to 167

Calories
14

Figure 4.17: Patient Side GUI

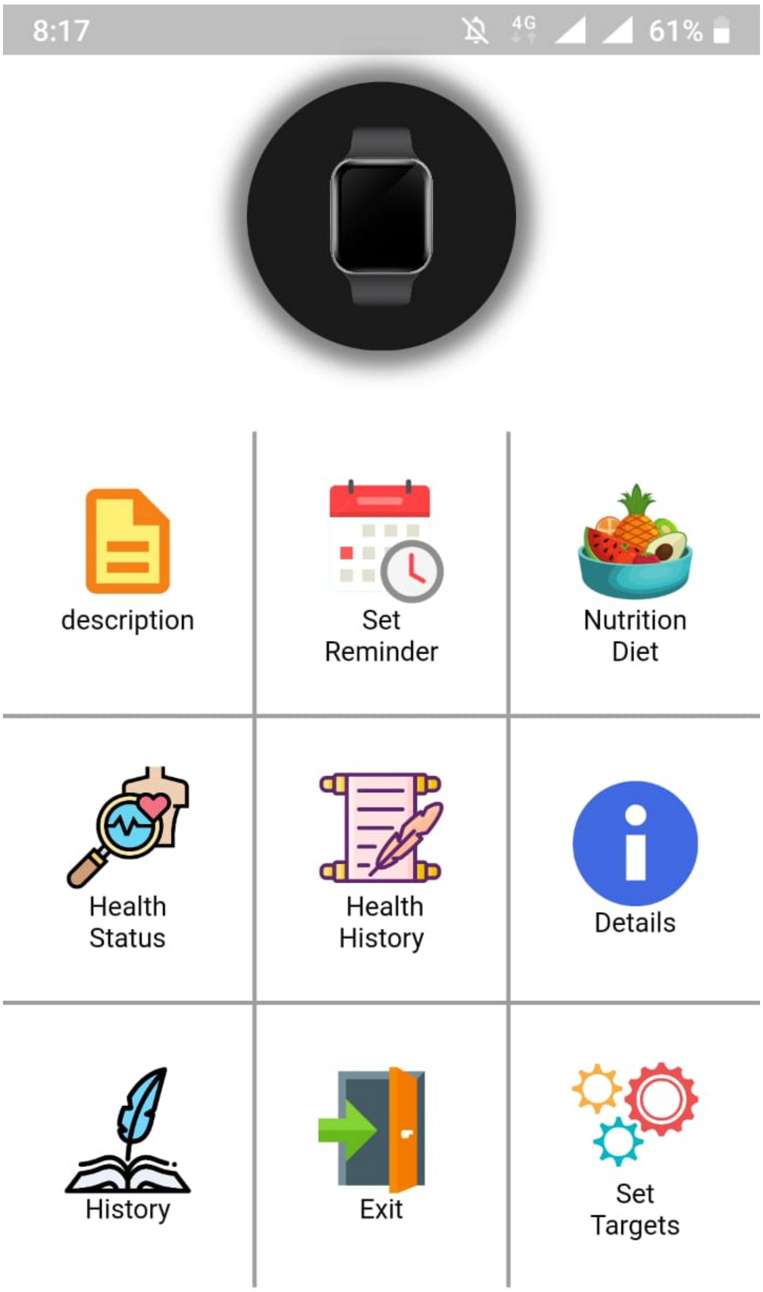
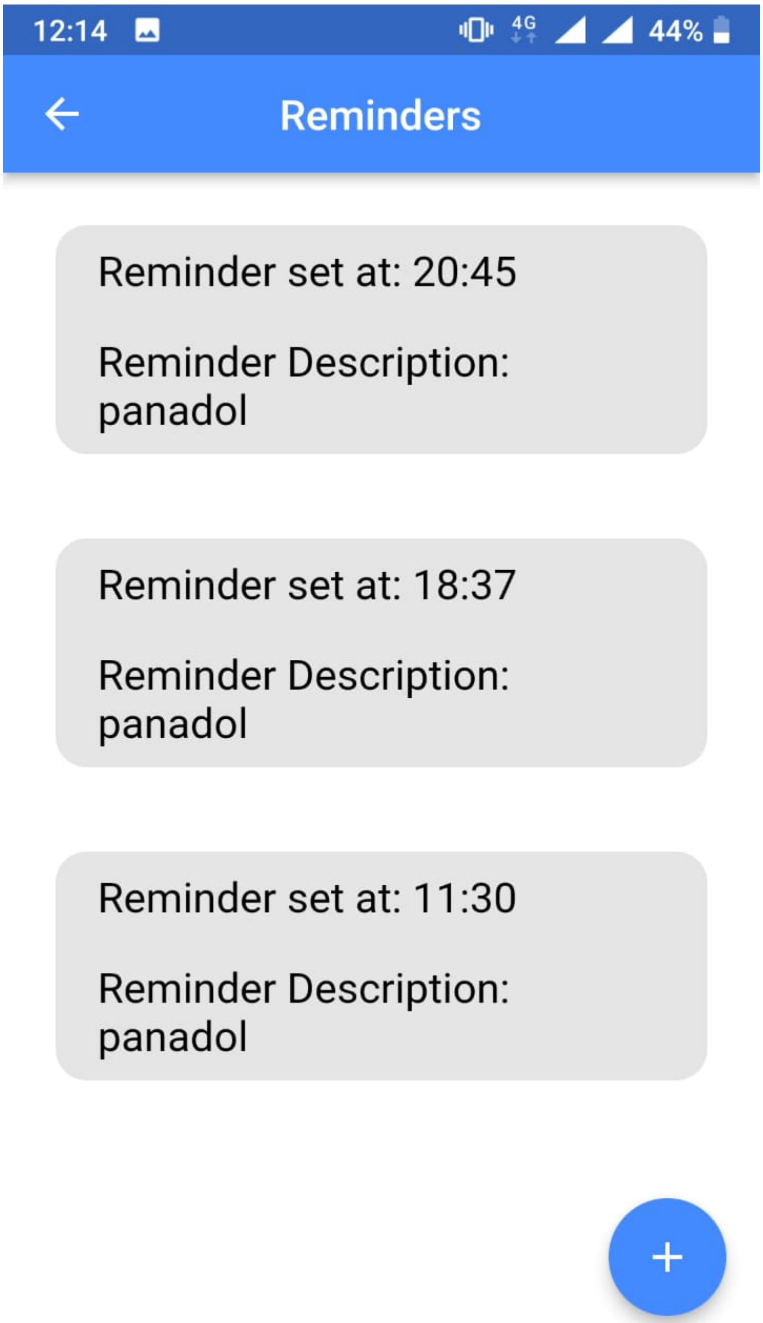


Figure 4.18: Patient Dashboard GUI



Reminder set at: 20:45

Reminder Description: panadol

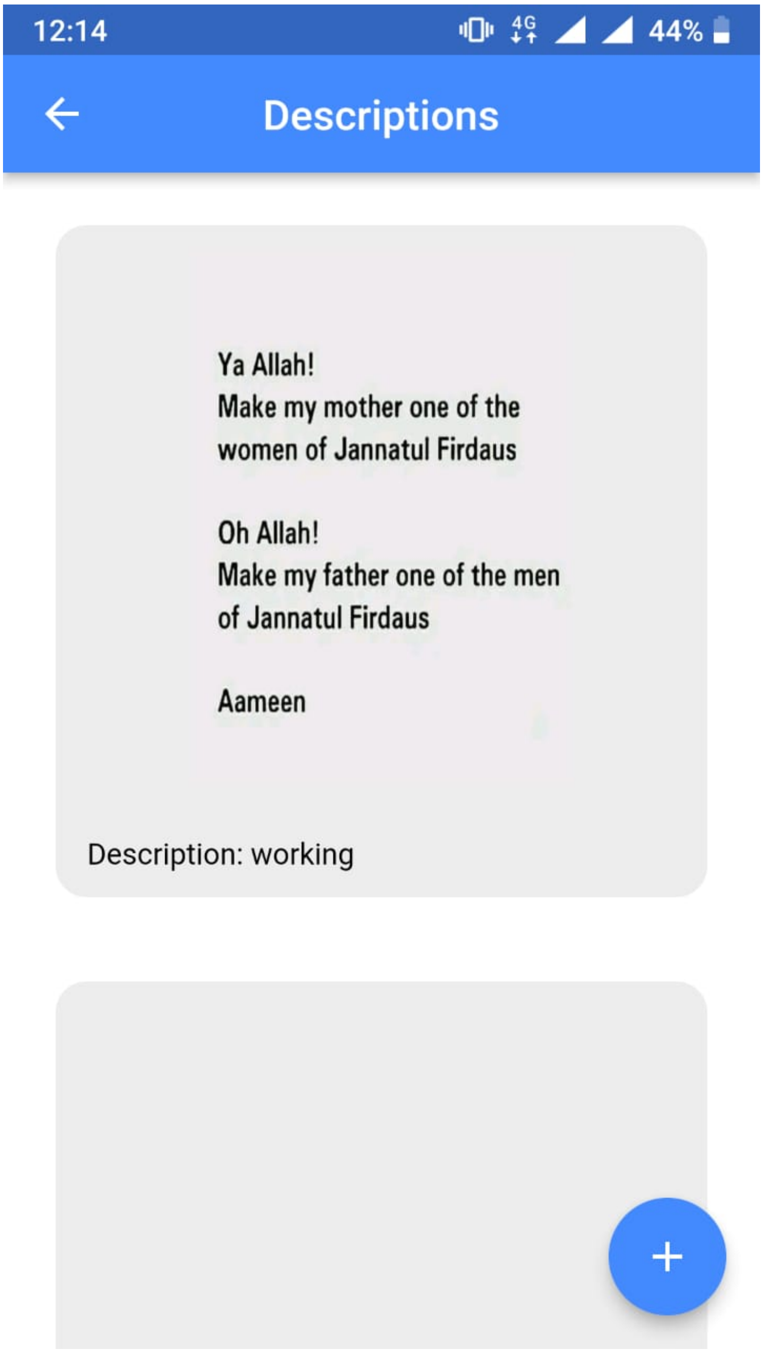
Reminder set at: 18:37

Reminder Description: panadol

Reminder set at: 11:30

Reminder Description: panadol

Figure 4.19: Set Reminder GUI



12:14 44%

Descriptions

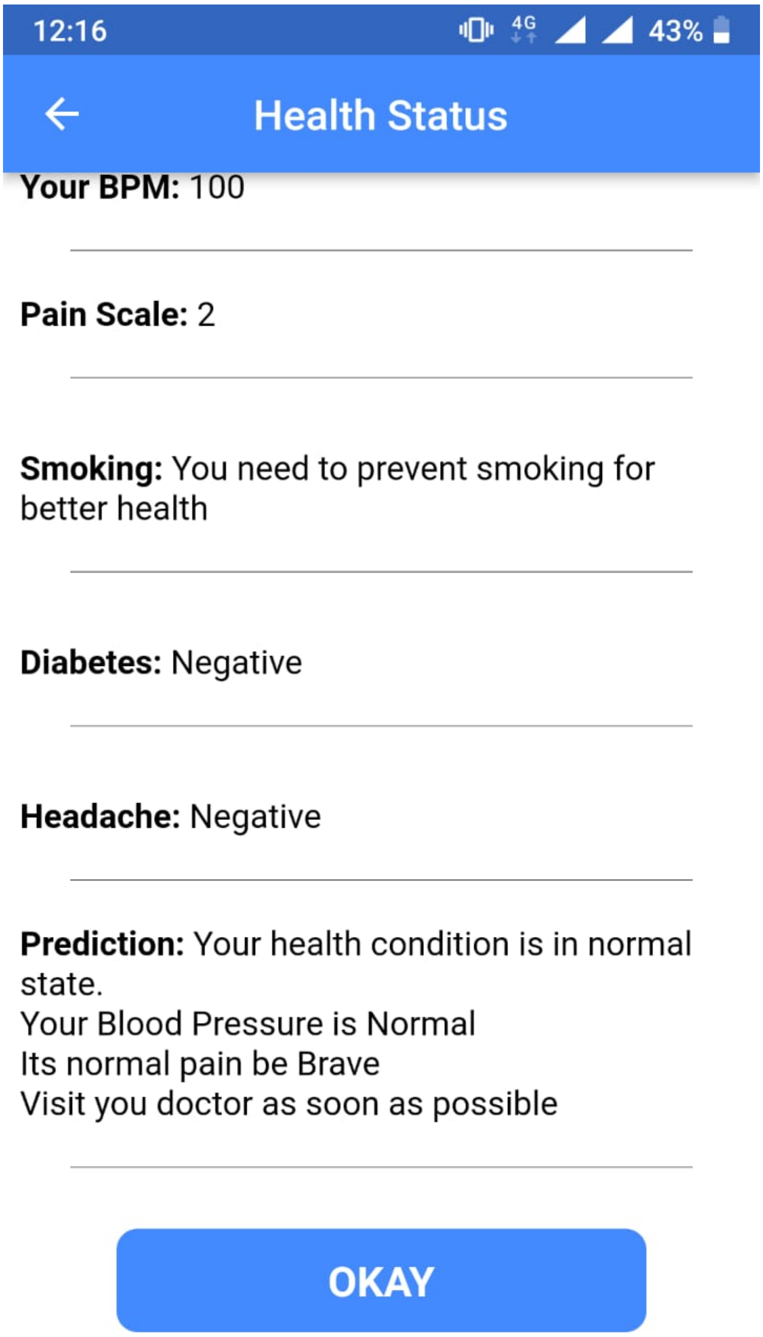
Ya Allah!
Make my mother one of the
women of Jannatul Firdaus

Oh Allah!
Make my father one of the men
of Jannatul Firdaus

Aameen

Description: working

Figure 4.20: Medical Description View GUI



Your BPM: 100

Pain Scale: 2

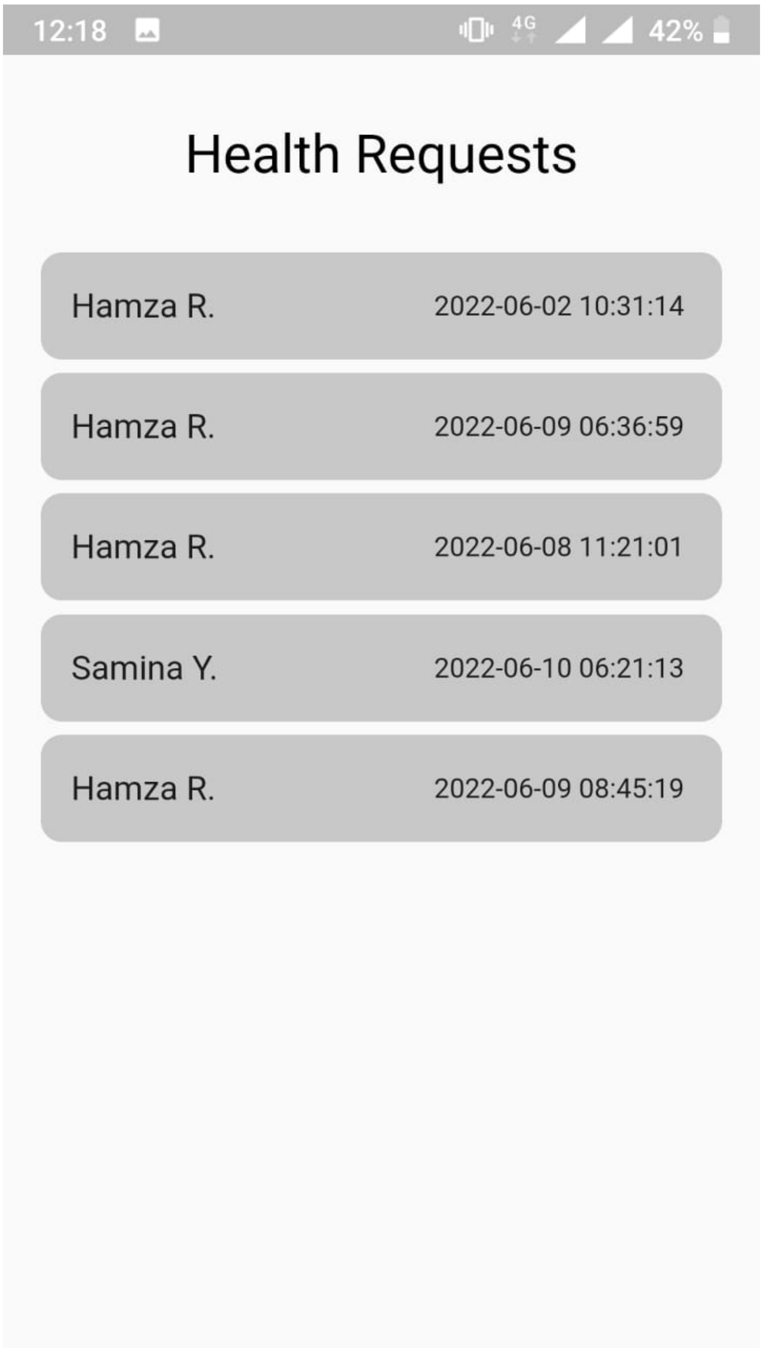
Smoking: You need to prevent smoking for better health

Diabetes: Negative

Headache: Negative

Prediction: Your health condition is in normal state.
Your Blood Pressure is Normal
Its normal pain be Brave
Visit you doctor as soon as possible

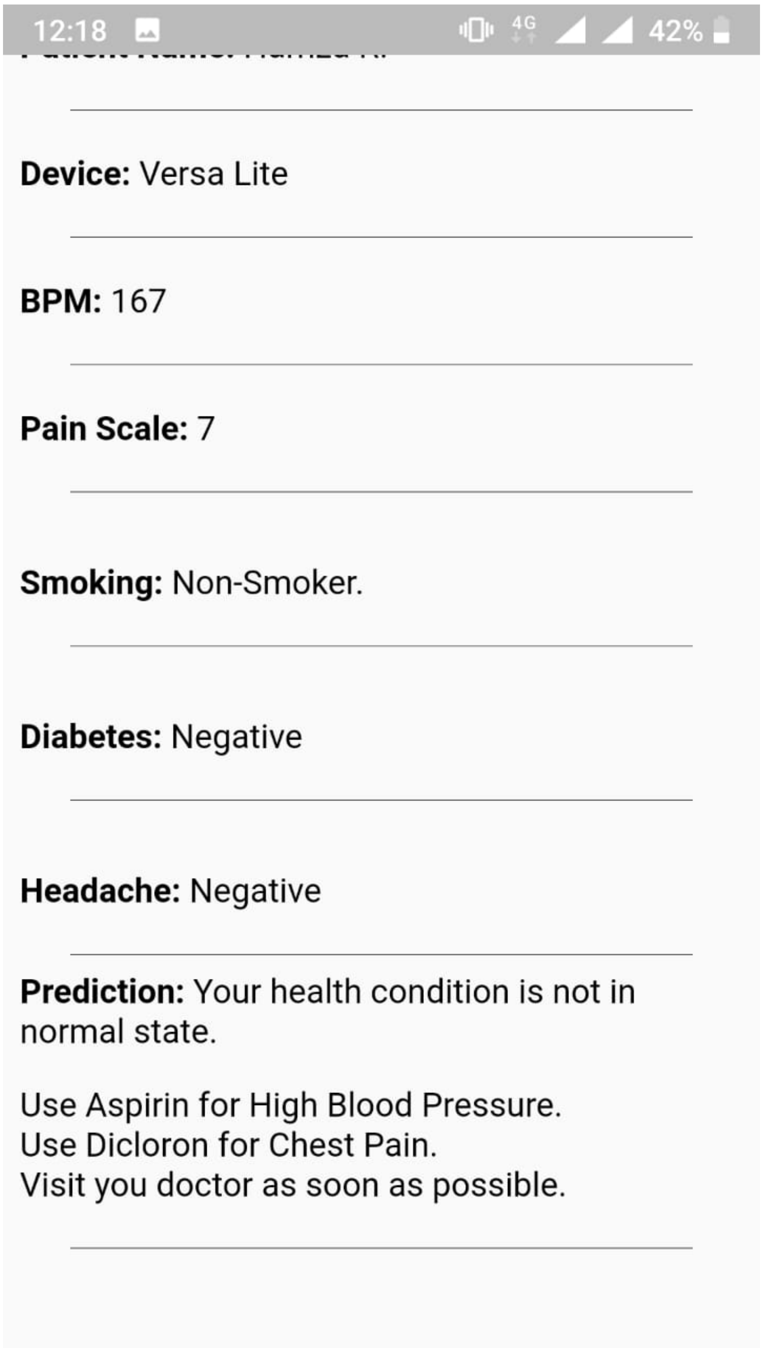
Figure 4.21: Check Health Status GUI



Health Requests

Hamza R.	2022-06-02 10:31:14
Hamza R.	2022-06-09 06:36:59
Hamza R.	2022-06-08 11:21:01
Samina Y.	2022-06-10 06:21:13
Hamza R.	2022-06-09 08:45:19

Figure 4.22: Health Status History GUI



Device: Versa Lite

BPM: 167

Pain Scale: 7

Smoking: Non-Smoker.

Diabetes: Negative

Headache: Negative

Prediction: Your health condition is not in normal state.

Use Aspirin for High Blood Pressure.
Use Dicloron for Chest Pain.
Visit you doctor as soon as possible.

Figure 4.23: View Health Status GUI

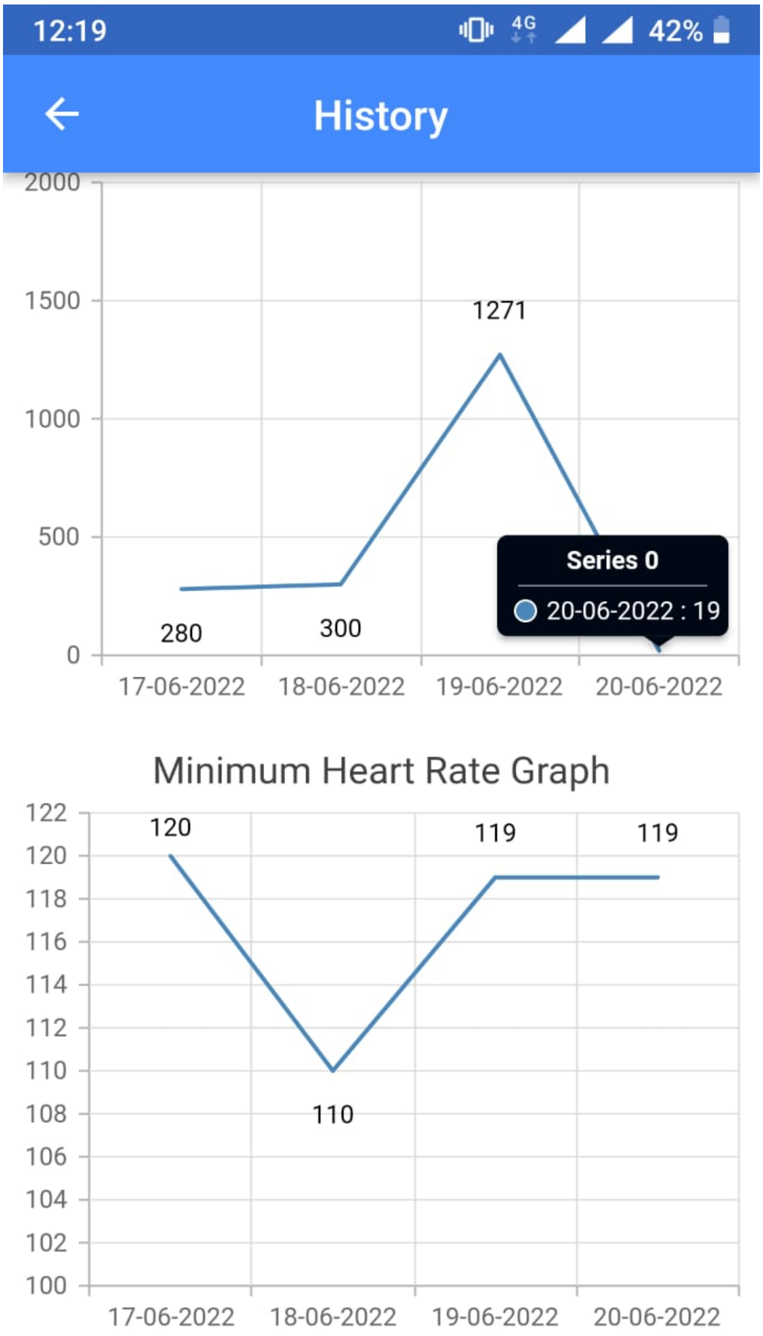


Figure 4.24: Graph Health Statistics GUI

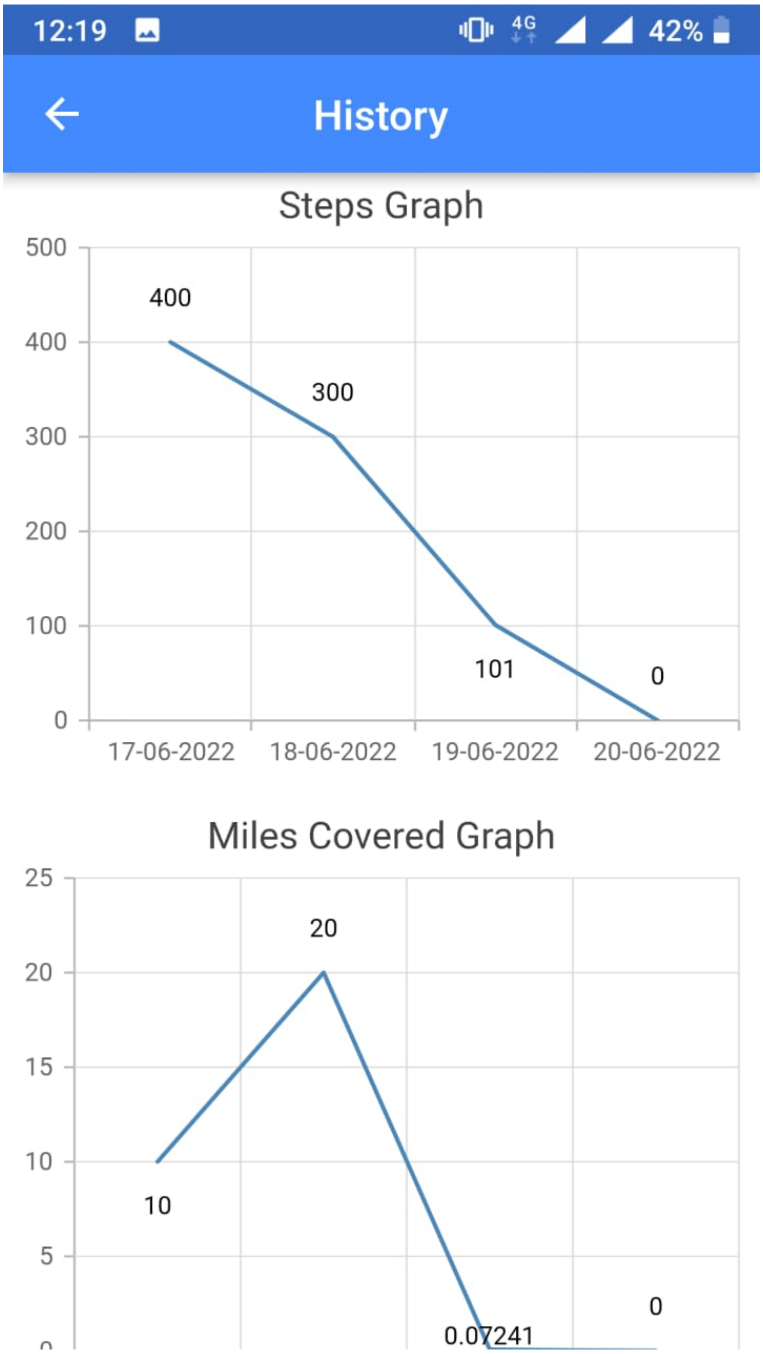
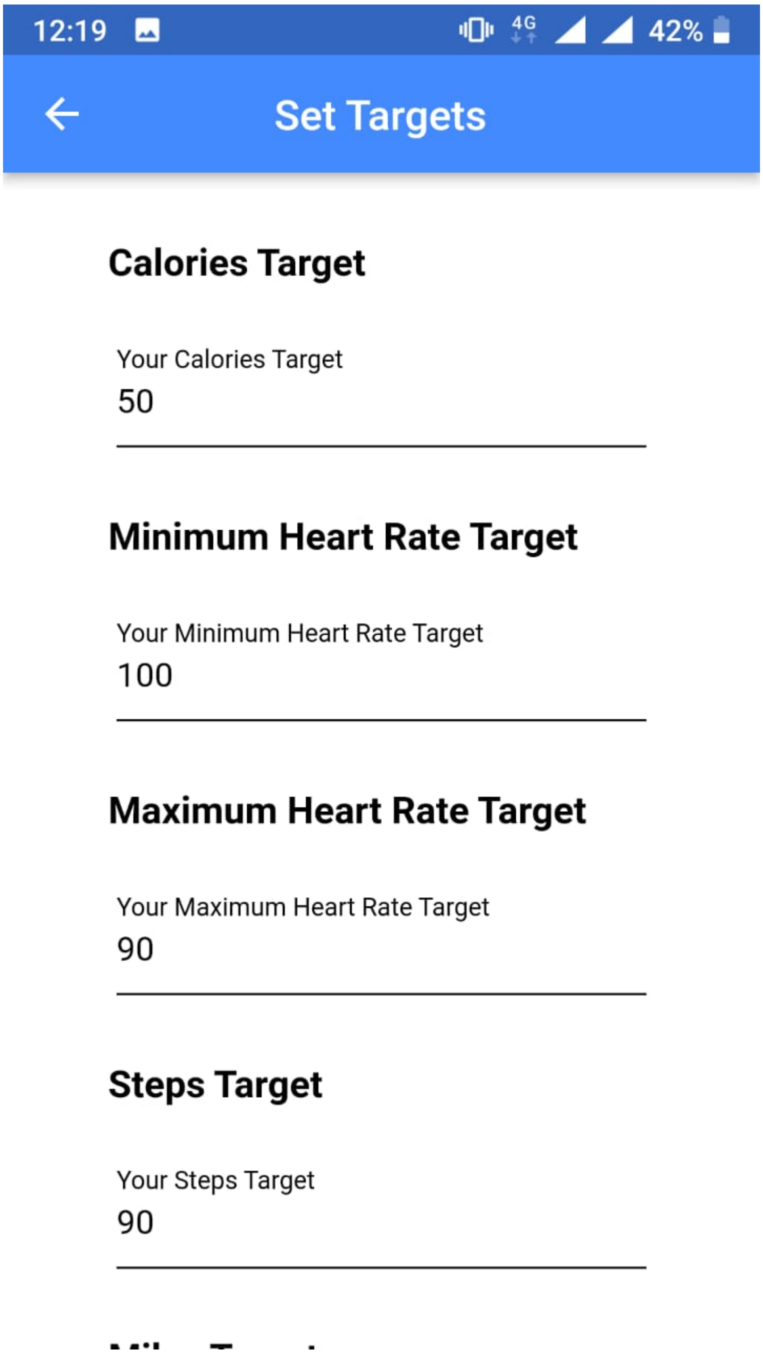


Figure 4.25: Graph Health Statistics GUI



Calories Target

Your Calories Target
50

Minimum Heart Rate Target

Your Minimum Heart Rate Target
100

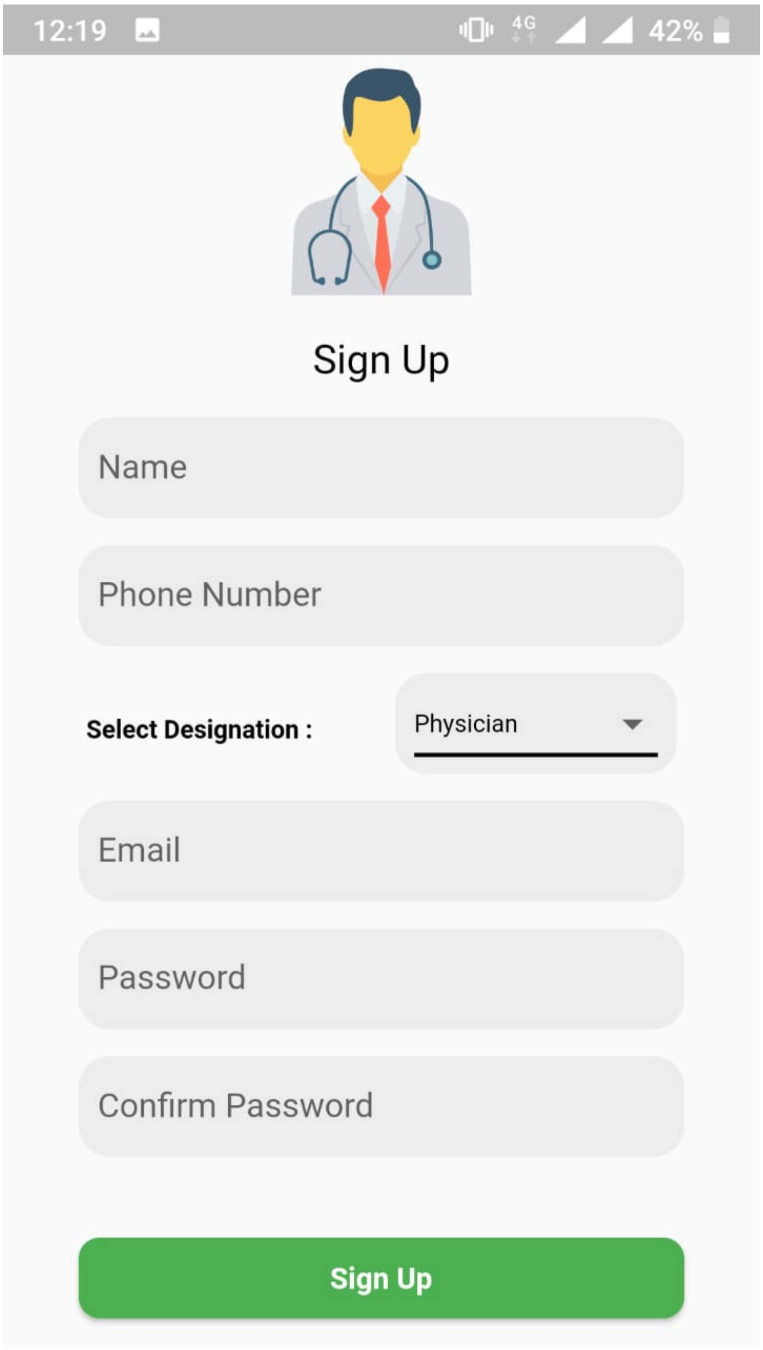
Maximum Heart Rate Target

Your Maximum Heart Rate Target
90

Steps Target

Your Steps Target
90

Figure 4.26: Set Targets GUI



12:19 42%

Sign Up

Name

Phone Number

Select Designation : Physician

Email

Password

Confirm Password

Figure 4.27: Doctor Sign up GUI

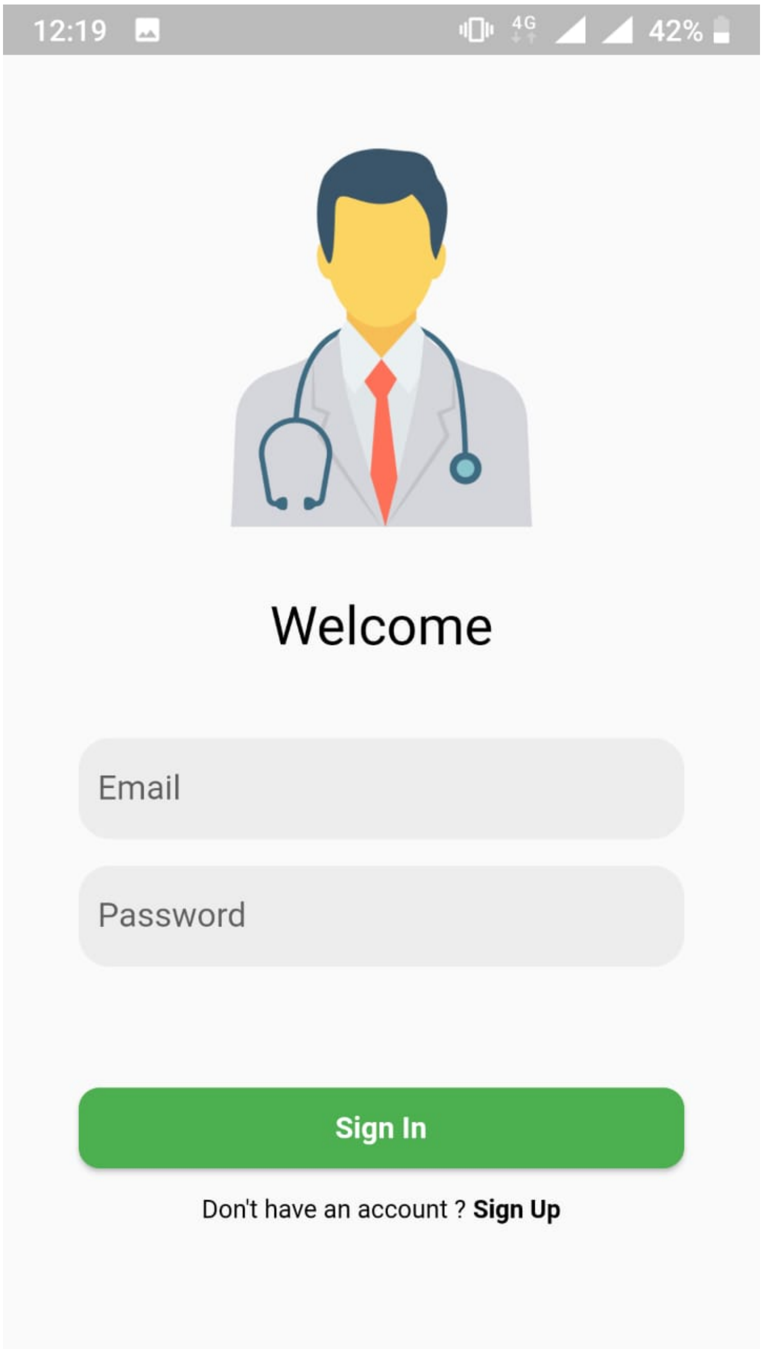
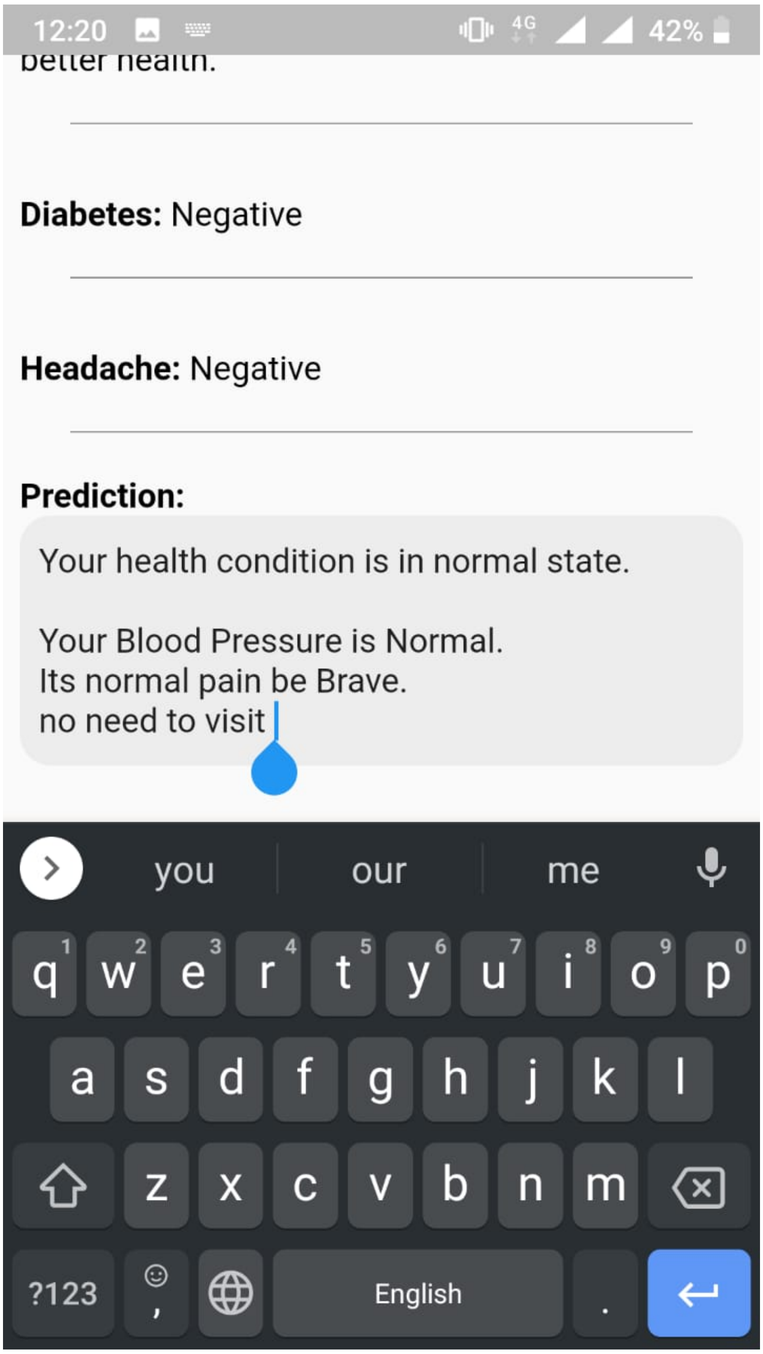


Figure 4.28: Doctor Login GUI



better health.

Diabetes: Negative

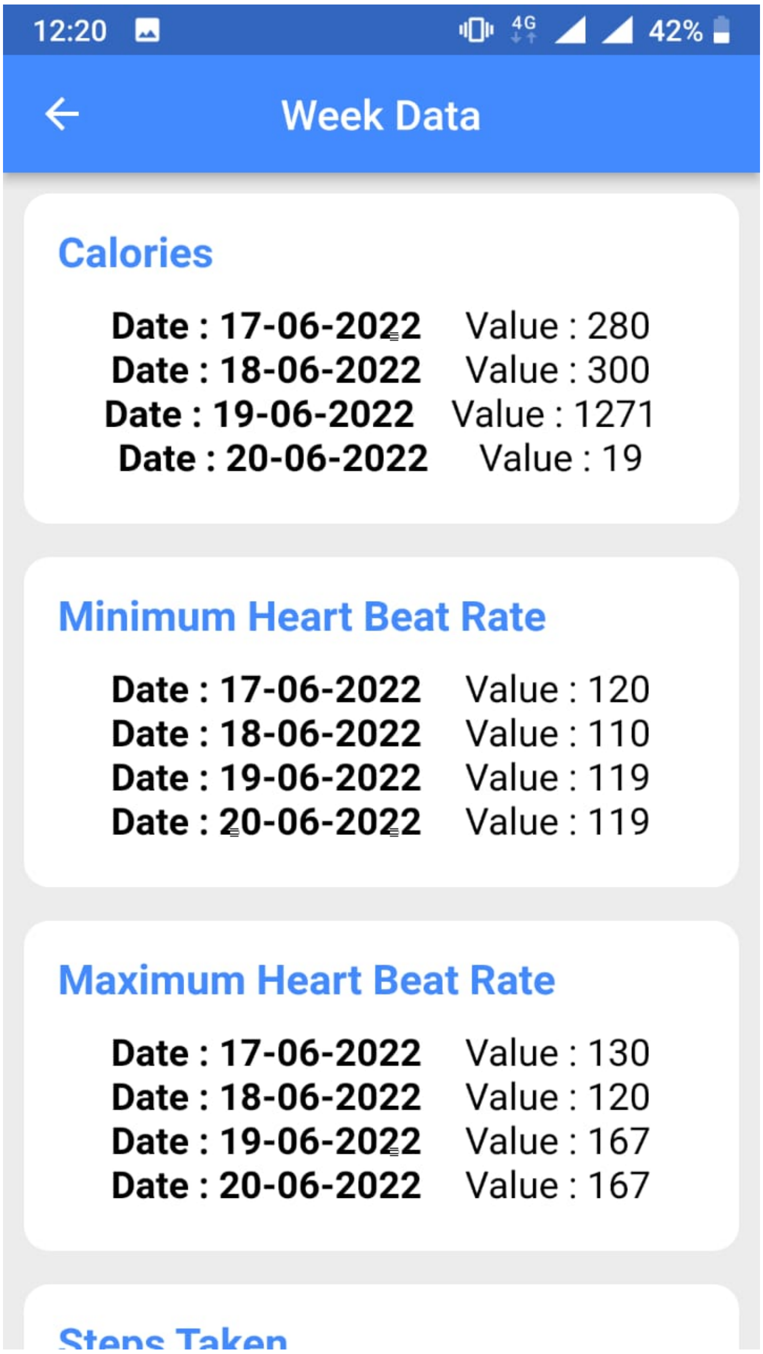
Headache: Negative

Prediction:

Your health condition is in normal state.

Your Blood Pressure is Normal.
Its normal pain be Brave.
no need to visit

Figure 4.29: Doctor Suggestions GUI



Week Data

Calories

Date : 17-06-2022 Value : 280
Date : 18-06-2022 Value : 300
Date : 19-06-2022 Value : 1271
Date : 20-06-2022 Value : 19

Minimum Heart Beat Rate

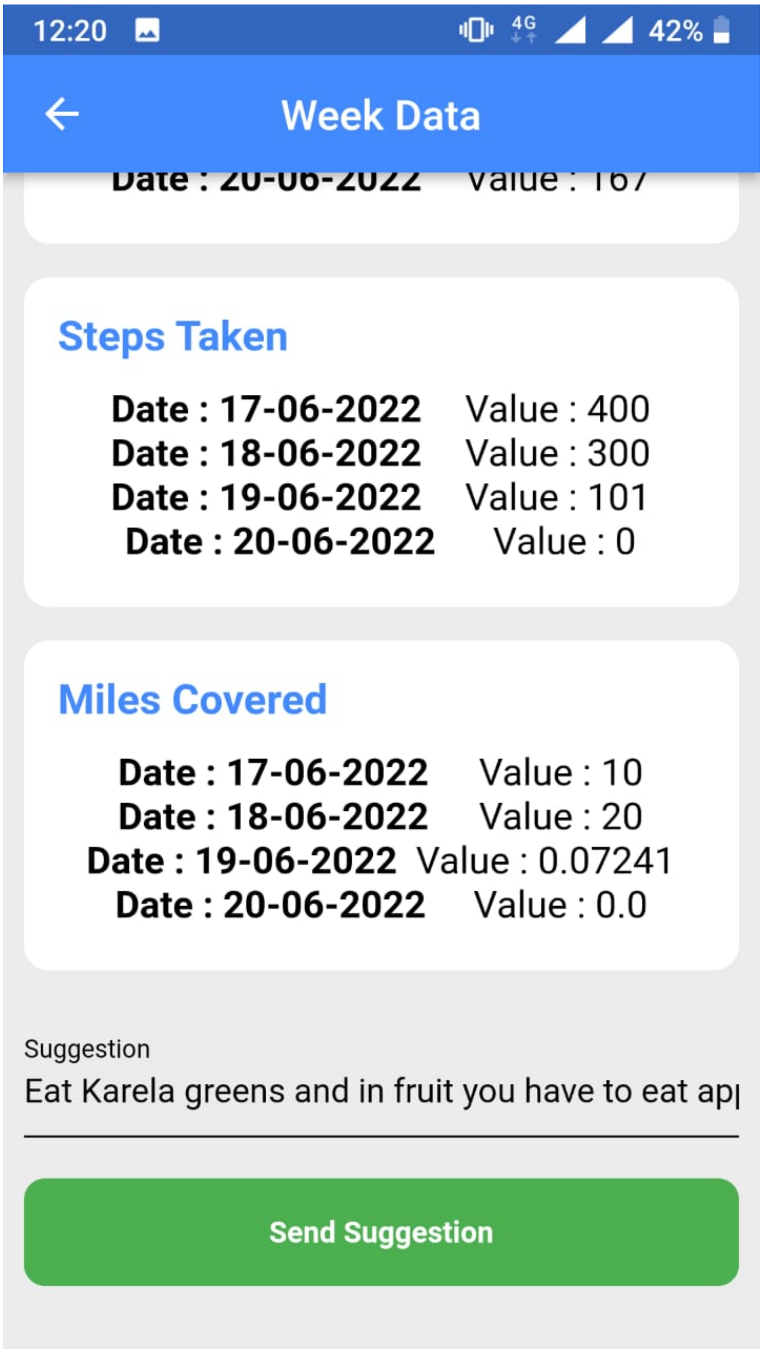
Date : 17-06-2022 Value : 120
Date : 18-06-2022 Value : 110
Date : 19-06-2022 Value : 119
Date : 20-06-2022 Value : 119

Maximum Heart Beat Rate

Date : 17-06-2022 Value : 130
Date : 18-06-2022 Value : 120
Date : 19-06-2022 Value : 167
Date : 20-06-2022 Value : 167

Steps Taken

Figure 4.30: Weekly Data GUI



Date : 20-06-2022 Value : 167

Steps Taken

Date : 17-06-2022 Value : 400
Date : 18-06-2022 Value : 300
Date : 19-06-2022 Value : 101
Date : 20-06-2022 Value : 0

Miles Covered

Date : 17-06-2022 Value : 10
Date : 18-06-2022 Value : 20
Date : 19-06-2022 Value : 0.07241
Date : 20-06-2022 Value : 0.0

Suggestion
Eat Karela greens and in fruit you have to eat ap

Figure 4.31: Nutritionist Suggestion GUI

Chapter 5

System Implementation

In this chapter, we will go through the implementation strategies that we utilised to create our Smart health monitoring Application. Therefore, this chapter discusses the tools and strategies used to implement the Smart Health Monitoring App.

5.1 Tools and Technology

The following tools and technologies were used to create the Smart Health Monitoring application:

5.1.1 Flutter Framework

Flutter is an open-source user interface software development kit. It is used to create cross-platform apps from a single codebase for Android, iOS, Linux, macOS, Windows, Google Fuchsia, and the web.

5.1.2 Dart Language

Dart is a programming language intended for client development, such as web and mobile applications. It was created by Google and may be used to create server and desktop apps. It is a garbage-collected, object-oriented language with C-style syntax. Flutter apps are created in the Dart programming language and take advantage of many of the language's sophisticated capabilities.

5.1.3 Firebase

For our project's database, we chose Firebase Database. It is a NoSQL database that offers cloud-based services. It saves the data during the runtime.

5.1.4 Local Notifications

In our application local notification is used to generate notifications alert to the user. A cross-platform plugin for showing and scheduling local alerts for Flutter applications, with platform-specific customization.

5.1.5 Android Studio

Android studio is used for development of android application as it is powered by google so it is easy to integrate Google API in android studio. Android studio offers variety of API level that supports many of android phones these levels categorize the use of API according to the OS versions of their phones.

5.2 Implementation Strategy

Our project's implementation technique was entirely gradual. We set various targets to reach, and at the conclusion of the app development, we had completed all of our project's milestones. Our project has the following milestones:

1. Create an appealing user interface.
2. Create a sign-up page.
3. Create a login page.
4. Pages and database integration.
5. Create a Medical Prescription page.
6. Create a Set Remainder page.
7. Create a Nutrition Diet page.
8. Testing all the pages

Chapter 6

System Testing and Evaluation

All our project's test cases, and test procedures are most likely to be found in the chapter on system testing and assessment. This chapter covers the performance and assessment of our Android app. Various methods and strategies are used to evaluate applications. The major goal of developing this application is to create a Smart health monitoring in a more easy and effective manner. This chapter covers testing the system and all its modules. The testing is regarded to be successful if the system produces results that meet the requirements. The commonly known testing methods are:

1. Graphical user interface testing
2. Software performance testing
3. Usability testing
4. Compatibility testing
5. Load testing
6. Exception handling

6.1 Graphical User Interface Testing

The process of analyzing how easy a user can interact with a mobile application using the interface is known as graphical user interface testing. The graphical user interface should be user-friendly so that a user who is unfamiliar with mobile applications may quickly learn how to use them by reading the text or graphics on the buttons. We have tested the user interface to ensure that each functionality is operating and that the activities are being performed as they should be. The user interface should be simple to understand. Text, graphics, layouts, and controls are all easily understood. The colour scheme is consistent across the layout, and the entire interface is responsive.

6.2 Software Performance Testing

The goal of software performance testing is to ensure that all of the system's non-functional criteria are met. This system's non-functional requirements include dependability, efficiency, and reaction time, among others. We checked each portion of the component during software performance testing to ensure that all the components are executing the tasks as planned. Like the performance testing for login is to ensure that the doctor is successfully logged in.

Steps	Task	Expected Outcome	Actual Outcome
1.	Patient page is working correctly	Pass/Fail	Pass
2.	Patient Dashboard working	Pass/Fail	Pass
3.	Click on Medical Description	Pass/Fail	Pass
4.	Click on check health status	Pass/Fail	Pass
5.	Click on previous health status	Pass/Fail	Pass
6.	Click on set remainder	Pass/Fail	Pass
7.	Click on nutrition diet	Pass/Fail	Pass
8.	Click on Details	Pass/Fail	Pass
9.	Click on Exit	Pass/Fail	Pass
10.	Doctor page is working correctly	Pass/Fail	Pass
11.	Doctor sign in page is working correctly	Pass/Fail	Pass
12.	Enter the correct Email/Password	Pass/Fail	Pass
13.	Click on forget password	Pass/Fail	Fail
14.	Click on signup button	Pass/Fail	Pass
15.	Click on health request	Pass/Fail	Pass
16.	Delete health request	Pass/Fail	Fail
17.	Update patient health request	Pass/Fail	Pass
18.	Click on logout	Pass/Fail	Fail
19.	Click on Nutritionist Page	Pass/Fail	Pass

Table 6.1: Performance Testing

6.3 Usability Testing

We perform usability testing to ensure that our Android application is usable by each user who interacts with the system. Furthermore, the application guides the user through the actions using understandable keywords and a sensible layout, allowing them to complete them quickly and without difficulty.

6.4 Compatibility Testing

Compatibility testing focuses on the mobile application's ability to run on any given platform. The application is tested on a variety of hardware devices during compatibility testing. It's done to see what kind of hardware and software are needed to operate the application and satisfy the functional requirements.

Steps	Task	Expected Outcome	Actual Outcome
1.	Android Version 2.3 Gingerbread	Pass/Fail	Fail
2.	Android Version 3.0 Honeycomb	Pass/Fail	Fail
3.	Android Version 4.0 Ice Cream Sandwich	Pass/Fail	Fail
4.	Android Version 4.1 Jelly Bean	Pass/Fail	Fail
5.	Android Version 4.4 KitKat	Pass/Fail	Fail
6.	Android Version 5.0 Lollipop [Tested]	Pass/Fail	Pass
7.	Android Version 6.0 Marshmallow [Tested]	Pass/Fail	Pass
8.	Android Version 7.0 Nougat [Tested]	Pass/Fail	Pass
9.	Android Version 8.0 Oreo [Tested]	Pass/Fail	Pass
10.	Android Version 9.0 Pie [Tested]	Pass/Fail	Pass

Table 6.2: Compatibility Testing

6.5 Exception Handling

Exception handling is integrated in the following modules of the mobile application. We have used all forms of checks in exception handling if there is any kind of user input to assure the application's speed. Moreover, it will not proceed to the next operation if the user provides any invalid input.

Steps	Task	Expected Outcome	Actual Outcome
1.	Enter into Patient module	Pass/Fail	Pass
2.	Enter into Doctor module	Pass/Fail	Pass
3.	User provide valid email and password for Doctor module login	Pass/Fail	Pass
4.	User provide invalid email and password for doctor login	Pass/Fail	Fail
5.	Patient can see graph	Pass/Fail	Pass
6.	Patient can upload and export images	Pass/Fail	Pass
7.	Nutritionist default login	Pass/Fail	Pass
8.	Nutritionist can sign up	Pass/Fail	Fail
9.	Nutritionist provide invalid email and password	Pass/Fail	Fail

Table 6.3: Exception Handling

6.6 Load Testing

The response time of a mobile application is the focus of load testing. During load testing, we check the application under a variety of loads to determine the application's speed and capacity. We tested the app on three to four different smartphones at the same time, and the layout controls and functionality worked perfectly on all of them.

Steps	Task	Expected Outcome	Actual Outcome
1.	Application run on multiple devices at a same time	Pass/Fail	Pass
2.	Performance Test	Pass/Fail	Pass
3.	Graphical Design check on multiple device	Pass/Fail	Pass
4.	Reliability Check	Pass/Fail	Pass
5.	Working Perfectly	Pass/Fail	Pass

Table 6.4: Load Testing

6.7 Test Cases of IOT based Smart Health Monitoring System

6.7.1 Smart Health Monitoring System successfully run Test Case

The smart health monitoring system and its features, such as retrieving watch data from a Fitbit server, running different modules, and displaying a diet plan suited to the patient on a GUI, were all executed and tested for reference, as shown in the table 6.5.

Table 6.5: Smart Health Monitoring Application successfully run test case

Test Case id	1
Function to be tested	The mobile application should function properly.
Initial State	The device should be able to connect to the internet.
Input	Open Application.
Expected Output	Mobile Application should run Smoothly and Successfully.
Actual Output	Mobile Application executed successfully.
Status	Pass

6.7.2 Doctor Login Test Case

As security plays very important and crucial role for every system there login system for Doctor panel should run successfully and do not allow any unauthorised access into the System. For reference see table 6.6.

Table 6.6: Doctor Login into Smart Health Monitoring System Test Case

Test Case id	2
Function to be tested	Login with correct email and password
Initial State	Use correct email and password.
Input	Credentials.
Expected Output	Doctor should login.
Actual Output	Doctor Logged in.
Status	Pass

6.7.3 Doctor Registration Test Case

To utilise the program and assist the patient, the user must first register. If a user does not exist in the database, the application will not enable that user to log into the system and will instead send that user to the sign up page. for reference see table 6.7.

Table 6.7: Smart Health Monitoring System Doctor Registration Test Case

Test Case id	3
Function to be tested	Sign up.
Initial State	Data must be filled in the required fields.
Input	Email and Password should be provide.
Expected Output	Successfully account will be registered.
Actual Output	Registration Successfully
Status	Pass

6.7.4 Smart Health Monitoring System Doctor Dashboard Test Case

When doctor login into the system doctor will see its patient health status where doctor can recommend his/her medical advice if it is needed. for reference see table 6.8.

Table 6.8: Smart Health Monitoring System Doctor Dashboard Test Case

Test Case id	4
Function to be tested	See patient health status.
Initial State	See and recommend medical advice to their patients.
Input	Check and recommend medical advice.
Expected Output	Check and recommend medical advice to patients successfully.
Actual Output	Working successfully.
Status	Pass

6.7.5 Smart Health Monitoring System Medical Description Test Case

In this module patient upload its medical description via camera or export picture from its phone gallery. for reference see table 6.9.

Table 6.9: Smart Health Monitoring System Medical Description Test Case

Test Case id	5
Function to be tested	Medical descritpion.
Initial State	Click on medical description.
Input	Upload image or export from gallery.
Expected Output	Picture is uploaded successfully and export successfully.
Actual Output	Both upload successfully.
Status	Pass

6.7.6 Smart Health Monitoring System Check Health Status Test Case

Patient can be check its health status by entering beats per minute chest pain and some other credentials. for reference see table 6.10.

Table 6.10: Check Health Status Test Case

Test Case id	6
Function to be tested	Check health status.
Initial State	Click on check health status page.
Input	Enter bpm chest pain and some other credentials.
Expected Output	Generate a message if following credentials are matched.
Actual Output	Performed successfully.
Status	Pass

6.7.7 Smart Health Monitoring System Nutritionist Test Case

Nutritionist provide diet plan to its patient according to its weekly data. The data will be in foam of calories, total steps covered, total miles covered, maximum and minimum heart rate. for reference see table 6.11.

Table 6.11: Nutritionist Test Case

Test Case id	7
Function to be tested	Nutritionist.
Initial State	Click on nutritionist page.
Input	Recommend diet plan to its patient.
Expected Output	Successfully provide diet plan to its patient .
Actual Output	Performed Successfully.
Status	Pass

6.7.8 History Test Case

A smart health monitoring software may also provide a weekly graph for their patient, which can be utilised to help them make better decisions. It was verified that the graph had been correctly constructed and that it had all of the necessary data in the form of values and dates. for reference see table 6.12.

Table 6.12: Generating Graph Test Case

Test Case id	8
Function to be tested	History.
Initial State	Save history.
Input	Select the option from patient dashboard to generate graph.
Expected Output	Graph should be generated Successfully.
Actual Output	Graph generated Successfully.
Status	Pass

Chapter 7

Conclusions

The goal of creating this app was to create a platform where user could find all medical assistance facility in a single app. This method will assist user in monitoring their health and will also direct communicate with their prescriptive doctor. The user will not have to waste time for various little health issues but will instead utilise our method to save time. We created this application to make life easier for the general population. People will be able to monitor their health easily. In this application it's provide facility to the user to enter their doctor's prescription in text form or in picture form. The people main problem was to manage their health record or reports in paper format was saved. By using this module people can save their record in soft copy. In our application people use set remainder module which helps user to get medicine on time. This is another big advantage of these two modules for our people, where people life get easier and simple. Finally, we learnt a lot, particularly about integrating numerous services and platforms. One of our key worries was dealing with such vast and time-consuming project tests and interactions, since there were many interactions in applications where a query was used in each step, and data structure, mapping, and linkages were also challenging and time-consuming. To apply, use. Second, while we had learnt in our lectures and courses about dealing with local hosting or running projects on a network of local computers, we had never worked online on a global network. We only addressed and taught cloud technologies in theoretical classes, despite our interest in them and desire to work on them. This project opportunity provided us with that possibility/opportunity, and we have implemented cloud services [for hosting] as part of supporting our application's back end.

7.1 Major Accomplishment

We provide you with the project; our greatest accomplishment has been to complete the application on schedule and within the frameworks and milestones that we agreed upon with our supervisor. During building our project, we learned a lot. We completed all of the modules on schedule and used highly efficient tools, which provided us with a larger view of programming and perhaps producing our paper.

7.2 Future Enhancement

We will continue to work on our project, and soon we will create our own APIs as well as an integrated system that will be included in this system to automate everything; with these future additions, our system will be incredibly dependable and efficient. In future it will highly beneficial for the patient. They can easily monitor their health on a daily basis. The Internet of Things (IoT) is becoming a more well-known technology on a worldwide scale. In a short time, its popularity has increased. Moreover, automation of IoT devices is now simple thanks to developments in AI and machine learning. IoT devices are typically combined with AI and machine learning technologies to deliver effective automation. As a result, the Internet of Things (IoT) has expanded the range of sectors in which it may be used.

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