



Faculty of Computers
& Artificial Intelligence



Benha University

Healthcare Monitoring System for Chronic Diseases

A senior project submitted in partial fulfillment of the requirements for the degree of Bachelor of Computers and Artificial Intelligence.

“Medical Informatics” Program,

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Project Abstract

This project discusses a problem that is alive and present among most patients. Especially those with chronic diseases. The purpose of this project is to reduce or almost eliminate the need for patients with chronic diseases to permanent residence in hospitals. Eliminate the continuous repetition of visiting doctors in the hospital on a regular basis. Especially for the elderly are the most vulnerable group for chronic diseases that require frequent visits, they cannot comfortably do so.

This project was designed to find a solution for people with these chronic diseases, including people with Chronic Heart Disease or newly out from surgeries who need constant follow-up, but cannot permanently reside in hospitals or go out all the time to visit the doctor because of their health conditions, also those with Chronic Kidney Disease and also those with Diabetes of all types.

The best solution to this problem is to follow up patients with chronic diseases from home. Record and manage their health conditions and medical records on a daily, monthly, and yearly basis. Making medical reports and charts to facilitate monitoring patient's health condition. It is also thought to create a broader system for managing patient records and some of their relatives, doctors' data, and laboratory data.

Our ideas were implemented in a realistic way that suits the medical field by building a web application, which is characterized by ease of access and dealing with it. The system provides the patient's data to the doctor, relatives, and the laboratory when needed. All of this is done to make the patient enjoy a stable condition as if he was inside the hospital. In addition, this application enables communication between all these entities. Most of the patient's vital signs are stored using sensors given to the patient in a database to be presented in his report. A machine learning model is applied to detect the probability of getting heart disease as an additional service.

ACKNOWLEDGMENT

The success of any project depends largely on the encouragement and guidelines of many others. We take this opportunity to express our gratitude to the people who have been instrumental in the successful completion of this project.

A special thanks goes to our helpful supervisor, Dr. Mona Arafa. And the support she gave truly helped in the progression of our project.

We greatly appreciate the contribution of our institution, Benha University Faculty of Computer and Artificial Intelligence (BFCAI).

DECLARATION

We hereby certify that this material, which we now submit for assessment on the program of study leading to the award of Bachelor of Computers and Artificial Intelligence in *Medical Informatics* is entirely our own work, that we have exercised reasonable care to ensure that the work is original, and does not to the best of our knowledge breach any law of copyright, and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the text of our work.

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ABSTRACT

First of all, our project discusses an important problem which is how to eliminate the need for patients to visit doctors at the hospital on a regular basis, which is exhausting for them because they have chronic diseases that require frequent visits, and they can't get out of their comfort house and also

Most of patients who have CHD are newly out from surgeries and they need constant follow-up, so they need to have same services but can't get out every certain time to visit their doctor, and some patients can't even get out of their beds, due to their conditions and, most likely, their age (chronic diseases are most common in the elderly).

We here want to help those patients get the same or even more services from home with the least effort from them.

And we are here to solve this problem by following up patients with chronic diseases from home and manage all their health conditions and their medical records, and we are here concerned with three important diseases: "Coronary Heart Disease" (CHD), "Chronic Kidney Disease" (CKD), and "Diabetes".

We make a comprehensive system to manage the patient records, doctors' data, lab appointment details, and also the data of patients' relatives.

We have made a website with different four interfaces to each user in our system as we have four users as follow ("Patient", "Doctor", "Laboratory", "Relative") this website will help organize each user data and will share the patient data as needed for doctor, relative, and lab to help make our patient feel better and organize his case or provide services to him.

Also, this project can be used for many health care, health centers and hospitals to reduce the number of residents in health care.

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LIST OF ACRONYMS/ABBREVIATIONS

ACRONYM Definition of Acronym

CHD	Coronary Heart Disease
CVD	Cardiovascular Disease
CKD	Chronic Kidney Disease
NCDs	Non-communicable diseases
SDLC	System Development Life Cycle
PERT	Program Evaluation Review Technique
MRN	Medical Record Number
ID	Identification Number
NFRs	Non-Functional Requirements
DFD	Data Flow Diagram
ERD	Entity Relationship Diagram
PHP	Hypertext Pre-processor
SQL	Structured Query Language
VS-code	Visual Studio Code
GPS	Global Positioning System

Chapter One

“Introduction”

Chapter One

1 INTRODUCTION

1.1 INTRODUCTION

Worldwide, the World Health Organization showed that chronic diseases caused the death of number of victims amounting to 36 million deaths, which is expected to increase these numbers by 17-24%, and this is a dangerous indicator. Chronic diseases are one of the types of non-communicable diseases, which are often related to the lifestyle of bad eating habits such as an abundance of sugars, salts, and fats.

Studies have shown that the death rate of people with these diseases to 60% caused in the year 2000 and most of the deceased were females, and most of them were under seventy years of age. It is unfortunate that the death rate increased until it reached 68% in 2012, and this is a dangerous indicator that must be faced, as approximately 5 million people die annually, at least, from these diseases, as high blood pressure alone causes the death of nearly to 7.5 million deaths, as well as high cholesterol, which causes nearly 2.6 million deaths, as well as obesity, which causes nearly 2.8 million deaths.

The most dangerous and common types of these diseases are cardiovascular diseases ‘CVD’ (like heart attacks, stroke and vascular disease), cancers, chronic respiratory diseases (such as chronic obstructed pulmonary disease and asthma), Diabetes, and chronic kidney disease ‘CKD’. These diseases were mentioned specifically because those infected with them are the most exposed to health problems from the occurrence of sudden strokes in the heart or brain or exposure to a sudden diabetic coma. Therefore, this project was made to face all these events in the fastest way possible.

Indeed, Recent studies have shown that the world has faced in recent periods many crises in the medical field, which affected the world in a noticeable negative way, such as the Covid_19 pandemic and other crises that prompted the world to make many attempts to overcome these, and one of the most important of these attempts, which has proven its role effectively is “telemedicine”, which is the method of providing medical care to the patient remotely and providing many health services to him without the need for his presence within the health care system, in the event that his condition is stable.

Therefore, this project is the most suitable option for what we want to present to this world and this sector that suffers from many health crises, the most important of which are chronic diseases of all kinds, in addition to the continuity of confronting these diseases. The idea of the project is based on many questions that surely came to your mind the moment you read the name of the project and tried to imagine its function. Among these questions, why was the focus specifically on helping people with chronic diseases? What types of diseases will be taken care of the injured? What is the method of treatment? How will a patient with this chronic disease be able to communicate with his doctor? All this and more are what prompted us to present this project to serve the medical field and help in its progress.

1.2 PROBLEM DEFINITION

First of all, our project discusses an important problem: how to follow up patients with chronic diseases from home and manage all their health conditions and their medical records, and we are here concerned with three important diseases: "Coronary Heart Disease" (CHD), "Chronic Kidney Disease" (CKD), and "Diabetes".

Following our investigation, we discovered that all of the diseases introduced were also related to one another, which is an important point that can be used to predict one disease based on the symptoms and conditions of a patient suffering from any of those diseases.

After all, we're here want to eliminate the need for patients to visit doctors at the hospital on a regular basis, which is exhausting for them because they have chronic diseases that require frequent visits, and they can't get out of their comfort house and also most of patients who have CHD are newly out from surgeries and they need constant follow-up , so they need to have same services but can't get out every certain time to visit their doctor, and some patients can't even get out of their beds, due to their conditions and, most likely, their age (chronic diseases are most common in the elderly). We here want to help those patients get the same or even more services from home with the least effort from them.

1.3 MOTIVATION

As we described above, our problem is primarily focused on eliminating the need for patients to visit doctors at the hospital on a regular basis, which is exhausting for them because they have chronic diseases that require frequent visits.

The first importance of the telemedicine problem was to reduce direct contact with patients during COVID-19, but now we want to use telemedicine for a completely different problem: following people with chronic diseases from home and developing tools for those patients that can be easily used by them with the least assistance from their comfort houses, as well as giving them advice about their case and how dangerous it is.

Our problem will also provide many services in addition to the online medical follow-up; we also provide online lab test appointments and also take test samples from home, and if the patient can't manage his profile by himself due to health conditions, old age, or even if he can't deal with technology, he can allow one of his relatives or anyone he trusts so much to manage his profile, follow his health condition by reading patient medical reports, and read the measured patient's vital signs.

1.4 PROBLEM SOLUTION, WHAT IS NEW?

Our current solutions are to first make a comprehensive system to manage the patient records, doctors' data, lab appointment details, and also the data of patients' relatives.

We have made a website with different four interfaces to each user in our system as we have four users as follows ("Patient", "Doctor", "Laboratory", "Relative") this website will help organize each user data and will share the patient data as needed for doctor, relative, and lab to help make our patient feel better and organize his case or provide services to him.

Our website will provide many services to patients from home. At the first meeting and diagnosis of a patient at the hospital, we provide patients with hardware devices holding the required sensors according to the patient's case to take them home to begin our journey by recording patients' medical measurements like "blood pressure," "heart beat rate," "blood sugar level," and "cholesterol level" automatically with the least help from them to guarantee accuracy, then predicting the state of his health conditions and giving him

the results, which will be evaluated by the system by comparing those measurements to standard levels of each measurement. We will also help patients contact our expert doctors to help them get better as fast as we can.

Not only that, but we will also afford patients the ability to book laboratory tests from home, and the lab will send a technician to them quickly to take samples and send results through the system after evaluating them in the laboratory. All financial transactions can be completed online through the system.

The services we provide to the patient are not yet complete because he can be overseen by his relatives, who can be family members or friends in whom he has the most trust to share his information after obtaining his permission to have them take charge of his case.

Also our website will predict if the patient case is emergency and immediately will call an ambulance to the patient current location (as we will enable the system to consume the live location of patients) any time the system feels there's emergency without any effort from patient, and the system will also send an emergency alarm to both of relative and doctor whom oversee the patient.

As previously described, each user will have a unique interface on the website with unique features, such as receiving patient current measurements, detailed information on the patient's case, receiving an alarm in an emergency, and contacting a specialised doctor on behalf of the patient. On the other hand, the doctor will have a list of all patients to follow up with, a list of all patients with emergency cases, will receive an alarm for emergency cases, will be allowed to show specific patient cases to contact him or change his medicine prescriptions as needed, and finally, the laboratory will receive test booking requests and process them through the website, sending technicians to patient homes to take samples back to the laboratory.

Finally, we can also afford to provide intensive care to patients with all supplies needed in the case of an emergency to help them get better as fast as possible.

When the doctor receives the emergency alarm and checks the patient's case, if he realises that his case is so critical that he needs to be kept in his intensive care unit, he will order that intensive care be prepared and supplied to him, as he will be directly sent there when the ambulance arrives at the hospital to save him from death as possible.

● **WHAT IS NEW?**

- Focus was placed on activating the usability feature, through the ease of movement within the application and the presence of tips at its inception to guide the user on how to use the application, and because most of the groups that use it are elderly, so it has been taken into account that there are no obstacles in using the application that the user cannot understand it easily.
- The focus was on simplicity and smoothness in building the application, as the screens were built in a standard way to suit all categories and clearly put all the services that the patient needs so that he can implement them easily without any distraction in choosing any function he wants to implement.
- The application was provided with many statistics, which are represented by more charts to make it easier for the patient to understand the stability of his health condition easily and quickly without the need to read more details, as well as in the doctor's platform appearing to contribute to taking quick actions.
- The application is easy to use, whether the patient uses it as a web application or downloads it as a mobile application, which only costs him to download it.
- The cost of the application is very low, as it consists in purchasing measuring tools for some vital measurements only, which are some sensors that are present with the patient and linked to the application to transfer the patient's measurements to the application to determine his condition.
- Also, the patient can move around with it due to its small size, and thus can use the application anywhere.
- The application was provided with a chat conversation with the doctor, in addition to making a video call, and all this to reassure the patient of his condition constantly from his specialized doctor.
- Some people close to the patient were also allowed to make an account on the application and allow them to know the patient's health status if the patient was unable to do so.
- The application was made to perform the required function quickly and with high accuracy, and because the patient often needs speed in knowing what he wants to know about his health condition.

- The patient can use the application to follow up on more than one disease after recording these diseases on the application, and this is the distinguishing feature of the application.
- The patient's interaction with the application instead of his presence in the hospital in case of stable condition protects him from many infectious diseases and provides places for those in need of residence in health care and the need for direct follow-up from the doctor who specializes in their condition.
- The feature of activating the alarm was made for the patient and the doctor in case the patient was neglected sometimes to follow up on his health condition.
- The application creates weekly and monthly statistics and presents them to the patient and the specialist doctor to understand the extent of the patient's health condition.

1.5 SUMMARY

Finally we can confirm that, our website will predict if the patient case is emergency and immediately will call an ambulance to the patient current location (as we will enable the system to consume the live location of patients) any time the system feel there's emergency without any effort from patient, and the system will also send an emergency alarm to both of relative and doctor whom oversee the patient. It also provides services related to medical tests and provides many laboratories that the patient can communicate with and request a test then the sample is taken from the patient without the need to go to the laboratory, then the system displays the results of the tests to the patient and the specialist doctor to take the necessary actions as soon as possible.

The cost of the application is very low, as it consists in purchasing measuring tools for some vital measurements only, which are some sensors that are present with the patient and linked to the application to transfer the patient's measurements to the application to determine his condition. The website will be provided with a chat conversation with the doctor, in addition to making a video call, and all this to reassure the patient of his condition constantly from his specialized doctor. This project can be used for many health care, health centers and hospitals to reduce the number of residents in health care.

Chapter Two

“*Related Work*”

Chapter Two

2 RELATED WORK

Before presenting our system and describing how it will help to solve many problems and what new services which we have added but also before we start to think about this system with its structure, we searched for the best telemedicine apps ranked high in user ratings, quality, and overall reliability to understand more which point we should start from. Our system must have an added value which will distinguish it from other systems. So, now we will discuss the existing telemedicine apps and its limitations.

- **Application Name:** “MDLive”

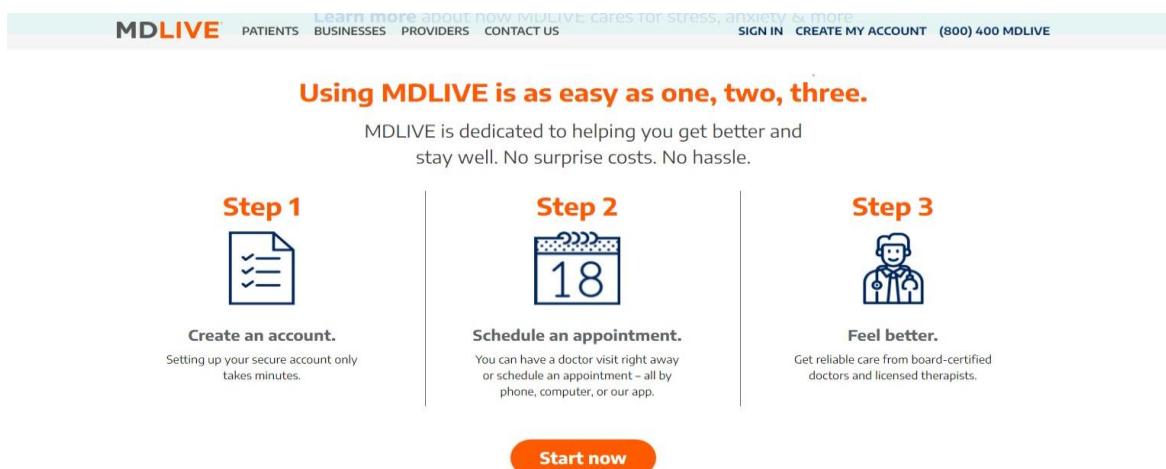


Figure 2-1. MDLive Website

- **Used for:**

Offer access to a doctor for nonemergency issues when your primary care physician isn't available. You'll need to set up your secure account first, which takes around 15 minutes. You can then schedule an appointment for a time that's convenient for you, or in some cases, you can see a doctor right away.

- **It's Limitations:**

It takes a little while to set up an account. While you can request an appointment at any time, you may have to wait some time to see a doctor or mental health professional.

- **Application Name:** Teladoc

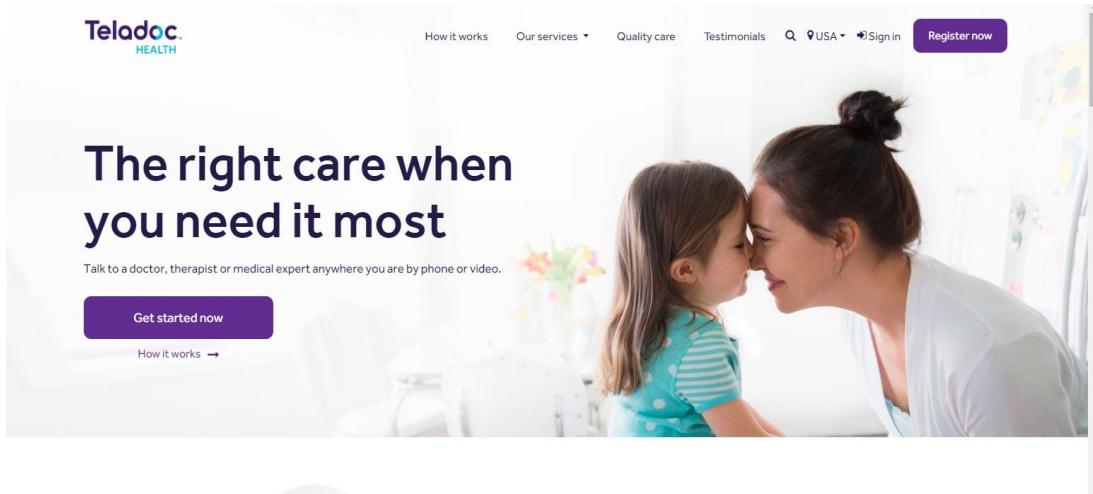


Figure 2-2. Teladoc Website

- **Used for:**

It is a convenient way for patients to access a national network of doctors. This allows them to speak to a medical professional about routine illnesses and health issues. This means that patient relationships are not intended to be long-term as much as simply ensuring someone is available to listen to and advise on their concerns. The service is strictly related only to routine prescriptions can be made out for medicines such as antibiotics. Controlled substances cannot be prescribed through this system, and emergency calls must be routed through to a dedicated clinic or hospital.

- **It's Limitations:**

Pricing varies according to the service provided.

Isn't suitable for emergency care or physical conditions requiring a healthcare professional. Certain prescriptions can't be filled.

You can't build a long-term relationship with the current doctor because it can and will be replaced next time you use the app.

- **Application Name:** Blood Sugar App

- **Used for:**

Makes it easy and fast to record, monitor blood glucose, and manage your diabetes. It can make a quick analysis of your blood glucose levels and help you understand the meaning of measurement values.

- **It's Limitations:**

The application does not contain notifications to alert the user to return to the application to continue to follow up on his health status. The user enters the glucose measurements manually, which increases the possibility of human error.



Figure 2-3. Blood Sugar App

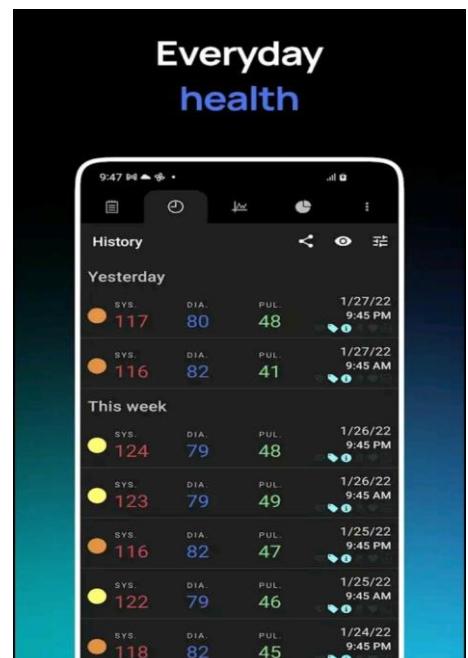
- **Application Name:** Blood Pressure app

- **Used for:**

This application Controls a patient's blood pressure with multiple built-in features like measurements analysis, statistics, graphs, comprehensive reports a doctor will love, and many other tools to analyze high or low blood pressure.

- **It's Limitations:**

Keep in mind that this app does NOT measure blood pressure, but our app does.



It doesn't provide any communication facility between the doctor and his patient unlike our app.

Figure 2-4. Blood Pressure app

Chapter Three

“Planning”

Chapter Three

3 PLANNING

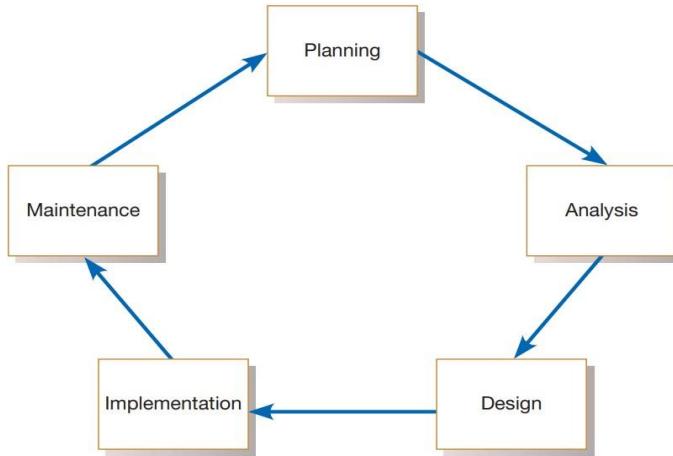


Figure 3-2-1. SDLC

3.1 SCOPE

- **This system includes:**

Dealing with patients with coronary heart diseases ‘CHD’, Diabetes, and chronic kidney disease ‘CKD’, to follow up the patient's condition carefully and continuously and provide the results of all vital body measurements to the patient and specialist doctor who follows up on this patient's condition and alerting the patient, the doctor, and patient's relatives when any problems occur in order not to endanger the patient's life. The application also includes the interaction of specialized doctors and the provision of their own platform, to facilitate them to reach their patients with ease and to follow their cases continuously, even if the patient neglects sometimes to follow up. This application can be used for many health care, health centres and hospitals to reduce the number of residents in health care. Protecting patient data and respecting the privacy of this data. Providing the patient with treatment by his doctor according patient's health condition and setting an appointment to meet laboratory physician to make medical tests.

- **This system excludes:**

The patient cannot communicate with a doctor who is not in the system’s database. The patient cannot share his data with medical institutions that are not present in the system. The patient cannot modify the system in any way.

3.2 USED TECHNOLOGIES AND TOOLS

Technologies:

- ❖ The PHP programming language will be used
- ❖ Laravel framework will be used
- ❖ SQL programming language will be used in Database
- ❖ Arduino

Tools:

- ❖ MAX30102 Heart Rate Sensor And Pulse Detection Blood Oxygen Concentration
- ❖ NodeMCU (ESP8266 WiFi Programming & Development Kit) (CH340)
- ❖ Breadboard 830 point
- ❖ Connecting Jumper Wires for Bread Board & Arduino (65 Wire) 22AW
- ❖ Arduino USB Programming Cable

Applications:

- ❖ VS-code is used in programming
- ❖ My-SQL is used in data base
- ❖ Arduino

3.3 SCHEDULE ALLOCATION

1. Activity list

The project has been defined to contain the following list of activities along with their required times for completion:

Activity Number	Activity Name	Duration (Days)	Start	Finish	Preprocessor
1	Initial Meetings	3	3/11/2022	5/11/2022	
2	Discussions with stakeholders	7	6/11/2022	12/11/2022	1
3	Requirements collection	7	13/11/2022	19/11/2022	1,2
4	Analyze processes	4	20/11/2022	23/11/2022	3
5	Analyze data	3	24/11/2022	26/11/2022	3
6	Database construction	5	27/11/2022	1/12/2022	5
7	Software design	10	2/11/2022	11/12/2022	4,5,8
8	screen design	5	12/12/2022	16/12/2022	4,5
9	Create design specification	3	17/12/2022	19/12/2022	4,5
10	Design reports	1	20/12/2021	20/12/2021	9
11	Design Complete	5	21/12/2022	25/12/2022	10
12	Training programmers	7	26/12/2022	1/1/2023	7,11
13	Software Programming	4	24/1/2023	27/1/2023	11
14	Debug & Testing	2	28/1/2023	29/1/2023	12,13
15	System Test& User Documentation	4	30/1/2023	2/2/2023	6,14
16	Install	1	3/2/2023	3/2/2023	15

Table 3-1. Activity List

2. Expected Time of Activity List

The following table showing the Expected Time for each activity:

Activity Name	Optimistic time (o)	Realistic time (r)	Pessimistic time (p)	Expected time (ET) = o + 4r + p/6
Initial Meetings	2	3	4	3
Discussions with stakeholders	5	7	9	7
Requirements collection	5	7	9	7
Analyze processes	1	4	7	4
Analyze data	2	3	4	3
Database construction	4	5	6	5
Software design	7	10	13	10
screen design	4	5	6	2
Create design specification	2	3	4	3
Design reports	1	1	1	1
Design Complete	4	5	6	5
Training programmers	5	7	9	7
Software Programming	7	10	13	10
Debug & Testing	1	2	3	2
System Test& User Documentation	1	4	7	4
install	1	1	1	1

Table 3-2. Expected Time List

3. PERT

This table determines the Critical path and the slack time for each activity:

- To calculate the Time Early: $T_{E_c} = T_{E_p} + ET_c$ c: current
- To calculate the Time Late: $T_{L_c} = T_{L_p} - ET_p$ p: previous

Activity Name	Duration (Days)	Preprocessor	Time early (TE)	Time late (TL)	Slack time $=TL-TE$	Critical path
On-Site Meetings	3		3	3	0	✓
Discussions with stakeholders	7	1	10	10	0	✓
Collect requirements	7	1,2	17	17	0	✓
Analyze processes	4	3	21	21	0	✓
Analyze data	3	3	20	21	1	
Design database	5	5	25	42	17	
Software design	10	4,5,8	31	33	2	
Interface design	2	4,5	23	24	1	
Create design specification	3	4,5	24	24	0	✓
Design reports	1	9	25	25	0	✓
Design complete	5	10	30	30	0	✓
Training programmers	7	7,11	38	40	2	
Coding program	10	11	40	40	0	✓
Debug & Testing	2	12,13	42	42	0	✓
Test and document	4	6,14	46	46	0	✓
Install	1	16	47	47	0	✓

Table 3-3. PERT

3.4 NETWORK DIAGRAM

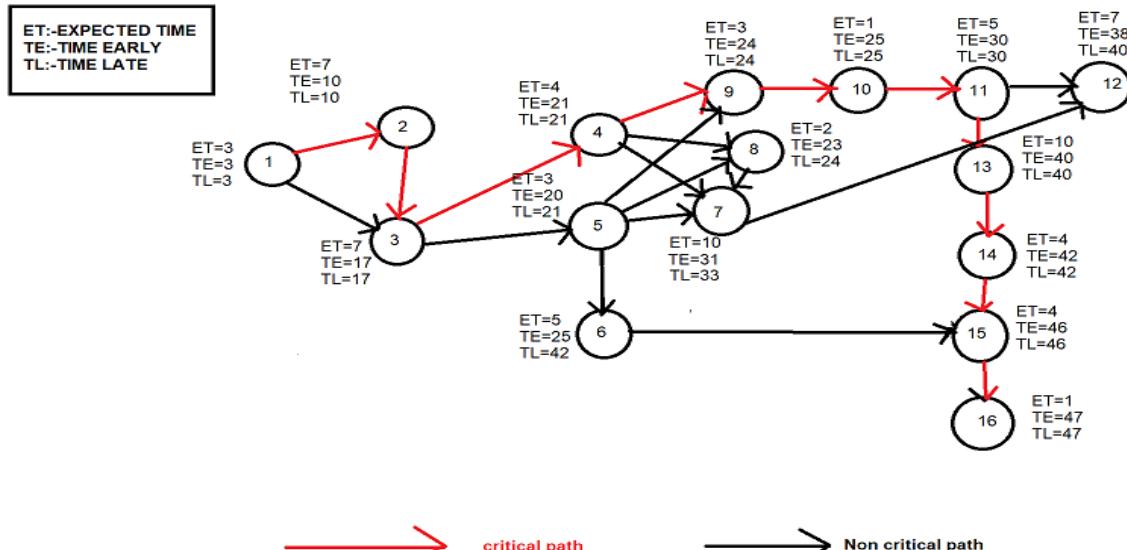


Figure 3-2. Network Diagram

3.5 GANTT CHART

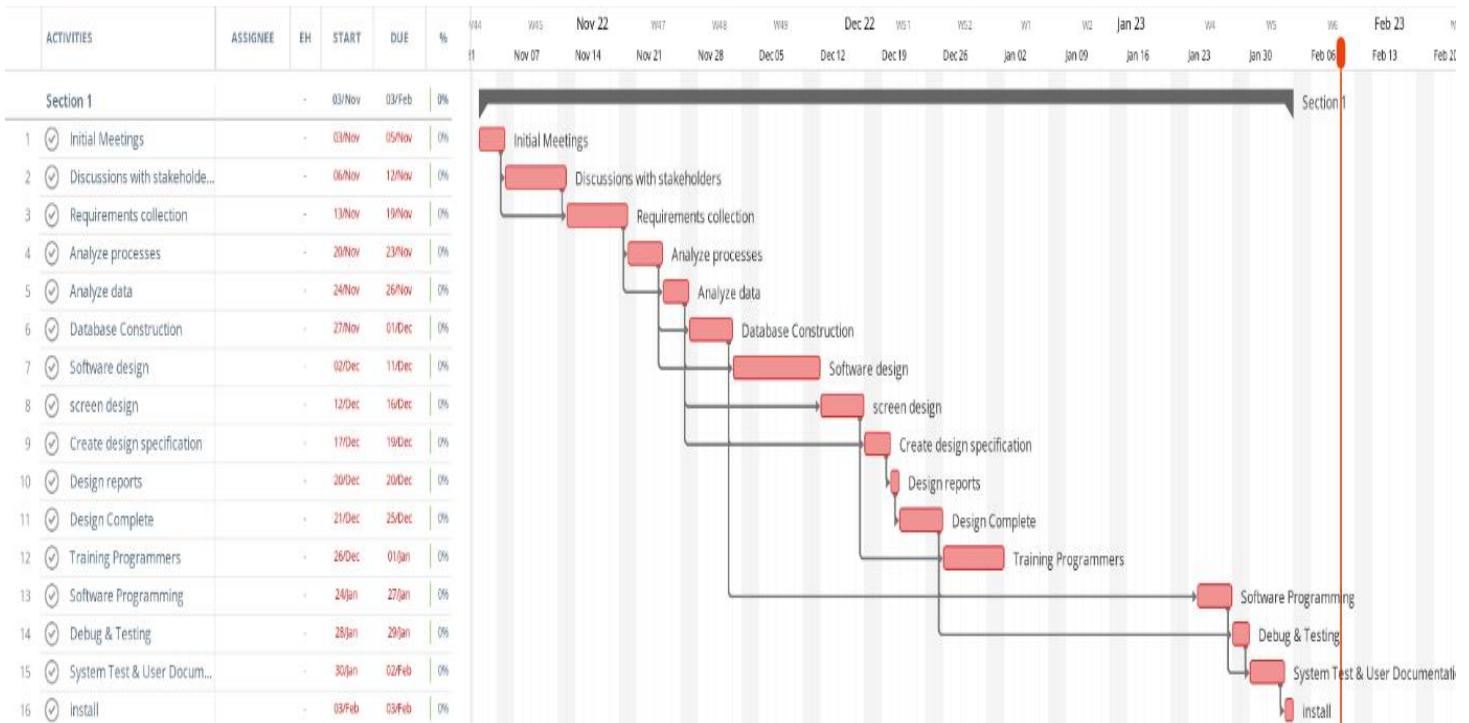


Figure 3-3. Gantt chart

3.6 COST ESTIMATION

COSTS				
Category	Item	Quantity	Price	Total
Hardware & Services	MAX30102 Heart Rate Sensor And Pulse Detection Blood Oxygen Concentration	1	EGP 150.00	EGP 150.00
	NodeMCU (ESP8266 WiFi Programming & Development Kit) (CH340)	1	EGP 150.00	EGP 150.00
	breadboard 830 point	1	EGP 50.00	EGP 50.00
	Connecting Jumper Wires for Bread Board & Arduino (65 Wire) 22AW	1	EGP 50.00	EGP 50.00
	Arduino USB Programig Cable	1	EGP 25.00	EGP 25.00

Table 3-4. Cost Estimation

Chapter Four

“Analysis and Design”

Chapter Four

4 ANALYSIS AND DESIGN

4.1 USER AND SYSTEM REQUIREMENTS

First of all, we have made a main website carrying the whole system information to help all users understand the system, summarization about the services which system will provide, location and contact info, and a section holding the four interfaces links from which each user can start his journey from it to our system.

This point is divided into functional and non-functional requirements as follow:

4.1.1 Functional Requirements

In our project we have four different users each one may have different requirements as:

- **Patient**

1. The system must provide the patient with hardware device with specified sensors at hospital after first diagnosis.
2. The system must provide the patient with detailed information about the device and how to use the device from home.
3. The system must login the patient to the website after he enters a valid working email and password, and he must fill in those two required fields.
4. The system must provide the patient with a variety of options depending on the disease he has, and he should be able to select more than one disease, up to three, if he so desires and it is appropriate for his case.
5. The system must show detailed information about each disease with its symptoms, measures, and risk factors before the patient get started.
6. The system must record patient measurements after patient start using the hardware device given to him.

7. The system must test the patient measurements against the normal ranges.
8. The system must then evaluate the results and present them to the patient in charts that are easily understood by him.
9. The system must allow the patient to communicate with his doctor by calling him or chat with him through the website.
10. The system must provide the patient with monthly reports of his health condition and those reports also can be printed or sent by patient.
11. The system must allow the patient to view the relatives overseeing his case and make contact with them, or even remove them to prevent them from managing his case anymore.
12. The system must allow the patient to book laboratory tests and also process the payments through the website.

- **Relative**

1. The system must register the relative to the website and make him fill all required fields with valid information.
2. The system must send verification message to the patient to ask him if he approves to the relative that registered to oversee him or not approved.
3. The system must prevent the relative registration with an error message that his request is denied by patient.
4. The system must login the relative then to system with valid working email and password and make him fill those two required fields.
5. The system must show the relative the patients' list that he is following and allow him to choose only one patient to show his case.
6. The system must show current measurements of patient updated every time the patient measures new ones.

7. The system should represent patient case to relative as graphical charts to be understood easily.
8. The system must evaluate monthly reports of the patient's medical case to be viewed by his relatives to keep up-to-date on his health conditions.
9. The system must allow the relative to contact patient's doctor by calling him or chatting with him through the website.
10. The system must allow the relative to receive alarm on the emergency case where patient condition is very bad and need immediate help.
11. The system must allow the relative to track the ambulance path to the hospital after it arrives to patient house to enable the relative to go after the ambulance or make sure that the patient safely arrived to the hospital.
12. The system must allow the relative to show his profile settings to enable him edit profile details or change the profile picture.
13. The system must allow relative to show patient profile to get location and other information also to show the doctor profile.
14. The system must allow the relative to add new patients to his list of patients that he oversees by using the patient MRN, and then choose the relativity degree to prioritize patient approval.
15. The system must allow the relative to delete any patient he want from patient list through the website.

• **Doctor**

1. The system must login the doctor to the website after he enters a valid working email and password, and he must fill in those two required fields.
2. The system must view a summary of the cases to the doctor who follow up those cases also represent information on graphical charts for time saving.

3. The system must provide the unstable patients' list to the doctor on the main page of the website and enable him show the profile of any one of them.
4. The system must allow the doctor to see a list of all patients he follow-up which contain patient name, age, address, contact number, and profile link.
5. The system must allow the doctor to show the patient profile after clicking on "view profile" and that allow the doctor to know patient's personal and medical information and he also can leave notes on patient case which will be sent to patient and relative.
6. The system must allow the doctor to download patient medical report to be printed by the doctor to have it on hand if needed.
7. The system must allow the doctor to chat with the patient and the relative through the website.
8. The system must send an emergency alarm to the doctor if there is any emergency case to take action just like ordering to prepare intensive care to the patient before the ambulance delivers the patient to hospital.
9. The system must allow the doctor to show a list of all emergency cases that are occurring at the current time, along with the risk factors and the very risky vital signs also all the last measurements of the patient.
10. The system must allow the doctor to lock the screen of his interface if he don't want to logout but also don't want make his profile available to be seen while he isn't on his office then he can open the profile again by only entering the password.

• **Laboratory Admin**

1. The system must login the lab admin to the website after he enters a valid working email and password, and he must fill in those two required fields.
2. The system must allow the lab admin to reset his password by clicking on "forget password," entering his email, and then clicking "send." The system will then send an email with instructions on how to reset the password.

3. The system must show a summary of number of all requested tests, number of new requests, and the lab total revenue.
4. The system must show to the lab admin the recent booked appointment list with the patient information, test type, and the price paid.
5. The system must provide a list of required upload files to lab admin that contain the patient's information and test type, and by clicking on the upload button, a pop-up page appears where lab admin can choose the test result file and enter the lab physician ID before clicking "upload" to deliver the file to the patient.
6. The system must allow the lab admin to show the list of new requests with detailed information on the request date, test type, and patient's information like patient name, diseases, and taken medicines and must allow him to accept or reject this request.
7. The system must allow the lab admin to contact patients through the website to answer patient's questions or get more accurate information about the patient requests if any information is not clear enough.
8. The system must allow the lab admin to select a date from the calendar to display the most recently booked appointment details, divided into patient and payment information, and to edit or delete the appointment also must provide graphical chart of done, cancelled, or postponed appointments.
9. The system must send notifications to the lab admin about the patient requests and allow him to reply with clicking “Accept” or “Reject” to process the request.

4.1.2 Non-Functional Requirements

Indeed, the project was designed to suit all non-functional requirements (NFRs). The application included the feature of meeting the patient's needs comprehensively. The application also proved that it is suitable for the purpose for which it was designed, based on its experiences by some patients. The application also proved its ability to develop and add more other chronic diseases. Although non-functional requirements are difficult to implement and understand easily and consume time and cost, we have tried hard to achieve them in the application as follows:

- Security: The application is designed with a high degree of security and protection from unauthorized access to maintain the confidentiality of patient data and not display it except to persons whom have an authorization. This was done using several computer science techniques for security.
- Performance: The application was designed to keep pace with all the requirements of patients and implemented with high capacity and accuracy. For example, the patient may need to know his health status regarding each disease registered on the application at the same time. The application was built on flexibility to receive all these requirements from large numbers of application users. And perform it effectively.
- Scalability: The application was built on flexibility and scalability to serve more functions related to other chronic diseases and to receive the largest number of patients with various chronic diseases. The application can expand at any time if necessary.
- Availability: The project has been increased with many technologies to make it available all the time so that the patient can use it at any time because the patient's health condition can change suddenly, so he can use the application, whether through the web application or the mobile application, and the project was provided with many safeties means so that we can make it available all the time.
- Diversity: The project was implemented as a web application and as a mobile application to suit all users, and the two applications are similar in the majority of the design to avoid user dispersion if the two applications are used together at the same time.
- Reliability: It has considered the use of all security means to protect the application from any hacking or unauthorized access, and all this so that we can gain the trust of the user.
- Maintenance: The project was built with many technologies that allow us later to maintain it easily and add many other technologies to it to increase its effectiveness and provide higher services.

- Compatibility: The project was designed based on international standards, laws and regulations in order to also be compatible with other applications.

Indeed, the focus has been on applying these Non-Functional Requirements (NFRs) because they are the most important criterion for owning a high-quality project, because they help ensure that the system meets the user's needs. If the Functional Requirements presented the application mechanism, the Non-Functional Requirements presented how to implement this mechanism. STAKEHOLDERS

In fact, the users of this application are diverse because of the diversity of services provided by the project, the users of this project are diverse among doctors, relatives, lab and patients with chronic heart disease and chronic kidney disease, as well as those with diabetes of all types, and they are the most benefited from the project, as the project is based on their service and can be represented as:

- Patients with cardiovascular diseases 'CVD' (like heart attacks, stroke and vascular disease) as vascular diseases such as coronary artery disease, patients cardiac arrest, patients with heart muscle disease and heart valve disease, as well as those prone to stroke and heart failure, and patients with elevated cholesterol levels In the blood, which later causes atherosclerosis if untreated, and those with high blood pressure are more prone to heart attacks.
- Patients with chronic kidney disease 'CKD' and the most common of this disease is kidney failure, which represents a gradual loss of kidney function, and those with kidney disease and urinary tract infection are more at risk of kidney failure if proper health care is not provided.
- Patients affected by diabetes in all types will be presented as follows:
 - Diabetes type 1: which is common in children and teenagers and which depends directly on insulin in its treatment, therefore, missing a dose of insulin can cause a disturbance in the ratio of insulin in the patient's blood, so type 1 diabetes patients must use the application daily to avoid those health problems and regulate the insulin ratio in the blood the blood.

- Diabetes type 2: It mostly affects adults over middle age > 45, but unfortunately it is currently prevalent among children, and in the case of children, the parents of these children can follow up on their health status through the application in the event that the children are young to do this, and this type is not dependent on directly on insulin, which is injected into the blood, and insulin can be replaced in the form of capsules that contain a specific percentage of insulin that can be determined according to the patient's condition.
- Gestational diabetes: which affects pregnant women during their pregnancy, so they must use the application periodically. It is possible that these pregnant women will later develop type 2 diabetes, along with their children. Therefore, the mother must be followed up on her condition since her infection to reduce the possibility of her developing type 2 diabetes in the future.
- Insulin resistance patients: in which the cells lose response to the insulin produced, and in which the pancreas weakens of growth, and all this is a prelude to the second type of diabetes, so the application must be used for early diagnosis of this condition and to avoid infection if the patient regularly follows up on his health condition and the percentage of insulin and to ensure the stability of his condition every this is through the application.

4.2 SYSTEM DIAGRAMS

4.2.1 Block Diagram

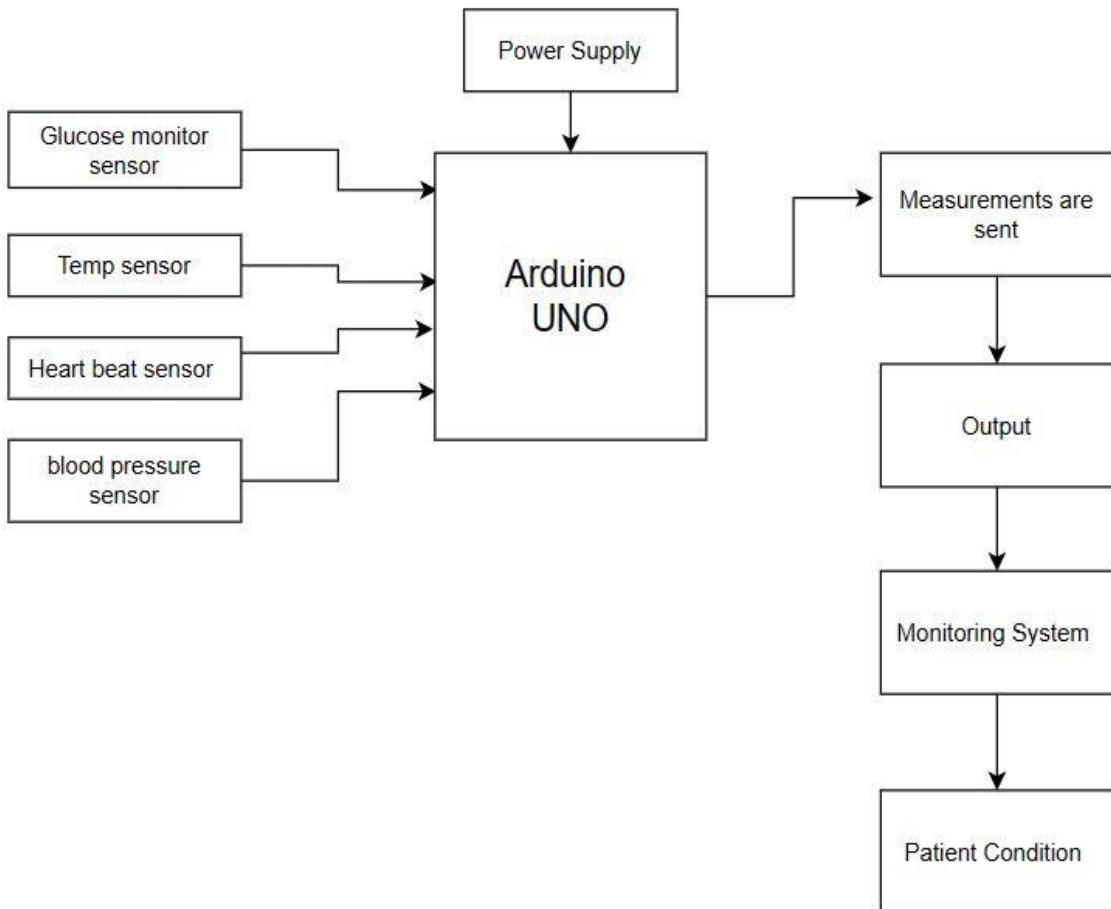


Figure 4-1. Block Diagram

4.2.2 Use Case

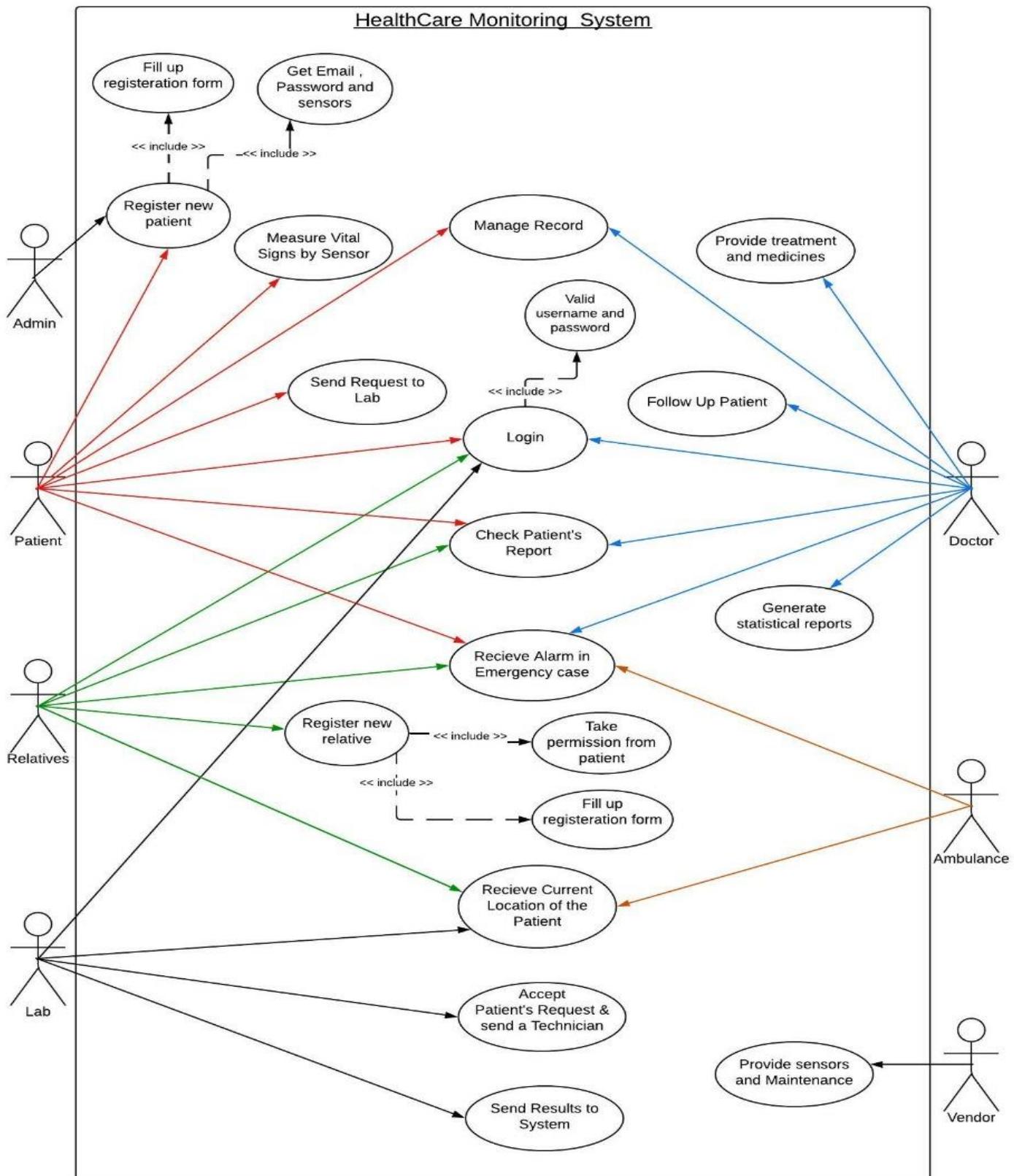


Figure 4-2. Use Case

4.2.3 Activity Diagrams

1. Enter As Activity Diagram

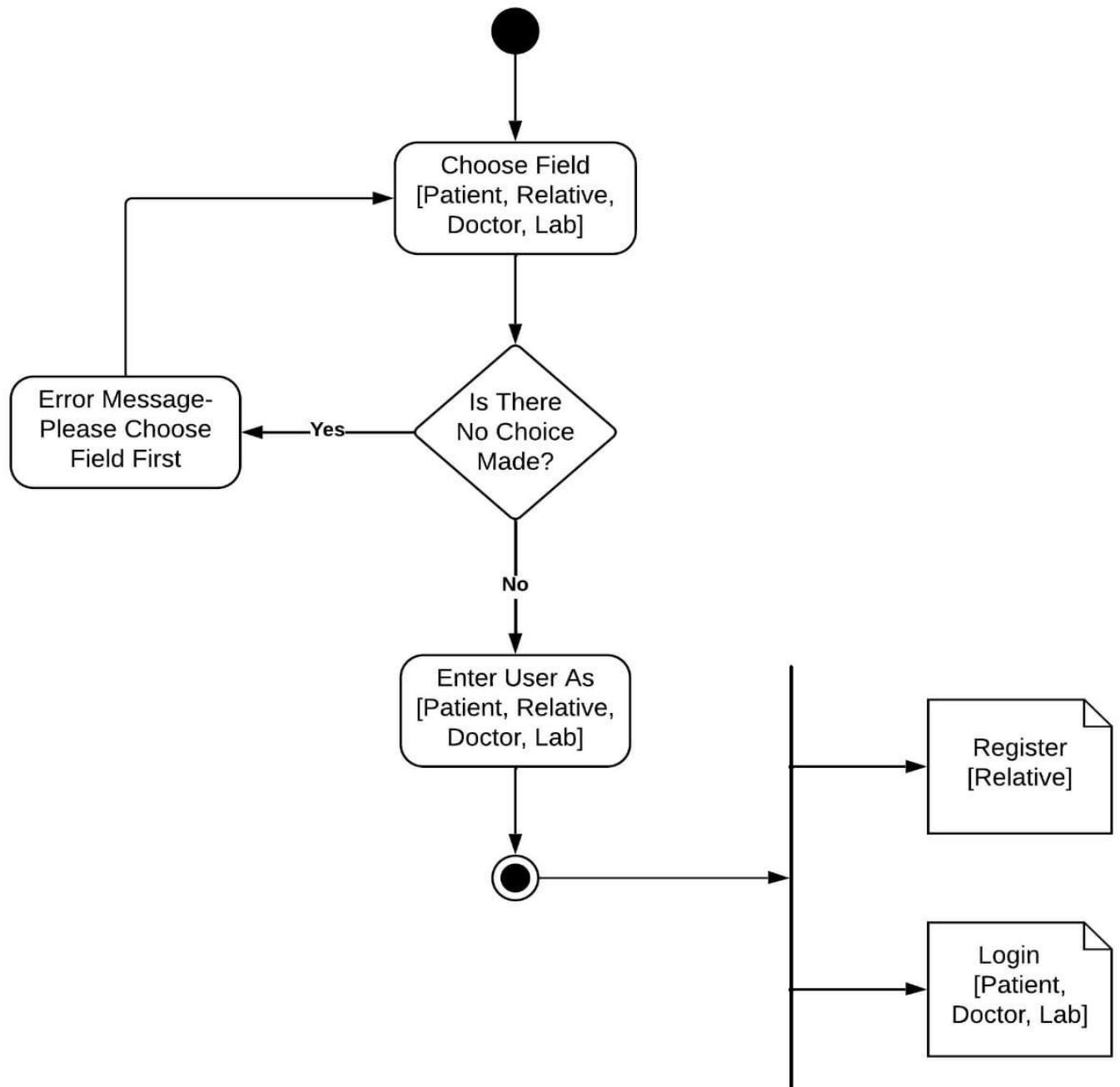


Figure 4-3. Enter As Activity Diagram

2. Patient Login Activity Diagram

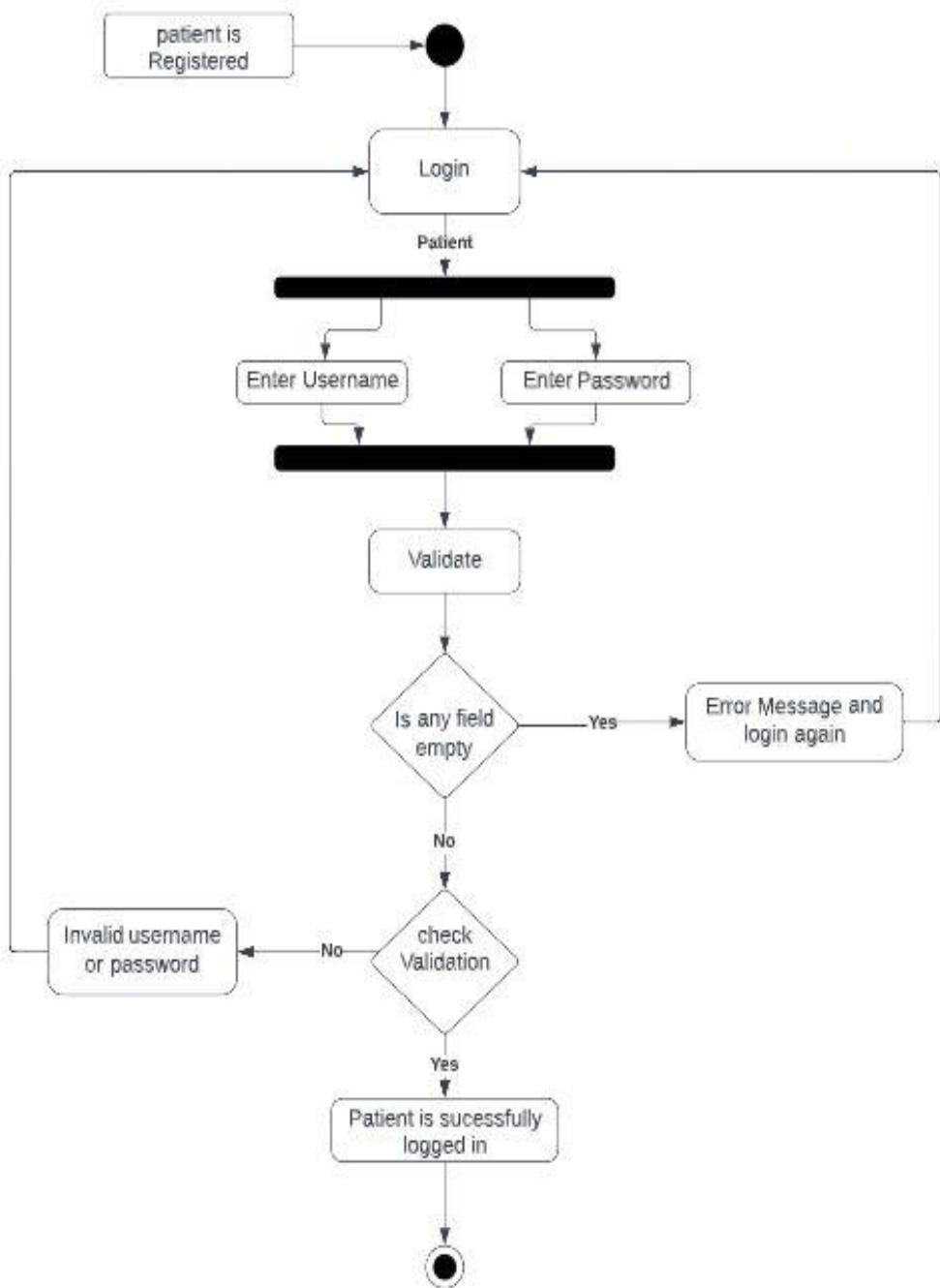


Figure 4-4. Patient Login Activity Diagram

3. Patient Reports Generation Activity Diagram

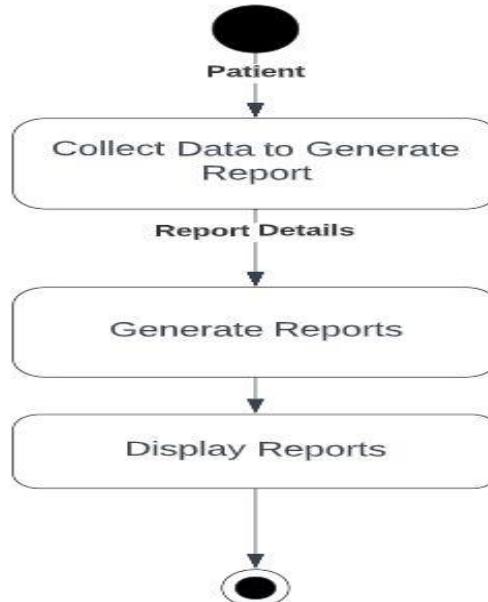


Figure 4-5. Patient Reports Activity Diagram

4. Patient Measurement Process Activity Diagram

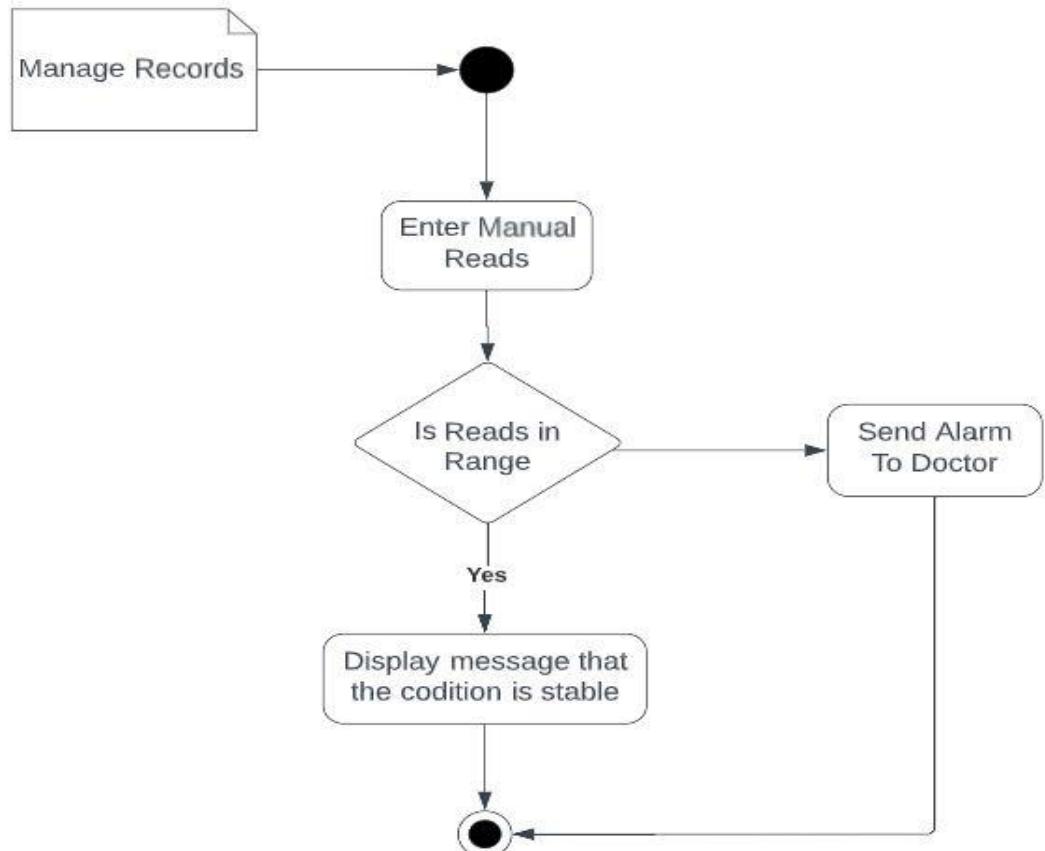


Figure 4-6. Patient Measurement Activity Diagram

5. Request Lab Tests Activity Diagram

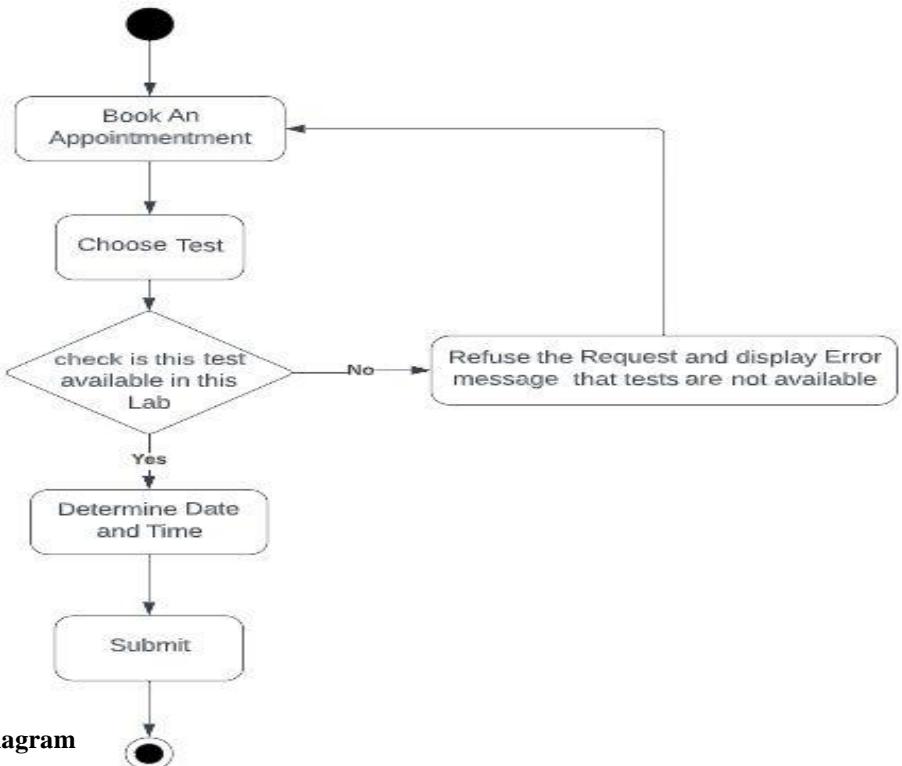


Figure 4-7. Request Lab Tests Activity Diagram

6. Request Test Results Activity Diagram

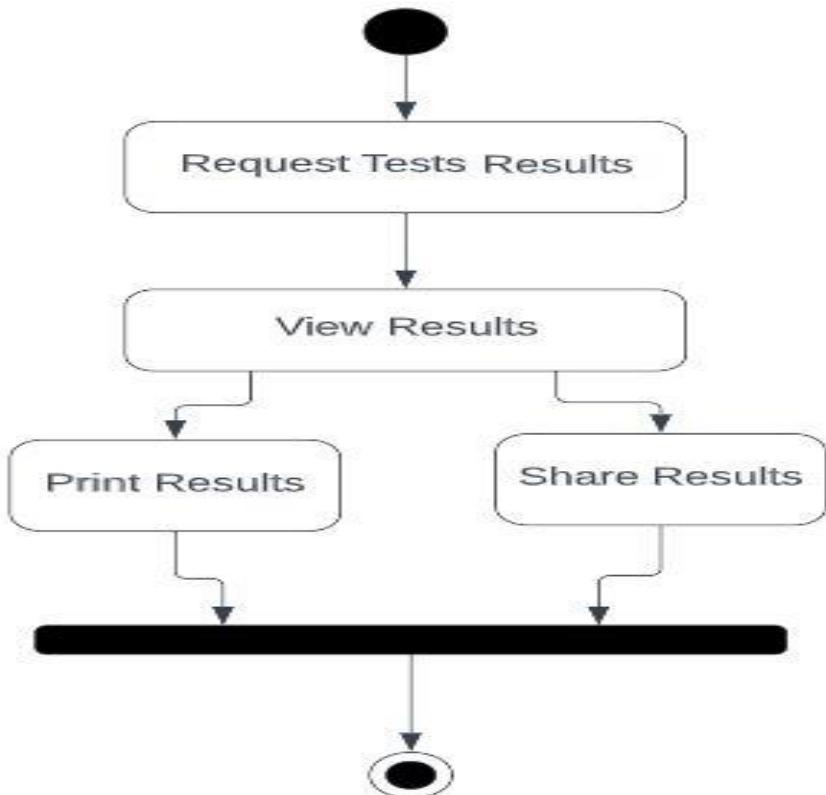


Figure 4-8. Request Test Results Activity Diagram

7. Register Relative Activity Diagram

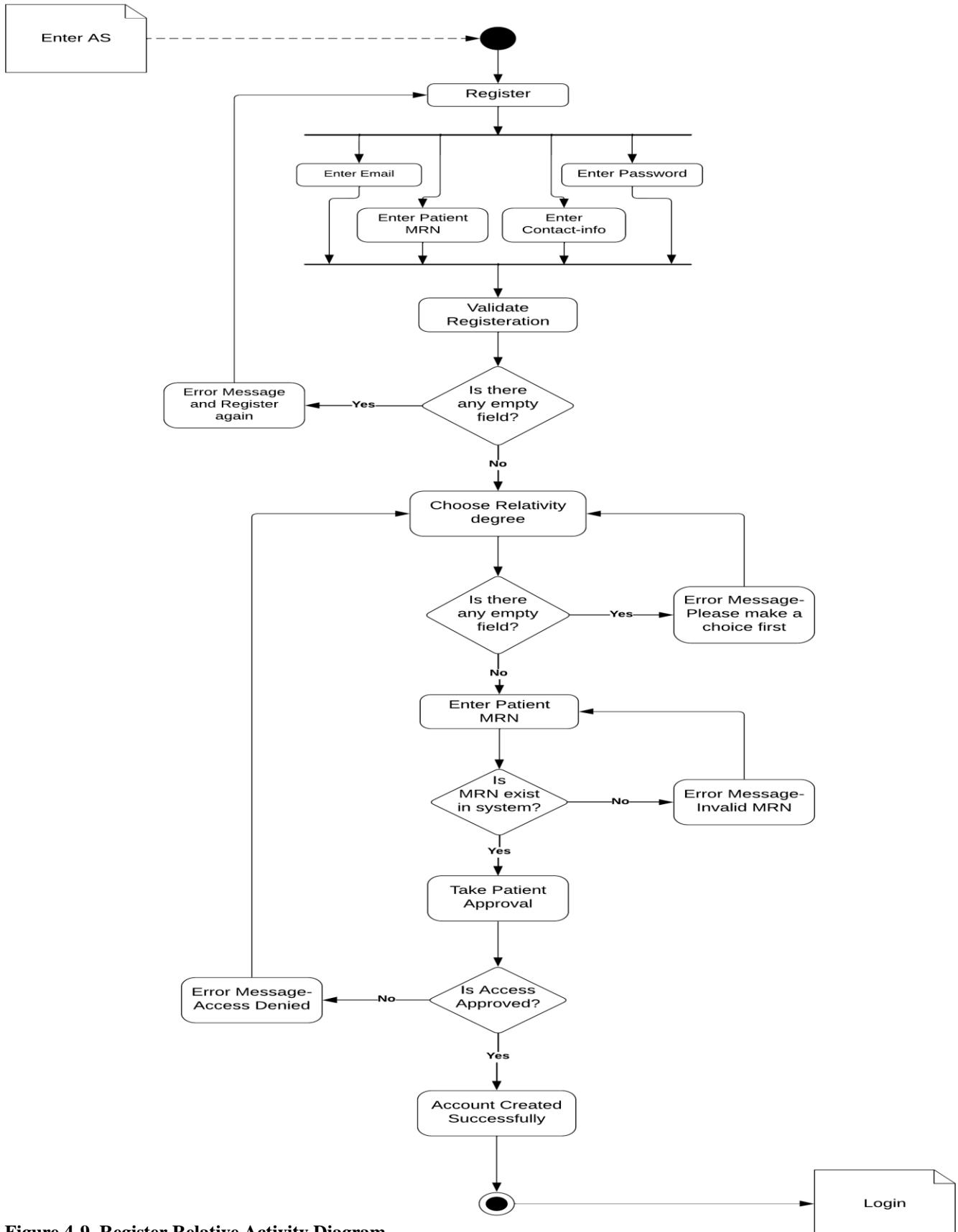


Figure 4-9. Register Relative Activity Diagram

8. Login Relative Activity Diagram

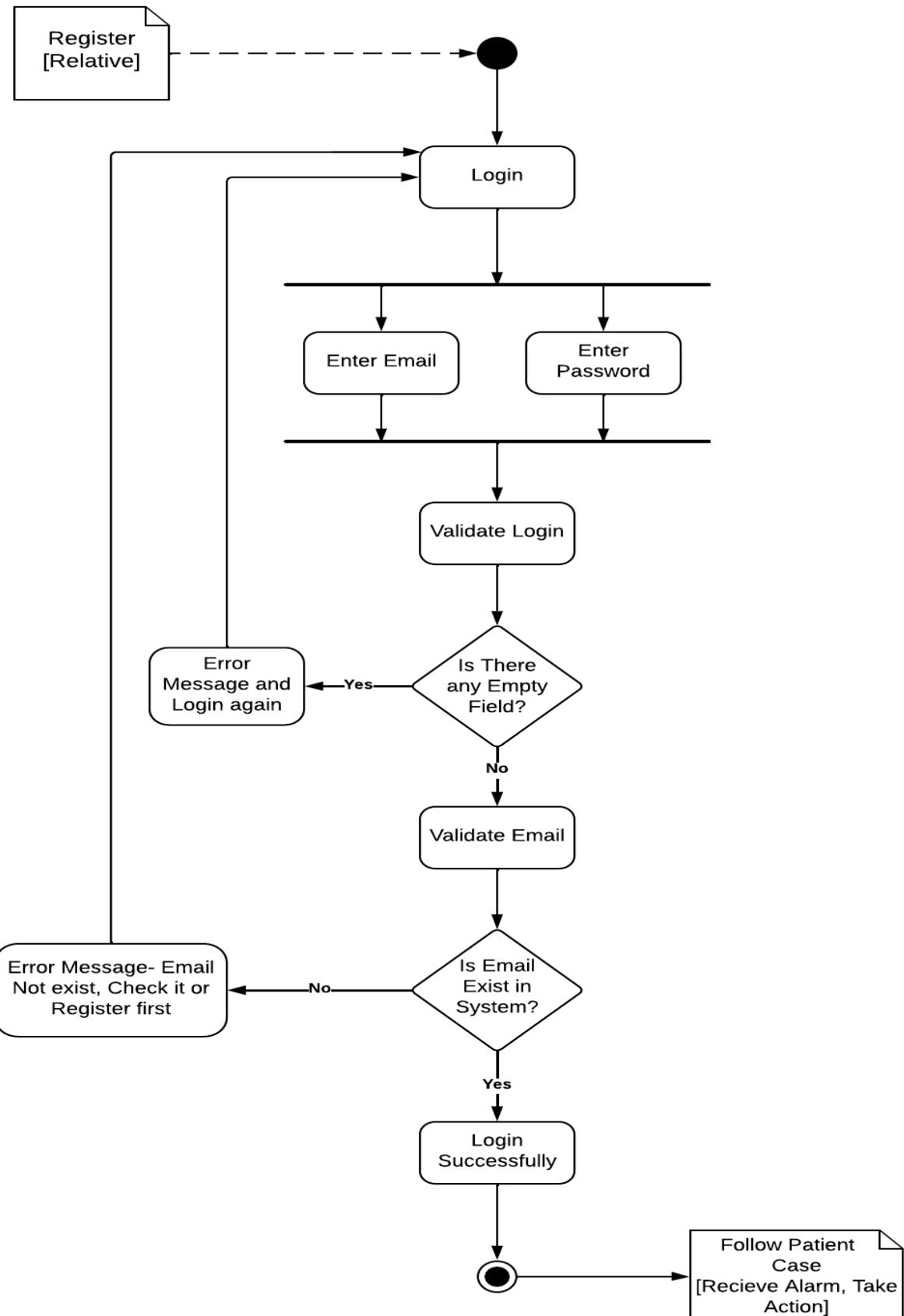


Figure 4-10. Login Relative Activity Diagram

9. Relative Follow-Up Patient Activity Diagram

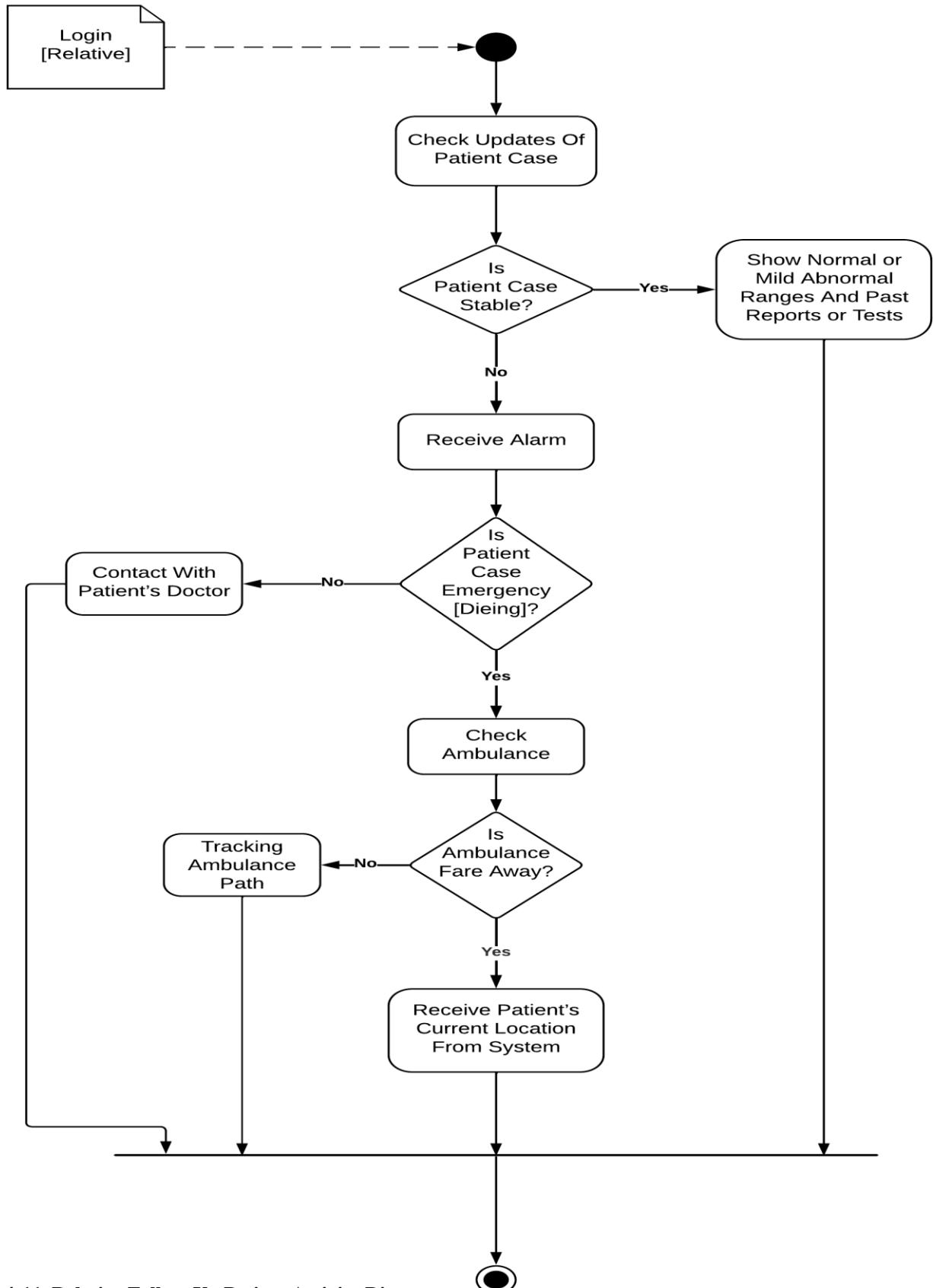


Figure 4-11. Relative Follow-Up Patient Activity Diagram

10. Doctor Follow-Up Activity Diagram

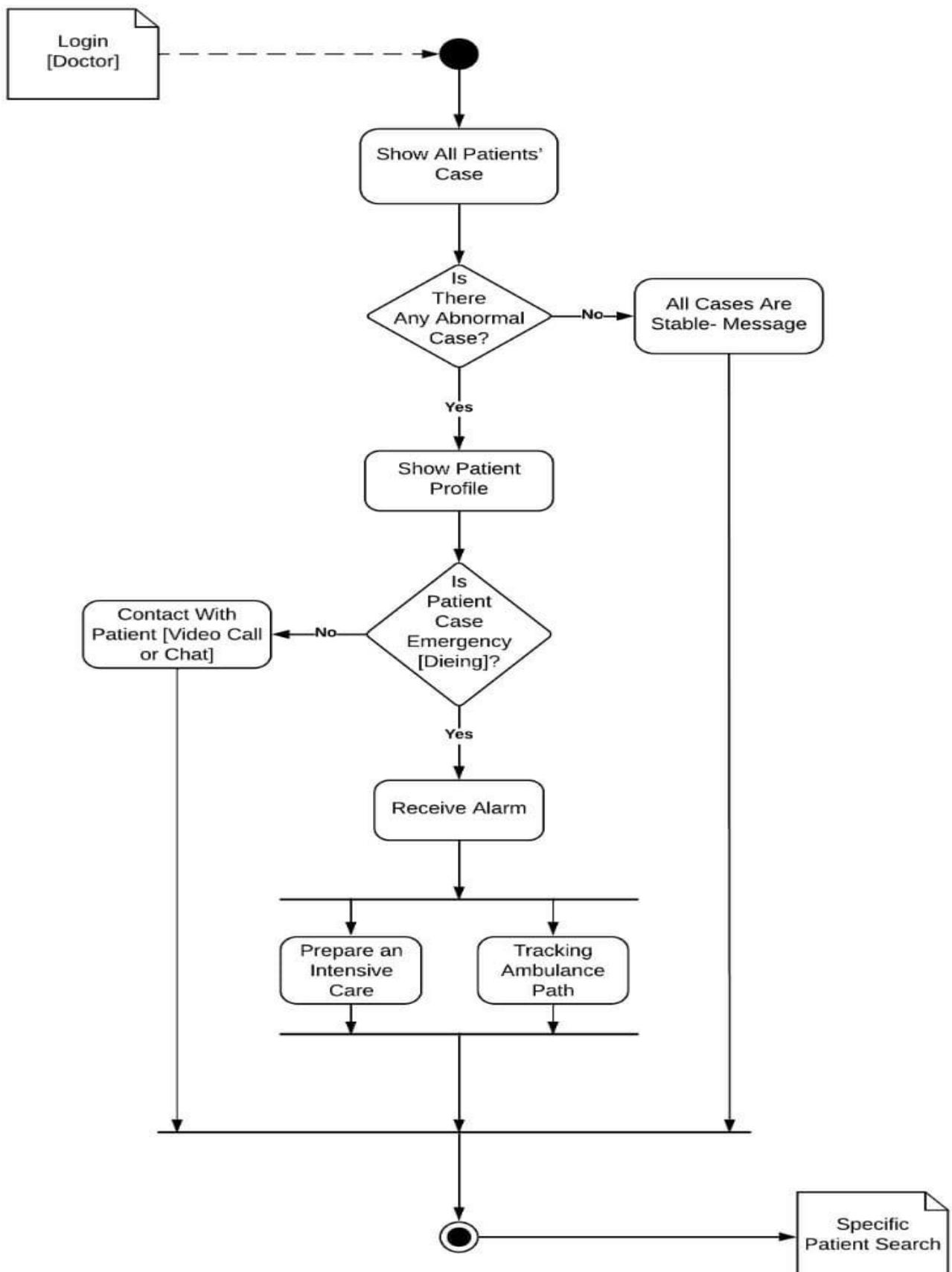


Figure 4-12. Doctor Follow-Up Activity Diagram

11. Doctor Search for Specific Patient Activity Diagram

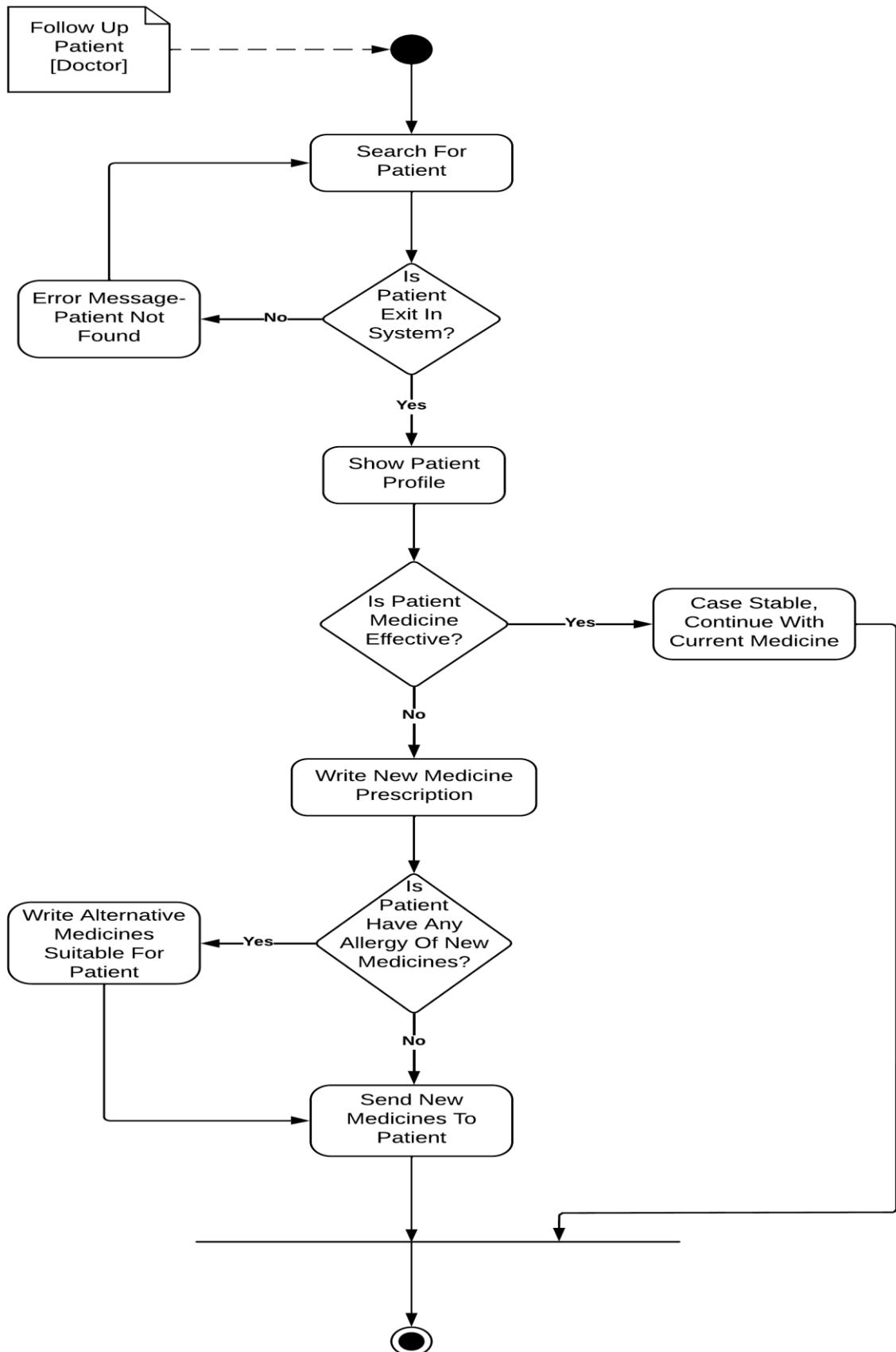


Figure 4-13. Doctor Search for Patient Activity Diagram

12. Lab Process Test Request Activity Diagram

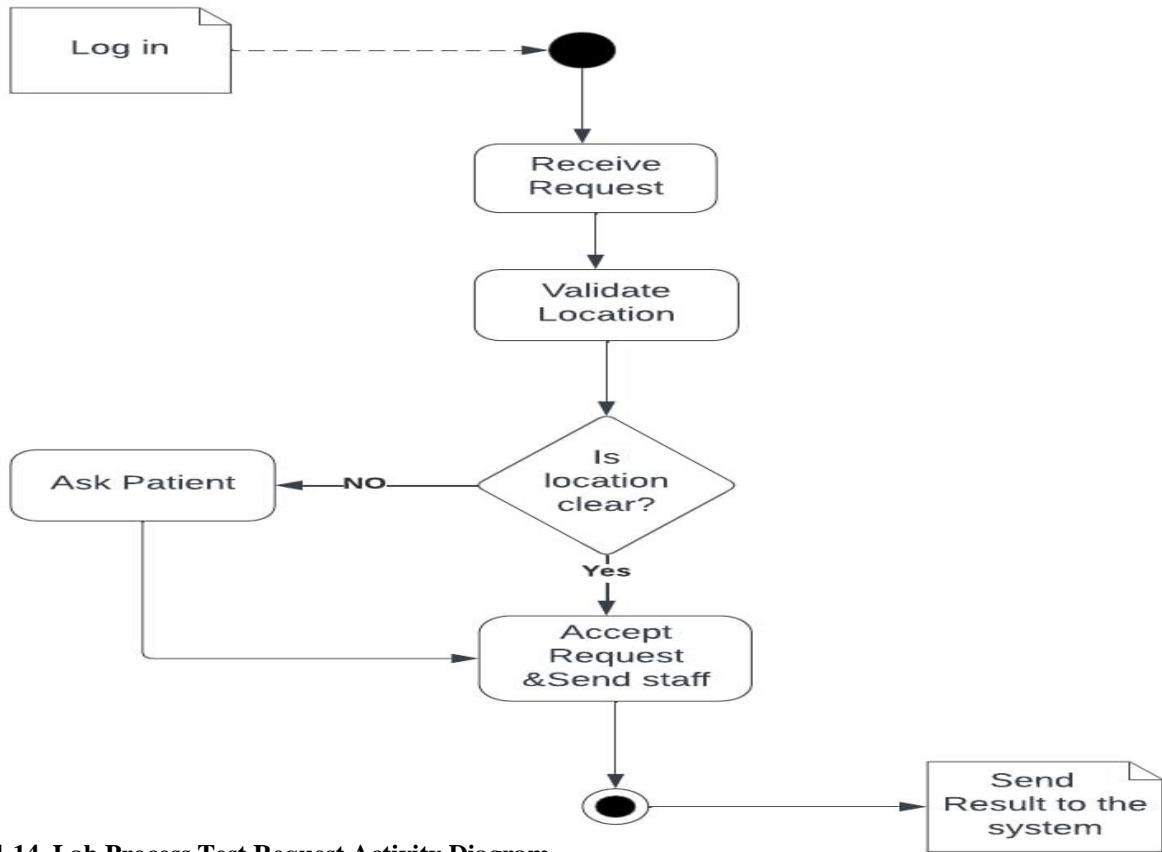


Figure 4-14. Lab Process Test Request Activity Diagram

13. Lab Send Test Results to The System Activity Diagram

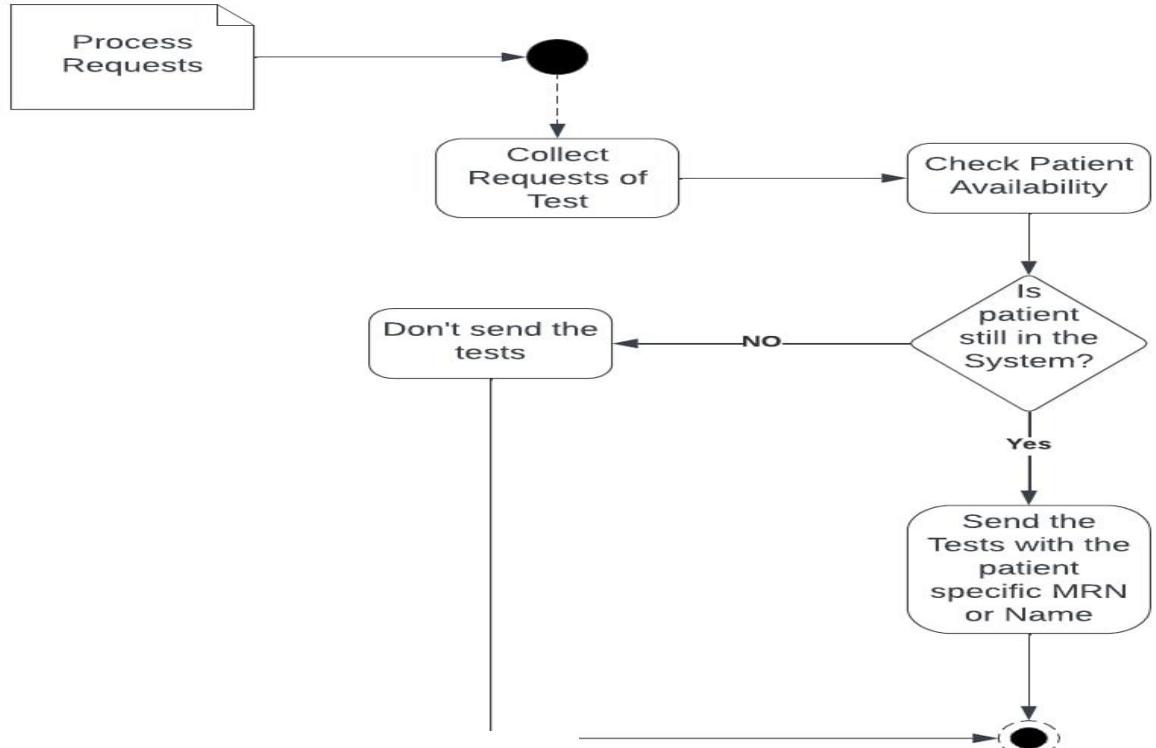


Figure 4-15. Lab Send Test Results to System Activity Diagram

14. Sending Ambulance Activity Diagram

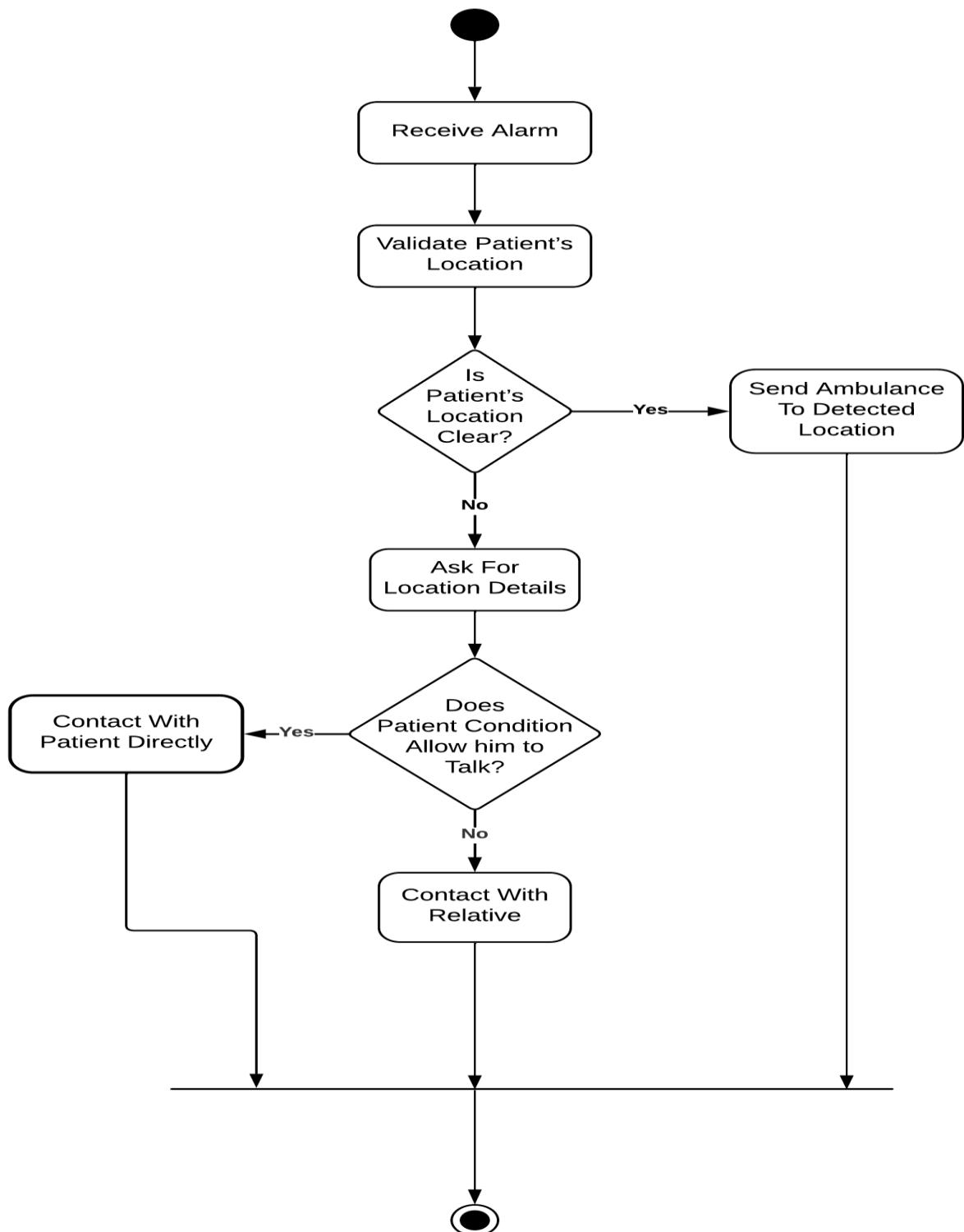


Figure 4-16. Sending Ambulance Activity Diagram

4.2.4 Sequence Diagrams

1. Patient Sequence Diagram

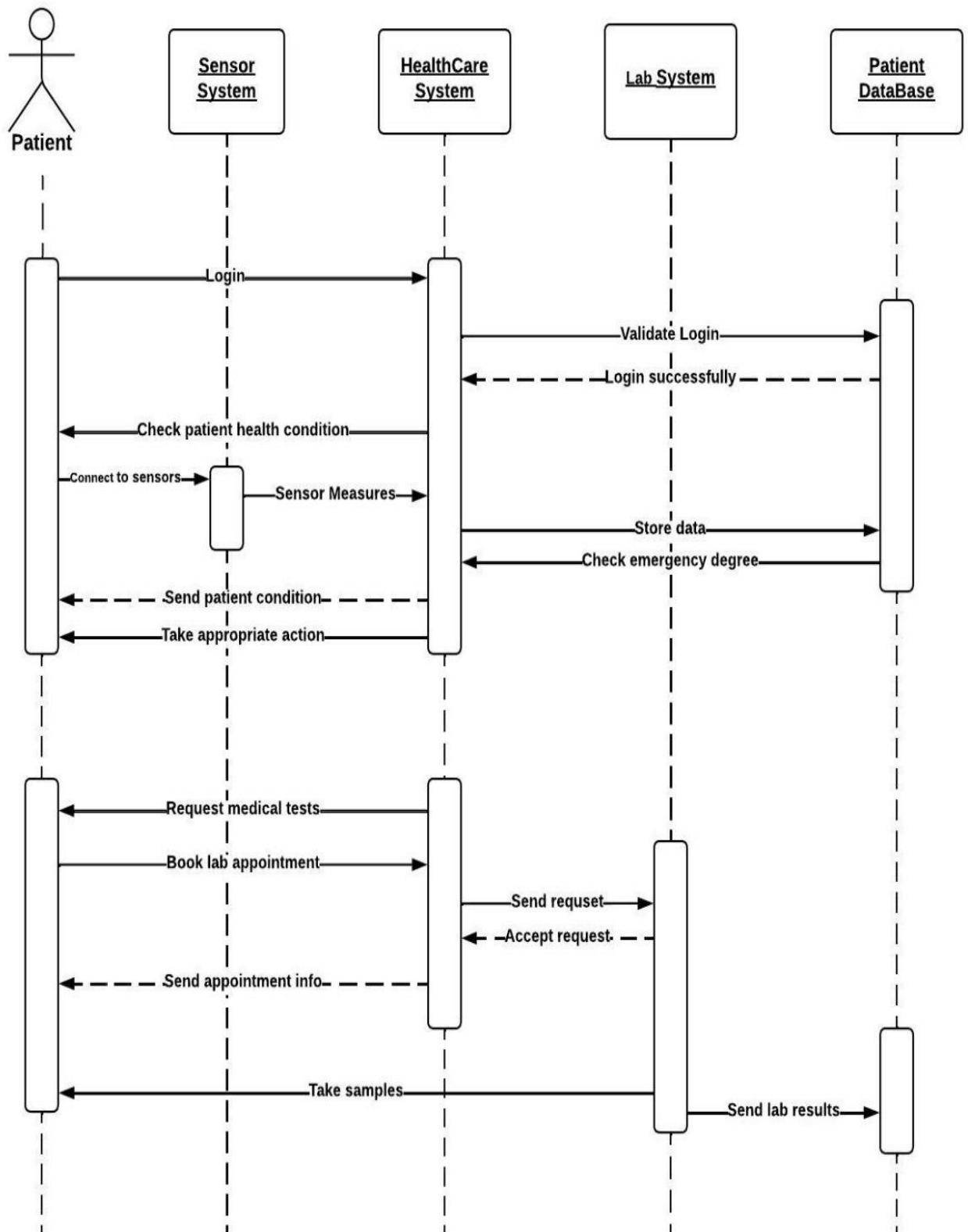


Figure 4-17. Patient Sequence Diagram

2. Doctor Sequence Diagram

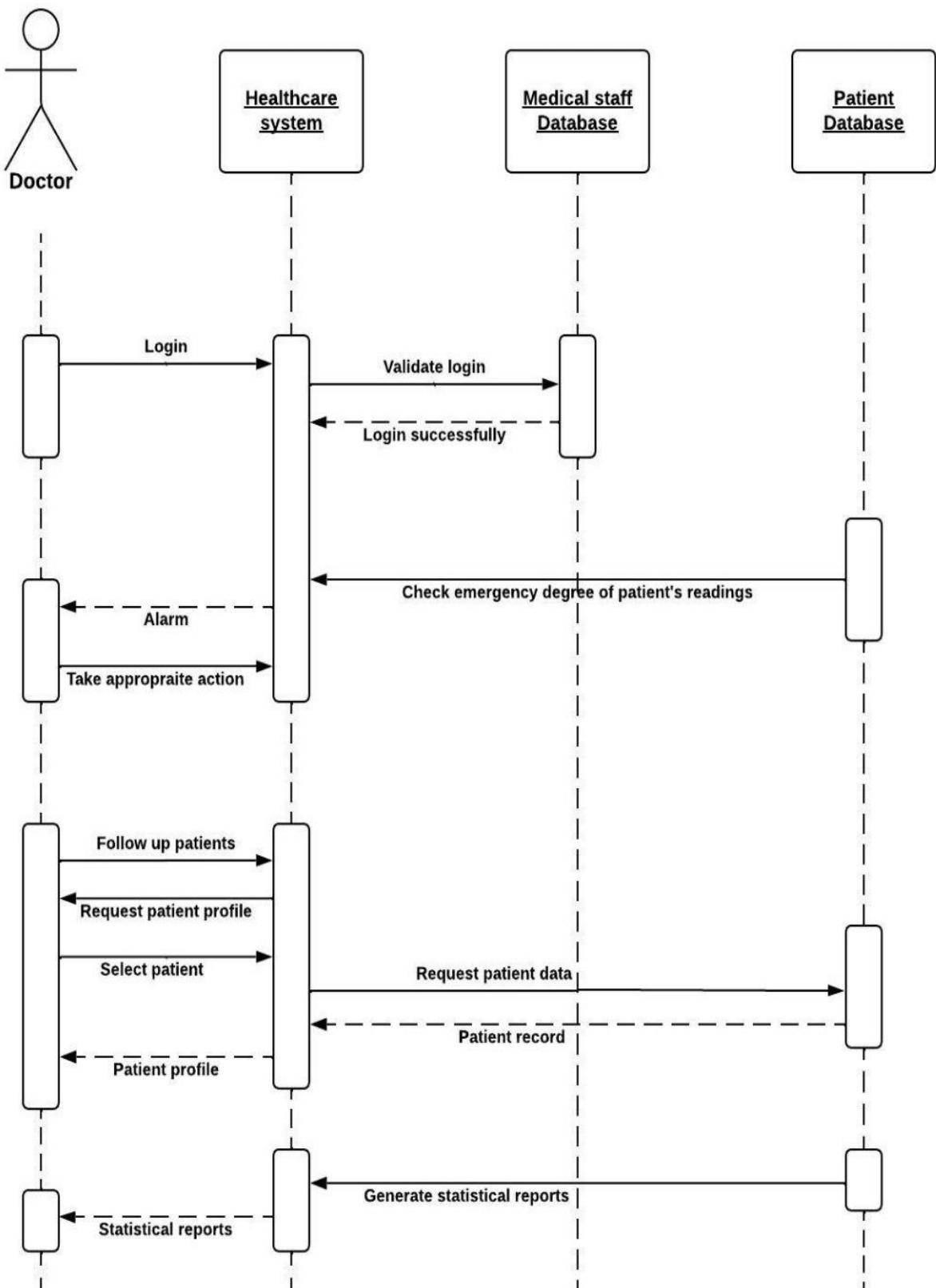


Figure 4-18. Doctor Sequence Diagram

3. Relative Sequence Diagram

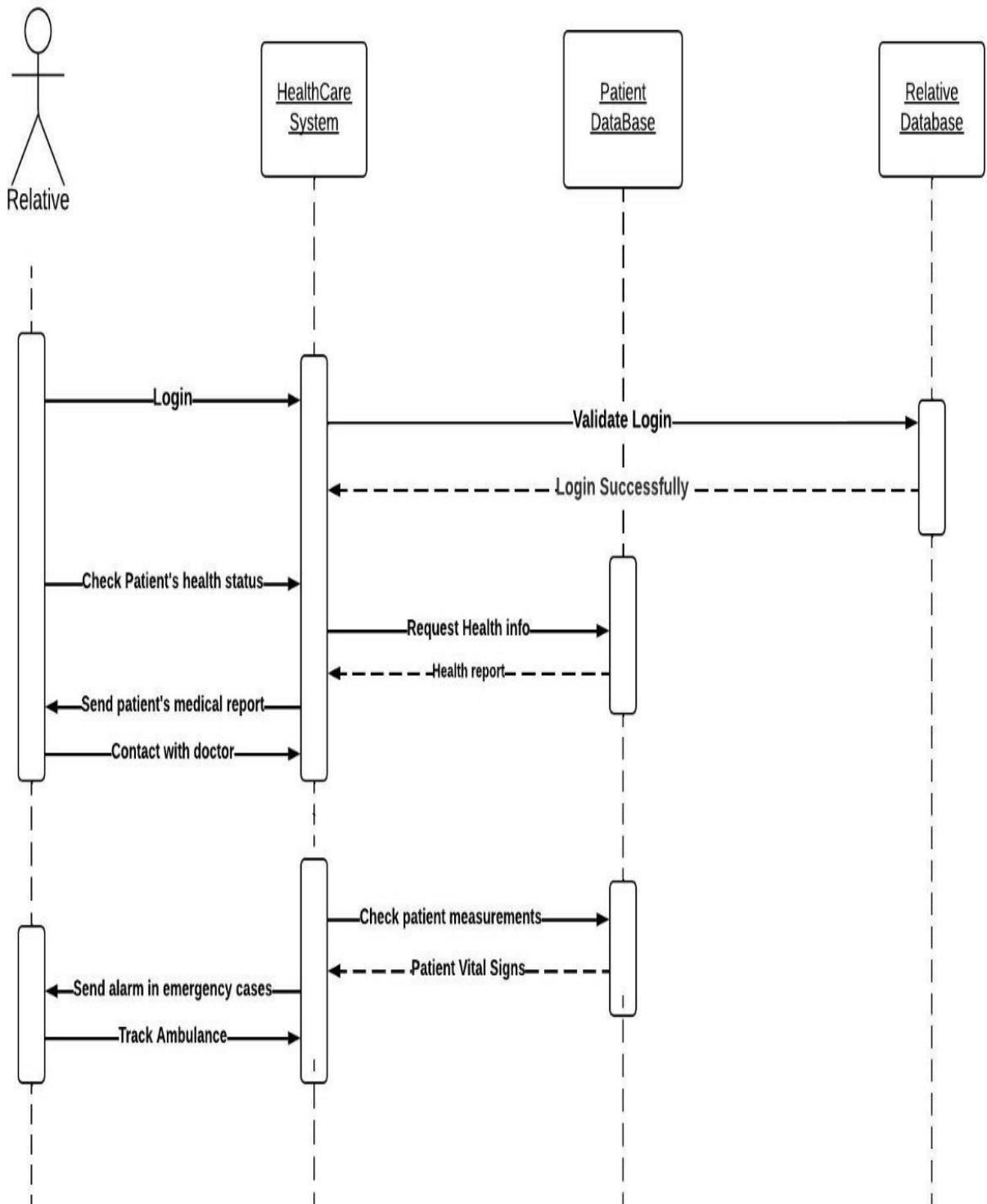
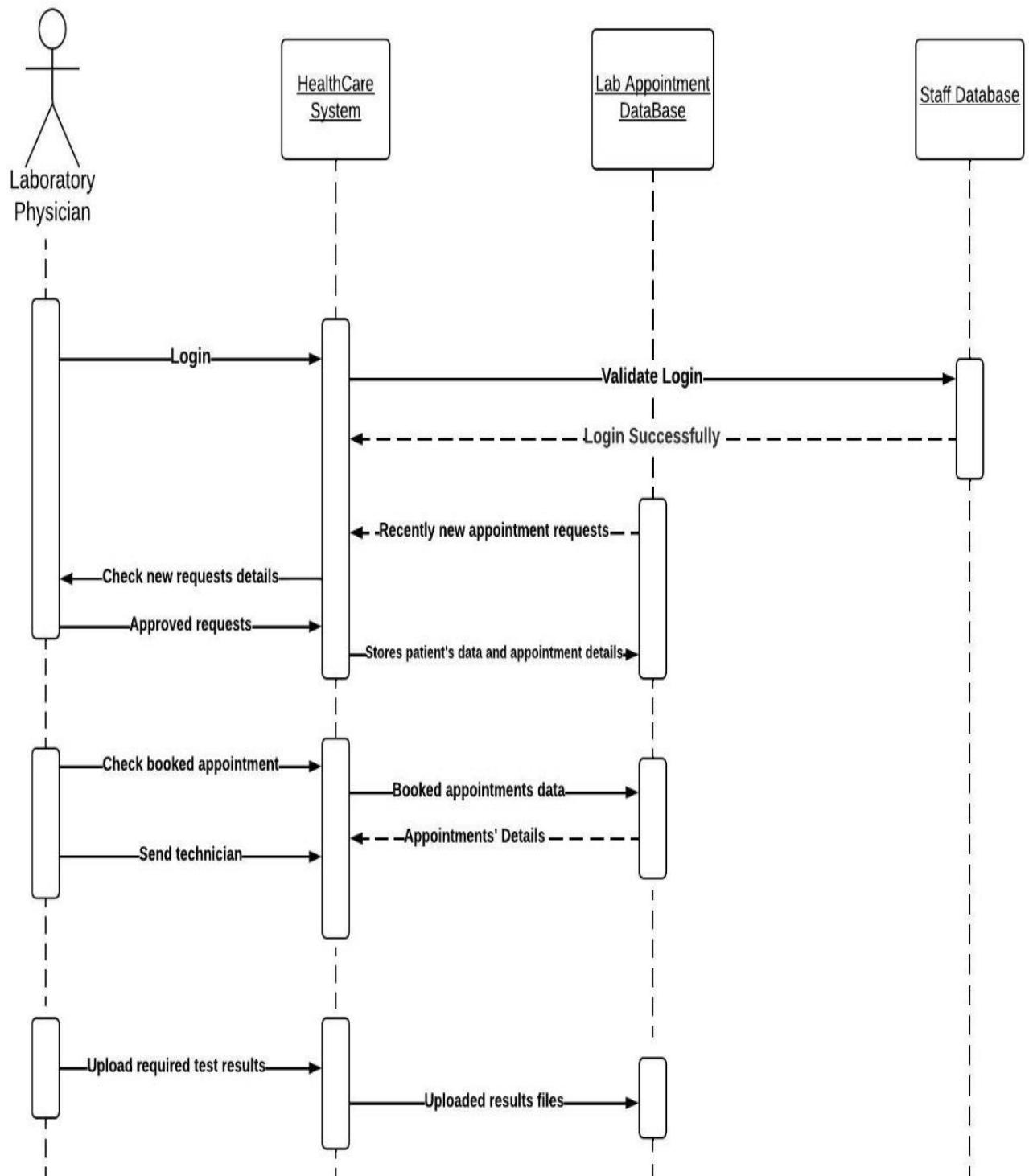


Figure 4-19. Relative Sequence Diagram



4. Laboratory Sequence Diagram

Figure 4-20. Laboratory Sequence Diagram

4.2.5 DFD

1. Context Diagram

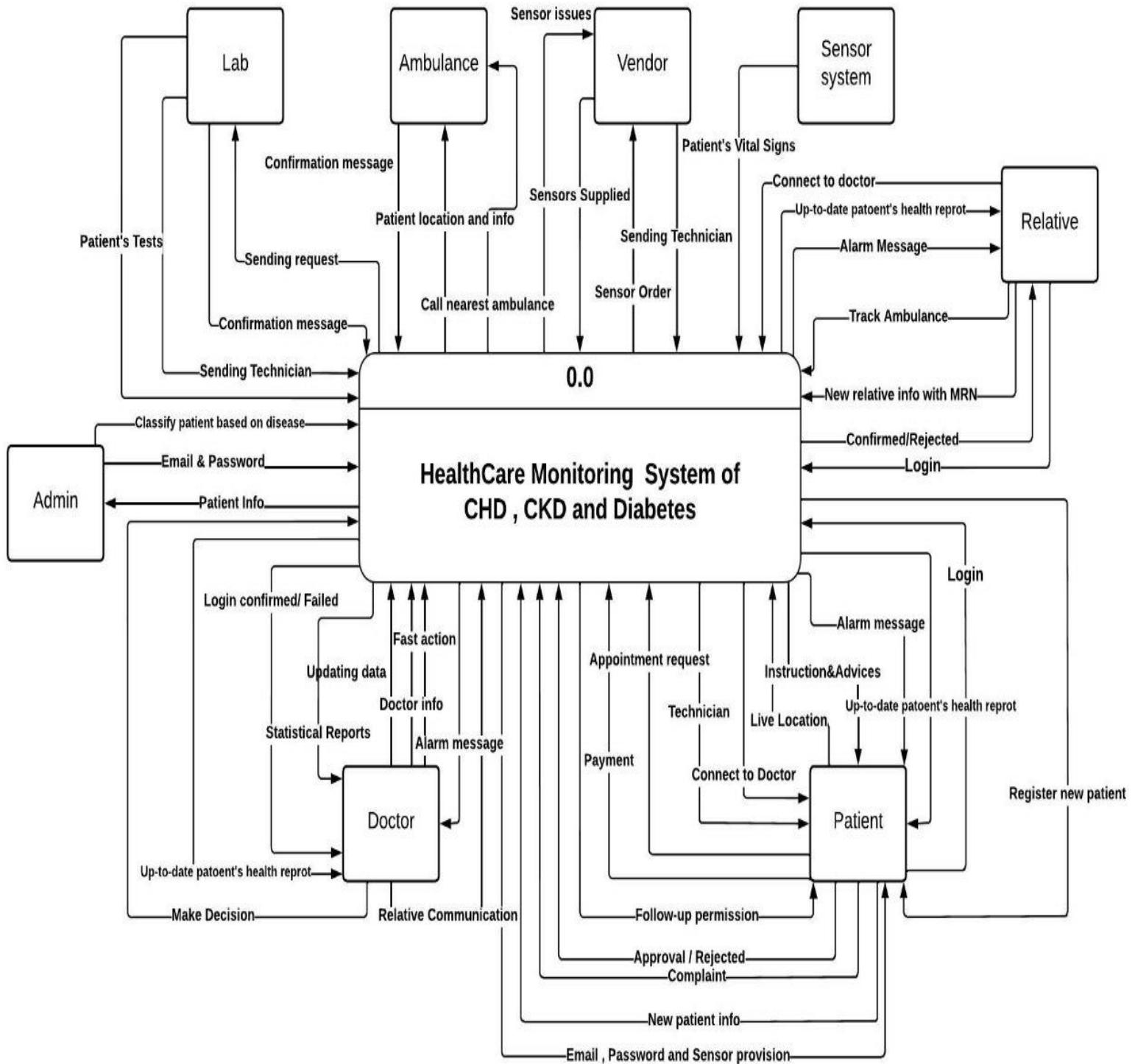


Figure 4-21. Context Diagram

2. DFD Level 1

a)

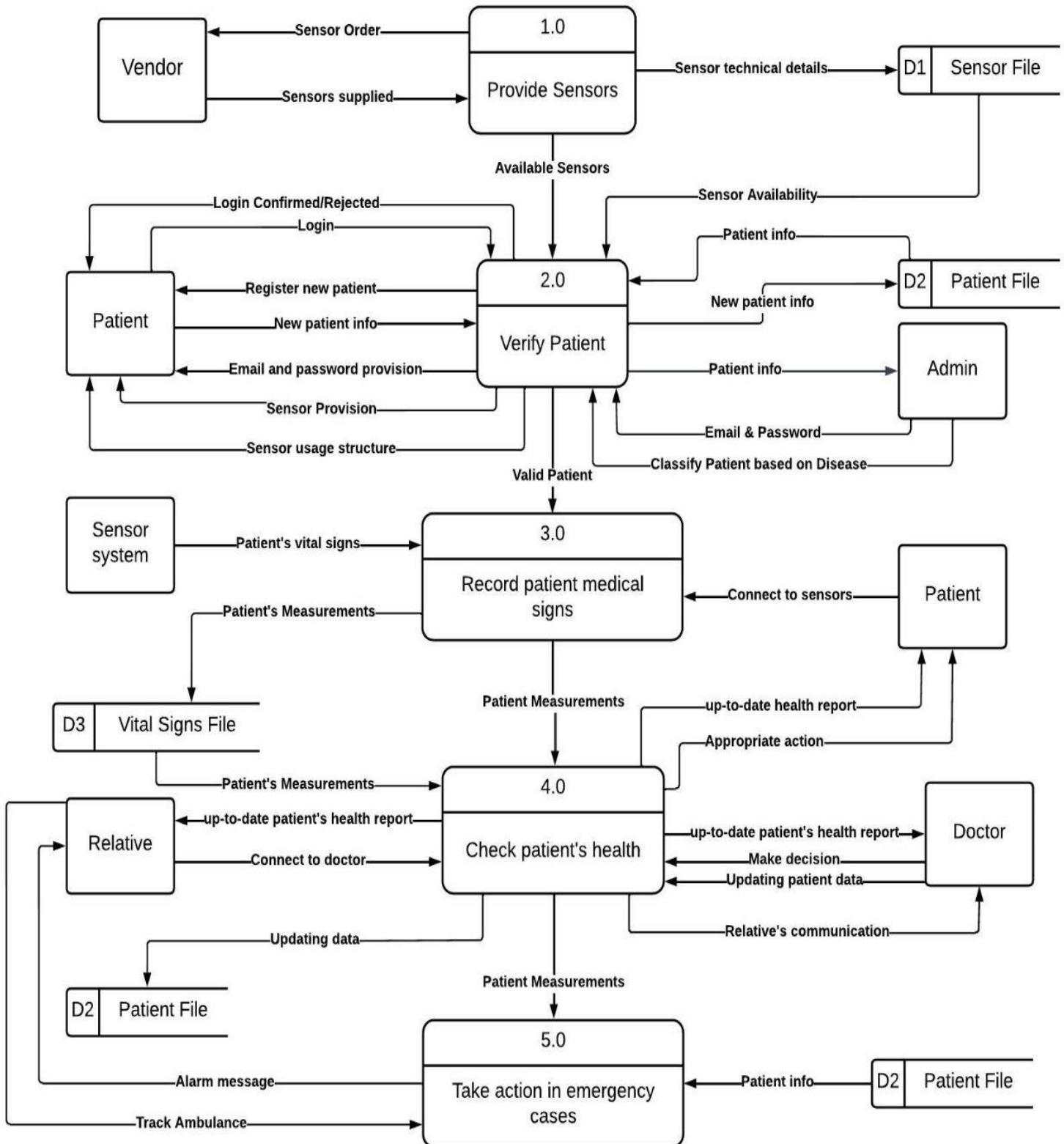


Figure 4-22. DFD Level 1

b)

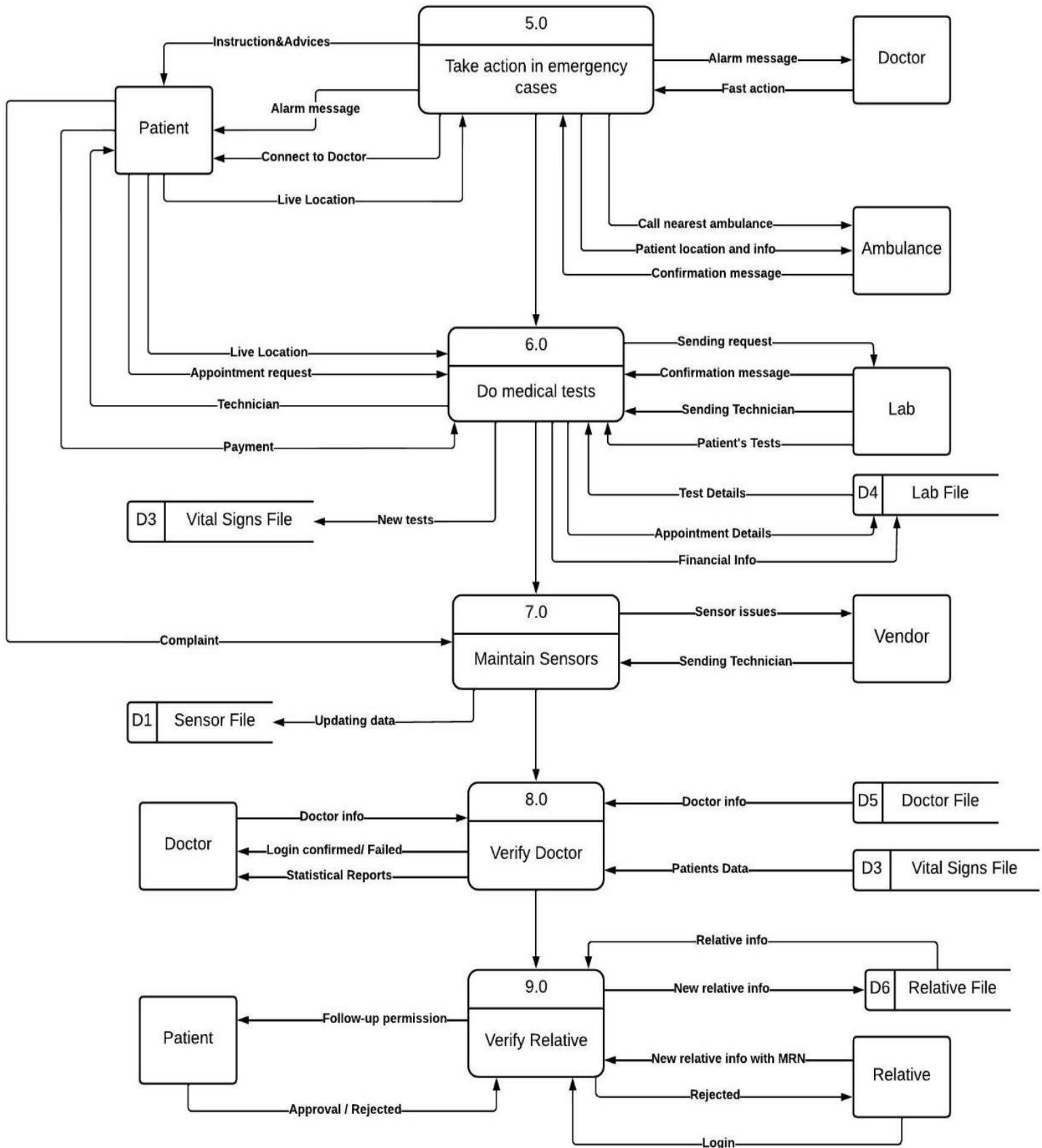


Figure 4-23. DFD Level 1

3. DFD Level 2

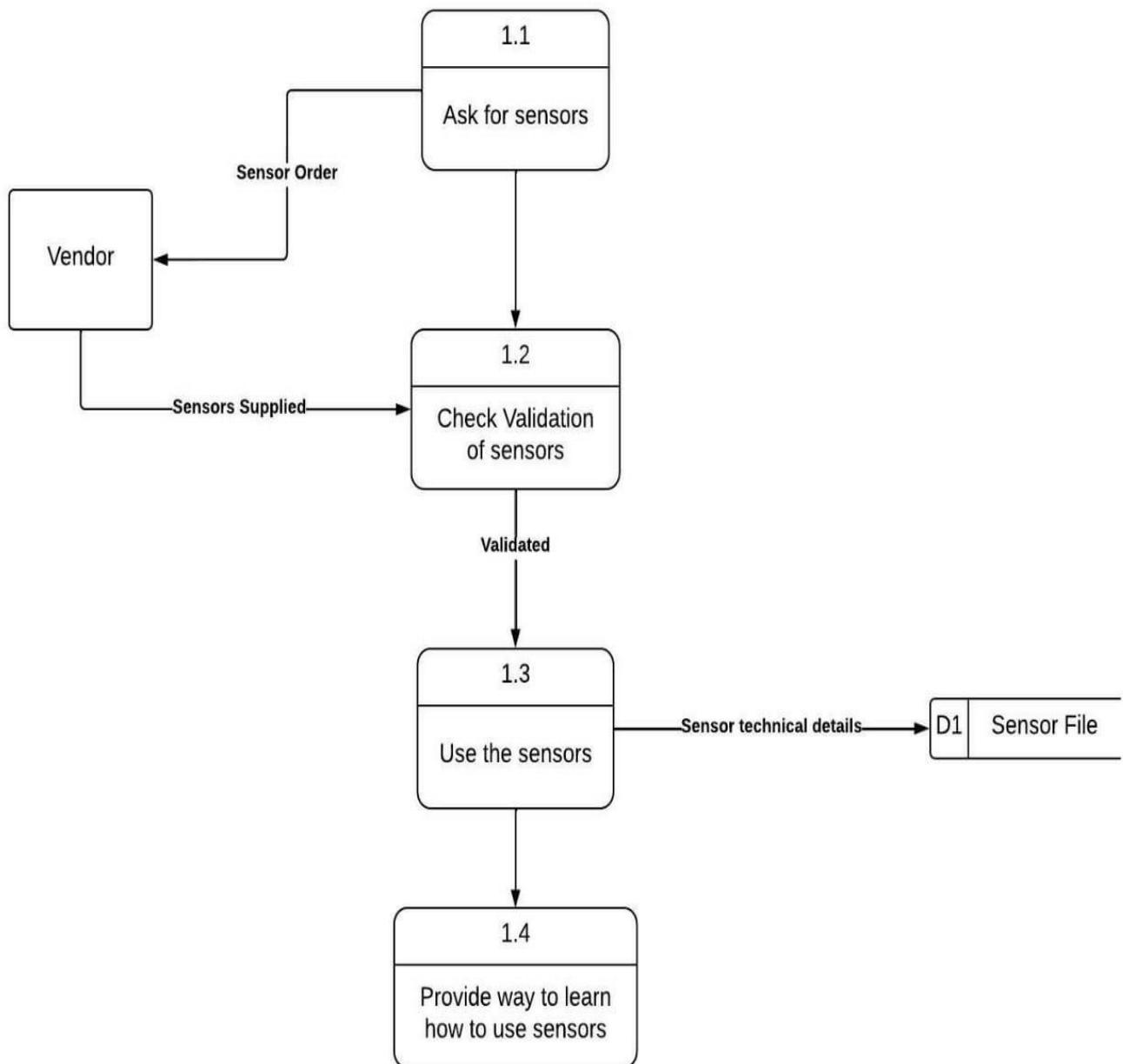


Figure 4-24. Provide Sensors DFD Level 2

3. DFD Level 2 [Continue]

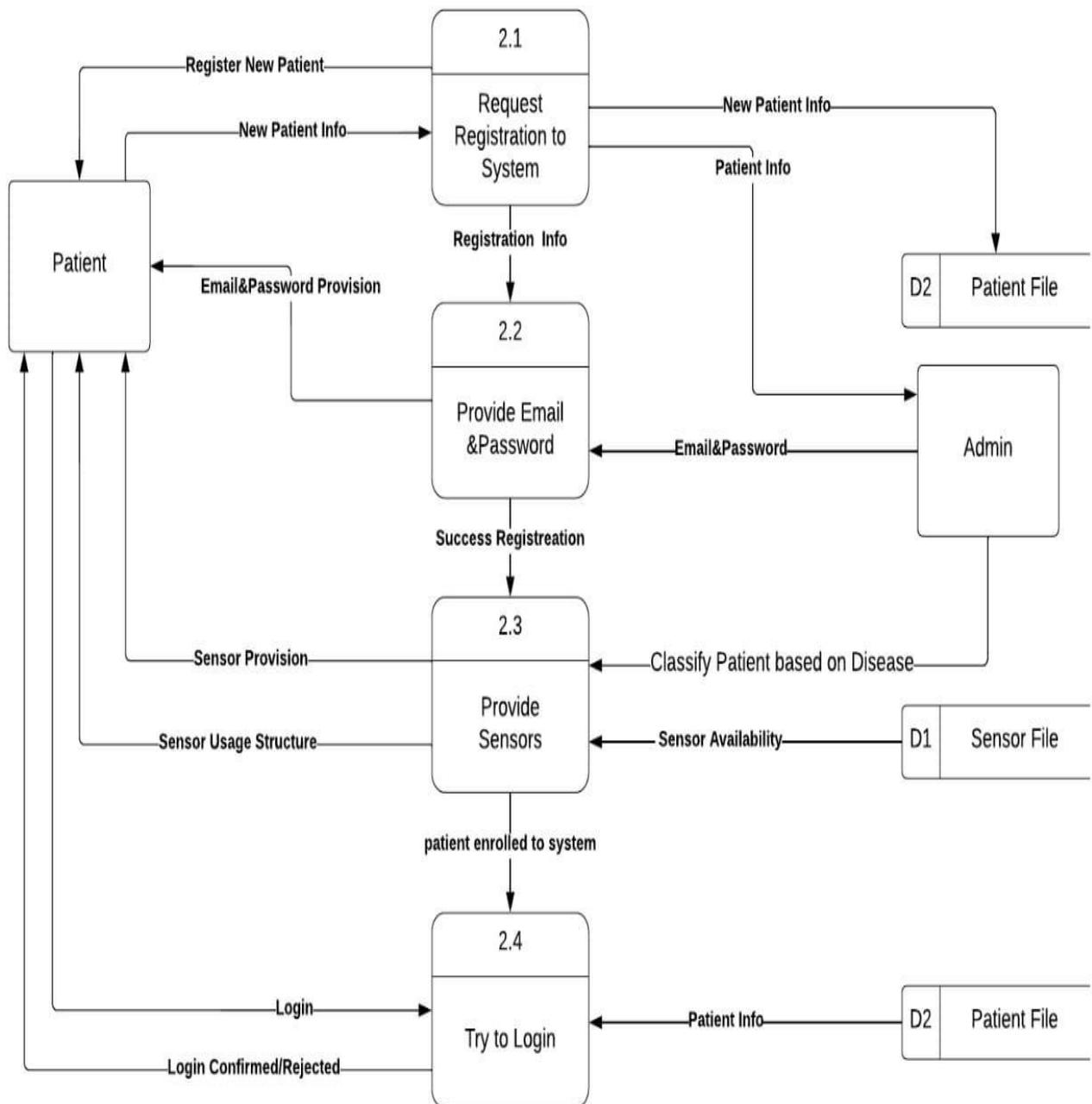


Figure 4-25. Verify Patient DFD Level 2

3. DFD Level 2 [Continue]

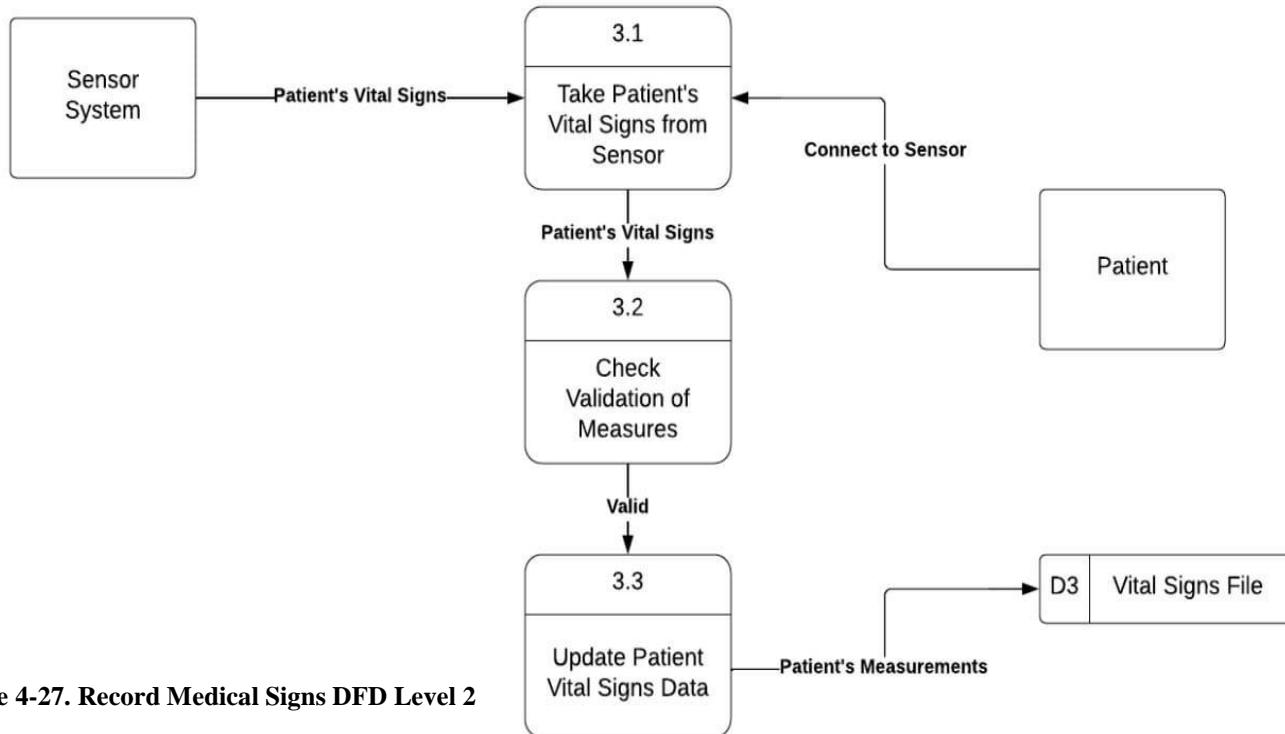


Figure 4-27. Record Medical Signs DFD Level 2

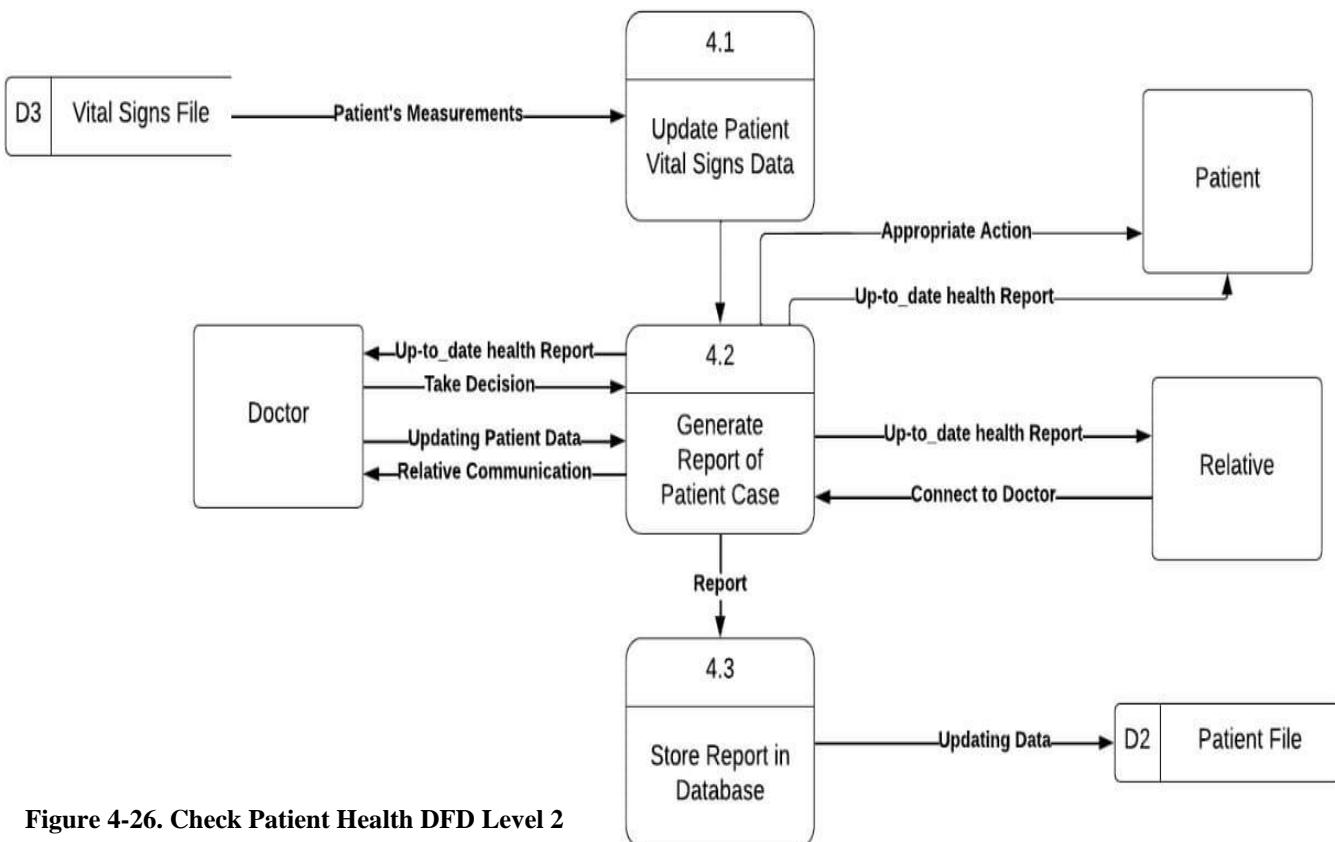


Figure 4-26. Check Patient Health DFD Level 2

3. DFD Level 2 [Continue]

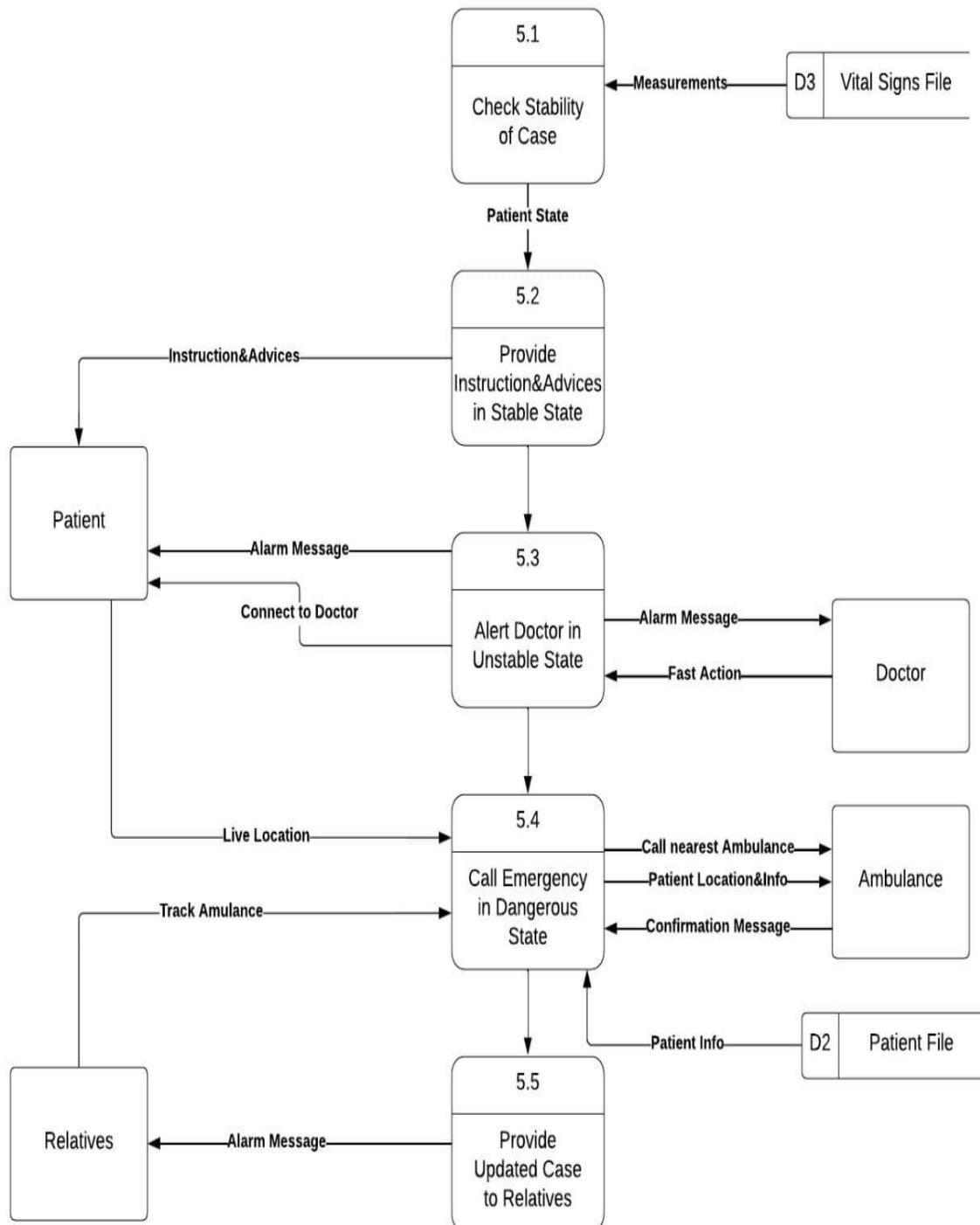


Figure 4-28. Take Action in Emergency DFD Level 2

3. DFD Level 2 [Continue]

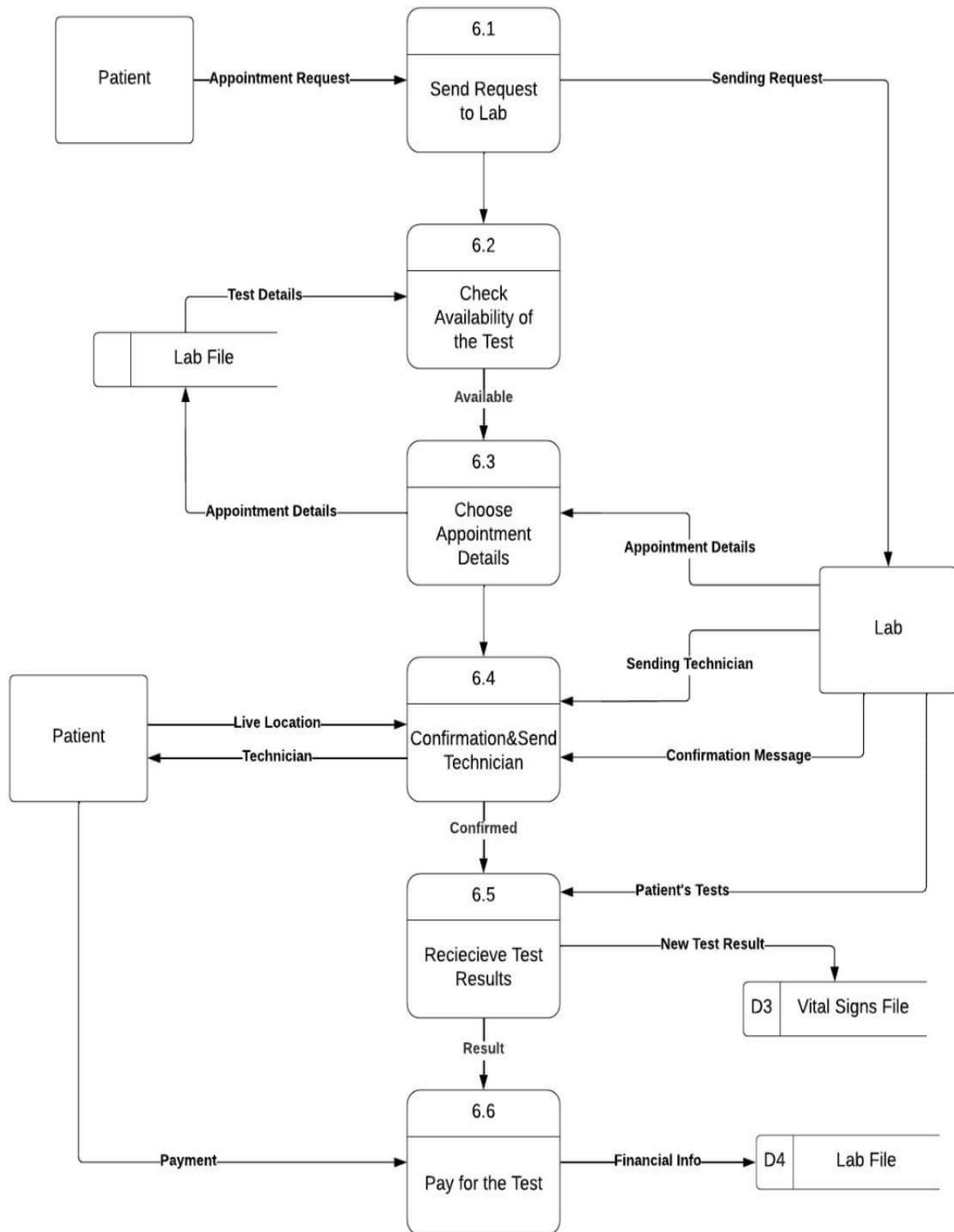


Figure 4-29. Do Medical Tests DFD Level 2

3. DFD Level 2 [Continue]

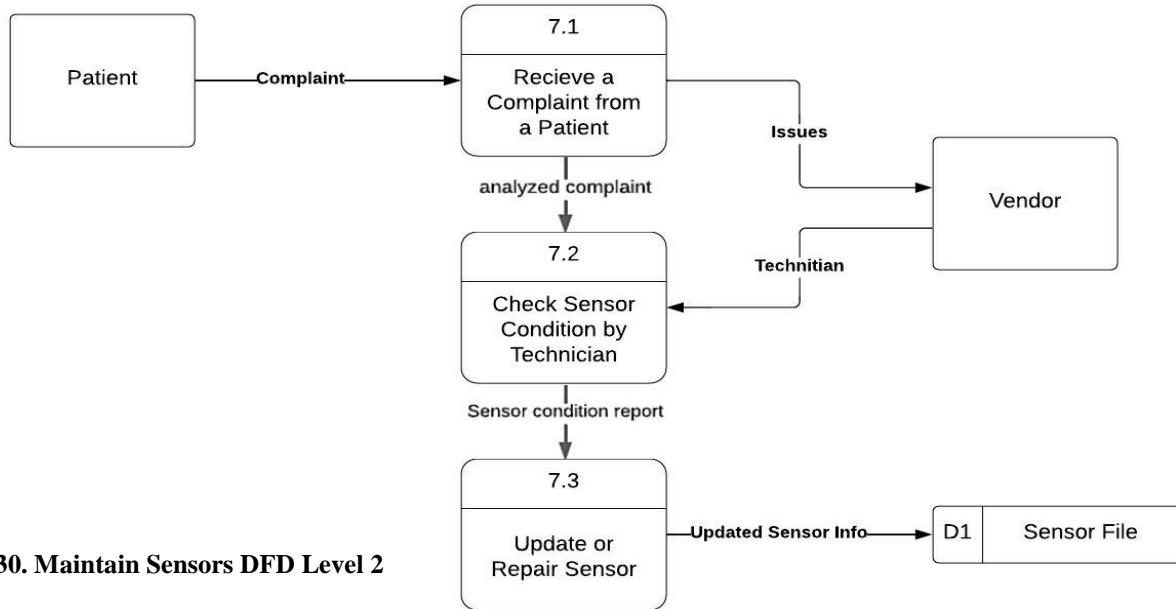
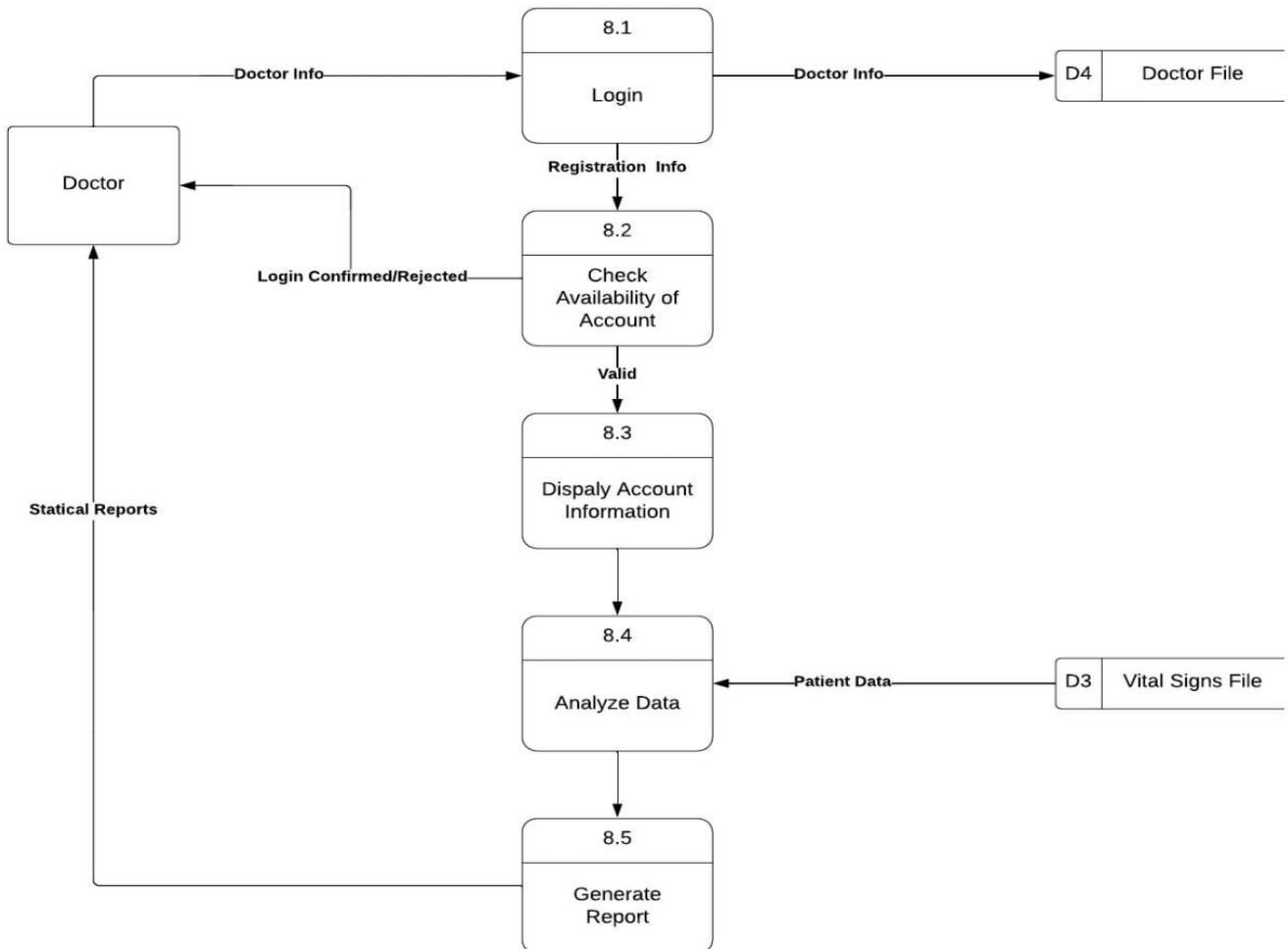


Figure 4-30. Maintain Sensors DFD Level 2



3. DFD Level 2 [Continue]

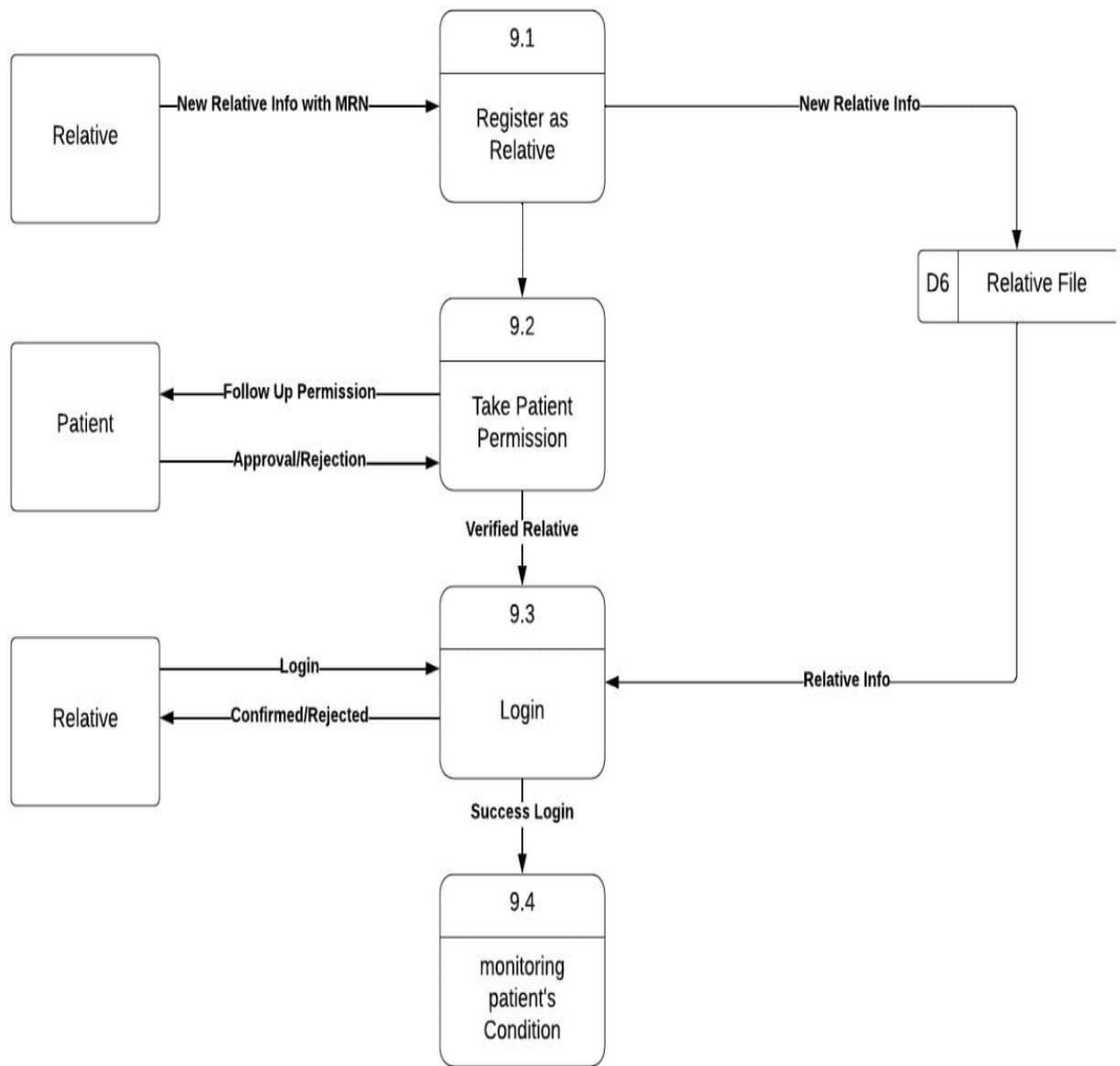


Figure 4-32. Verify Relative DFD Level 2

4.2.6 Class Diagram

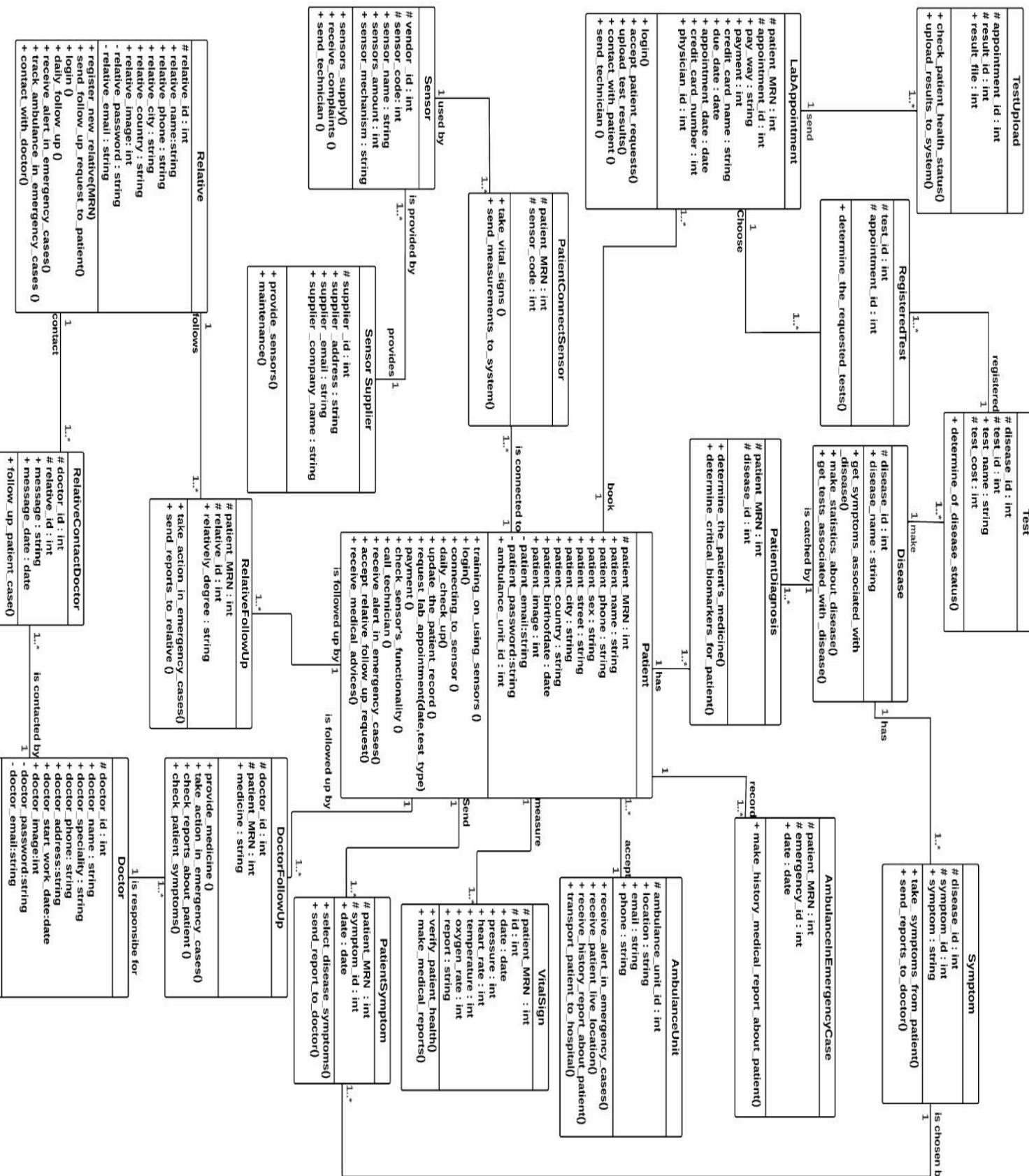


Figure 4-33. Class Diagram

4.2.7 Database Design

1. ER Diagram

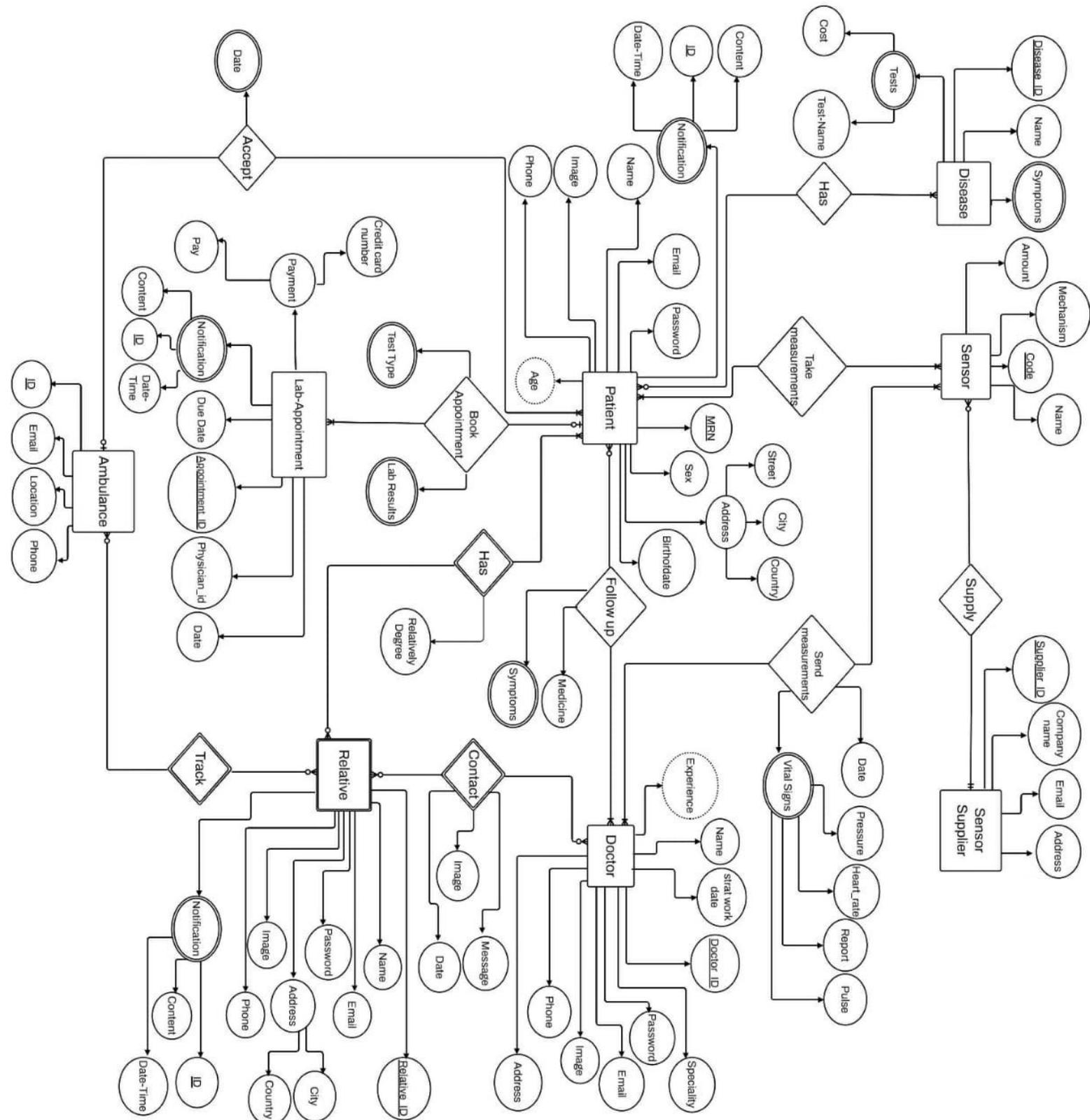


Figure 4-34. ERD

2. Relational Database Schema Diagram

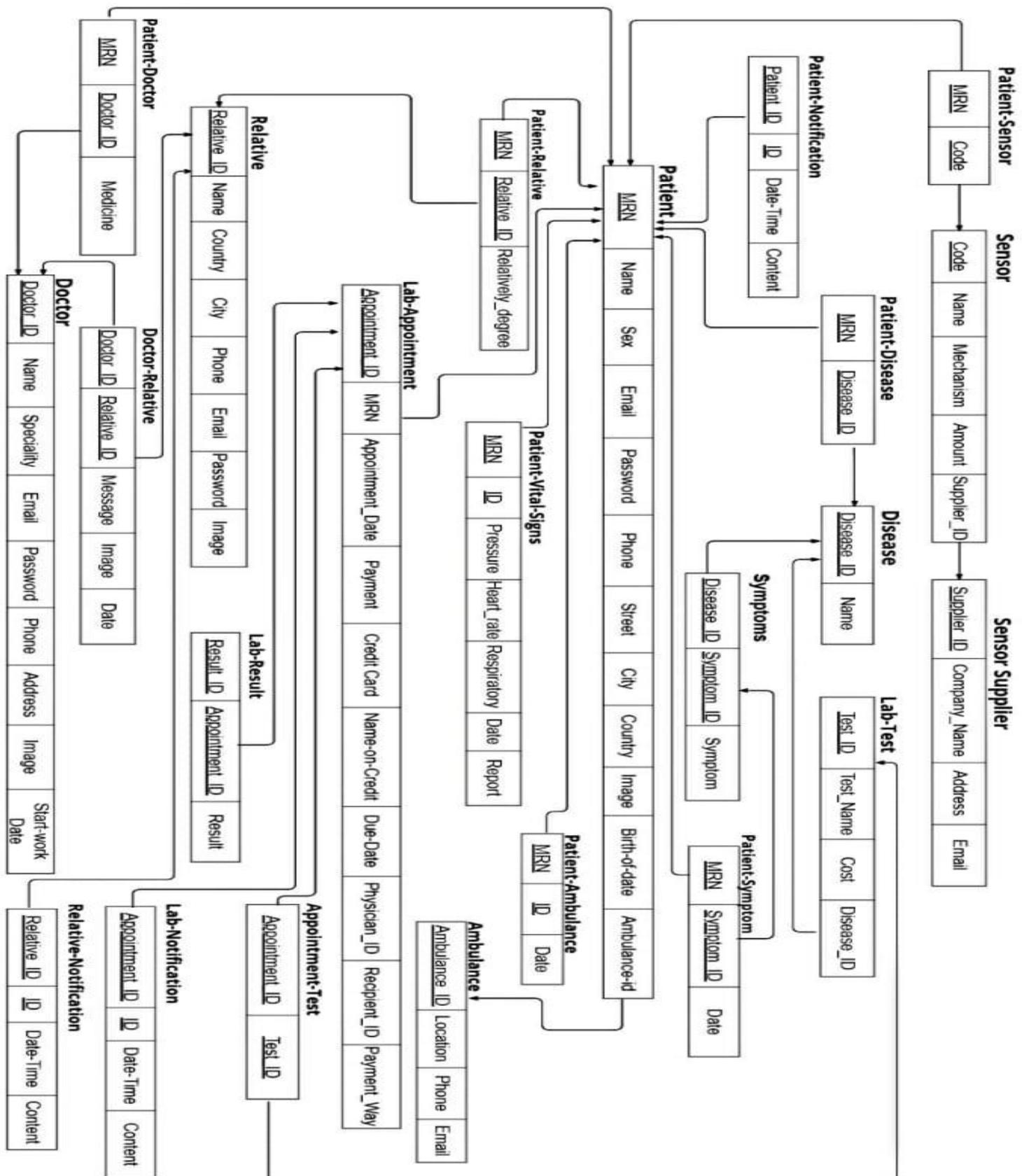


Figure 4-35. Database Schema Diagram

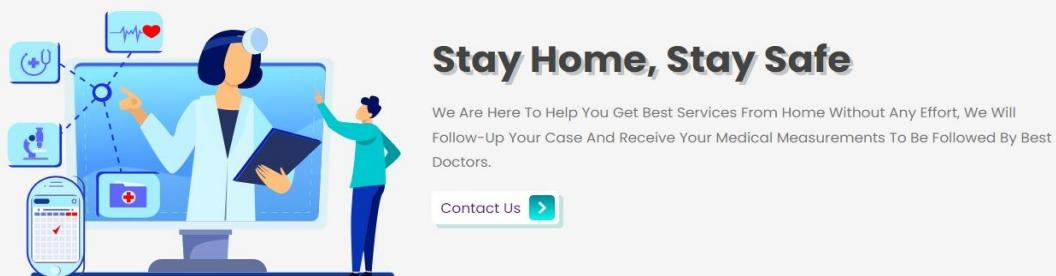
4.3 SYSTEM DESIGN

4.3.1. HOME WEBSITE

These are some pictures of our home website which include brief about the system services and main functions.

TeleMed

Home Services About Get Started Doctors Book Lab Location



Stay Home, Stay Safe

We Are Here To Help You Get Best Services From Home Without Any Effort, We Will Follow-Up Your Case And Receive Your Medical Measurements To Be Followed By Best Doctors.

Contact Us



Figure 4-37. Home Page 1

TeleMed

Home Services About Get Started Doctors Book Lab Location

OUR SERVICES



Free Checkups

We Are Here To Guarantee Your Comfort And Health By Affording You The Most Easy Way Of Checkups.



24/7 Ambulance

We Will Call An Ambulance To Your Location Any Time We Feel There's Emergency Without Any Effort From You.



Expert Doctors

We Have The Best Doctors To Take Care Of You And Make Daily Checkups Of Your Case And Also Make You Feel Better.



Medicines

We Will Provide You With Medicines Up-To-Date According To Your Health Conditions With Best Doctors Suppervision.



Bed Facility

We Can Also Afford Intensive Care To You With All Supplies You Need In The Case Of Emergency To Help You Be Better As Fast As We Can.



Lab Tests

We Help You Book Laboratory Tests From Home, And The Lab Will Send You A Technician Quickly To Take Your Samples.



Relative Oversight

Our Approach Enables You To Be Overseen By Your Friends And Family After Obtaining Your Approval To Take Charge Of Your Case.



Total Care

We Will Care Of Your Health In Many Directions As We Have Facility To Take Care Of You If You Have Diabetes ,CHD Or CKD Diseases.

Figure 4-36. Home Page 2

The screenshot shows the 'ABOUT US' section of the website. At the top left is the logo 'TeleMed'. The top navigation bar includes links for Home, Services, About, Get Started, Doctors, Book Lab, and Location. The main heading 'ABOUT US' is displayed in large, bold, dark letters. Below it is a sub-heading 'We Take Care Of Your Health And Safe'. A paragraph of text follows, stating: 'We Are Here To Provide You With The Best Services From Your Comfortable And Safe Home, Even From Your Bed. We Will First Take Your Measurements Automatically Without Any Help From You To Guarantee Accuracy, Then Predict Your Health Conditions And Give You The Result. We Will Also Help You Contact Our Expert Doctors To Help You Feel Better.' A 'Get Started' button with a right-pointing arrow is located at the bottom of this text block.

Figure 4-39. Home Page 3

The screenshot shows the 'ENTER AS' section of the website. At the top left is the logo 'TeleMed'. The top navigation bar includes links for Home, Services, About, Get Started, Doctors, Book Lab, and Location. Below the navigation is a large heading 'ENTER AS'. There are four cards below it, each representing a user type: 'Patient' (with a person icon holding a stethoscope and a heart rate monitor), 'Doctor' (with a person icon wearing a lab coat), 'Relative' (with a person icon above two smaller person icons), and 'Lab' (with a microscope icon). Each card has a blue rectangular button with a white right-pointing arrow at the bottom right corner.

Figure 4-38. Home Page 4

- Here we display the list of doctors working in our system with their speciality

The screenshot shows a web page titled "OUR DOCTORS". It features three columns, each containing a doctor's profile. Each profile includes a photo, name, title, and a "Show Profile" button.

Profile	Name	Title	Action
	Sarah Ahmed	Expert Doctor	Show Profile >
	Ahmed Osama	Expert Doctor	Show Profile >
	Ahmed Osama	Expert Doctor	Show Profile >

Figure 4-40. Home Page 5

- Another service that we offer to our users is to enable them to test if they have Chronic Heart Disease (CHD) by our machine learning model.

The screenshot shows a web page titled "TAKE HEALTH SURVEY". It features a large graphic of a clipboard with a pen and a red plus sign. To the right, there is a section titled "Check Your Health" with descriptive text and a "Start Now!" button.

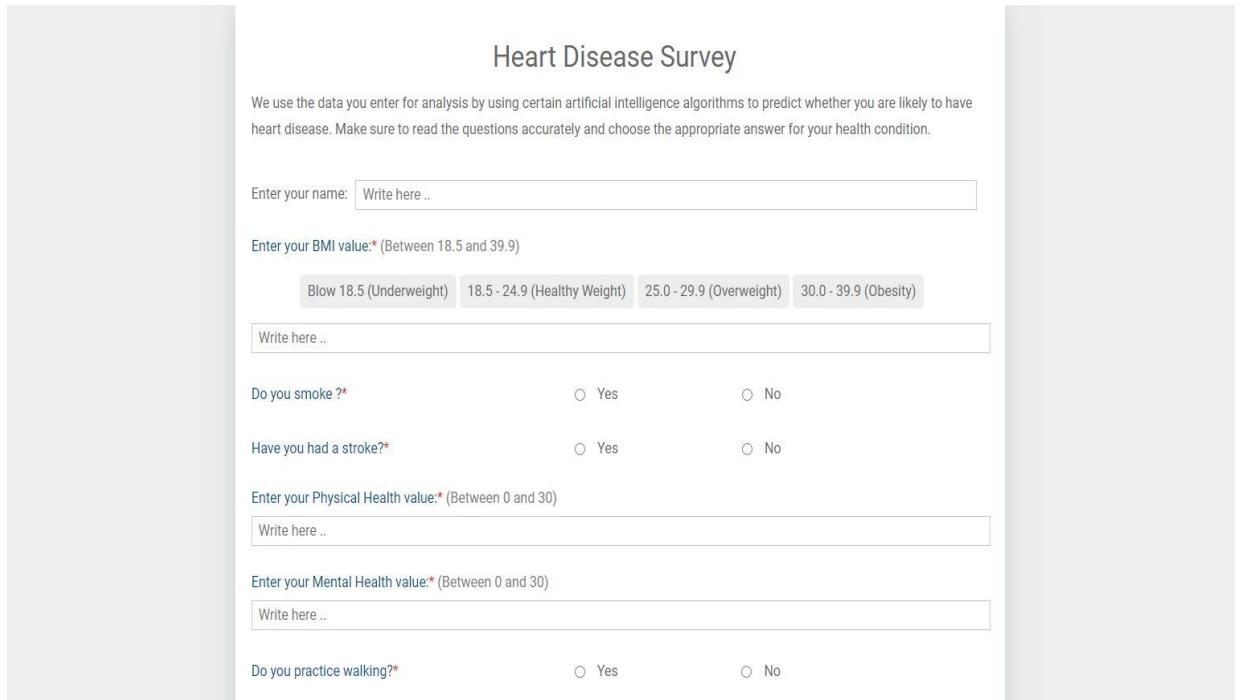
Check Your Health

We Can Predict If You Have Any Of Diseases Which We Focused On(CHD,CKD,Diabetes) By Taking The Symptoms You Complaining From In The Following Survey So If You Need To Test Your Health Condition You Can Take The Survey Below.

Start Now!

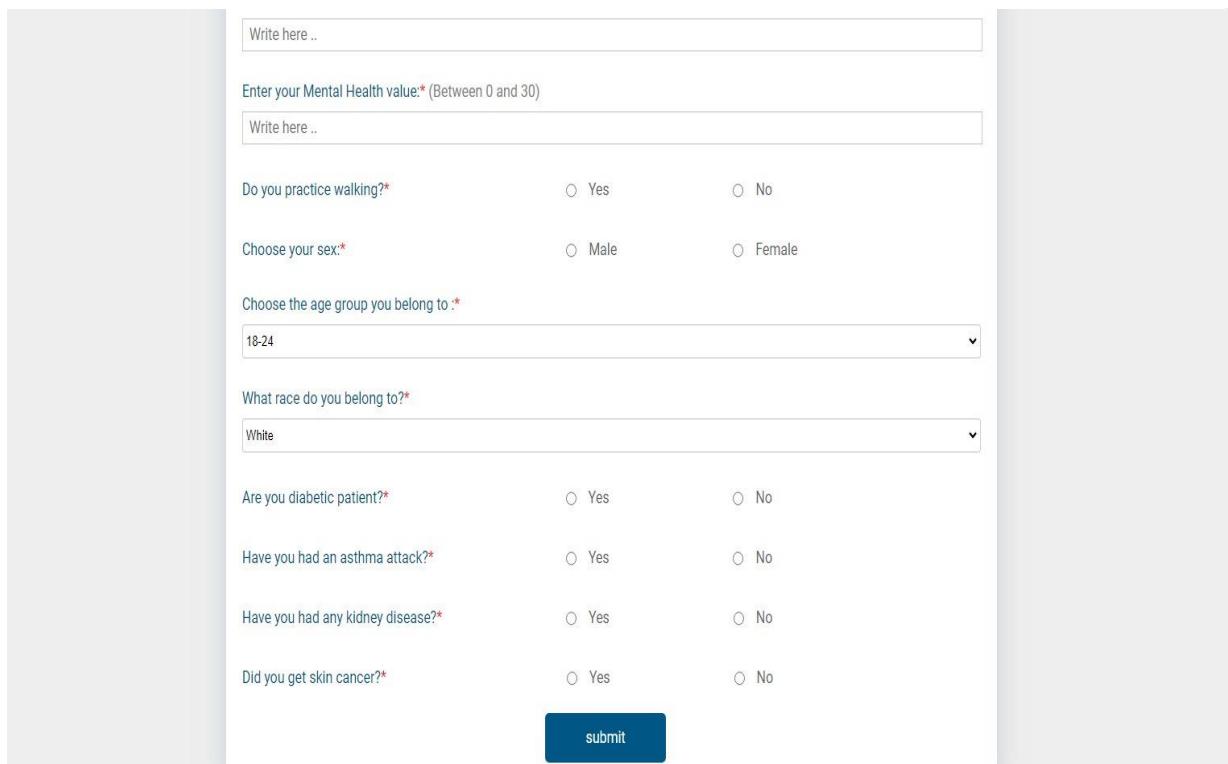
Figure 4-41. Home Page 6

- By clicking start on the previous screen he enters a new page which contain a form of some questions he should fill them to evaluate results by our testing model.



The screenshot shows a survey titled "Heart Disease Survey". The instructions state: "We use the data you enter for analysis by using certain artificial intelligence algorithms to predict whether you are likely to have heart disease. Make sure to read the questions accurately and choose the appropriate answer for your health condition." There is a text input field for "Enter your name:" followed by a placeholder "Write here ..". Below it is a text input field for "Enter your BMI value: * (Between 18.5 and 39.9)" with a placeholder "Write here ..". A horizontal button bar below shows BMI ranges: "Below 18.5 (Underweight)", "18.5 - 24.9 (Healthy Weight)", "25.0 - 29.9 (Overweight)", and "30.0 - 39.9 (Obesity)". The next section asks "Do you smoke? *", with radio buttons for "Yes" and "No". The following section asks "Have you had a stroke?", also with "Yes" and "No" options. There are two text input fields for "Enter your Physical Health value: * (Between 0 and 30)" and "Enter your Mental Health value: * (Between 0 and 30)", both with placeholders "Write here ..". The final section asks "Do you practice walking?", with "Yes" and "No" radio buttons.

Figure 4-43. Heart Disease Survey 1



This screenshot shows a continuation of the survey. It starts with a text input field for "Enter your Mental Health value: * (Between 0 and 30)" with a placeholder "Write here ..". Below it is another text input field for "Enter your Physical Health value: * (Between 0 and 30)" with a placeholder "Write here ..". The next section asks "Do you practice walking? *", with "Yes" and "No" radio buttons. The following section asks "Choose your sex: *", with "Male" and "Female" radio buttons. A dropdown menu for "Choose the age group you belong to: *" shows "18-24" as the selected option. The next section asks "What race do you belong to? *", with a dropdown menu showing "White" as the selected option. There are several more questions with radio button options: "Are you diabetic patient? *", "Have you had an asthma attack? *", "Have you had any kidney disease? *", and "Did you get skin cancer? *". At the bottom is a large blue "submit" button.

Figure 4-42. Heart Disease Survey 2

- Final part in home website is a map of our Location with directions to it.

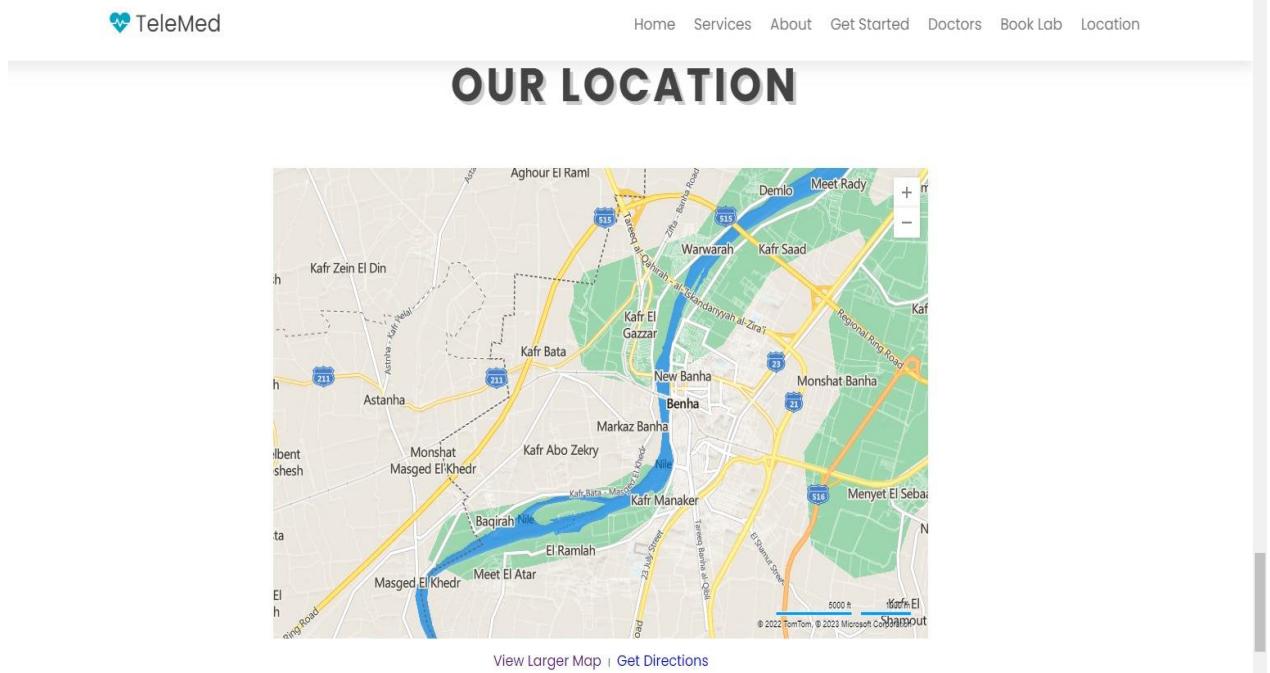


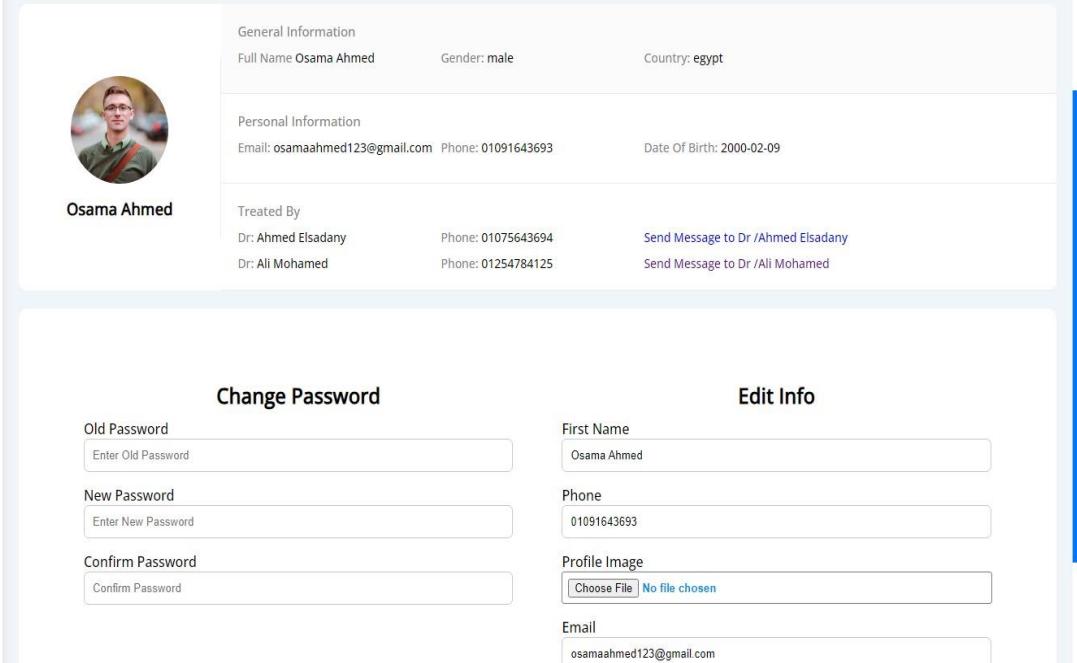
Figure 4-44. Home Page 7

- In our system we have different interfaces to the four users in the system as described before as follow:

4.3.2. PATIENT INTERFACE

Figure 4-45. Patient Dashboard

- Patient profile info with section for editing info or updating password.



The screenshot shows a patient profile interface. On the left is a sidebar with icons for Diseases, Check-Up, Request Lab, Chats, Zoom Meeting, Relatives, Reports, and Logout. The main area displays a circular profile picture of a man named Osama Ahmed. Below the picture, the name "Osama Ahmed" is displayed. The interface is divided into sections: "General Information" (Full Name: Osama Ahmed, Gender: male, Country: egypt), "Personal Information" (Email: osamaahmed123@gmail.com, Phone: 01091643693, Date Of Birth: 2000-02-09), and "Treated By" (Dr: Ahmed Elsadany, Phone: 01075643694; Dr: Ali Mohamed, Phone: 01254784125). At the bottom, there are two buttons: "Change Password" and "Edit Info". The "Edit Info" button is expanded, showing fields for First Name (Osama Ahmed), Phone (01091643693), Profile Image (Choose File | No file chosen), and Email (osamaahmed123@gmail.com).

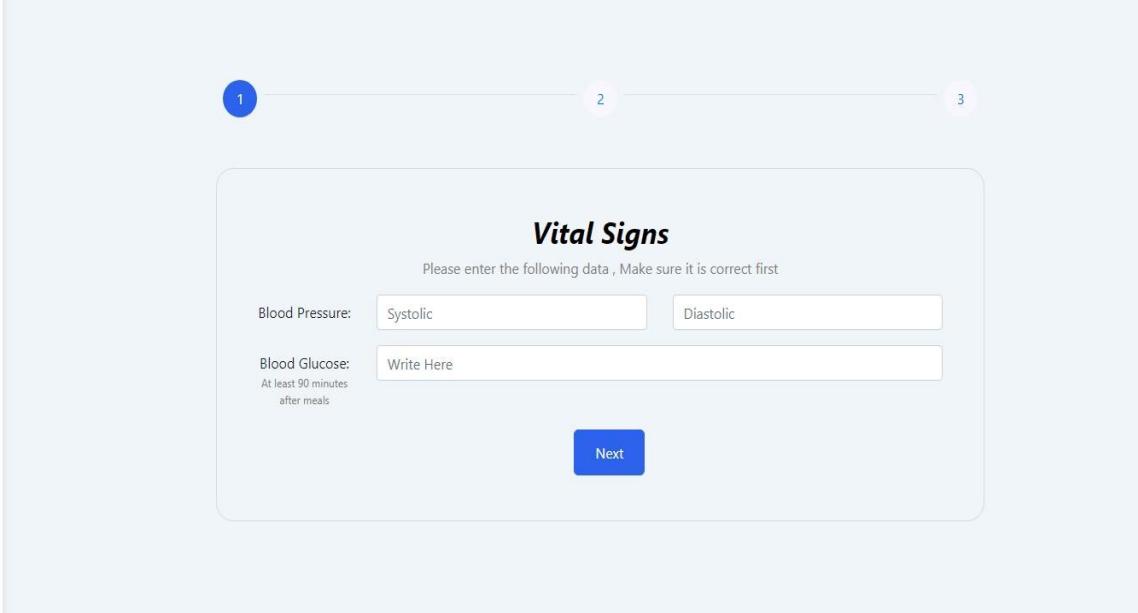
Figure 4-46. Patient Profile

- Here we display to patient his registered diseases and also we provide to him the capability to register more diseases from the diseases we cover.



Figure 4-47. Patient Register Disease

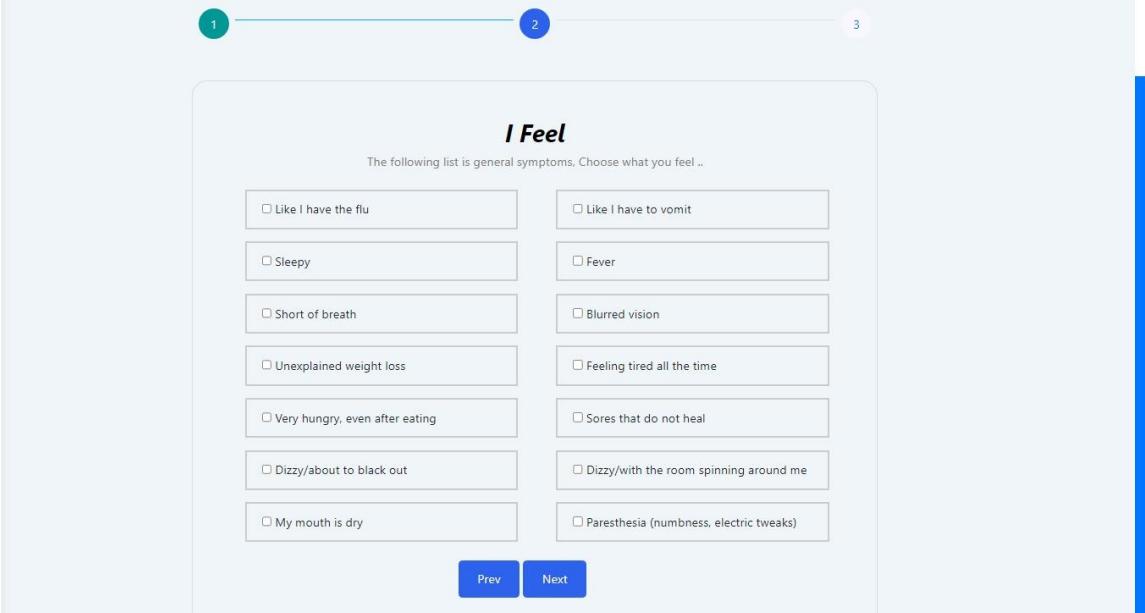
- Here the part where the patient enter his measurements which have taken by the sensors to test his case by the system and evaluate the results.



The screenshot shows a mobile application interface. On the left is a vertical sidebar with icons and labels: Advices, Profile, Diseases, Check-Up, Request Lab, Chats, Zoom Meeting, Relatives, Reports, and Logout. The main area has a progress bar at the top with three circles labeled 1, 2, and 3. Below the progress bar is a section titled "Vital Signs" with the sub-instruction "Please enter the following data , Make sure it is correct first". It contains fields for "Blood Pressure:" (Systolic and Diastolic), "Blood Glucose:" (with a note "At least 90 minutes after meals"), and a "Write Here" text input field. A blue "Next" button is located at the bottom right of this section.

Figure 4-48. Patient Measurements 1

- In this part he can choose one or more of these symptoms to make results more accurate.



The screenshot shows a mobile application interface. On the left is a vertical sidebar with icons and labels: Profile, Diseases, Check-Up, Request Lab, Chats, Zoom Meeting, Relatives, Reports, and Logout. The main area has a progress bar at the top with three circles labeled 1, 2, and 3. Below the progress bar is a section titled "I Feel" with the sub-instruction "The following list is general symptoms. Choose what you feel ..". It contains a grid of 16 checkboxes representing various symptoms: Like I have the flu, Like I have to vomit, Sleepy, Fever, Short of breath, Blurred vision, Unexplained weight loss, Feeling tired all the time, Very hungry, even after eating, Sores that do not heal, Dizzy/about to black out, Dizzy/with the room spinning around me, My mouth is dry, and Paresthesia (numbness, electric tweaks). At the bottom are "Prev" and "Next" buttons.

Figure 4-49. Patient Measurements 2

- Even more he can specify the medicines he currently take which can affect the results.

The screenshot shows a mobile application interface for reporting symptoms. On the left is a vertical navigation menu with icons for Check-Up, Request Lab, Chats, Zoom Meeting, Relatives, Reports, and Logout. The main content area has a title 'Medicine' and a subtitle 'In case that you take medicine and you have any of the following side effects , please choose them'. Below this is a grid of eight checkboxes, each with a symptom description. At the bottom is a text input field for 'If you have any other side effects or symptoms , Write what you feel in the next textarea:' followed by a 'Write Here ..' placeholder. At the very bottom are 'Prev' and 'Save' buttons.

Figure 4-50. Patient Measurements 3

- Here where the results of the patient case display depending on the measurements and symptoms entered and the result can be stable or emergency.

The screenshot shows a mobile application interface for displaying patient results. On the left is a vertical navigation menu with icons for Advices, Profile, Diseases, Check-Up, Request Lab, Chats, Zoom Meeting, Relatives, Reports, and Logout. The main content area has a title 'Results' and a subtitle 'Your Current Health Condition is : Stable' in green text. Below this are two sections: 'Current Vital Signs' and 'Remember'. The 'Current Vital Signs' section displays four vital signs: Blood Pressure (120 / 80 mmHg, Stable), Blood Glucose (120 mg/dL, Stable), Heart Rate (Stable), and Oxygen Saturation (Stable). The 'Remember' section contains four items with bell icons: 'Follow up with your doctor and contact him', 'Take care of your medications and take your medication on time', 'If you feel unwell at any time, do not hesitate to check your vital signs', and 'Contact the laboratory to get the results of Medical tests'.

Figure 4-51. Patient Results

- Here are the reports of the patient case over the past period displayed as charts.

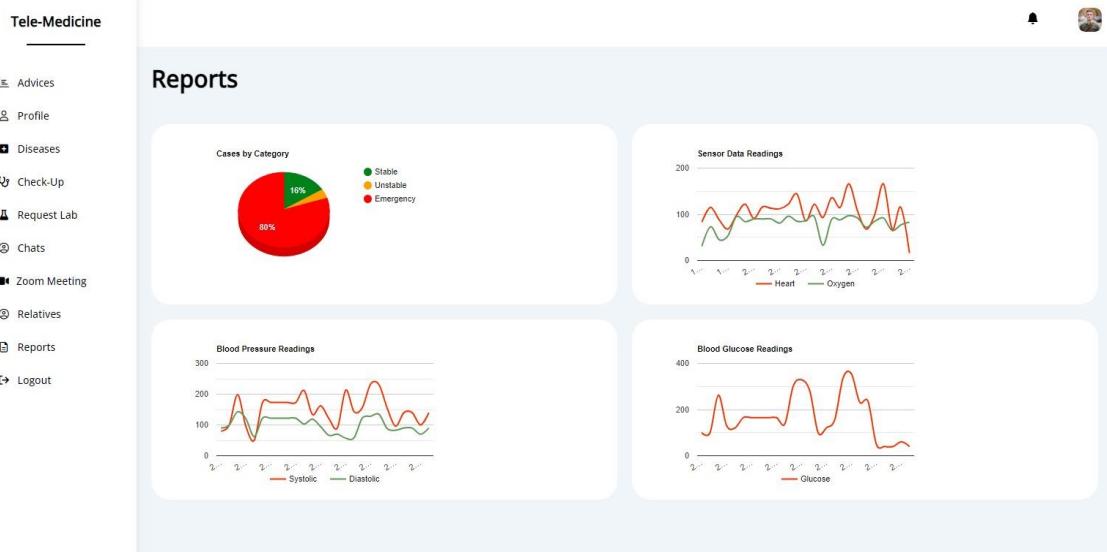


Figure 4-52. Patient Reports

- This form is where the patient can send lab tests to the laboratory unit.

Figure 4-53. Patient Request Lab

4.3.3. DOCTOR INTERFACE

- In this page we display the list of patients whom having an emergency case and need immediate help, by clicking on view medical record button he can see more info as follow:

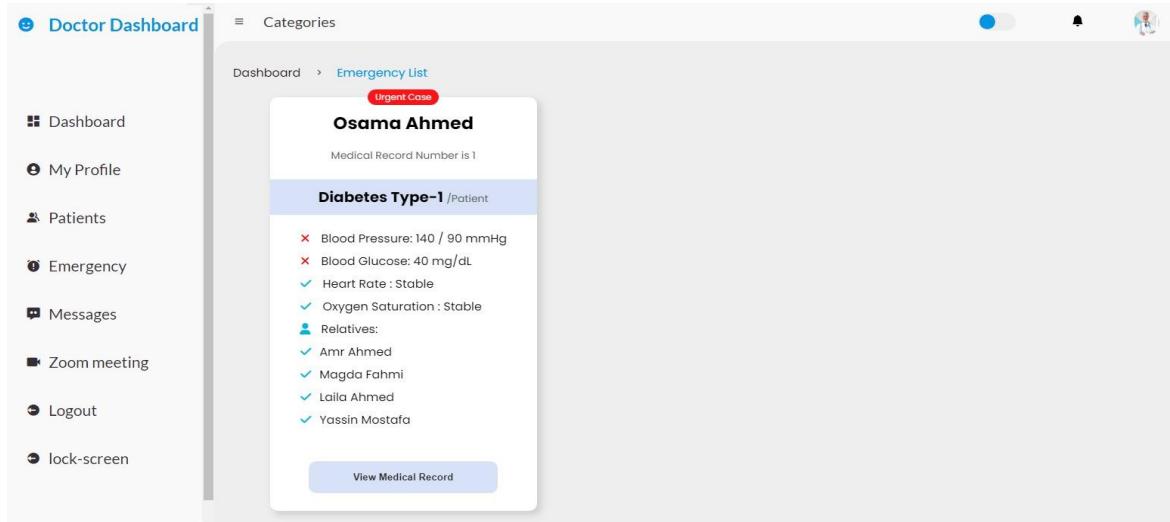


Figure 4-55. Emergency List

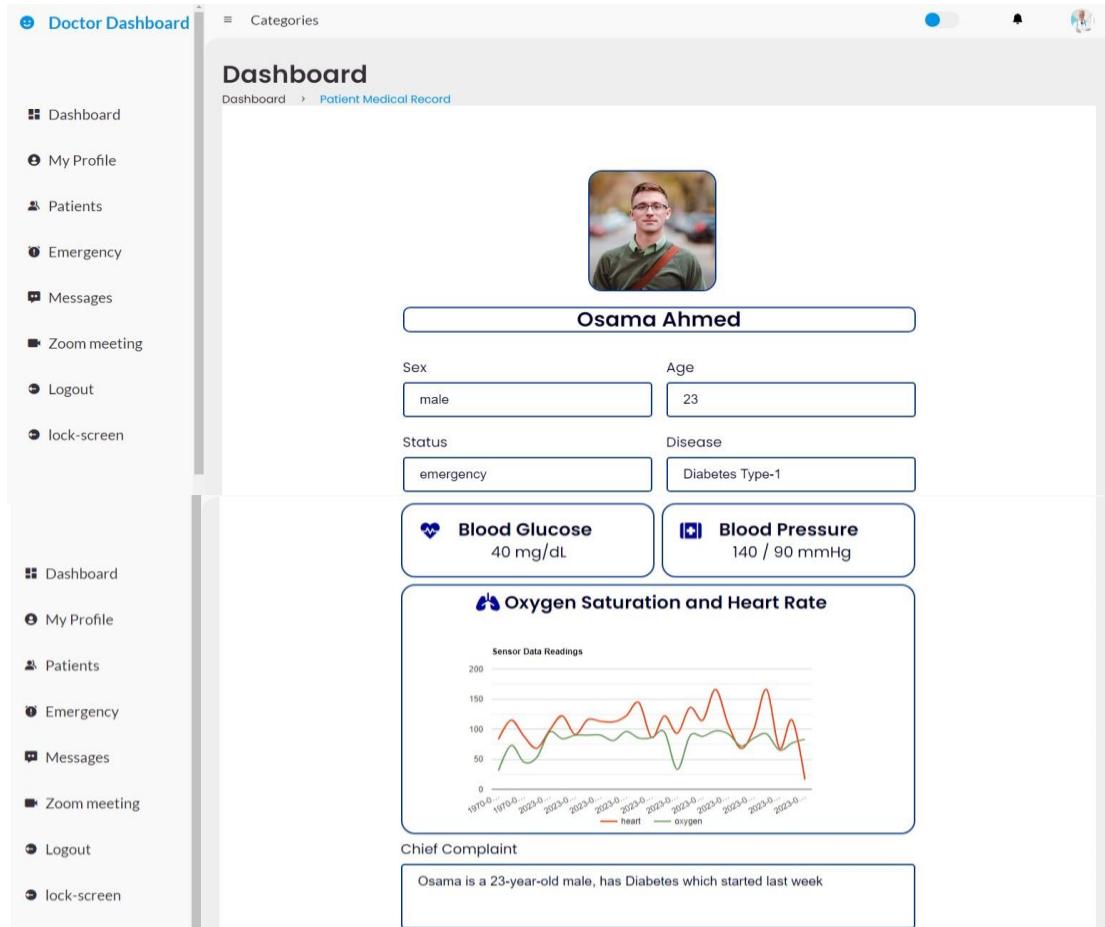


Figure 4-54. Emergency Case Profile

- Another feature in our system that we enable the Doctor and patient to enter a zoom meeting to enable the doctor do a virtual diagnosis with the patient from home.

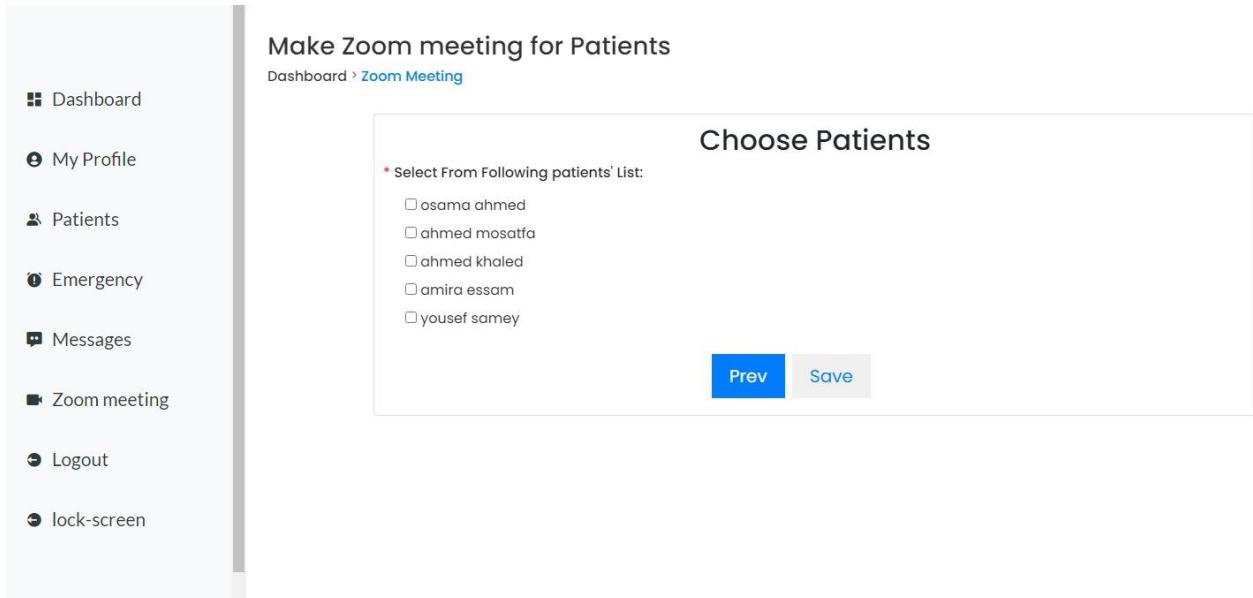


Figure 4-56. Zoom Meeting 1

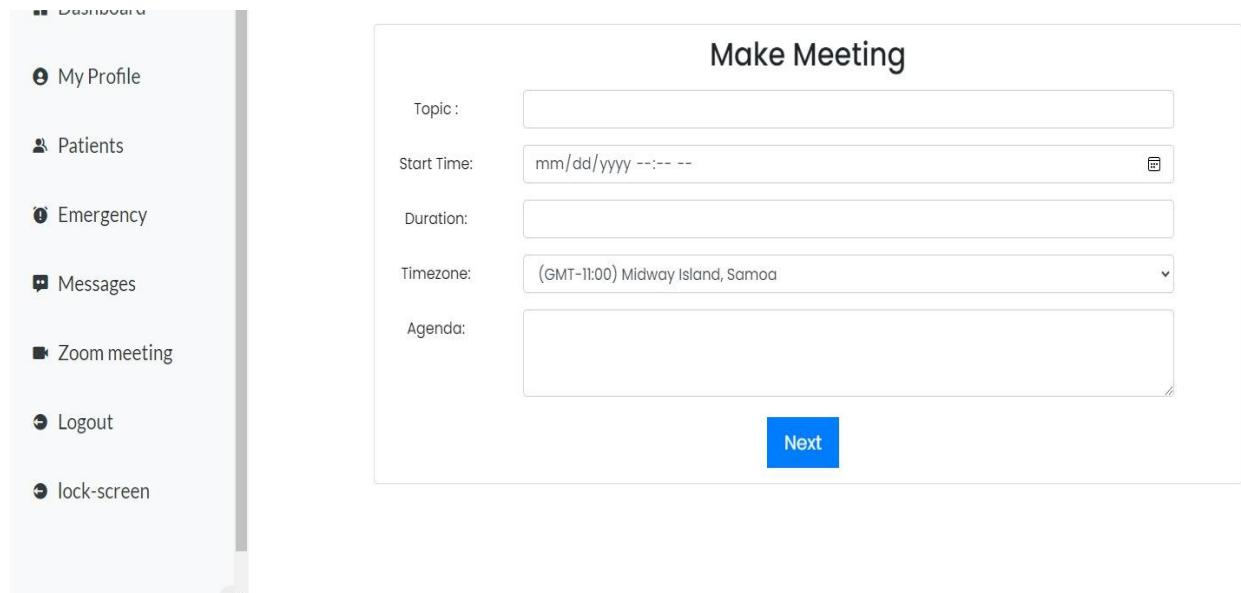


Figure 4-57. Zoom Meeting 2

4.3.4. LAB INTERFACE

- Laboratory dashboard that contain recent appointment wait for respond and statistical analysis of all past, recent requests and total revenue.

The screenshot shows the Al-Mokhtaber Lab Dashboard. At the top, there are four summary boxes: 'New Requests' (1), 'Booked Appointments' (1), 'Required Uploads' (1), and 'Total Revenue' (6890 EGP). Below these is a section titled 'New Booking Requests List' with a single entry:

MRN	Patient Name	Disease	Gender	Age	Test Name	Medicine	Booking Date	Address	Phone	Action
1	Osama Ahmed	Diabetes Type-1	Male	23 years	Complete Blood Count , Basic Metabolic Panel , Glomerular Filtration Rate , Creatinine Blood and Urine Tests	----	2023-05-31	001091643693		Comment ✓ ✗

Figure 4-58. Lab Dashboard

- Here the lab admin can process any of the booked appointments to confirm the date of the test and assign a laboratory physician to the patient.

The screenshot shows the 'Booked Appointments' section of the dashboard. It features a calendar for June 2023 with specific dates highlighted in yellow (e.g., June 15, 16, 22, 23) and a tooltip 'Ira Osama Ahmed'. To the right is a form for 'Today's Appointments' with fields for 'Patient Info' (MRN, Full Name, Email, Address, Phone), 'Payment' (Accepted Cards, VISA/Mastercard/Amex/Discover), 'Pay By' (Cache), 'Total Cost' (510 EGP), 'Payment Status' (Not Paid), 'Laboratory Physician ID' (Write Here..), 'Due Date' (mm/dd/yyyy), and a checkbox for 'Successful Payment Completed'. Buttons for 'Submit' and 'Edit' are at the bottom.

Figure 4-59. Lab Appointment

- At this page the lab admin can submit the test results to be delivered to patient, relative and doctor whom following this patient.

The screenshot shows the Al-Mokhtaber dashboard with the following interface elements:

- Header:** Al-Mokhtaber, Uploads, search, and user icons.
- Breadcrumbs:** Al-Mokhtaber - Dashboard / Booked Appointments / Required Uploads / Contact Patient.
- Section: Today's Required Uploads**
 - Osama Ahmed:** ID: 1, Remaining: 23H 42M, Test: Complete Blood Count, Basic Metabolic Panel, Glomerular Filtration Rate, Creatinine Blood and Urine Tests. A blue folder icon is next to the name.
- Section: Reminder of Next Uploads**
 - Ahmed Mosatfa:** ID: 2, Remaining: 2D 23H 42M, Test: Complete Blood Count. A blue folder icon is next to the name.

Figure 4-60. Submit Lab Result

4.3.5. RELATIVE INTERFACE

- Here sample of what the relative goes through before displaying the main dashboard he should first create account and after logging in he can choose any one from his followed patient list to show his case.

The registration form consists of the following fields:

- Username
- Email
- Password
- Confirm password
- City
- Country
- Phone Number

At the bottom are a "Register" button and a link "Already have account? Log in".

Figure 4-62. Register Relative

The interface displays the message: "Hello! Choose The Patient You Want To Follow-Up From Here". It features a dropdown menu labeled "Choose Patient Name" and a "Show Patient Case" button.

Figure 4-61. Relative Choose Patient

- This is the relative dashboard to follow patient current and previous measurement, to take control of his case and receiving emergency alarms or lab test results on behalf of the patient.

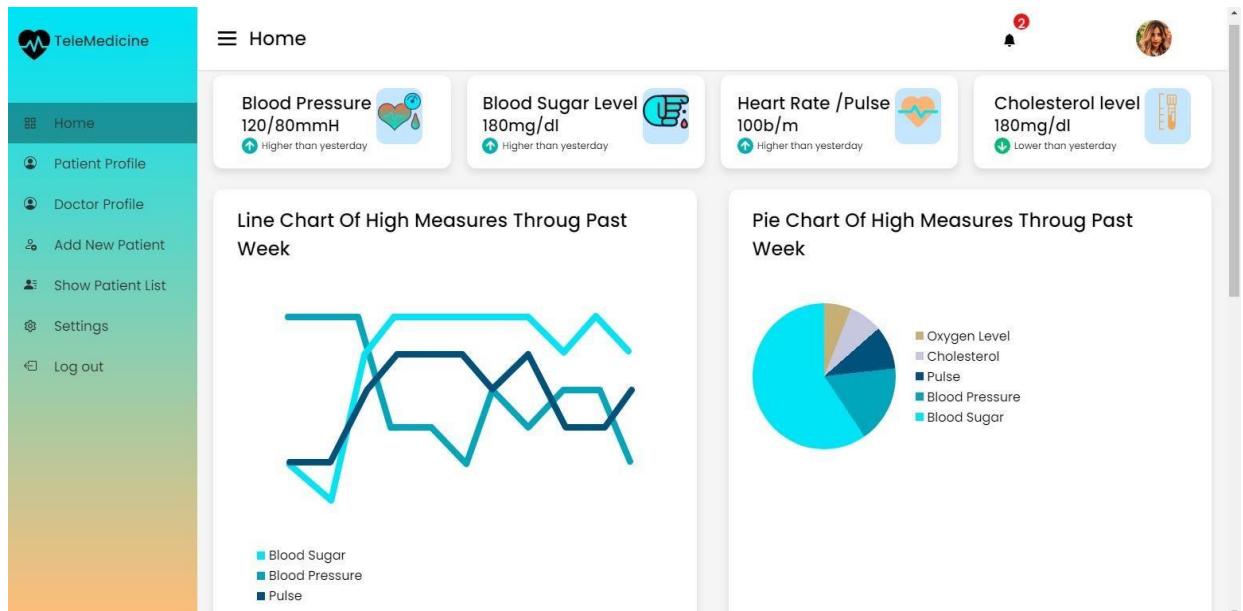


Figure 4-63. Relative Dashboard

- Patient profile page for displaying patient case information and personal information to his relative with message button to redirect relative to a chatting interface with this patient.

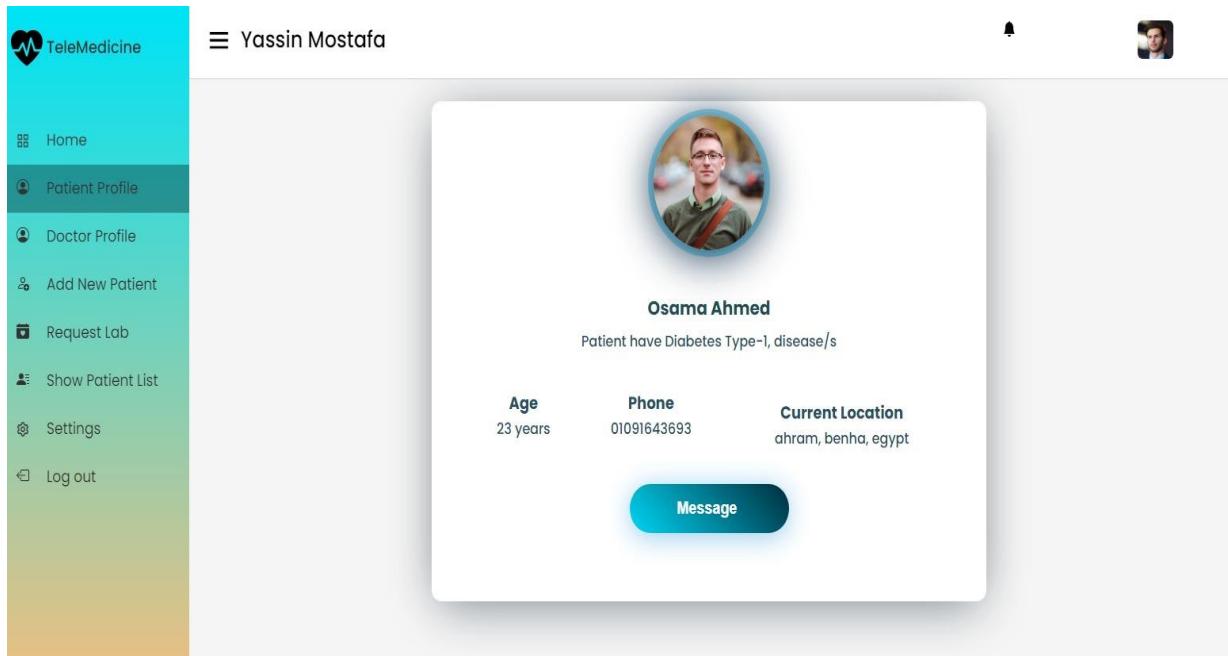


Figure 4-64. View Patient Profile to Relative

- The following screens are for first add anew patient to relative followed patients' list and second for showing the list of patient an individual relative follow and also can delete any of them.

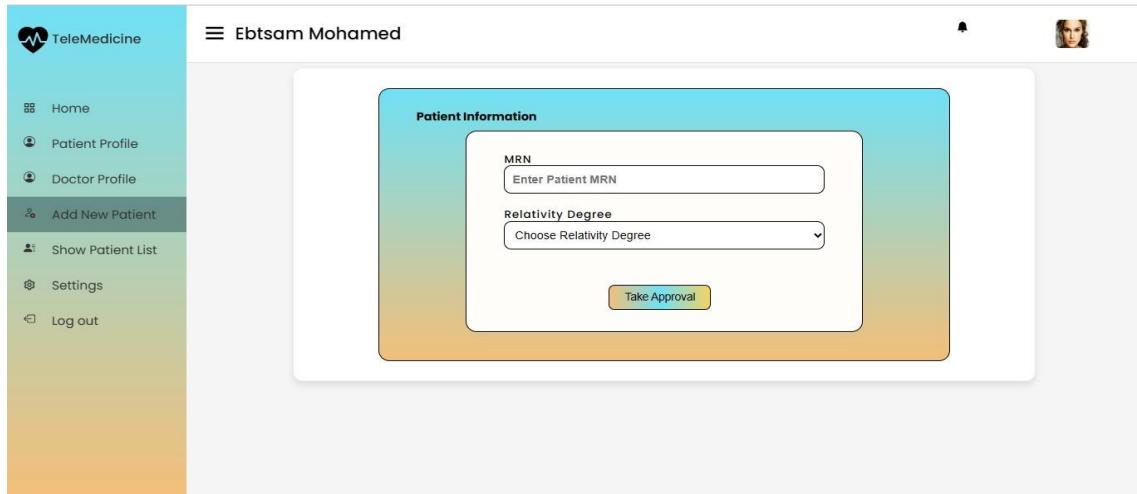


Figure 4-65. Relative Add patient

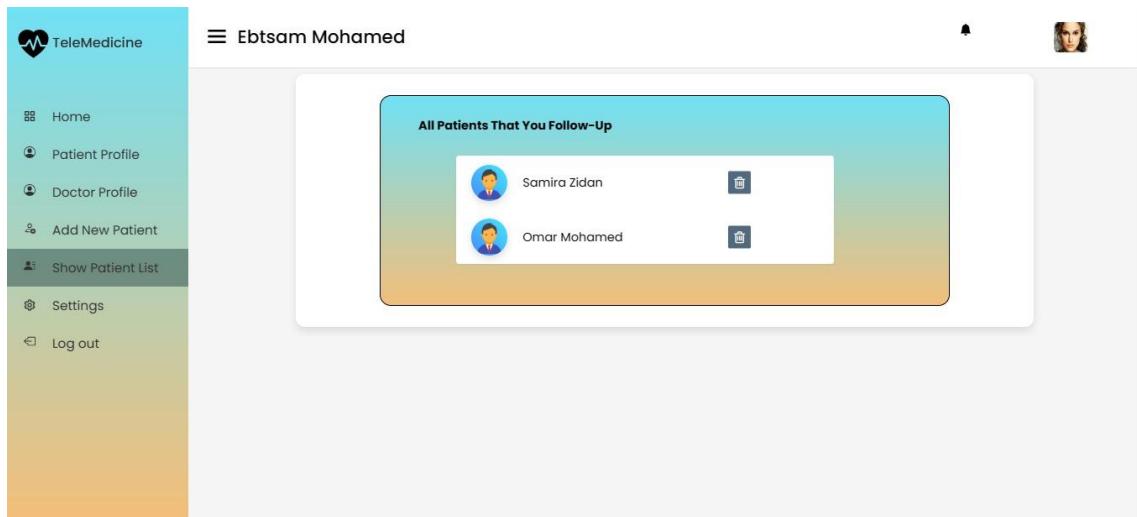


Figure 4-66. Relative followed patients ' List

4.4 SUMMARY

At the end of the analysis and design stage, we will have clarified the problem facing patients with chronic diseases, dividing the system into its components, and explaining the users of the system, who are patients, doctors, relatives, and first aid, and the functions that the system performs, and clarifying that the system can be shared by several users, and clarifying the diagrams that explain the progress of the information used in the system. The design phase is followed by the implementation phase.

Chapter Five

“DELIVERABLES AND EVALUATION”

Chapter Five

5 DELIVERABLES AND EVALUATION

5.1 PROJECT DELIVERABLES

- External deliverables: In addition to providing different platforms to the users according to user's types and functions they need; we also will provide medical device to patients after training them how to use it. Users would be delivered user manual which describes our system, we concern to explain to our users how to use the system either the software or the hardware which will be a simple medical device consisting of number of sensors to take some vital signs from patient, so we describe how to use it and how to act in non-expectable cases.

The software in user manual will be as design guidance document which will help the users to understand system interfaces and how to deal with it and also, we provide troubleshooting section to how deal with non-expectable errors.

- Internal deliverables: are medical reports provided to the patients, doctors, and relatives which reflect the patient's health condition according to his vital signs. We will also provide weekly and monthly reports to the users predicting if his health condition is stable or it will be sign to another harmful disease or even it will lead to bad stage in his disease.

We also will provide the tests' results to the patient, his relatives, and his specified doctor after uploading them in the system by the laboratory physician.

5.2 PRACTICAL IMPLEMENTATION

- We can spot on a very important function in our system which is “Notifications” which sent to patient, relative, doctor interfaces simultaneously in case that patient have emergency case and need to go hospital so we inform all users concerned to help the patient as fast as they could. Although the notifications not only for emergency it also used to inform users (Patient, Relative, Doctor) with the lab appointment confirmations and lab tests results.
- Process done as follow: when patient's entered measurements from both sensors and manual measurements exceed the normal ranges his case become an emergency case and the notifications then sent to all users.

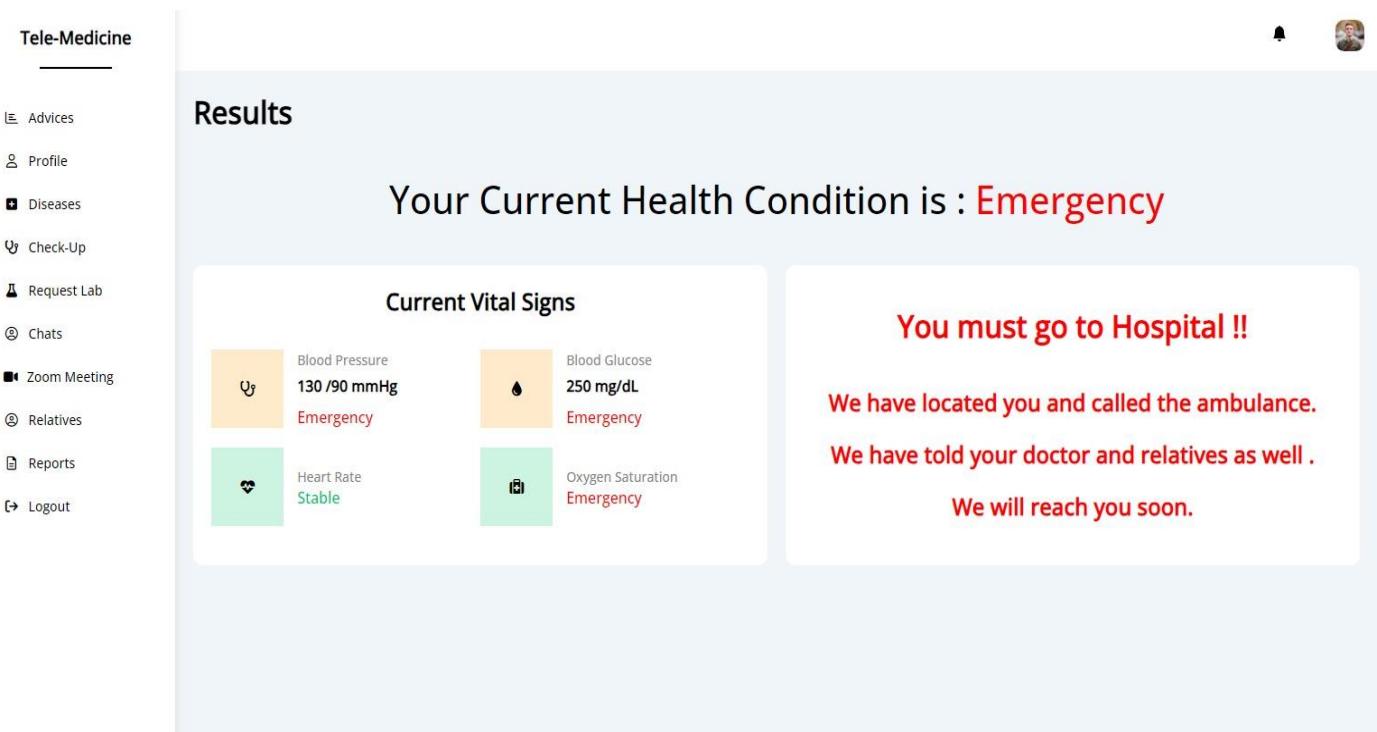


Figure 5-1. Patient Results

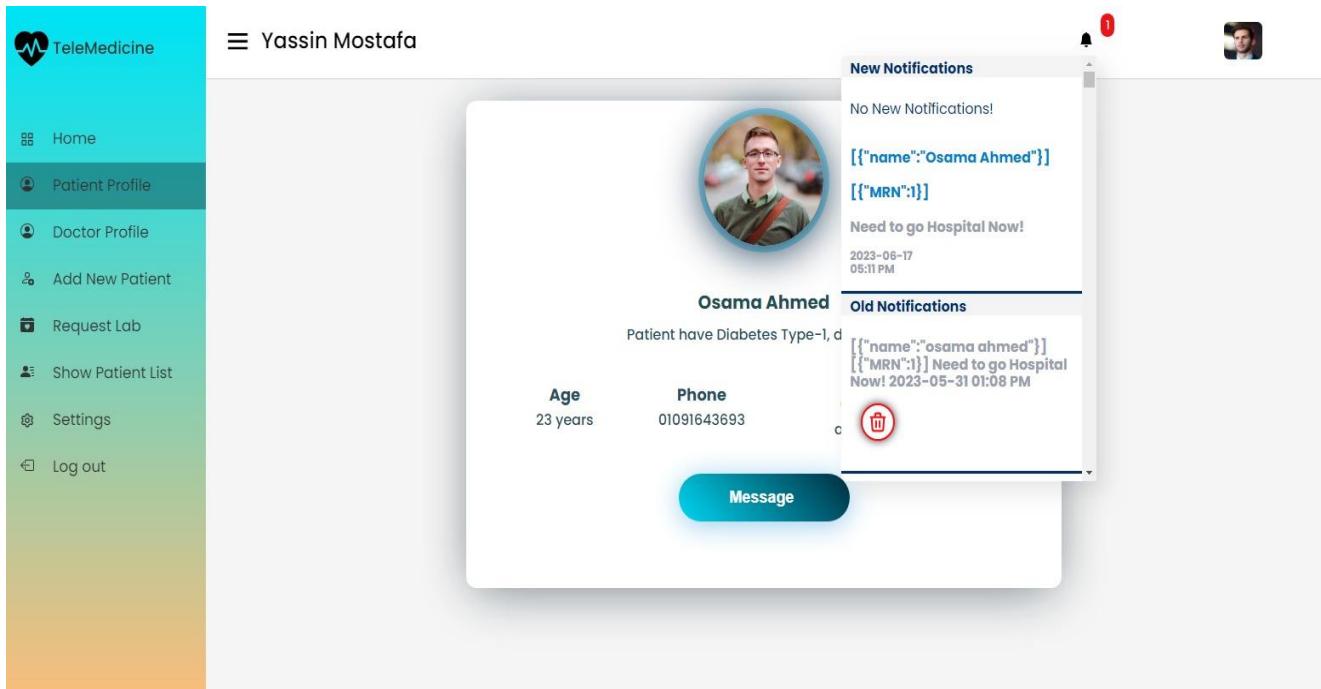


Figure 5-3. Relative Notifications

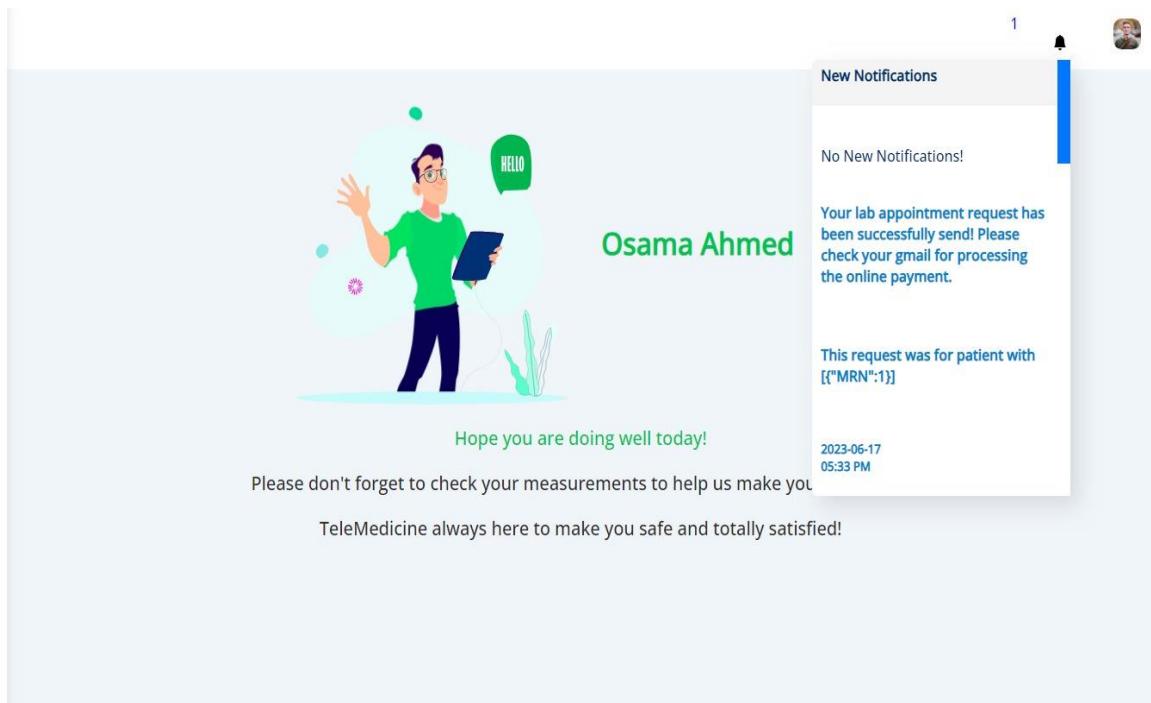


Figure 5-2. Patient Notifications

- By clicking on the emergency notification the user [Relative, Doctor] can get the current location of that patient by another new feature in our system which is “**Live Location**” to help patient get rapid support.



Figure 5-4. Patient Live Location

- Part Notification code from our source code:

```

File Edit Selection View Go Run Terminal Help
navbar.blade.php - HealthCareWebsite - Visual Studio Code
EXPLORER ...
HEALTHCAREWEBSITE
approval_form_after_mail.blade.php
chat_Relative.blade.php
Choose-Patient-Relative.blade.php
Doctor_profile_Relative.blade.php
forgetPass.blade.php
HomeRelative.blade.php
index.blade.php
Lab-main-template.blade.php
LabBookedAppointment.blade.php
LabChat.blade.php
LabCustomPagination.blade.php
LabDash.blade.php
LabImageView.blade.php
LabLogin.blade.php
LabMapView.blade.php
LabSearch.blade.php
LabUploads.blade.php
loginRelative.blade.php
MachineSurvey.blade.php
main_template_relative.blade.php
navbar.blade.php
New Text Document.txt
patient_Approval.blade.php
patient_profile_Relative.blade.php
PatientOrRelative.blade.php
PaymentError.blade.php
> OUTLINE
> TIMELINE
119 </div>
120
121 <div class="notification">
122   <a href="#">
123     <div class="notBtn" href="#">
124       <!--Number supports double digits and automatically hides itself when there is nothing between the numbers-->
125       <div class="dropdown dropdown-notifications">
126         <a href="#notifications-panel" class="dropdown-toggle" data-toggle="dropdown">
127           <i data-count="0" class="glyphicon glyphicon-bell notification-icon"></i>
128           <span class="notif-count"></span>
129         </a>
130       </div>
131       <svg style="margin-left: 50px; margin-top: -60px" xmlns="http://www.w3.org/2000/svg" width="100px" height="60px">
132         <path d="M8 16a2 2 0 0 2-2H6a2 2 0 0 0 2 2zm.995-14.901a1 1 0 1 0-1.99 0A5.002 5.002 0 0 1 16 16z" />
133       </svg>
134     <div class="boxnot">
135       <div class="cont">
136         <h4 style="margin-left: 10px; margin-top: 5px">New Notifications</h4>
137       </div>
138       <div class="sec">
139         <div class="collapse navbar-collapse">
140           <ul class="nav navbar-nav">
141             <li class="dropdown dropdown-notifications">
142               <div class="dropdown-container">
143                 <div class="dropdown-toolbar">
144                   &if($MRN_abnormalcase->isEmpty())&
145                     <div class="dropdown-toolbar-actions">
146                       | No New Notifications!
147                     </div>
148                   &endif
149               </div>
150             </li>

```

Ln 13, Col 11 Spaces: 4 UTF-8 CRLF

Figure 5-5. Notification Source Code 1

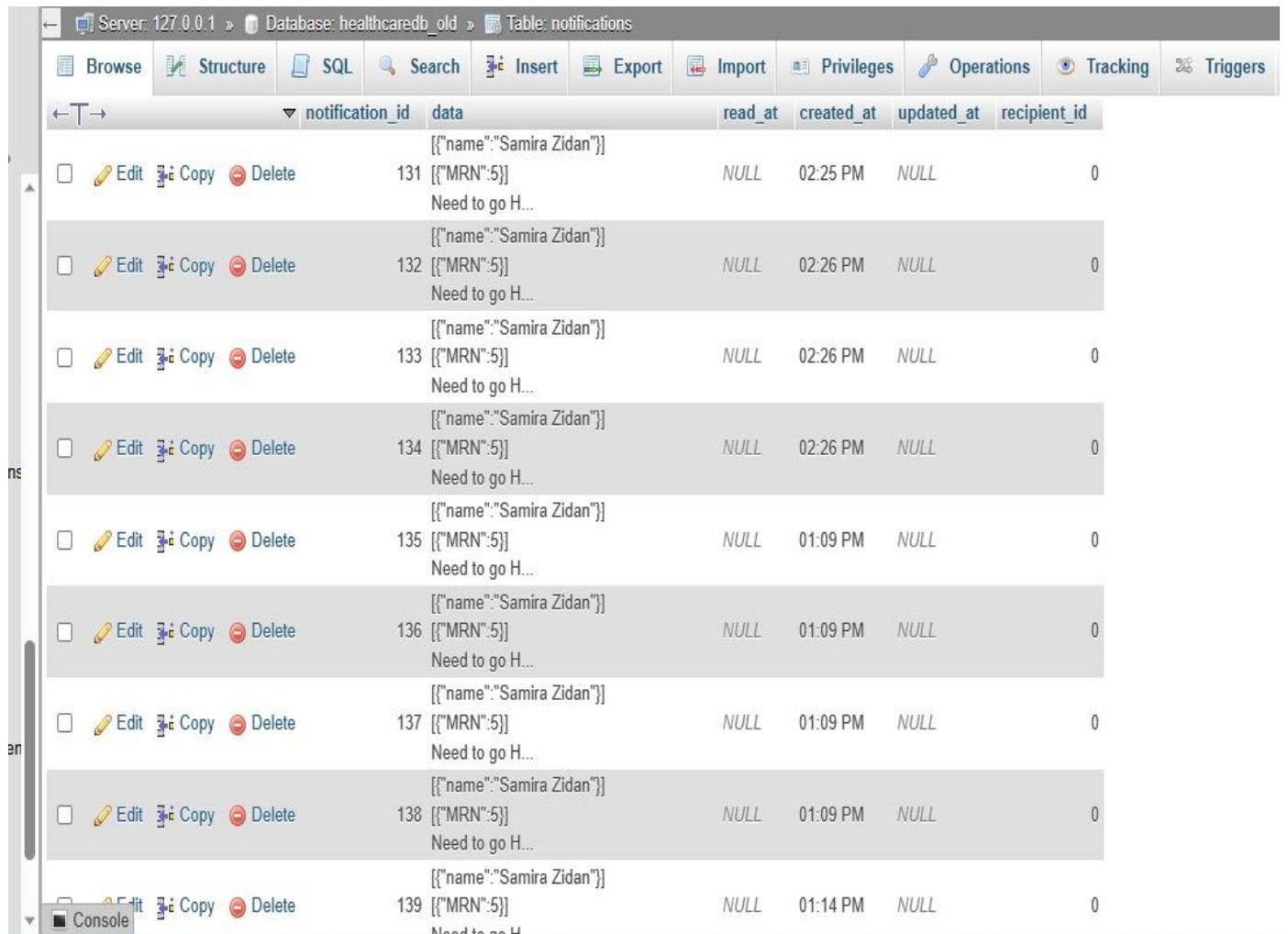
```

File Edit Selection View Go Run Terminal Help
pusherNotifications.js - HealthCareWebsite - Visual Studio Code
EXPLORER ...
HEALTHCAREWEBSITE
> .htaccess
> favicon.ico
> index.php
> robots.txt
> resources
  > css
  > js
  > views
    > emails
JS pusherNotifications.js ...
public > js > JS pusherNotifications.js ...
1 var notificationsWrapper = $('.dropdown-notifications');
2 var notificationsToggle = notificationsWrapper.find('a[data-toggle]');
3 var notificationsCountElem = notificationsToggle.find('i[data-count]');
4 var notificationsCount = parseInt(notificationsCountElem.data('count'));
5 var notifications = notificationsWrapper.find('ul.dropdown-menu');
6
7 // Subscribe to the channel we specified in our Laravel Event
8 var channel = pusher.subscribe('EmergencyAlarm');
9 // Bind a function to a Event (the full Laravel class)
10 channel.bind('NewNotification', function (data) {
11   var existingNotifications = notifications.html();
12   var newNotificationHtml =
13     | `^<a style="color:#3f81ce;"` + `^<div class="media-body"><h6 class="media-heading text-right" style="font-size:medium; margin-bottom:0">` + data.notification.message + `^</h6>` + `^</div>` + `^</a>`;
14   notifications.html(newNotificationHtml + existingNotifications);
15
16   notificationsCount += 1;
17   notificationsCountElem.attr('data-count', notificationsCount);
18   notificationsWrapper.find('.notif-count').text(notificationsCount);
19   notificationsWrapper.show();
20
21 });
22
23 channel.bind('LabNotification', function (data) {
24   var existingNotifications = notifications.html();
25
26   var newNotificationHtml =
27     | `^<a style="color:#3f81ce;"` + `^<div class="media-body"><h6 class="media-heading text-right" style="font-size:medium; margin-bottom:0">` + data.notification.message + `^</h6>` + `^</div>` + `^</a>`;
28   notifications.html(newNotificationHtml + existingNotifications);
29

```

Figure 5-6. Notification Source Code 2

- Part of Notification Database:



The screenshot shows the MySQL Workbench interface with the following details:

- Server:** 127.0.0.1
- Database:** healthcaredb_old
- Table:** notifications

The table structure is as follows:

	notification_id	data	read_at	created_at	updated_at	recipient_id
	131	["name":"Samira Zidan"] [{"MRN":5}] Need to go H...	NULL	02:25 PM	NULL	0
	132	["name":"Samira Zidan"] [{"MRN":5}] Need to go H...	NULL	02:26 PM	NULL	0
	133	["name":"Samira Zidan"] [{"MRN":5}] Need to go H...	NULL	02:26 PM	NULL	0
	134	["name":"Samira Zidan"] [{"MRN":5}] Need to go H...	NULL	02:26 PM	NULL	0
	135	["name":"Samira Zidan"] [{"MRN":5}] Need to go H...	NULL	01:09 PM	NULL	0
	136	["name":"Samira Zidan"] [{"MRN":5}] Need to go H...	NULL	01:09 PM	NULL	0
	137	["name":"Samira Zidan"] [{"MRN":5}] Need to go H...	NULL	01:09 PM	NULL	0
	138	["name":"Samira Zidan"] [{"MRN":5}] Need to go H...	NULL	01:09 PM	NULL	0
	139	["name":"Samira Zidan"] [{"MRN":5}] Need to go H...	NULL	01:14 PM	NULL	0

Figure 5-7. Notification Database

- In our system we allow patient to pay the lab tests cost through online payment using “**MyFatoorah**” by first send an email to him as bellow picture after the lab accepted and processed the appointment process.

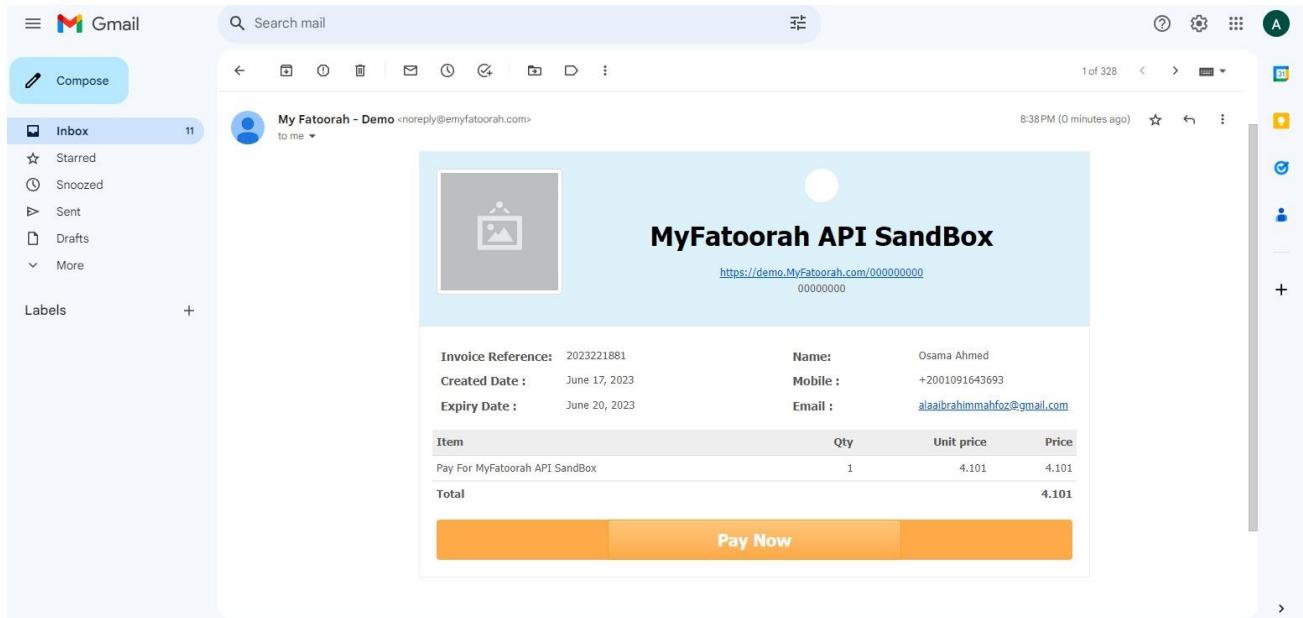


Figure 5-8. Online payment 1

- When user Click on Pay Now button that redirect him to the payment processing page as bellow:

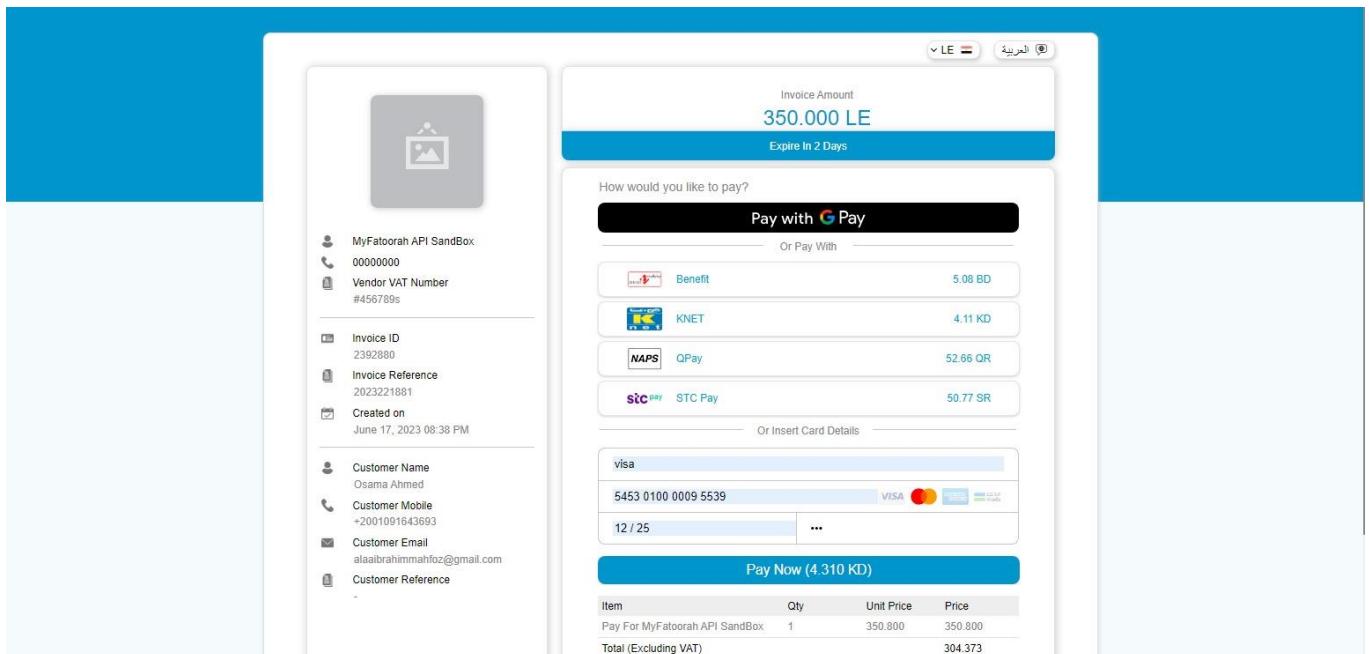


Figure 5-9. Online Payment 2

- Success Message appear here to confirm the successful payment process.

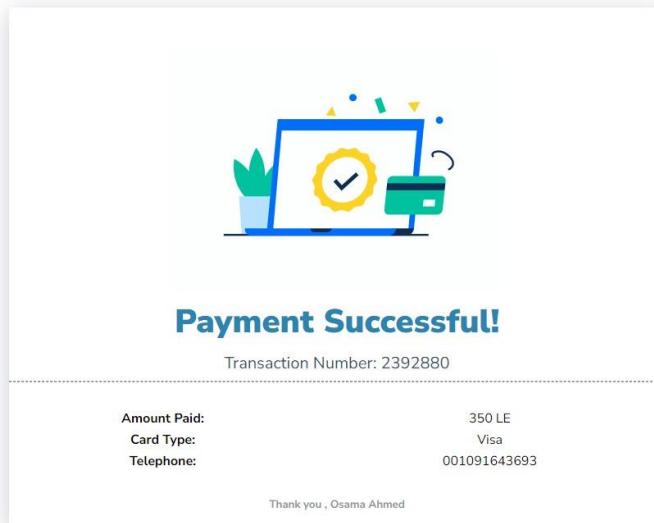


Figure 5-11. Online Payment 3

- Here is a part of online payment source code:

```

File Edit Selection View Go Run Terminal Help PaymentController.php - Gradpro - Visual Studio Code
EXPLORER GRADPRO ...
> .vscode
> app
> Events
> Exceptions
> Http
> Controllers
> Auth
> DoctorAuth
> PatientAuth
Controller.php
DoctorController.php
LabAdminController.php
LabRequestController.php
PatientController.php
PaymentController.php
RelativeController.php
RelativeSettingsController.php
ReportPDFController.php
ResetPassController.php
ZoomController.php
> Middleware
> Requests
> Services
Kernel.php
> Mail
> Models
> Providers
> bootstrap
> config
> database
> lang
> OUTLINE
> TIMELINE
app > Http > Controllers > PaymentController.php > App\Http\Controllers\PaymentController > DashAccept
200 //Online Payment
201 $data = [
202     'NotificationOption' => 'ALL', // SMS, 'EML', or 'ALL'
203     'InvoiceValue' => $result_decoded[0]['payment'],
204     'CustomerName' => $result_decoded[0]['name'],
205     'DisplayCurrencyIso' => 'EGP',
206     'MobileCountryCode' => '+20',
207     'CustomerMobile' => $result_decoded[0]['phone'],
208     'CustomerEmail' => $result_decoded[0]['email'],
209     //callback -> if payment process is successfully done
210     'CallBackUrl' => 'http://127.0.0.1:8000/LabPayment/Success',
211     'ErrorUrl' => 'http://127.0.0.1:8000/LabPayment/Error',
212     'Language' => 'en'
213 ];
214 $paymentData = $this->fatoorahServices->sendPayment($data);
215 $invoiceID = $paymentData['Data'][0]['InvoiceId'];
216 $invoiceURL = $paymentData['Data'][0]['InvoiceURL'];
217 if(session('relative_id')){
218     $patient_MRN = DB::table('lab_appointment')
219         ->join('patient', 'patient.MRN', '=', 'lab_appointment.MRN')
220         ->where('lab_appointment.status', '=', 'booked')
221         ->where('lab_appointment.appointment_id', '=', $id)
222         ->join('patient_relatives', 'patient_relatives.MRN', '=', 'patient.MRN')
223         ->where('patient_relatives.relative_id', session('relative_id'))
224         ->select('patient.MRN')
225         ->get();
226 }else{
227     $patient_MRN = DB::table('lab_appointment')
228         ->join('patient', 'patient.MRN', '=', 'lab_appointment.MRN')
229         ->where('lab_appointment.status', '=', 'booked')
230         ->where('lab_appointment.appointment_id', '=', $id)
231         ->where('patient.MRN', session('id'))
232         ->select('patient.MRN')
233         ->get();
234 }
235 $data = [
236     'MRN' => $patient_MRN,
237 ];
238 event(new LabNotification_onlinePay($data));

```

Figure 5-10. Online Payment Code

- Additional feature in the system is to enable system users to chat with each other through the system.

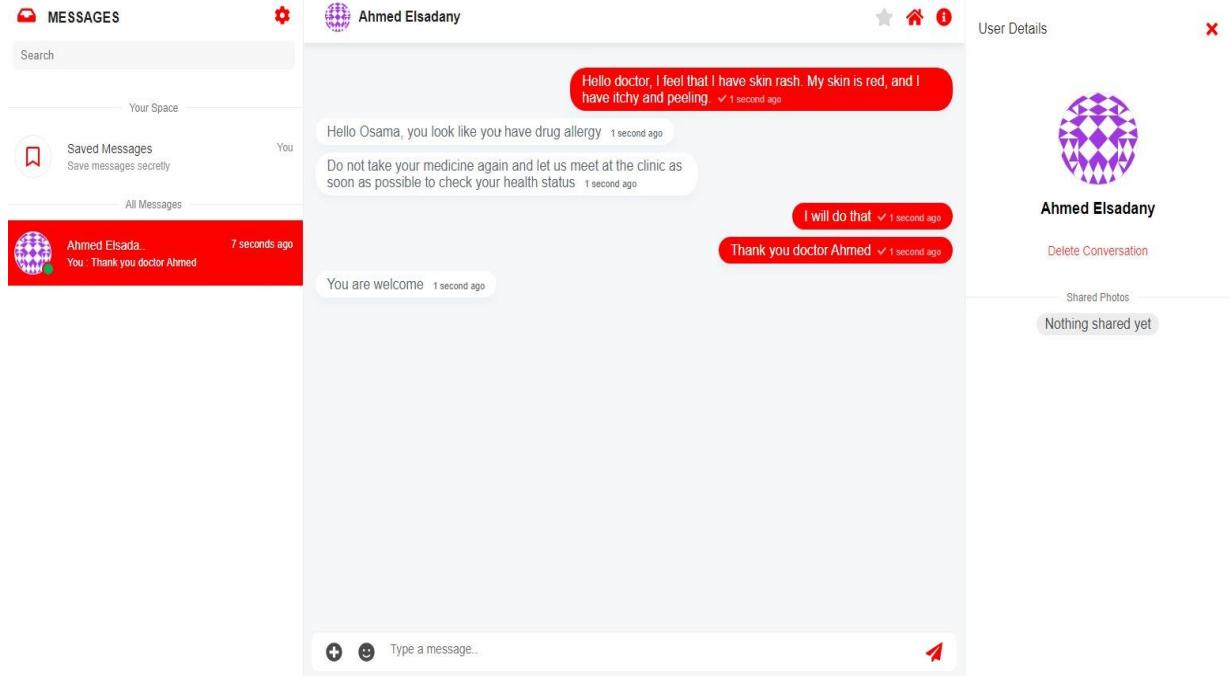


Figure 5-12. Chat Interface

- Part of chat source code:

The screenshot shows a Visual Studio Code editor window with the file 'messageCard.blade.php' open. The code is a Blade template for a message card. It includes PHP syntax and HTML/CSS. The code handles different message types (text, images, files) and includes logic for attachments and user interactions. The file is part of a project structure under 'GRADPRO' which includes 'resources', 'views', 'auth', 'doctor_auth', etc.

```

File Edit Selection View Go Run Terminal Help messageCard.blade.php - Gradpro - Visual Studio Code
EXPLORER resources > views > vendor > Chatify > layouts > messageCard.blade.php
1 <?php
2 $seenIcon = (!$seen ? 'check-double' : 'check');
3 $timeAndSeen = "<span data-time='{$created_at}' class='message-time'>
4 | ".($isSender ? '<span class='fas fa-$seenIcon seen'>' : '') . "<span class='time'$timeAgo</span>
5 | </span>";
6 ?>
7
8 <div class="message-card @if($isSender) mc-sender @endif" data-id="{{ $id }}>
9 | {{-- Delete Message Button --}}
10 | @if ($isSender)
11 | | <div class="actions">
12 | | | <i class="fas fa-trash delete-btn" data-id="{{ $id }}></i>
13 | | </div>
14 | @endif
15 | {{-- Card --}}
16 | <div class="message-card-content">
17 | | @if (@$attachment->type != 'image' || $message)
18 | | | <div class="message">
19 | | | | @if ($message == null && @$attachment != null && @$attachment->type != 'file') ? $attachment->title : nl2br($message) !!
20 | | | | (! $timeAndSeen !)
21 | | | | {{-- If attachment is a file --}}
22 | | | | @if(@$attachment->type == 'file')
23 | | | | | <a href="{{ route(config('chatify.attachments.download_route_name'), ['fileName'=>$attachment->file]) }}" class="file-download"
24 | | | | | | <span class="fas fa-file"></span> {{($attachment->title)}</a>
25 | | | | @endif
26 | | | </div>
27 | | @endif
28 | | @if(@$attachment->type == 'image')
29 | | | <div class="image-wrapper" style="text-align: {{($isSender ? 'end' : 'start')}}">
30 | | | | <div class="image-file chat-image" style="background-image: url('{{ Chatify::getAttachmentUrl($attachment->file) }}')">
31 | | | | | <div>{{ $attachment->title }}</div>
32 | | | | </div>
33 | | | <div style="margin-bottom:5px">
34 | | | | </div>
35 | | @endif
36 | </div>
37 | | </div>
38 | </div>
39 | </div>
40

```

Figure 5-13. Chat Source Code

- Part of chat Database:

Type to filter these. Enter	<input type="checkbox"/> Show all	Number of rows:	25	<input type="button"/> Filter rows:	Search this table	Sort by key:	None				
<input type="button"/> Extra options											
	<input type="button"/> Edit	<input type="button"/> Copy	<input type="button"/> Delete	id	from_id	to_id	body	attachment	seen	created_at	updated_at
<input type="checkbox"/>	Edit	Copy	Delete	e2ff80ca-bff2-4215-ac97-9c7abd3dd1f2	2	1	You are welcome	NULL	1	2023-06-17 17:58:09	2023-06-17 17:58:16
<input type="checkbox"/>	Edit	Copy	Delete	e3b21812-e5ba-4296-8e8b-76389f60d1b7	1	2	Thank you doctor Ahmed	NULL	1	2023-06-17 17:57:42	2023-06-17 17:57:47
<input type="checkbox"/>	Edit	Copy	Delete	68d46753-5c8e-4296-8fd3-97eaf15edbdd	1	2	I will do that	NULL	1	2023-06-17 17:57:12	2023-06-17 17:57:47
<input type="checkbox"/>	Edit	Copy	Delete	bb653162-857f-4a45-a609-dddb06704327	2	1	Do not take your medicine again and let us meet at...	NULL	1	2023-06-17 17:56:29	2023-06-17 17:56:40
<input type="checkbox"/>	Edit	Copy	Delete	e0be2784-06ba-4491-9174-598ed74f0fb	2	1	Hello Osama, you look like you have drug allergy	NULL	1	2023-06-17 17:55:26	2023-06-17 17:56:40
<input type="checkbox"/>	Edit	Copy	Delete	8f583cf3-5d56-4bc3-93bf-c94f86c466ef	1	2	Hello doctor, I feel that I have skin rash. My ski...	NULL	1	2023-06-17 17:52:44	2023-06-17 17:55:19

Figure 5-14. Chat Database

- Last and One of most important component in system is Hardware.

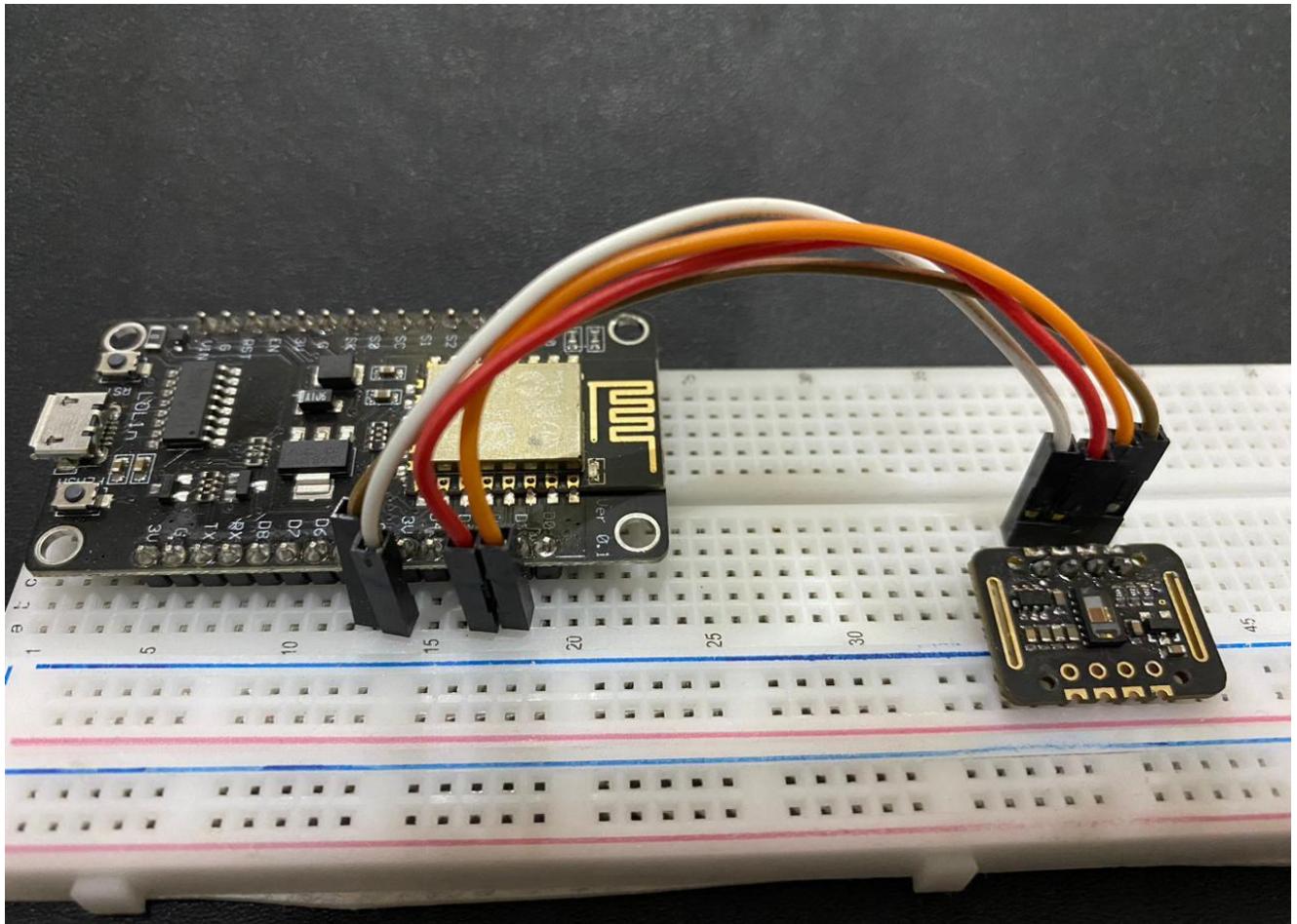


Figure 5-15. Hardware Components

- Sensor Database:

The screenshot shows the phpMyAdmin interface for the 'sensordata' table in the 'healthcaredb' database. The table has columns: id, heart, oxygen, created_at, updated_at, and patient_id. The data consists of 54 rows, each with a unique ID, heart rate, oxygen level, timestamp, and patient ID.

	Edit	Copy	Delete	id	heart	oxygen	created_at	updated_at	patient_id
	Edit	Copy	Delete	1	112	81	2023-04-22 20:30:23	NULL	1
	Edit	Copy	Delete	2	122	96	2023-04-22 20:30:53	NULL	1
	Edit	Copy	Delete	3	144	85	2023-04-22 20:31:06	NULL	1
	Edit	Copy	Delete	4	86	86	2023-04-22 20:31:39	NULL	1
	Edit	Copy	Delete	5	122	95	2023-04-22 20:32:10	NULL	1
	Edit	Copy	Delete	6	98	95	2023-05-01 20:32:23	NULL	1
	Edit	Copy	Delete	7	122	84	2023-05-01 20:32:41	NULL	1
	Edit	Copy	Delete	8	91	90	2023-05-01 20:32:52	NULL	1
	Edit	Copy	Delete	9	116	90	2023-05-01 20:33:08	NULL	1
	Edit	Copy	Delete	10	113	90	2023-05-01 20:33:22	NULL	1
	Edit	Copy	Delete	29	83	31	2023-05-01 20:33:24	NULL	1
	Edit	Copy	Delete	33	115	73	2023-05-01 20:33:26	NULL	1
	Edit	Copy	Delete	34	88	45	2023-05-01 20:33:30	NULL	1
	Edit	Copy	Delete	39	68	53	2023-05-01 20:33:32	NULL	1
	Edit	Copy	Delete	40	93	33	2023-05-25 12:38:53	NULL	1
	Edit	Copy	Delete	45	136	89	2023-05-25 12:40:28	NULL	1
	Edit	Copy	Delete	47	115	88	2023-05-25 12:41:06	NULL	1
	Edit	Copy	Delete	50	166	97	2023-05-25 12:42:00	NULL	1
	Edit	Copy	Delete	52	107	92	2023-05-25 12:42:39	NULL	1
	Edit	Copy	Delete	54	68	72	2023-05-25 12:43:16	NULL	1

Figure 5-16. Sensor Database

- Patient Vital Signs Database:

The screenshot shows the phpMyAdmin interface for the 'patient-vital-sign' table in the 'healthcaredb' database. The table has columns: diastolic, systolic, report, glucose, symptoms, effects, measureTextArea, recorded_at, glucose_result, pressure_result, heart_result, and oxygen_result. The data consists of 11 rows, each with vital sign measurements and associated symptoms and effects.

	diastolic	systolic	report	glucose	symptoms	effects	measureTextArea	recorded_at	glucose_result	pressure_result	heart_result	oxygen_result
1	123	156	emergency	337	blurred vision,feeling tired all the time,dizzy/ab...	new heart palpitations,tendon, muscle or joint pai...	NULL	2023-05-27 19:31:15	emergency	emergency	emergency	emergency
1	128	233	emergent	355	like I have the flu,fever,blurred vision,feeling t...	new heart palpitations,tendon, muscle or joint pai...	NULL	2023-05-27 19:31:15	emergency	emergency	emergency	emergency
1	135	231	emergency	232	fever,short of breath,blurred vision,very hungry, ...	Soft stools, short-term diarrhea,Headache	NULL	2023-05-27 20:08:39	emergency	emergency	stable	stable
1	88	154	emergency	235	like I have the flu,like I have to vomit,short of ...	new heart palpitations,skin rash that may include ...	NULL	2023-05-27 21:48:18	emergency	stage1	stable	stable
1	83	96	emergency	50	like I have the flu,like I have to vomit,sleepy,fe...	new heart palpitations,Soft stools, short-term dia...	NULL	2023-05-27 23:29:23	emergency	stage1	stable	stable
1	90	140	emergency	40	NULL	NULL	NULL	2023-05-31 15:50:34	emergency	emergency	stable	stable
1	90	140	emergency	40	NULL	NULL	NULL	2023-05-31 15:55:44	emergency	emergency	stable	stable
1	90	140	emergency	40	like I have the flu,like I have to vomit,sleepy,fe...	NULL	NULL	2023-06-15 22:00:00	emergency	emergency	stable	stable
1	80	120	stable	120	NULL	NULL	NULL	2023-06-16 02:22:54	stable	stable	stable	stable
1	90	130	emergency	250	blurred vision	oedema	NULL	2023-06-17 20:11:41	emergency	emergency	stable	emergency

Figure 5-17. Patient Vital signs Database

- Part of Hardware Code:

```
serial.println("Connecting");
while(WiFi.status() != WL_CONNECTED) {
    delay(300);
    Serial.print(".");
}
Serial.println("");
Serial.print("Connected to WiFi network with IP Address: ");
Serial.println(WiFi.localIP());
```



```
while (!particleSensor.begin()) {
    Serial.println("MAX30102 was not found");
    delay(1000);
}
```



```
particleSensor.sensorConfiguration(/*ledBrightness=*/50, /*sampleAverage=*/SAMPLEAVG_4, \
/*ledMode=*/MODE_MULTILED, /*sampleRate=*/SAMPLERATE_100, \
/*pulseWidth=*/PULSEWIDTH_411, /*adcRange=*/ADCRANGE_16384);
}
```



```
int32_t SPO2; //SPO2
int8_t SPO2Valid; //Flag to display if SPO2 calculation is valid
int32_t heartRate; //Heart-rate
int8_t heartRateValid; //Flag to display if heart-rate calculation is valid
```



```
void loop()
{
    Serial.println(F("Wait about four seconds"));
    particleSensor.heartrateAndOxygenSaturation(/*&SPO2= */&SPO2, /*&SPO2Valid= */&SPO2Valid, /*&heartRate= */&heartRate, /*&heartRateValid= */&heartRateValid);
    //Print result
    Serial.print(F("heartRate="));
    Serial.print(heartRate, DEC);
    Serial.print(F(", heartRateValid="));
```

Figure 5-18. Hardware Source Code

Chapter Six

“CONCLUSION”

Chapter Six

6 CONCLUSION

5.1. INTRODUCTION

In this chapter, we will discuss the outcomes of our project that we have accomplished till now. The main outcome of the system is to follow up and classify a patient's health condition as stable, unstable, or emergency case. If the system classification indicates the patient to stable case the measurements of the patient's vital signs are stored in the database. Once the doctor wants to view the patient's medical record the data comes directly from the database and is displayed to the doctor. Then the doctor can take any action like writing notes or changing medications.

If the system classification indicates the patient to an unstable case, after storing measurements in the database. This patient is highlighted in a separate table and got high priority so the doctor can view his report first.

If the system classification indicates the patient to an emergency case. An alarm is sent to the doctor and his relatives and can also send this alarm to the emergency department at the hospital.

Relatives can track all these actions and always be updated with the latest report of the patient's health condition. Relatives have a connection with the doctor and can view the medical report.

The system allowed the patient to make his lab tests easier. All he has to do is to send a request to the lab then the lab will accept or reject this request.

This chapter provides a reflection on the system process. The importance and the limitations are discussed, as well as the implications for the interpretation of the results. This chapter ends with several recommendations for the future.

5.2. MAIN FINDING

Measurements taken by sensors or entered manually into the website are stored directly in the database and analyzed by the system to classify the health condition of the patient whether it's stable, unstable, or emergent then a decision is made by the doctor based on the previous classification.

The main users of the system are patients with chronic diseases like diabetes, CHD, or CKD who need to track their health state especially if they are living on their own.

Medical staff like a doctor who is responsible for following up this patient. Relatives of this patient who have the authority to track his case and check it from time to time. They are also able to communicate with the doctor who is following up their patient. The last user is the lab which is responsible for receiving lab test requests then accepting them and sending the technician to the patient's address or rejecting his request.

There are many services provided to the users using our system. For the patient, we provide him with sensors at affordable prices. These sensors are connected to our system. For relatives, we provide them with the ability to track and check the condition of their patients all the time. For doctors, we provide them the ability to display and follow up their patients if both of them are at different locations. Doctors can take decisions according to the case whether to send him an ambulance, write new notes or ask for a lab test.

All these operations are connected with each other in our system whether using the website or the mobile application. Any operation done in the system is stored in the database. All data is retrieved and displayed from the database.

We need to pay money for the hardware and provide it to the users. We also need to pay more money for the maintenance and enhancement of the system

5.3. WHY IS THIS PROJECT IMPORTANT

This system is very important for all users (patients, medical organizations, relatives, and lab)

Our system will help any health organization in decision-making, especially in critical situations by providing a fast and accurate response.

The following points will explain the importance of the system:

- Our system reduces the number of patients in health organizations and also reduces the risk of getting any infection or disease.
- The system decreases the interaction between the patient and the doctor by providing sensors to measure some vital signs at home.
- Decision-making became easier and more accurate based on the patient's condition and degree of danger. The system will provide a number of patients and classify them into normal, unstable, and emergency cases. all these numbers are viewed by the doctor so he can access any medical record and take appropriate action

- We provide a link between the patient and his authenticated relatives through the system even if they are in different countries
- Relatives can track their patient's health condition through the application or website and view his medical record anytime
- Providing a chat between the relatives and the doctor makes communication between them easier and faster.
- It helps in decision-making in critical situations which need fast action in emergency cases like a patient getting into a coma or falling suddenly.
- Providing periodical follow-up for the elder living alone and patients having chronic diseases and generating monthly statistical reports of their health condition
- The clarity and ease of the application and website interface make use of the system very easy and will attract others to deal with it.
- Providing the ability for patient's relatives to receive an alarm in an emergency and know actions taken and updates on the patient's condition also tracking the ambulance on its way to the patient.
- Generating a daily report of a patient's case will allow the doctor to check the condition of the patient faster and easier and write notes or new medicines.
- This report can also be accessed by the relatives to view the new updates
- Sending a verification message to the patient asking permission for those who need to track his condition enhances security. This feature will prevent unauthorized persons from viewing the patient's condition
- Adding actors in the system like a lab makes communication easier between patients asking for a lab test and the lab. Sending a request then the lab will accept or reject the request all these operations are done in our system using a simple interface.
- The result of the test will automatically be updated in the patient's medical record so that doctors can view it by viewing this record and writing new notes if they exist.
- Providing communication methods between patient and doctor and between patient and lab makes the system more consistent and integrated.
- Allowing a patient to add more than one relative and all of them can track the patient's condition makes our system more effective.

- The same patient can choose more than one disease which makes our system powerful.

5.4. FUTURE WORK

- Adding new diseases and enabling the system to track them.
- Improve the performance of the system and reduce the error rate.
- Increasing the speed of the system and the model while maintaining or increasing its accuracy.
- Provide a model to detect the probability of a diabetic patient contracting coronary heart disease.
- Provide a model to detect the probability of a diabetic patient contracting chronic kidney disease.
- Make pharmacies and radiology centers part of the system.
- Adding more sensors and uploading the readings to the system directly to replace entering measurements manually.
- Enhance the system to include the whole hospital.
- Use diabetes measurements to detect the probability of contracting another disease.
- Improve the hardware device to provide higher accuracy and efficiency.
- Apply the system in many hospitals and clinics.
- Using more advanced sensors and technologies to facilitate using our system.
- Provide a model to detect a suitable diet for diabetic patients.
- Provide reports of the patient's health condition over a long period.

5.5. CONCLUSION SUMMARY

Chronic diseases are diseases or conditions that usually last for 3 months or longer and may get worse over time. Chronic diseases tend to occur in older adults and can usually be controlled but not cured. The most common types of chronic diseases are heart disease, diabetes, and kidney disease. Chronic diseases require ongoing medical attention or limit activities of daily living or both. In our system, we focus on three of these chronic diseases: Diabetes, coronary heart disease (CHD), and chronic kidney disease (CKD).

We help the patient control his disease by providing a system tracking his health condition. The system can also classify his case whether it's normal, abnormal, or emergent. The system provides a connection between the patient and his doctor. The system enables relatives of the patient to track their patient's condition and see his medical reports, in addition to the ability to communicate with the doctor of their patient.

Our system takes into consideration epidemic periods and overcrowding in hospitals, so we decrease the crowding at hospitals especially when there is an epidemic or any infectious diseases. In addition to decreasing the crowd at medical organizations, we reduce face-to-face interaction between medical staff and patients. Tracking diabetic, kidney disease patients, or patients after heart surgeries from home became true nowadays.

We provide the patient with sensors to measure some vital signs, these measures are added to our system to classify them as normal or abnormal and stored in a database. Doctors can check these measures whenever he wants to write new recommendations or take appropriate actions. An alarm is sent directly to the doctor, the emergency department of the hospital, and the patient's relatives in emergency cases.

We facilitate the process of making lab tests, patients send a request to a lab then the lab will send a response whether by sending a technician to the patient's current location or rejecting the request.

Using our website and mobile application all these operations can be done smoothly.

Finally our main slogan is “Stay Home, Stay Safe” which mean that we can afford comfort and safety to our patients with the least effort from them because we care about them and need to facilitate all medical services to them from their comfort home.

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- <https://laravel.com/docs/10.x>
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- <https://devnote.in/laravel-8-custom-pagination-example/>
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- <https://github.com/DFRobot>

ملخص المشروع

يناقش هذا المشروع مشكلة ما زالت حية و موجودة بين معظم المرضى. خاصة المصابين بأمراض مزمنة. الغرض من هذا المشروع هو تقليل أو تقييماً إلغاء حاجة المرضى الذين يعانون من أمراض مزمنة من الإقامة الدائمة في المستشفيات. إلغاء الزيارات المستمرة للأطباء بالمستشفى بشكل منتظم. خاصة بالنسبة لكتاب السن هم الفئة الأكثر عرضة للإصابة بالأمراض المزمنة التي تتطلب زيارات متكررة.

تم تصميم هذا المشروع لإيجاد حل للأشخاص الذين يعانون من هذه الأمراض المزمنة ، بما في ذلك: الأشخاص المصابون بمرض القلب المزمن أو الذين خرجموا حديثاً من العمليات الجراحية ويحتاجون إلى متابعة مستمرة ، لكن لا يمكنهم الإقامة بشكل دائم في المستشفيات أو الخروج طوال الوقت لزيارة الطبيب بسبب حالتهم الصحية وكذلك المصابين بمرض الكلى المزمن وكذلك مرض السكري بجميع أنواعه.

أفضل الحلول لهذه المشكلة هو متابعة مرضى الأمراض المزمنة من المنزل. تسجيل وإدارة حالاتهم الصحية وسجلاتهم الطبية على أساس يومي وشهري ، وعمل المخططات والتقارير الطبية لتسهيل متابعة الحالة الصحية للمريض. من المفترض أيضاً إنشاء نظام أوسع لإدارة سجلات المرضى وبعض أقاربهم وبيانات الأطباء وبيانات المختبر.

تم تنفيذ المشروع بشكل واقعي يتاسب مع المجال الطبي من خلال بناء تطبيق ويب يتميز بسهولة الوصول إليه والتعامل معه. يوفر النظام عرض بيانات المريض للطبيب والأقارب والمختبر عند الحاجة. كل هذا لجعل المريض يتمتع بحالة مستقرة وكأنه داخل المستشفى. بالإضافة إلى ذلك ، يتيح هذا التطبيق التواصل بين جميع هذه الكيانات. يتم تخزين معظم العلامات الحيوية للمريض في قاعدة بيانات لعرضها في تقريره الطبي باستخدام أجهزة استشعار تُعطى للمريض ، ويتم تطبيق نموذج التعلم الآلي لاكتشاف احتمالية الإصابة بأمراض القلب كخدمة إضافية. يمكن التطبيق أقارب المريض أو الأشخاص المعنيين بأمره من متابعة حياته الصحية بشكل مستمر. بالإضافة إلى امكانية التواصل مع المختبرات الطبية لطلب إجراء أي من التحاليل الطبية اللازمة للمريض.



كلية الحاسوبات والذكاء
الاصطناعي



جامعة بنها

نظام مراقبة الرعاية الصحية للأمراض المزمنة

مشروع التخرج المقدم استيفاءً جزئيًّا لمتطلبات درجة بكالوريوس الحاسوبات والذكاء الاصطناعي

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