كلية الصيدلة
PHARMACY

جامعة ٦ أكتوبر
October 6 University

علوم الحاسب ونظم المعلومات
Info Sys & Comp Science

Graduation Project

Clinical Pharmacist Recommendation System

By

Abdelrahman gaber sayed Abdelmajeed	CS
Mohamed Abdelmoneim Elsayed Mohamed	CS
Karim Abd El-Raouf Mohamed Abd El-Raouf	CS
Ahmed Ayman Ahmed Sayed	IS
Boshra Alameer Mohamed Abdulhamed	CS
Abdullah Mustafa Muhammed Ahmed	CS

Supervised by

Prof. Dr. Hussam Elbehiery

Dr. Mohamed Abdelsattar

Coordinator
(Faculty of Pharmacy at O6U)

Prof. Dr. Samir Osman
(Vice dean Faculty of Pharmacy)

Dr. Ahmed Essam
(Assistant lecturer in Clinical Pharmacy Department)

Co- Supervisor

Eng. Ahmed sherif

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Acknowledgment

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It is a blessing from Allah that we reach where we are now, this stage which is preparation for a new life full of adventures and risks. It is a new challenge in which we ask Allah to do well. We actually started preparing for the graduation project about five months ago, analyzing it, collecting data, and forming a desired and semi-final form. Now, we present it to you, hoping for your approval. We are glad to receive your suggestions and your observations to produce it in the best possible way on the digital system.

We had to thank the supervisors from the members' body and the supporting staff, as well as our coordinators from the College of Pharmacy during the previous period, which was preparation for the start of coding.

We are particularly thankful to the Dean **Dr. Nabila Mohamed Hassan** for her guidance and constant supervision as well as for allowing us to collect data and conduct analysis that would not have been possible otherwise.

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Abstract

Abstract

Clinical pharmacists play a vital and effective role with the diagnosed doctors to provide the best care for the patient and follow up on the developments of his health condition. Clinical pharmacists can adjust the treatment plan of the diagnosed doctor after the doctor approves his suggestions.

In the framework of the Egyptian state's endeavor to digitize things and dispense with paper-based dealing because of the fatigue and waste of time and effort it entails, the Faculty of Pharmacy on October 6 University asked us to present this service - the clinical pharmacist service - in digital form due to what he suffers in making recommendations and take their approval in writing, as well as write reports on patients and transform them at the end of each month as an excel sheet file.

Chapter One

"Introduction"

Chapter One
Introduction

1.1 What is the Clinical Pharmacy? And Who is the Clinical Pharmacist?

Clinical pharmacy is defined by the job of the clinical pharmacist. **Clinical pharmacists** work directly with physicians, other health professionals, and patients to ensure that the medications prescribed for patients contribute to the best possible health outcomes. So, they have frequented and regular interactions with physicians and other health professionals, contributing to better coordination of care.

Clinical pharmacists are frequently granted patient care privileges by collaborating physicians and health systems that allow them to perform a full range of medication decision-making functions as part of the patient's health care team UNDER CONDITION of getting acceptance from the physician who directly diagnosed the patient.

This means some points concerting to the clinical pharmacists:

1- they accompany the specialist doctor in the hospital.

2- they **visit** all hospitalized patients to review the medication regimen,

follow their progress to determine the effects of medications on their health, and **assess** the status of their health problems and determine whether the prescribed medications are optimally meeting the patient's needs and goals of care,

3- The work of the clinical pharmacists takes place after the treating physician diagnoses and writes the medication prescription

4- The clinical pharmacists cannot acknowledge a medication modification except after the doctor's approval, and if the doctor refuses and something unexpected happens to the patient; The responsibility lies with the attending physician.

5- They refer the patient to his or her physician or other health professionals to address specific health, wellness, or social services concerns as they arise.

6- They continue to follow up until one of these cases occurs:

- disease recovery and discharge from the hospital.
- transfer the patient to another hospital.
- patient death.

7- Finally, if the patient has been recovered and will charge the hospital, a clinical pharmacist should hold a session with the patient to give him some tips and warnings. They advise the patient on how to best take his or her medications and support the health care team's efforts to educate the patient on other important steps to improve or maintain health, such as exercise, diet, and preventive steps like immunization.

1.2 Actually, What and How a clinical pharmacist do his tasks?

As we have said, the clinical pharmacist accompanies the specialist doctor in the hospital, he is responsible for visiting all hospitalized patients to review the medication regimen and follow their progress.

If he notices:

- a change in the patient's status for the worse, or
- that the treatment prescribed by the doctor diagnosed has a conflict between medications and others, or

- that the number of doses of a particular drug should be changed, or
- other reason that cause anxiety,

Then, he resorts to writing some recommendations to the doctor who diagnosed this patient based on the situation he sees, asking for approval to acknowledge it to the patient. He consults with the patient's physicians and other health care providers to develop and implement a medication plan that can meet the overall goals of patient care established by the health care team. **Accordingly,** the doctor's approval or not is the criterion for acknowledgement the clinical pharmacist's recommendations.

After that, the clinical pharmacist must make a hand-written report about this patient, his/her status and some other important attributes which have been set as a standard form from the Egyptian Ministry of Health.

Monthly, it is a must that every clinical pharmacist collect his/her written reports and transfer them into an Excel file, which is the standard of the Egyptian Ministry of Health.

This standard sheet:

- includes many important useful attributes as [patient medical record, problem type, clinical pharmacist recommendation, …, etc.].
- is attached with this documentation.
- we will talk about its attributes in detail later.

1.3 From the benefits of this sheet

1- Proof of the clinical pharmacist's work status and his follow-up of patients. This is important for the hospital manager.

2- Documenting the opinion of the clinical pharmacist in each case and the opinion of the attending physician in the modifications that the clinical pharmacist sees, Even if any worsening of the patient's condition or status. It is a serious matter for accounting and investigations.

3- This helps to maintain different pathological conditions in different conditions. This makes it easier for the entire medical staff later when diagnosing or following up on a new patient.

4- It is certain that changing the number of drug doses or any modification will change the economic return, whether for the patient or the hospital. Calculation of this return may depend on the patient’s position regarding his presence in health insurance or not?

From this point on, the idea of this system came at the request of the project Co-Ordinator from the Faculty of Pharmacy, October 6 University, which came as follows:

Building a mobile application aims to:

1- Collecting the recommendations of the clinical pharmacist in hospitals.

This means replacing the paper report written by the clinical pharmacist with a digital report through this system.

2- Calculating the economic return on the hospital and the patient.

1.4 From the benefits of this system

1- Saving time and effort for the employee responsible for collecting written reports and entering them into the Excel file.

As the clinical pharmacist will write the report directly through the application.

2- Trying to make a stronger analysis of patients' cases and economic returns.

1.5 Description of the system

- The system will allow the clinical pharmacist to send his recommendations to the attending physician, asking for approval by writing them on the application or writing them on paper and doing a scan for them. This, of course, is in addition to preserving the possibility of obtaining approval on paper, as is the case now.

- The doctor will also be able to send the response directly to the clinical pharmacist, whether by approval or rejection, or by scanning the paper response.

- If the clinical pharmacist and the attending physician need to discuss, in addition to the central system located in the hospital, the system will allow chatting between the two parties or making a voice call through the phone operating system.

- If the clinical pharmacist or the attending physician feels any sense that the other part always rejects his/her decisions for any reason, whether for personal reasons or a sense of complicity with a certain pharmaceutical company, for example, to market its product, then he can send a contradiction/complaint to the hospital manager directly

But the manager's decision will be on the ground, not by application.

- The hospital manager, departments managers or the responsible employee can at any time view the detailed reports for any clinical pharmacist or for all of them.

- The system will perform a complete analysis of the work of every pharmacist and doctor, as well as statistics of the economic return on the patient and the hospital.

1.6 Tools and Technologies Suggested

1.6.1 TechnologiesForMobile Application Development

- Dart Programming Language.
- Flutter Framework.
- Clean Architecture.
- MVVM Architecture.

1.6.2 Technologies For Web Development

1.6.2.1 Frontend

- Html
- CSS
- JavaScript
- Bootstrap or tailwind CSS
- React JS

1.6.2.2 Backend

- Nodejs
- Express
- Mongo dp

1.6.3 Tools

- Git and GitHub
- Chrome Dev Tools
- Figma UI Design Tool

Chapter Two

"Literature Review"

Chapter Two

Literature Review

2.1 Similar projects

2.1.1 Electronic Health Records (EHR)

Electronic Health Records (EHR) is probably the most popular and the most crucial type of healthcare software. EHR systems store patients' data: medical and family history, laboratory and other test results, prescribed medications history, and more. The most important EHR feature is that the patient's health information can be created and managed by authorized providers, and then shared with other providers across more than one healthcare organization. This does not only automate and streamline the providers' workflow, as they do not need to collect the same information all over again from the same patient, but they also visibly improve the patient's care. EHRs reduce errors, improve patient safety, and support better patient outcomes. Some of the EHRs not only keep records of patient medications and allergies but automatically check an integrated medication database when a new medication is prescribed to alert the doctor to a potential conflict or allergy. They often include a finance module for invoicing and payment with billing information, and all of them: a separate portal for the patient to access their data. Overall, EHRs reduce the risk of data replication, losing data, or important information about a patient's health. They are also cost-efficient, compared to paper medical records, which are more likely to be duplicated, illegible, or destroyed over a long period of time. EHRs are used in both clinics and hospitals and are usually integrated with internal hospital/clinic management software.

2.1.2 E-prescriptions software

E-prescriptions software may differ from country to country as it's highly reliant on Government regulations. The core value, however, does not change. E-prescribing software allows doctors not only to write new prescriptions but also to track the prescriptions history, renew or cancel them if necessary. In some countries, the software enables direct contact with a pharmacy of your choice for convenience. In general, E-prescriptions software increases patients' and doctors' safety and time and allows doctors to check for any conflicts with the already taken medications.

2.1.3 Medical billing software

Billing software is dedicated to financial operations at healthcare institutions. It helps manage invoices, receipts, and insurance claims, and allows for all transactions. Healthcare billing software is still available as stand-alone apps, but many Hospital Management Systems also offer this feature.

2.1.4 Central Square Medworxx

Medworxx, from Central Square, is a predictive analytics software solution for hospitals, aiming to provide better data to improve care coordination and patient satisfaction. The solution equips healthcare team with clinical-decision support software that takes the guesswork out of capacity management across the entire hospital.

2.1.5 Aarogya

Aarogya is hospital management software that manage the operations of small, medium and large hospitals, investigations labs and polyclinics. The vendor states it can improve the operational efficiency, reduces medical error, and delivers quality of care. It maintains records of the patients and their medical

history. It is designed to help hospitals deal with patient invoicing, report generation and other administrative tasks.

2.2 CRP Requirements

2.2.1 Business requirements

-CPR (Clinical pharmacist Recommendations) will allow hospital's clinical pharmacist and doctor to communicate to share information specifically drugs conflicts and recommendations in order to save time and make it easy to analyze the mistakes and costs.

-CPR will provide a financial information to the hospital specifically the cost of the drugs doses in order to save money on the hospital.

2.2.2 User requirements

-The manager shall create the hospital, add or remove the doctors and clinical pharmacists, have access to the reports and convert it to Excel sheet.

-The clinical pharmacist shall upload a patients report to the application in order to allow the doctor to review the report and make his reply (rejection or acceptance).

-The system shall calculate the cost saved and spent on the drugs.

2.2.3 Software requirements

2.2.3.1 Functional requirements

-The user shall choose between sign in with an (email if he is a manager or username if he is an employee) and password from 8 characters or "register a hospital."

-If the user chooses “register a hospital.” then the system will request his information (Full name*, Email*, Password*, Phone number) and his hospital information (Hospital name*, Address).

-The manager shall add an Employee (Full name*, Category “doctor or clinical pharmacist”*, Phone number, username*, password*).

-The clinical pharmacist shall add a new report containing:

- Patient information (Medical record number*, Name, Phone, Age, Gender, Department).
- Doctor name*.
- Problem information (as included in the Excel sheet).
- Recommendations.

-If the clinical pharmacist added the report then the doctor included in the report get notified and the report get added to clinical pharmacist’s report history.

-If the doctor received a notification he can accept or reject from the notification and this report get added to his report history. -The clinical pharmacist shall communicate with the doctor as a text message or show his number to call him.

-Each registered user can export his report history at any time as an Excel sheet. -The system will calculate the spent money on each drug for each patient.

2.2.3.2 Non-functional requirements

-None of the employees can access another employee’s report list. The system should not take no longer than 5 seconds delay from any operation.

-The system can work under any condition and under any number of users.

2.3 System Design Model

The system design model that we use is agile model according to system needs and our team suggestions.

2.3.1 What is agile model ?

Agile is iterative approach is taken and working software build is delivered after each iteration. Each build is incremental in terms of features; the final build holds all the features required by the customer.

2.3.2 Phases of Agile Model.

- Requirements gathering.
- Design the requirements.
- iteration.
- Testing.
- Deployment.
- Feedback.

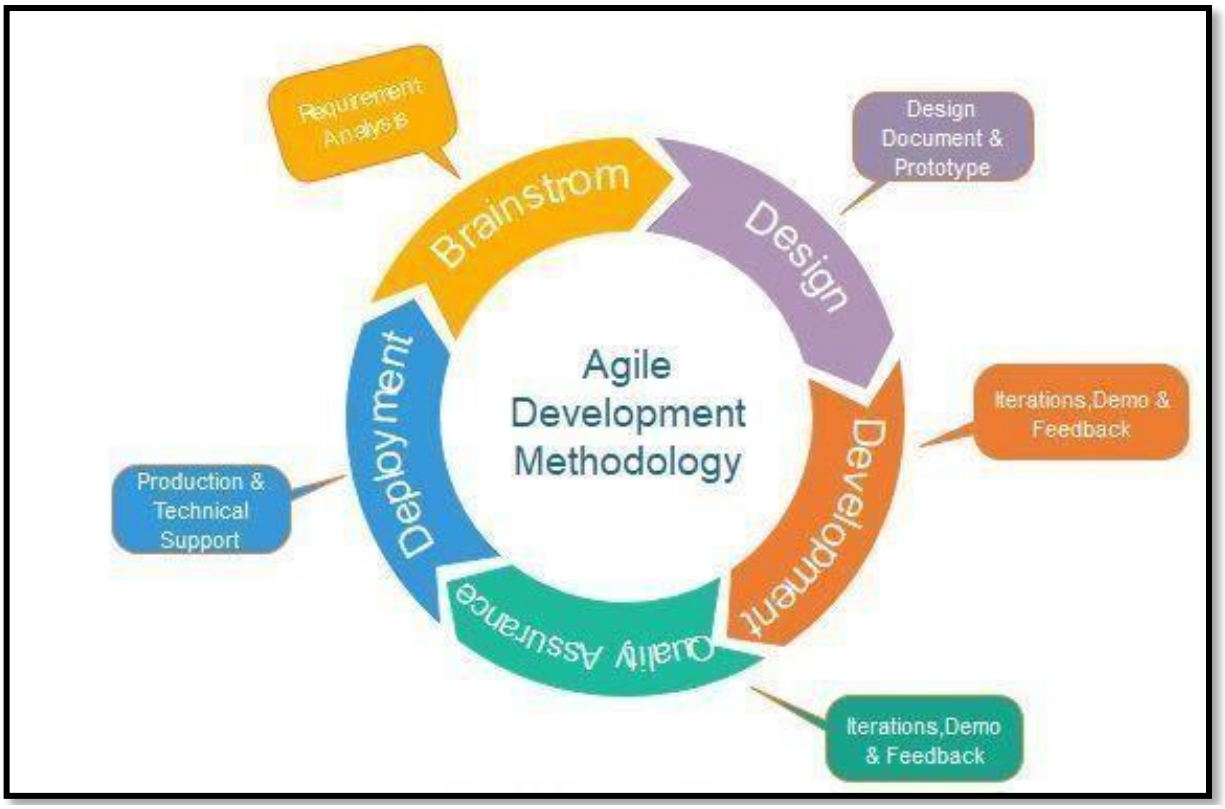

Fig. 2.1 Agile Model Digram

2.3.3 Advantages of agile model.

- Is a very realistic approach to software development.

- Suitable for fixed or changing requirements.

- Gives flexibility to developers.

2.3.4 Disadvantages of agile model.

- Depends heavily on customer interaction, so if customer is not clear, team can be driven in the wrong direction.

- Due to the shortage of formal documents, it creates confusion and crucial decisions taken throughout various phases can be misinterpreted at any time by different team members.

Chapter Three

"Methodology"

Chapter Three : Methodology

3.1 System Models

3.1.1 Interaction perspective

3.1.1.1 Use Case Diagram

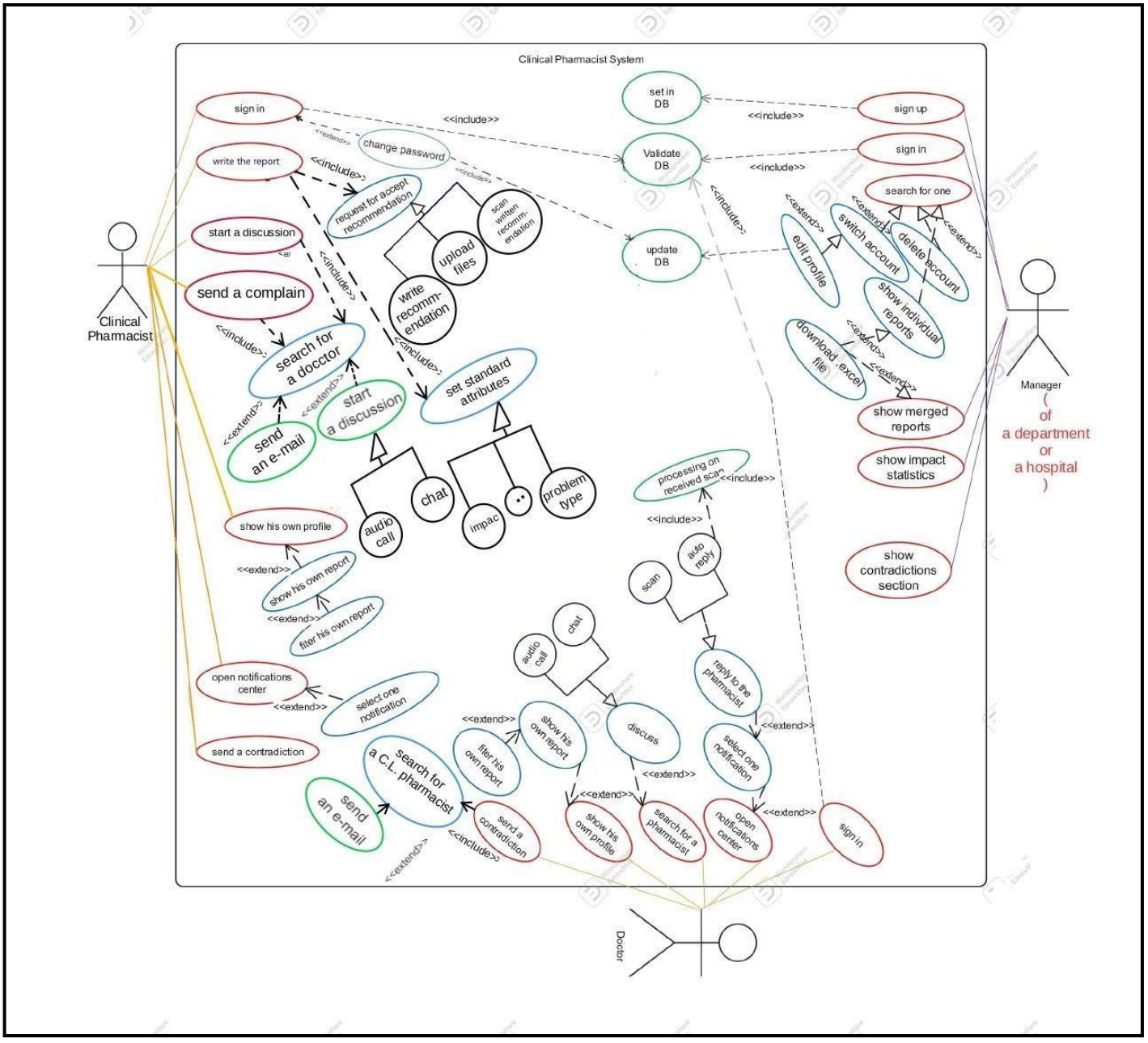

Fig. 3.1 Use Case Diagram

3.1.1.2 Sequence Diagram

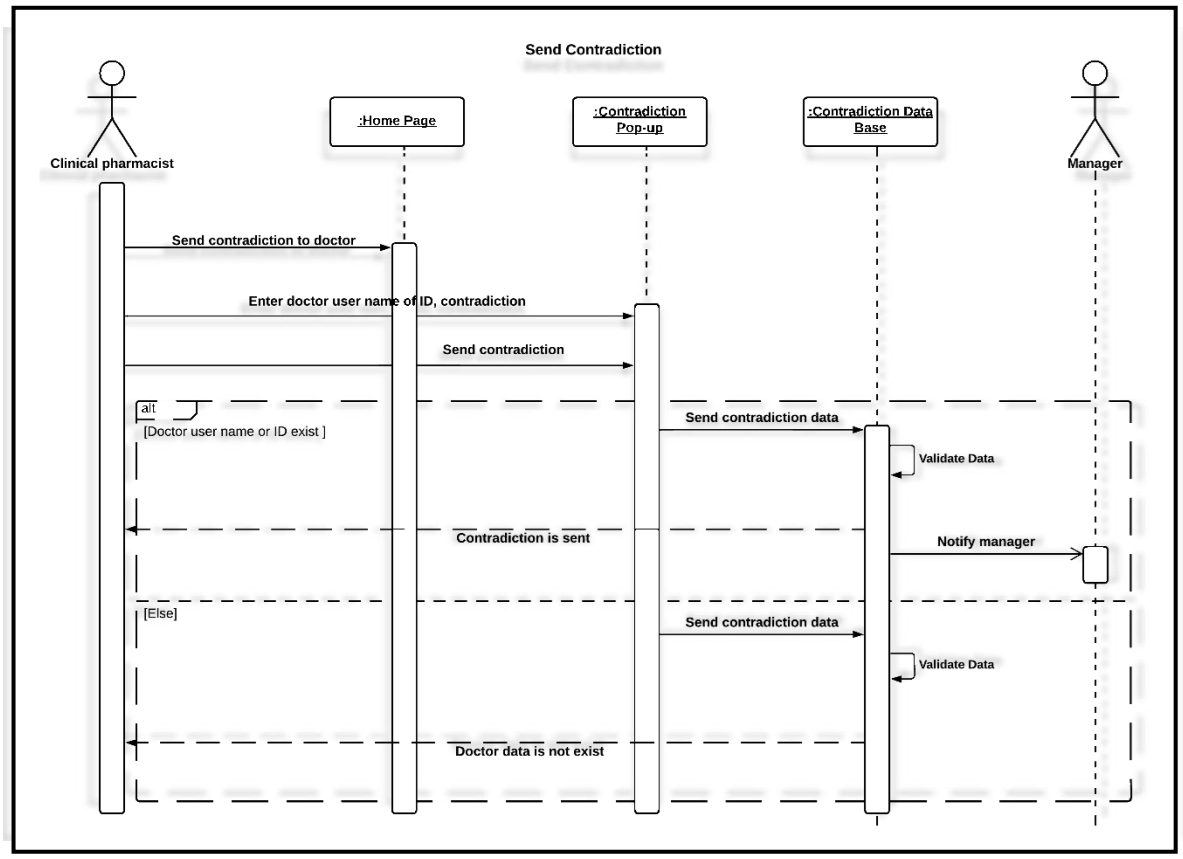

Fig. 3.2 Sequence Diagram-send contradiction

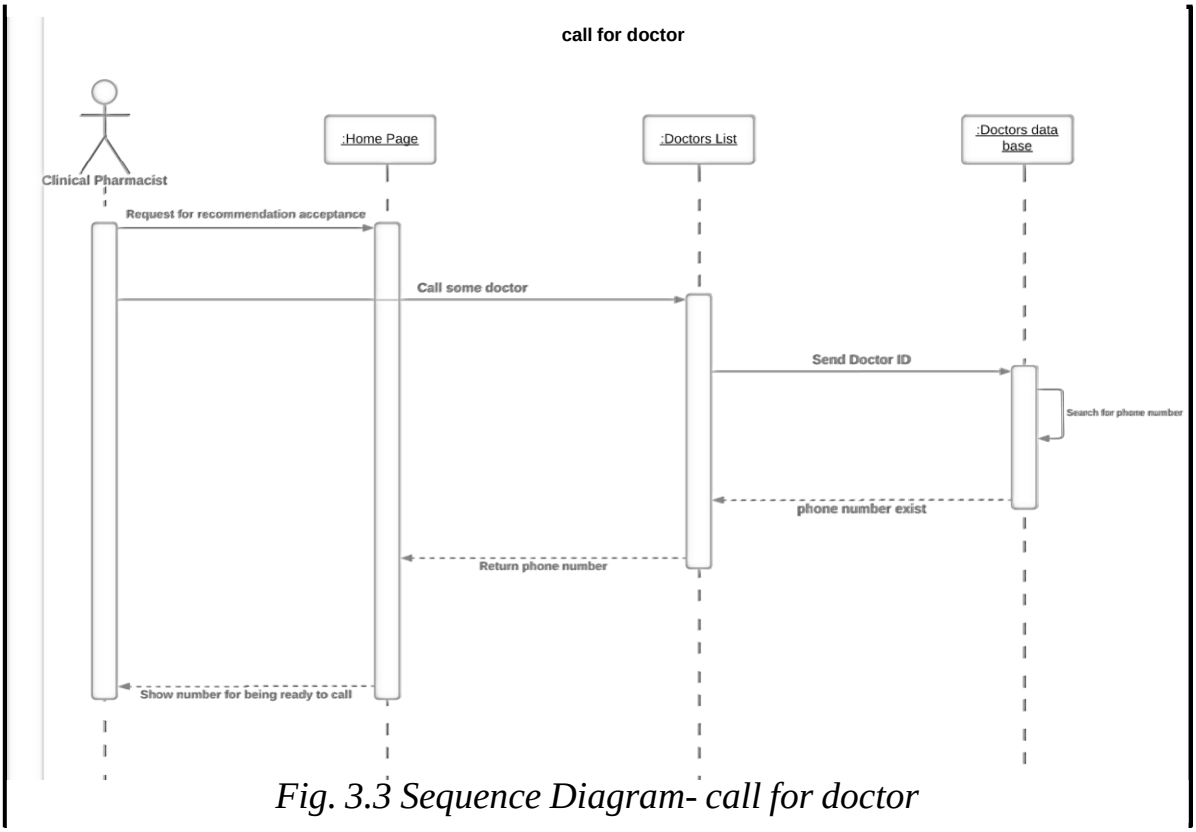

Fig. 3.3 Sequence Diagram- call for doctor

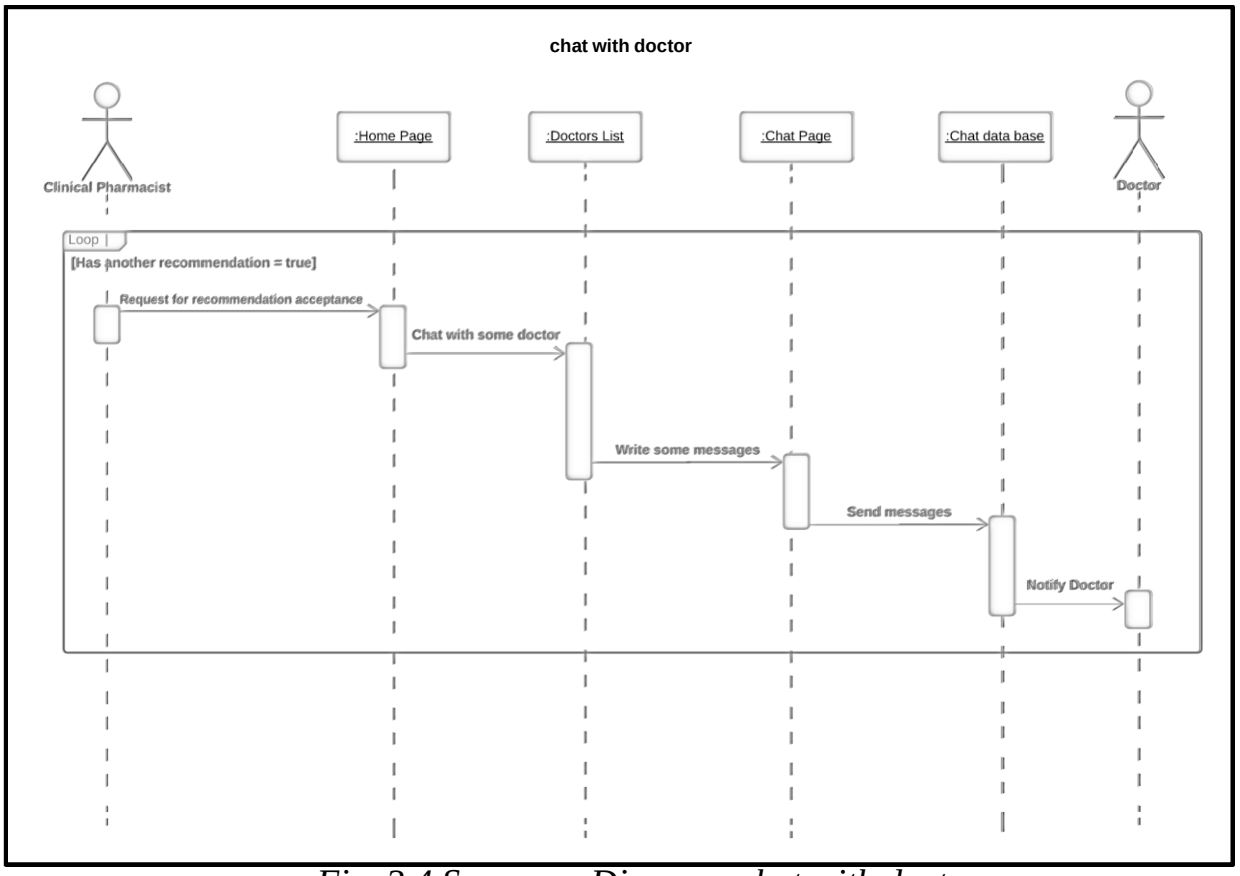

Fig. 3.4 Sequence Diagram-chat with doctor

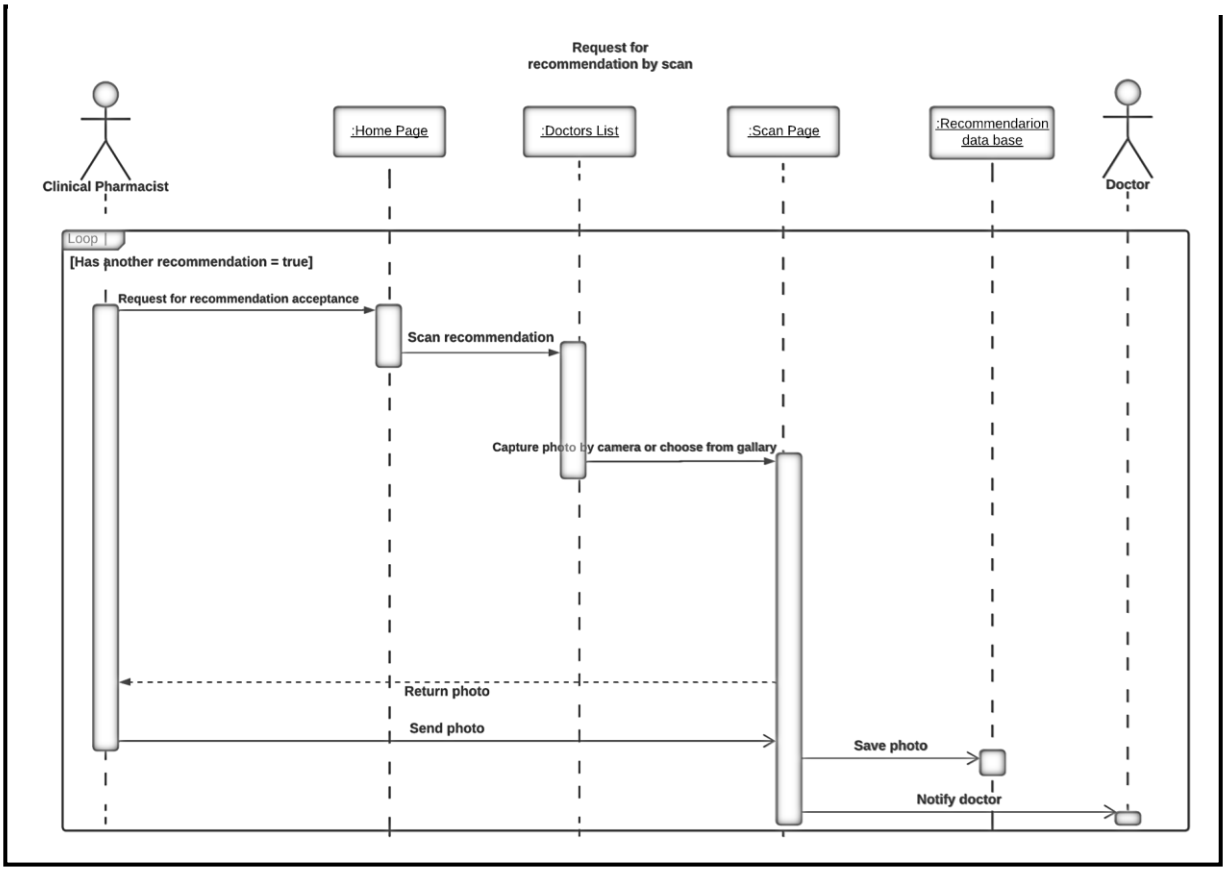

Fig. 3.5 Sequence Diagram-request for recommendation by scan

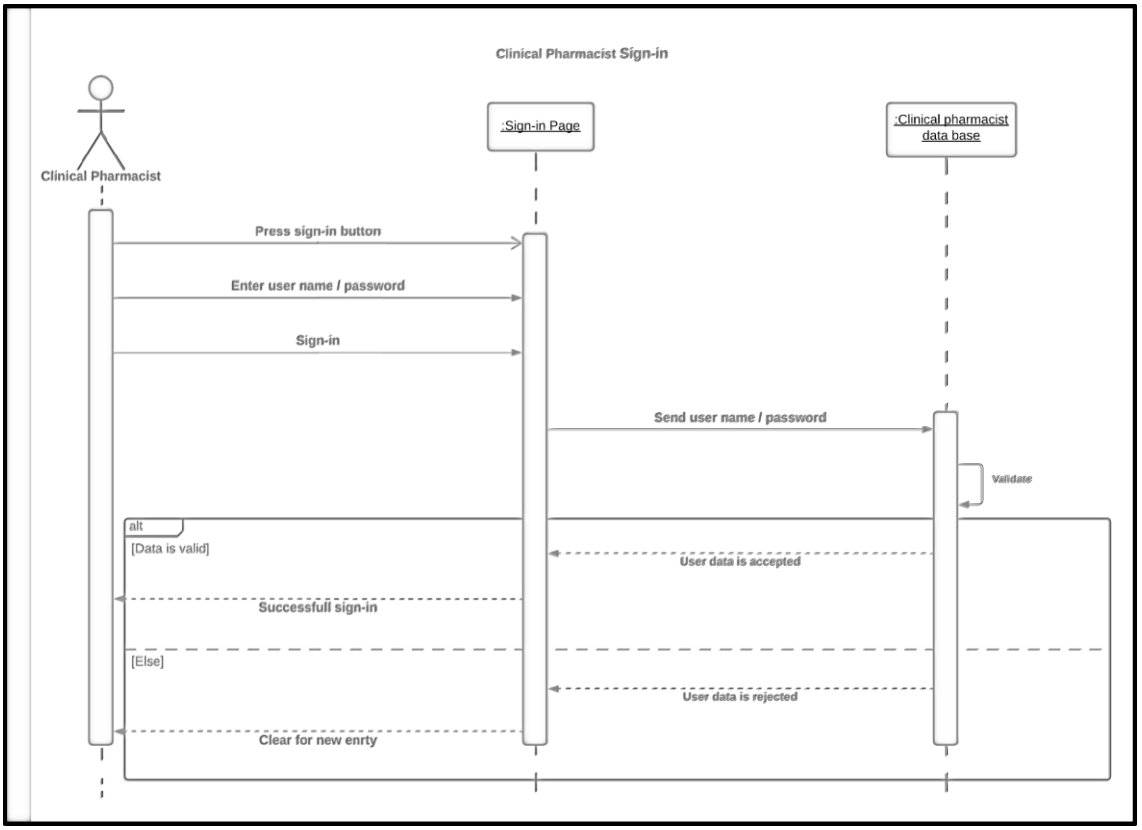

Fig. 3.6 Sequence Diagram-clinical pharmacist sign in

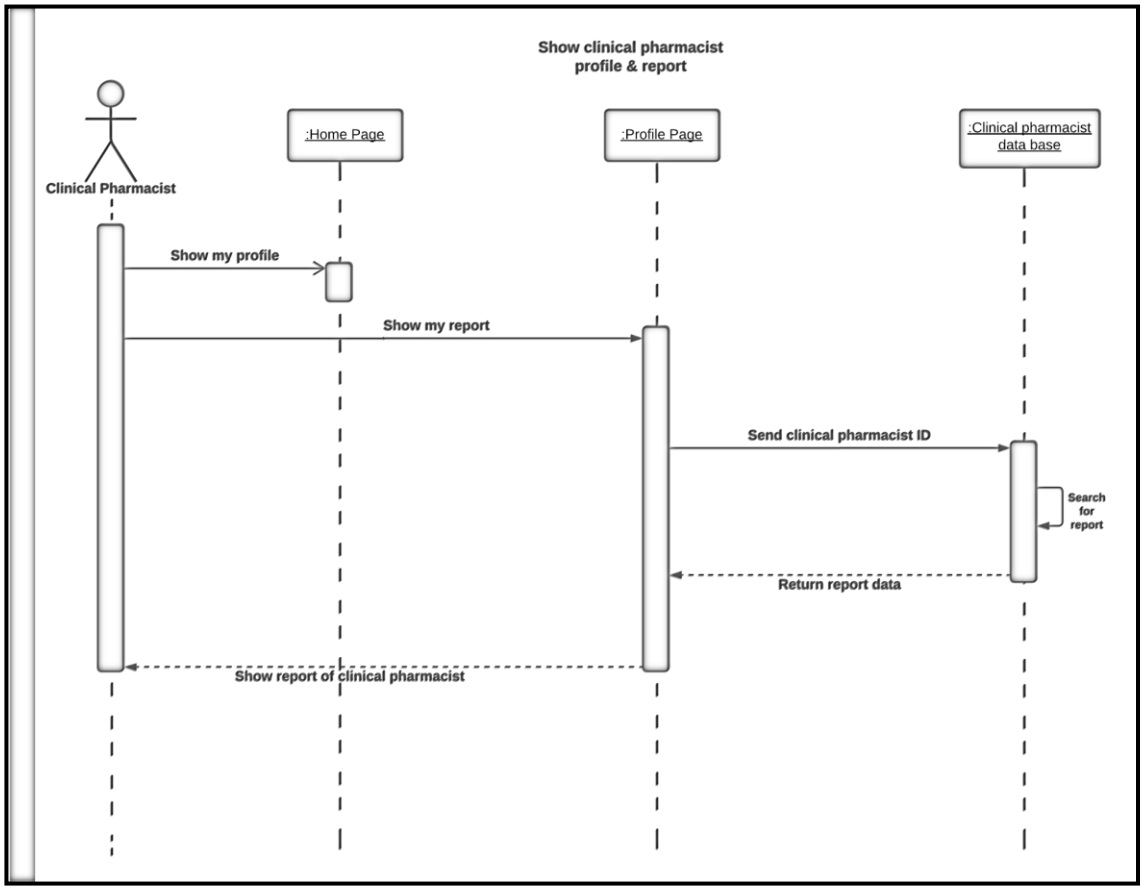

Fig. 3.7 Sequence Diagram-show clinical pharmacist profile&report

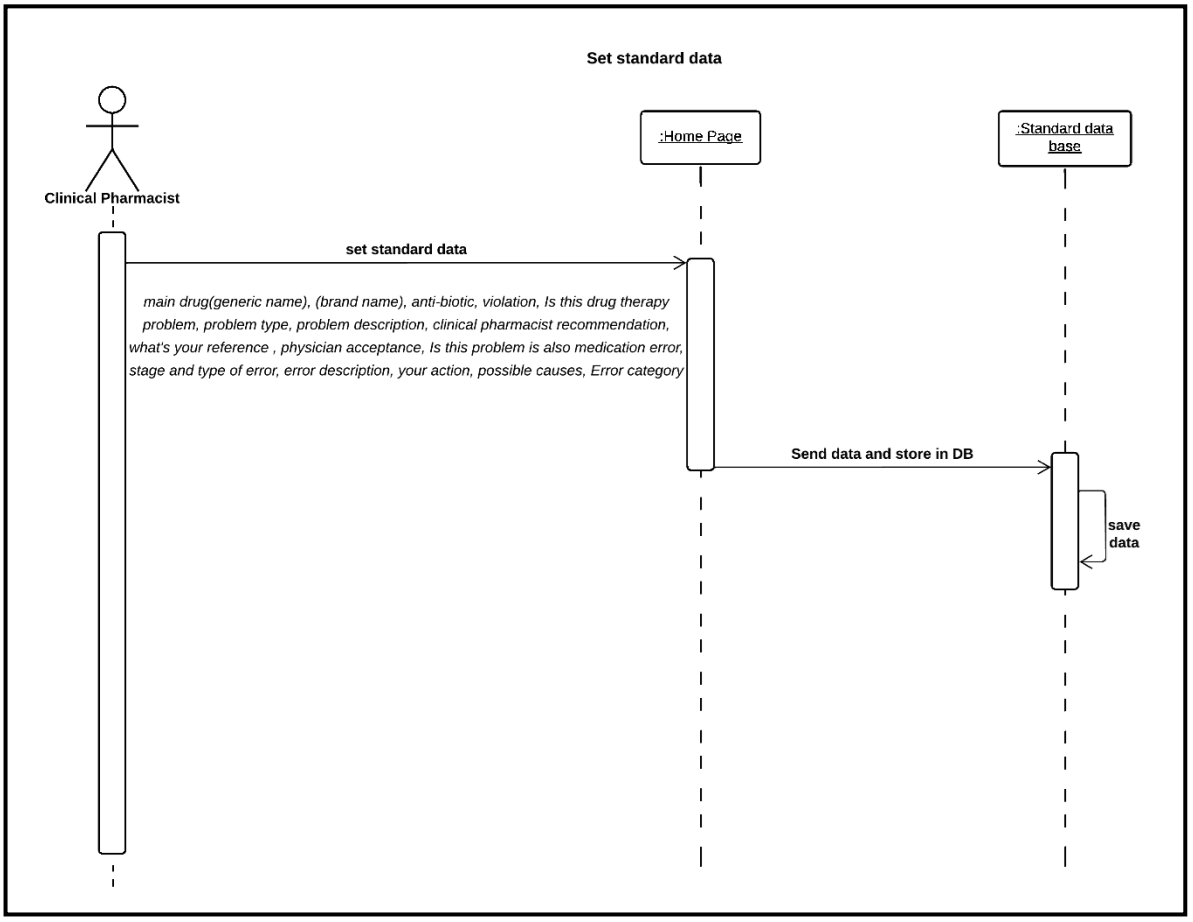

Fig. 3.8 Sequence Diagram-set standrad data

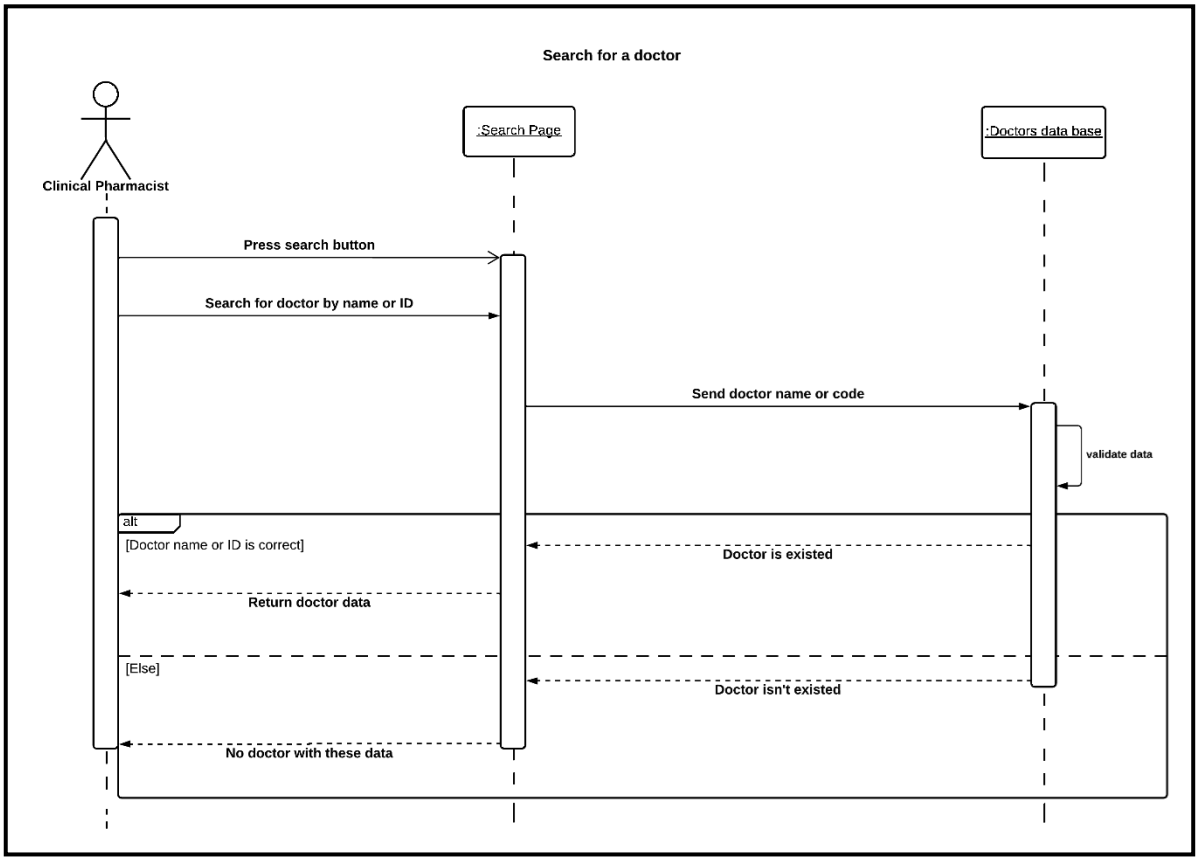

Fig. 3.9 Sequence Diagram-search for a doctor

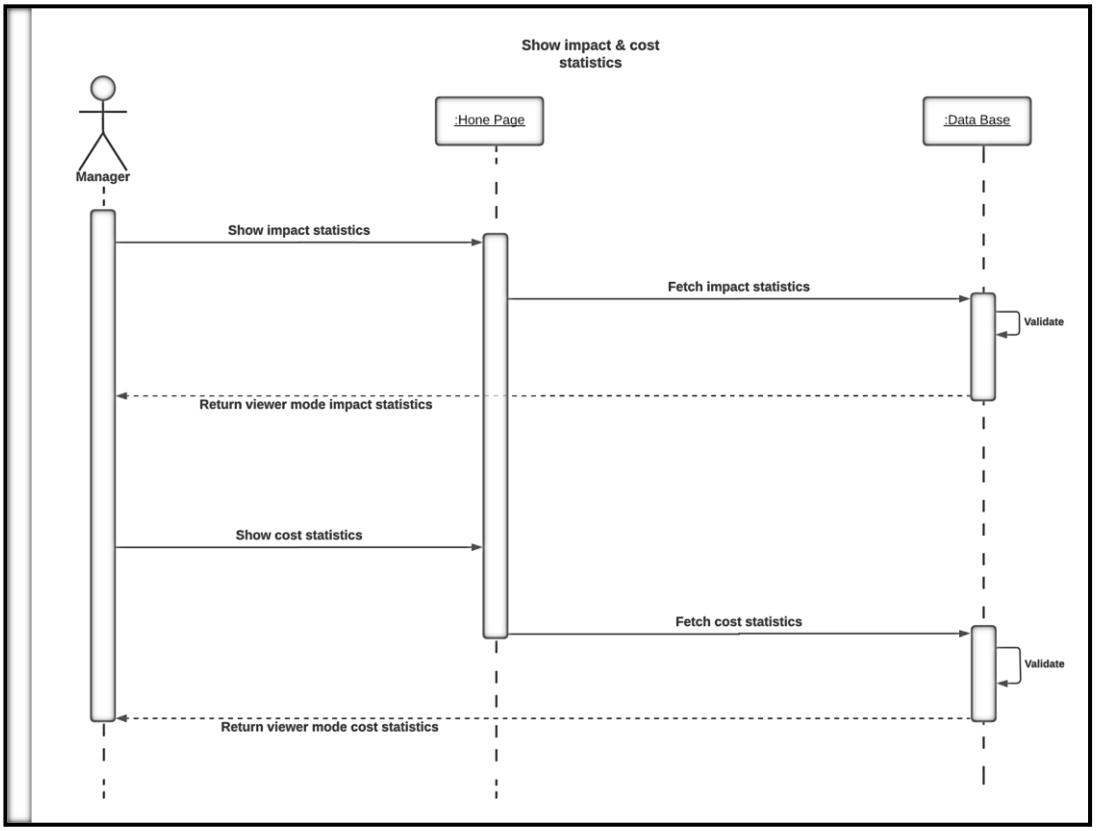

Fig. 3.10 Sequence Diagram-show impact and cost statistics

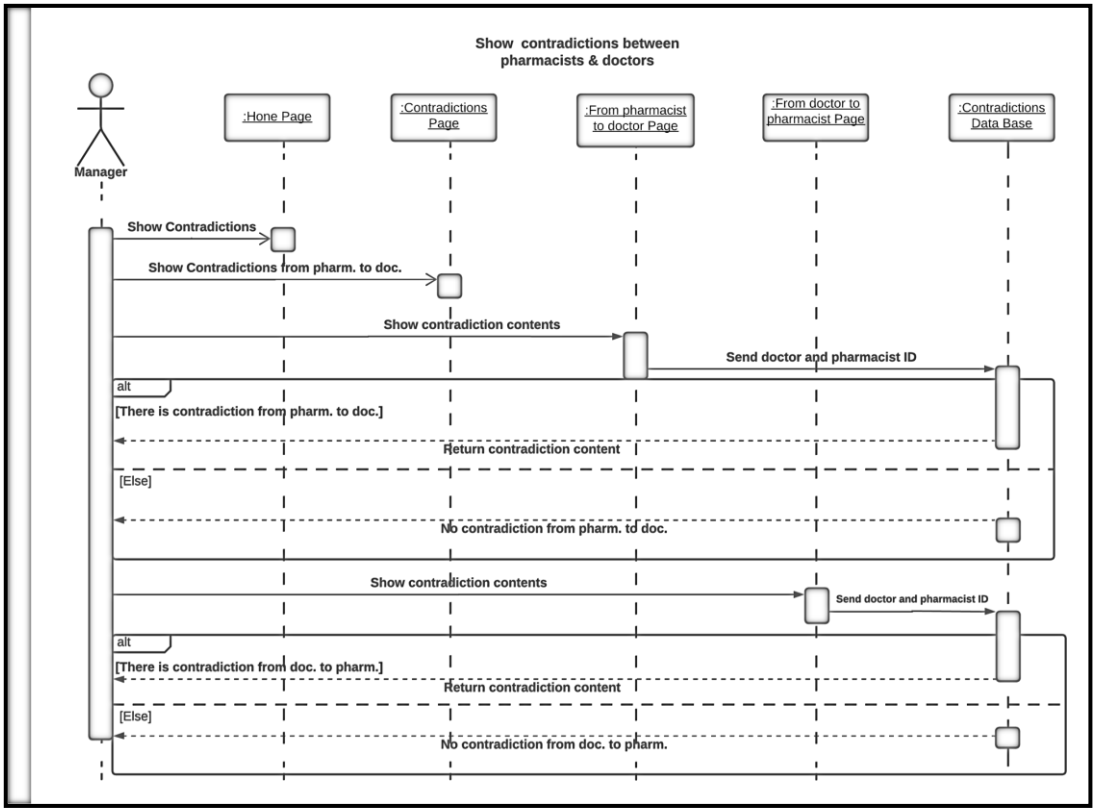

Fig. 3.11 Sequence Diagram-show contradictions between doctors and pharmacists

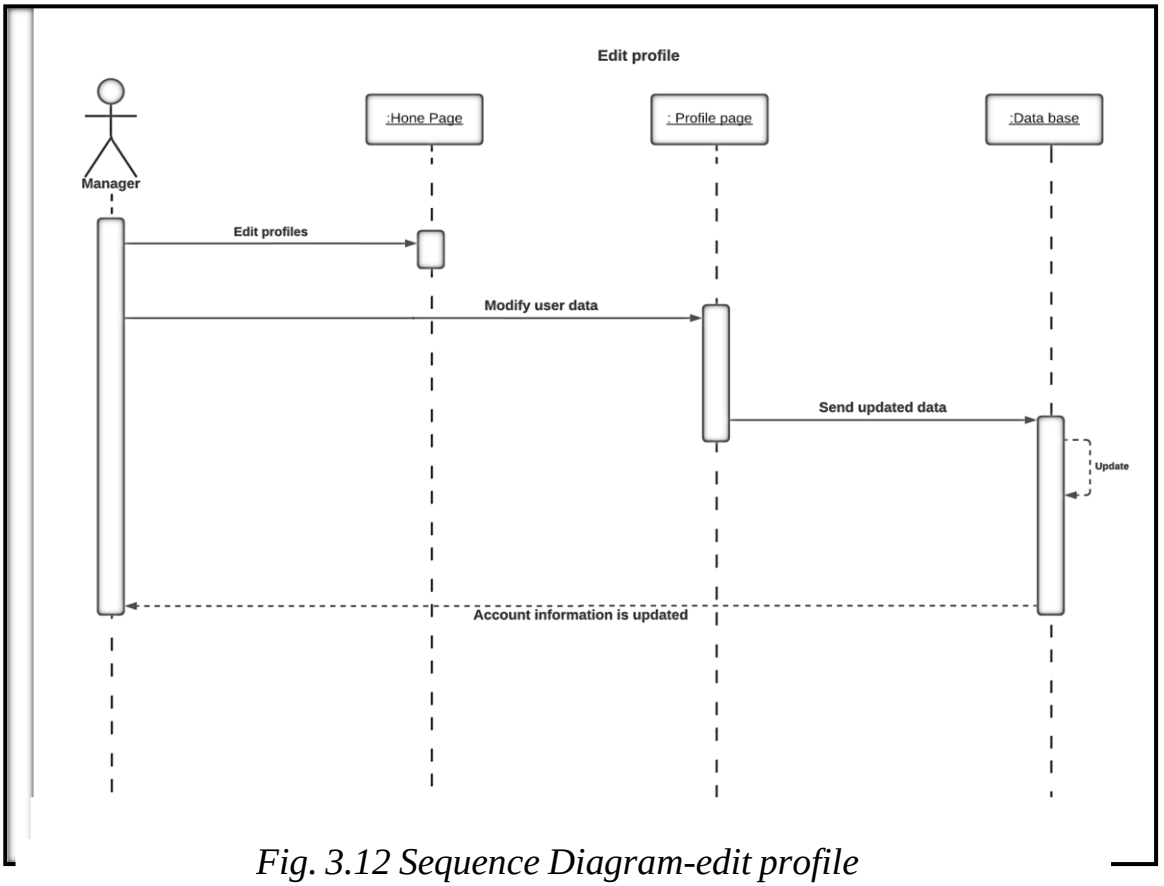

Fig. 3.12 Sequence Diagram-edit profile

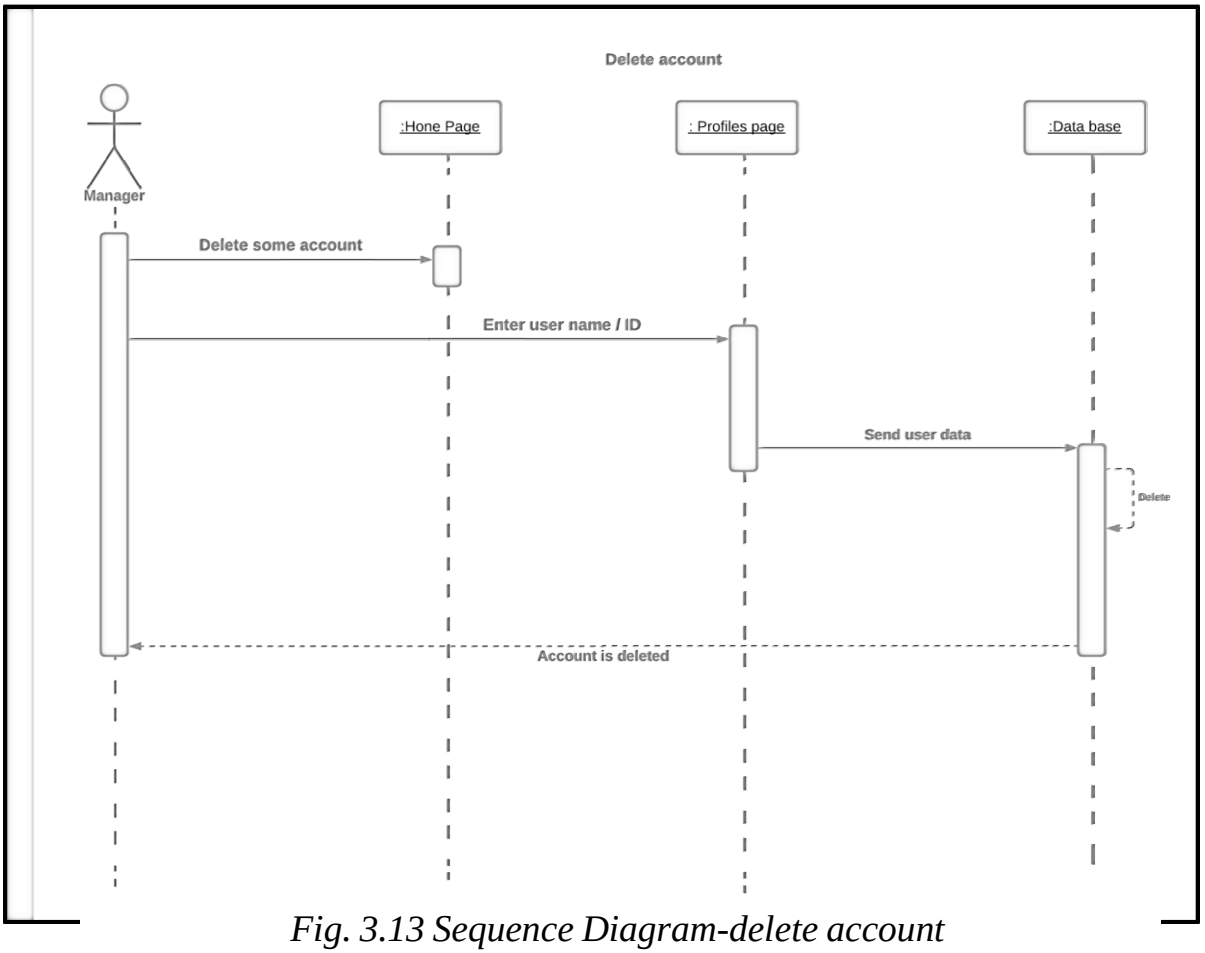

Fig. 3.13 Sequence Diagram-delete account

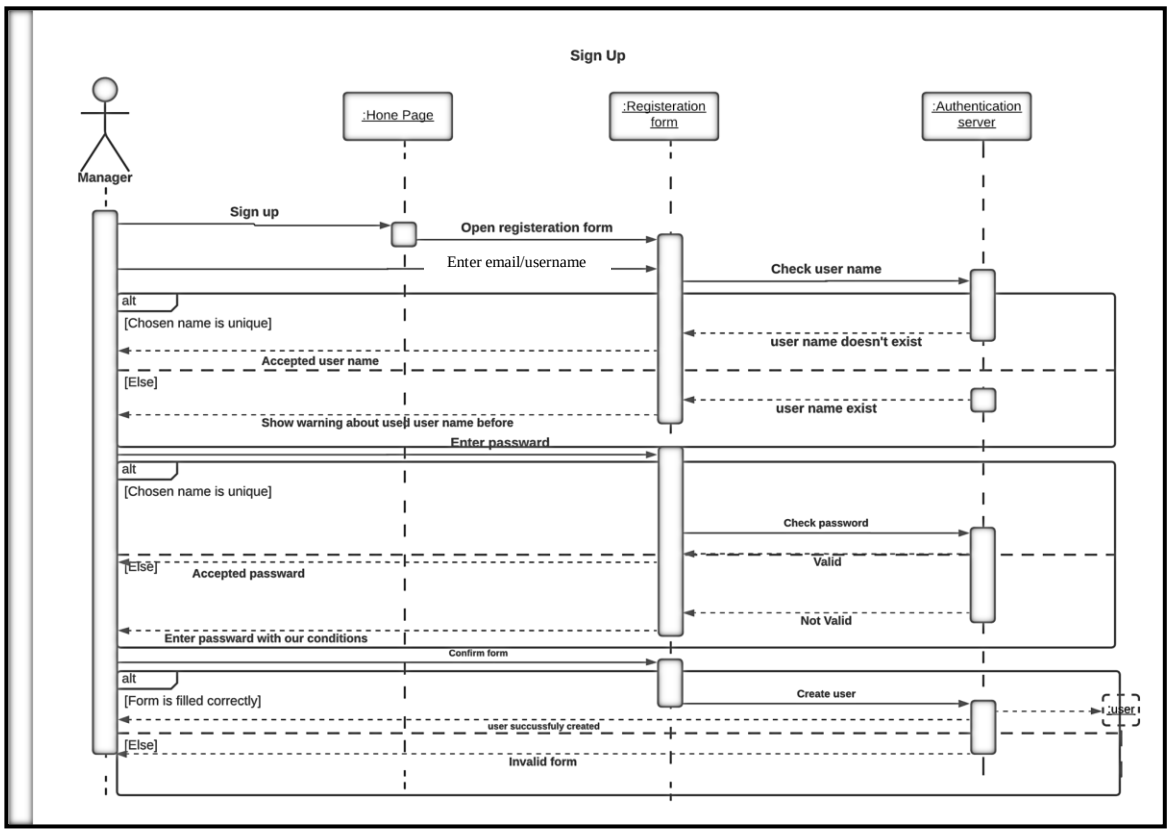

Fig. 3.14 Sequence Diagram-sign up

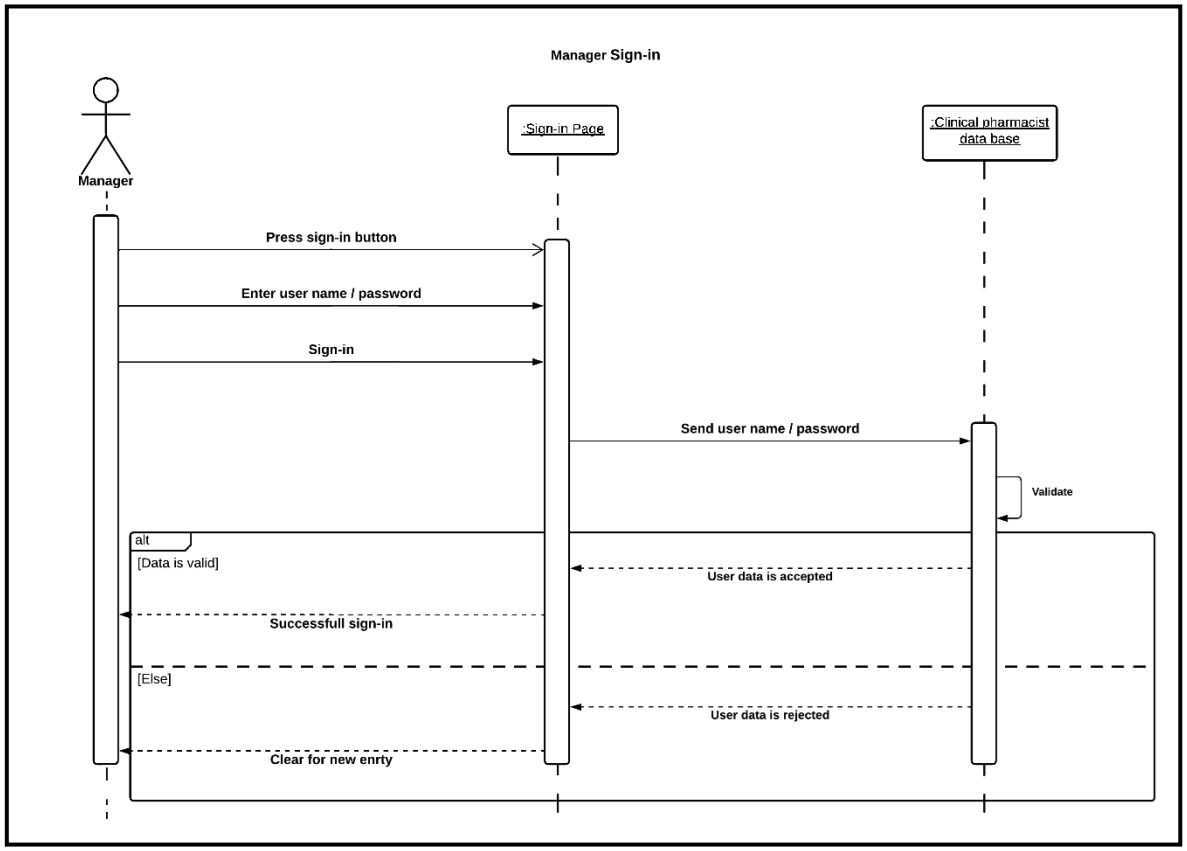

Fig. 3.15 Sequence Diagram-manager sign in

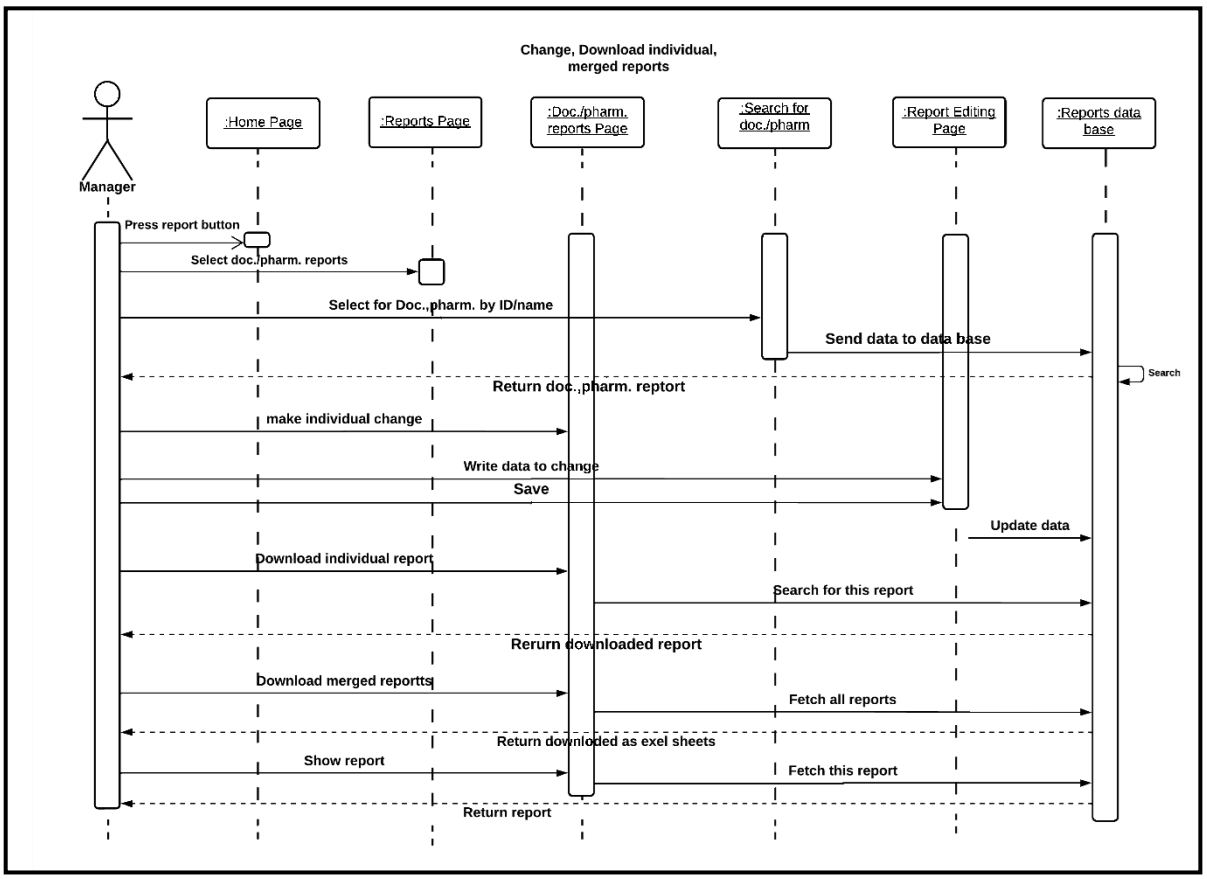

Fig. 3.16 Sequence Diagram- change, download individual, merged reports

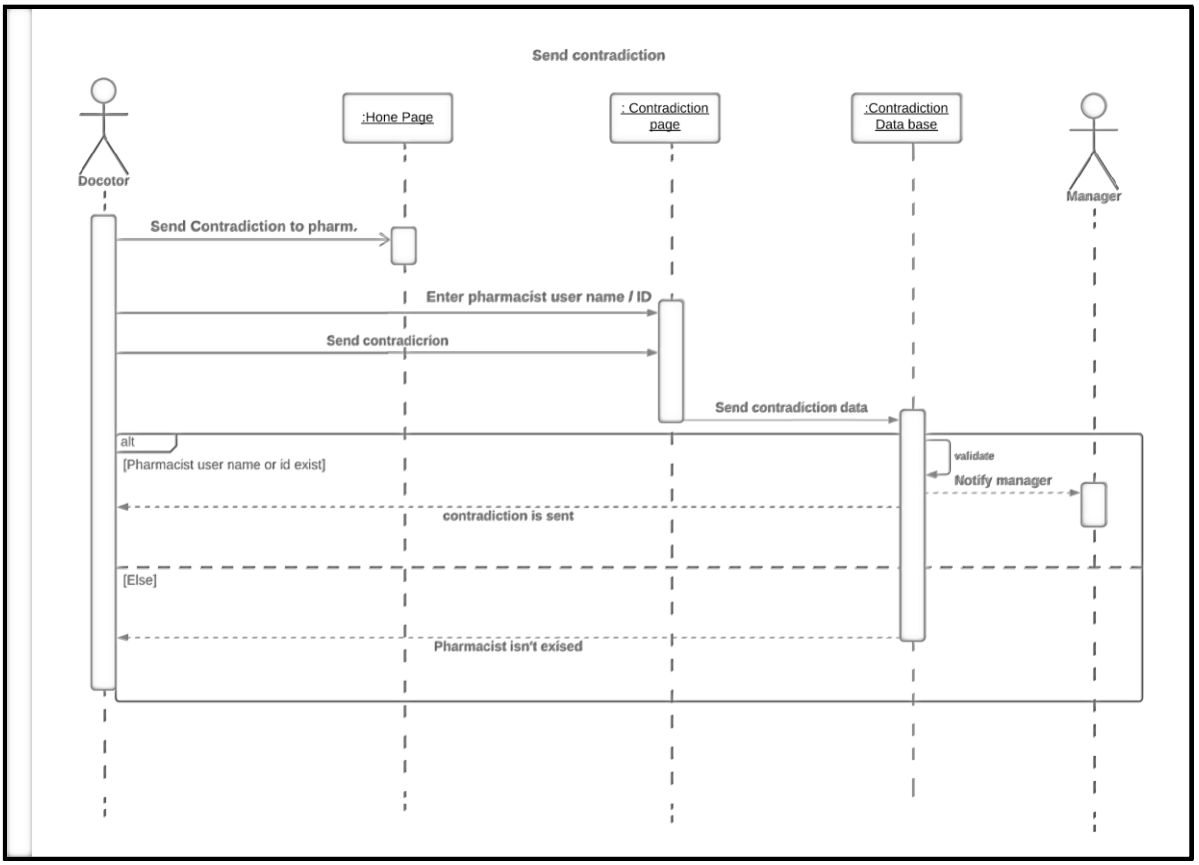

Fig. 3.17 Sequence Diagram- send contradiction

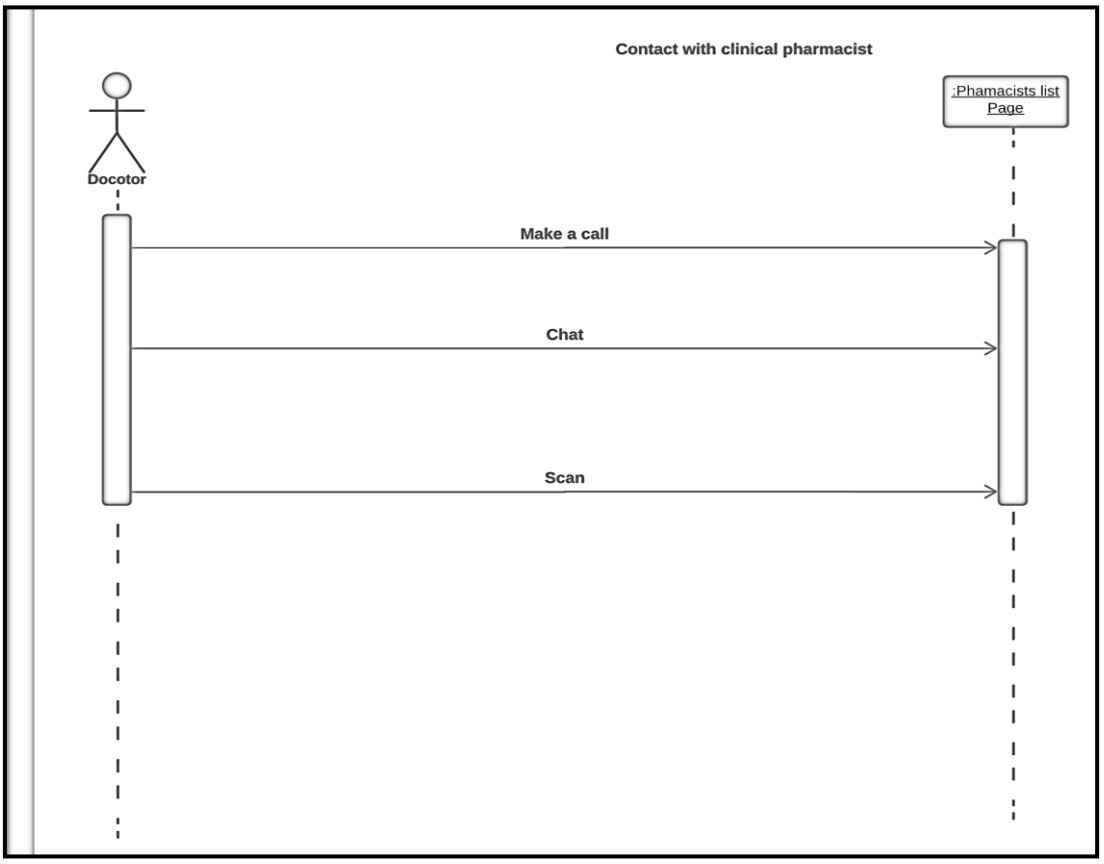

Fig. 3.18 Sequence Diagram-contact with clincal pharmacist

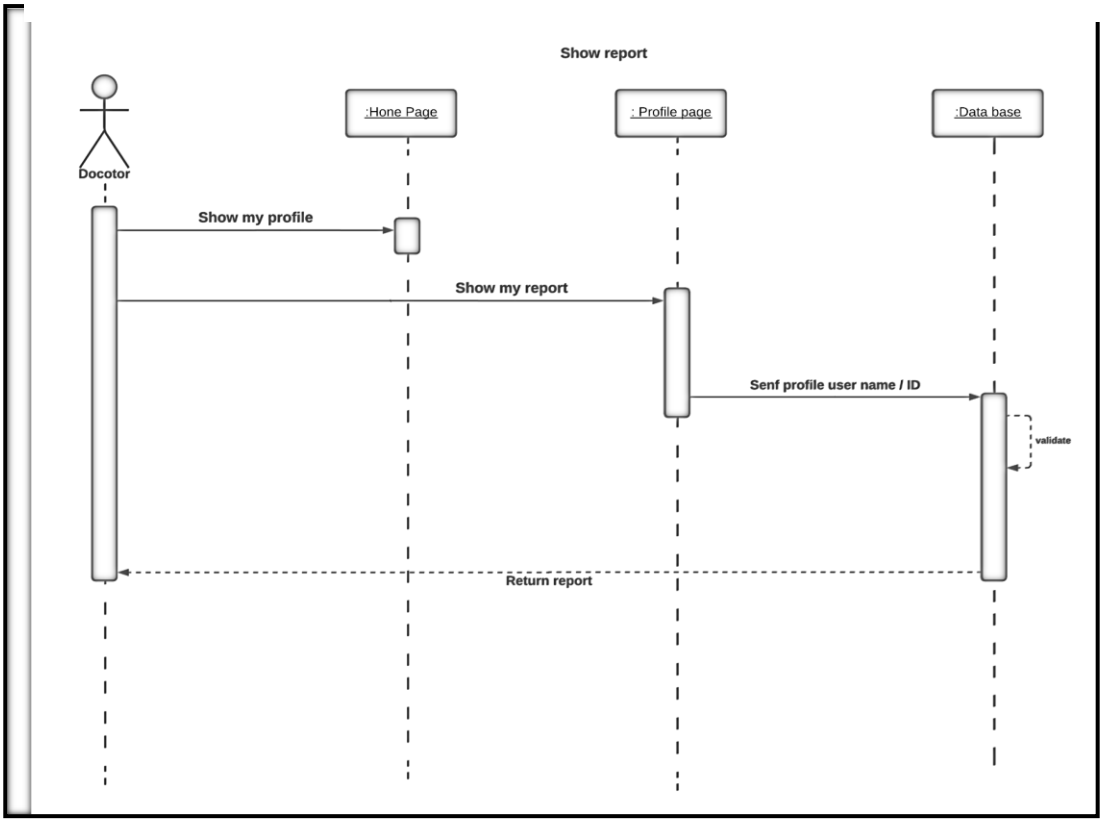

Fig. 3.19 Sequence Diagram-show report

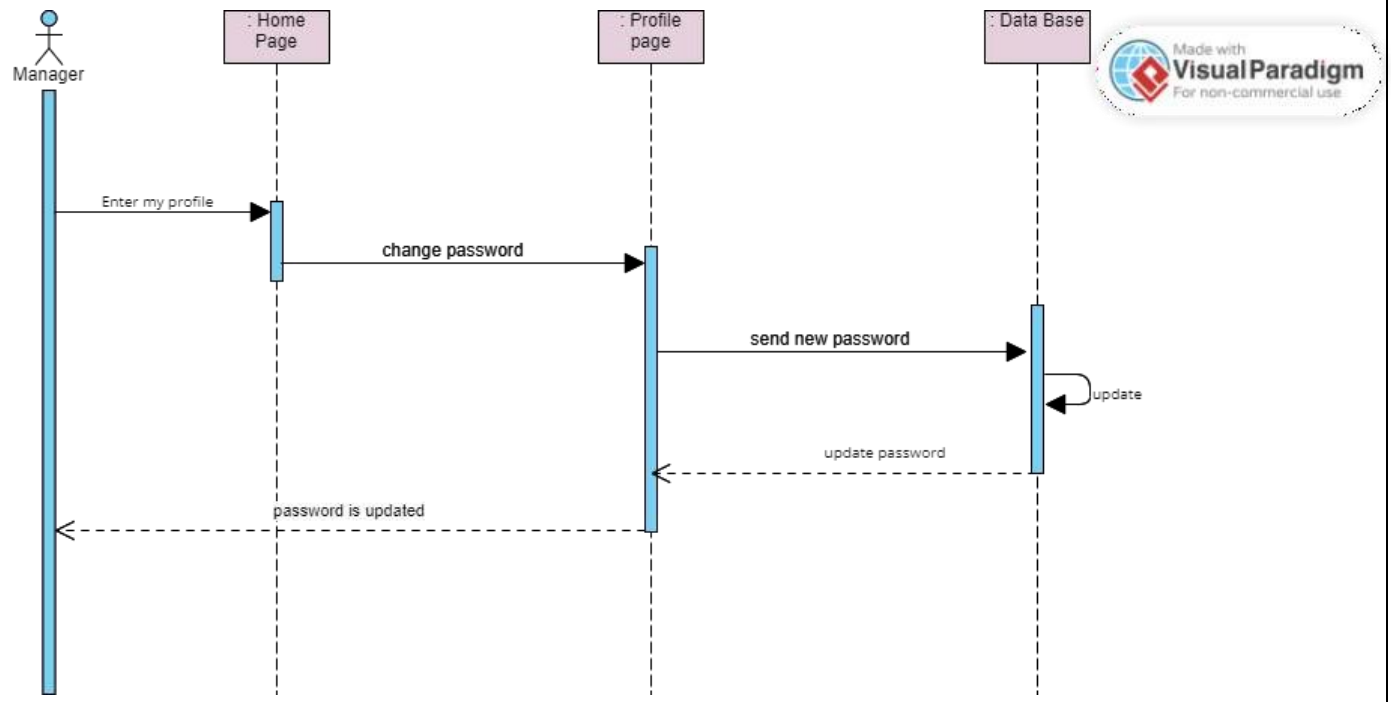

Fig. 3.20 Sequence Diagram-change password of manager

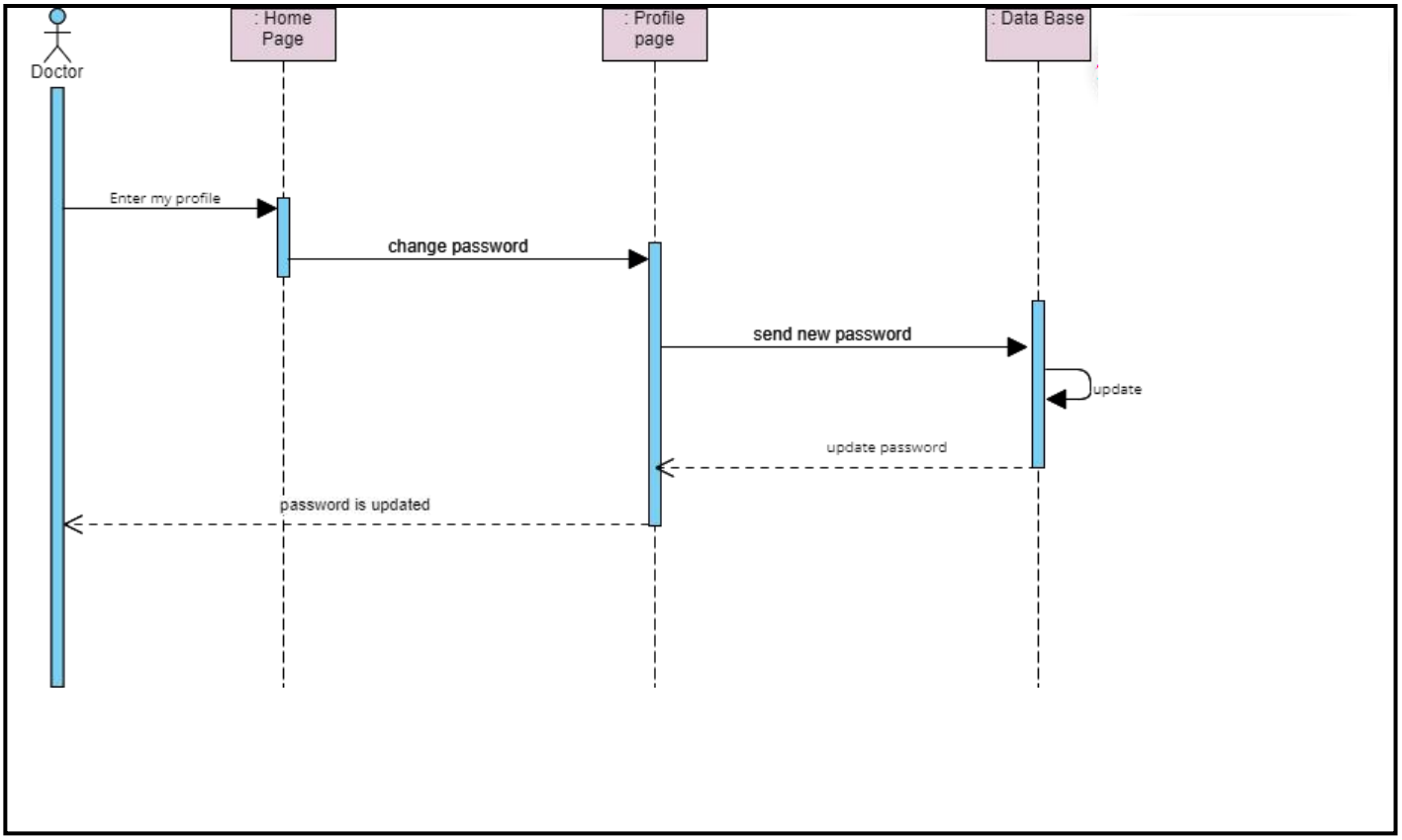

Fig. 3.21 Sequence Diagram-change password of doctor

3.1.2 Data Flow Diagram(DFD)

i. Context Diagram

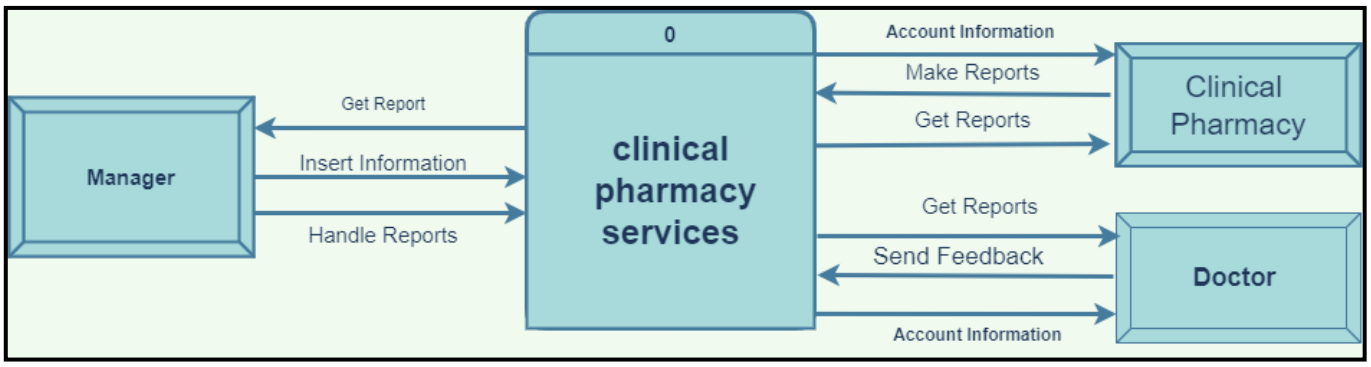

Fig. 3.22 Data Flow Diagram-context diagram

ii. DFD (Level 1)

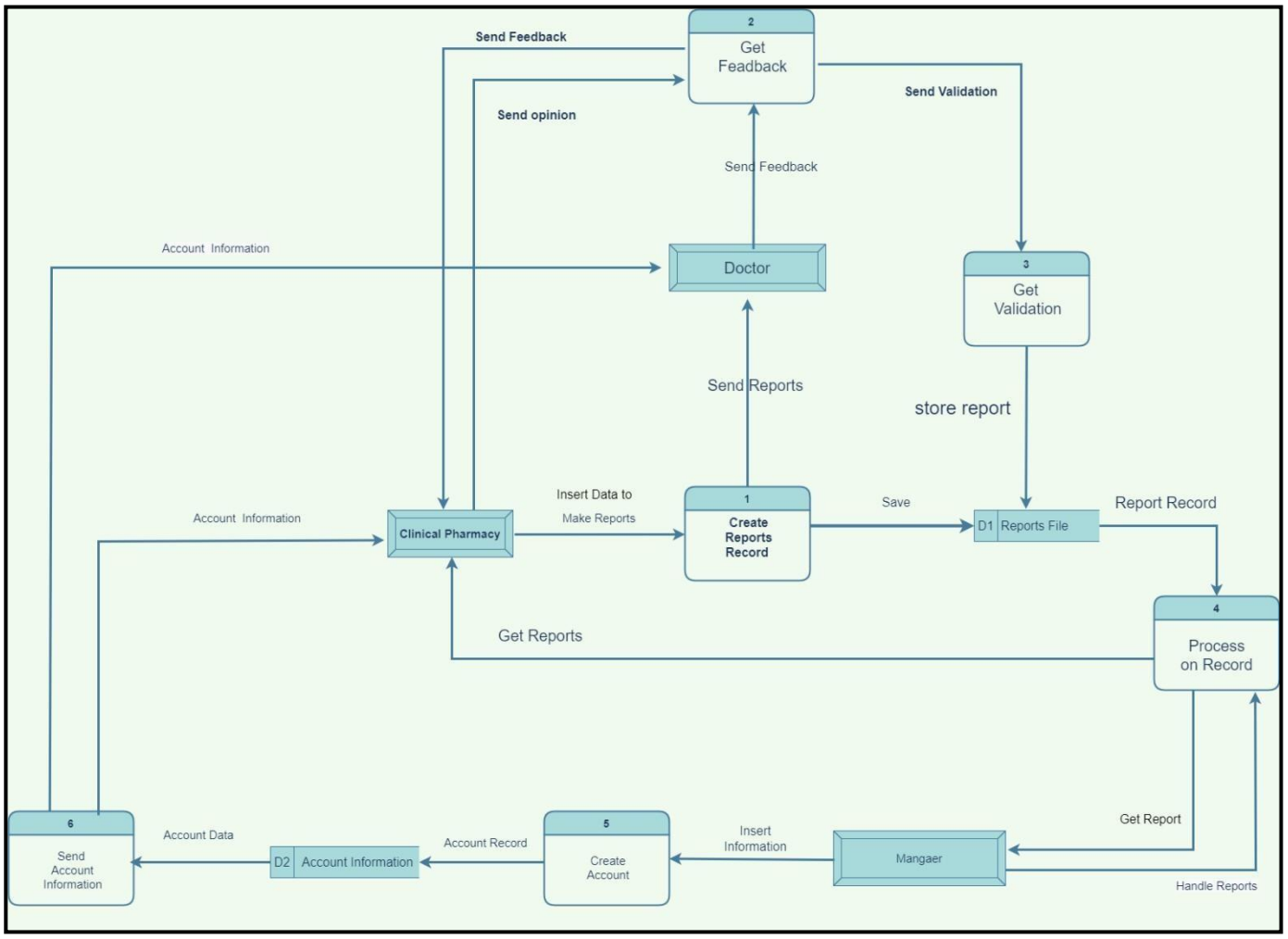

Fig. 3.23 Data Flow Diagram - level 1

iii. DFD (Level 2)

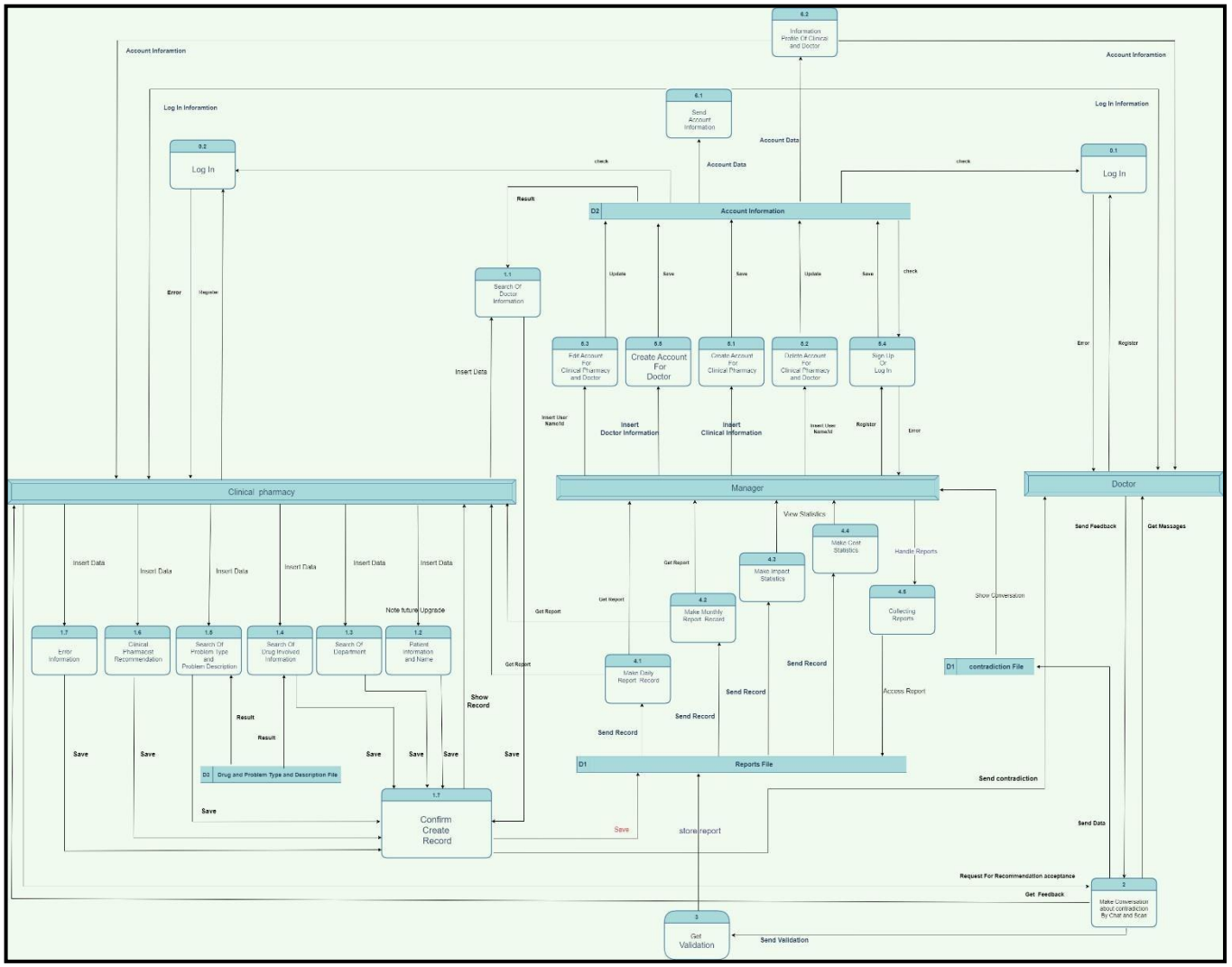

Fig. 3.24 Data Flow Diagram - level 2

3.1.3 Activity Diagram

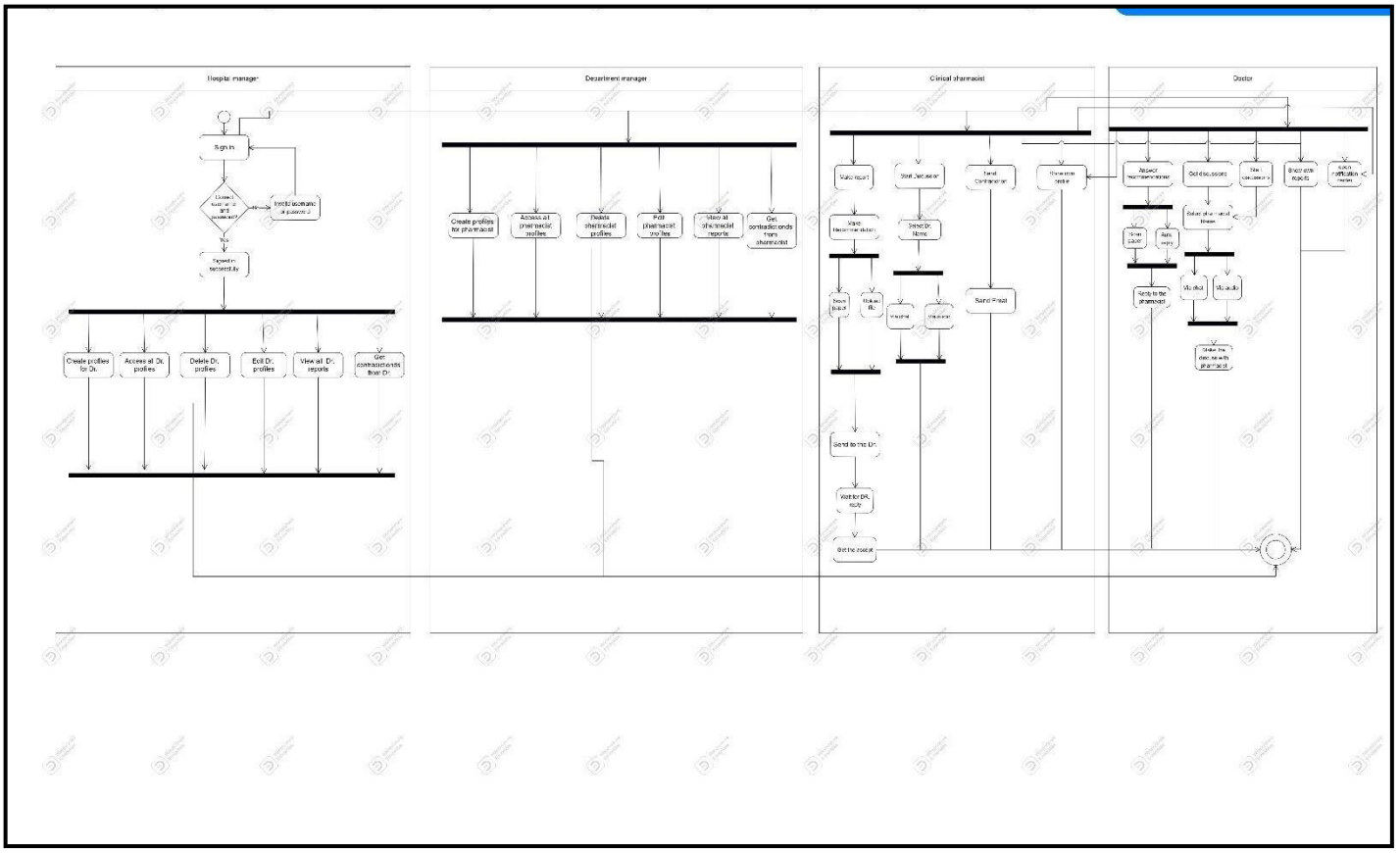

Fig.3.25 Activity Digram

3.1.4 Structural perspective

3.1.4.1 Class Diagram

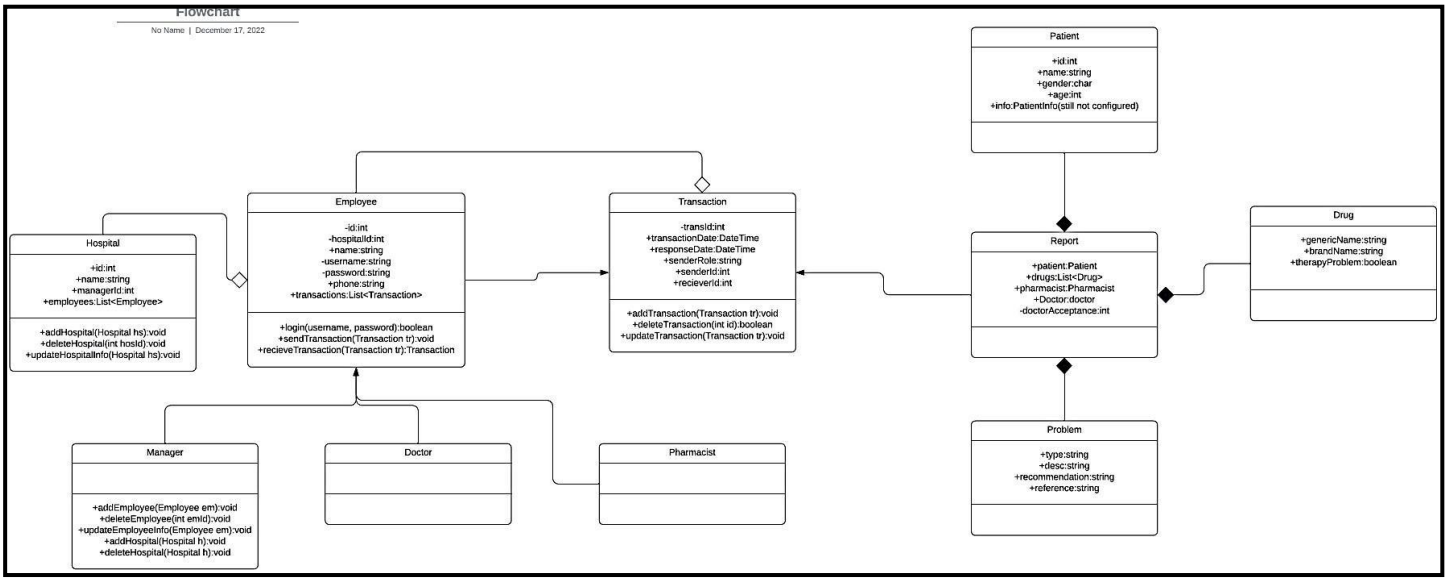

Fig. 3.26 Class Diagram

3.1.5 Entity Relationship Diagram(ERD

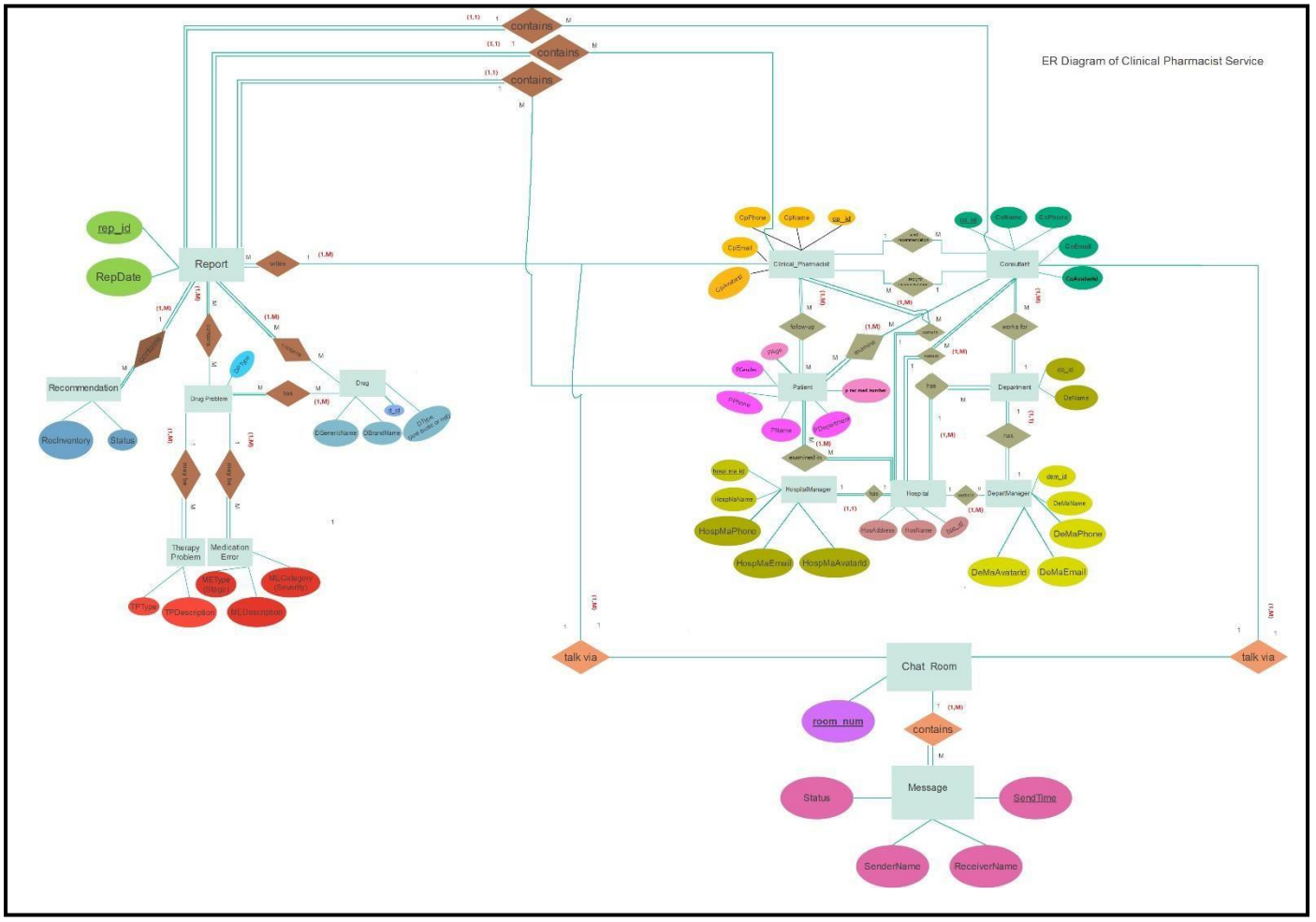

Fig. 3.27 Entity Relationship Diagram

Chapter Four

"Implementation work"

Chapter Four: Implementation work

4.1 Overview

This chapter provides an overview of the screens used in the application. Showing all the screens of the application and each screen is described in detail, to help understanding all screens.

4.2 *Splash screen*

Fig. 4.1 Splash Screen: Introductory screen displayed by an application after it is loaded and just before it starts.

4.3 On boarding screen

Fig. 4.2 Onboarding screens: appears when launching the app for the first time to help get oriented and understand the program.

4.4 Registration screen

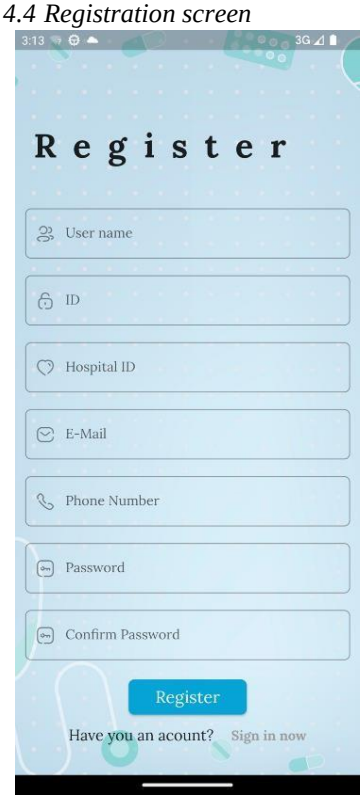

Fig. 4.3 Registration screen: Register when the user using the app for the first time, filling all the required personal details.

4.5 Login screen

Fig. 4.4 Login screen: The screen that requires user identification and authentication performed by entering a username and password combination, if the user don't have an account but have access to create one, user can click to sign up and create them account.

4.6 Home screen

Fig 4.5 Home screen: main screen from which users interact with most options of the application.

4.7 Profile

Fig 4.6 Profile: show and edit personal data or login details.

4.8 Notification

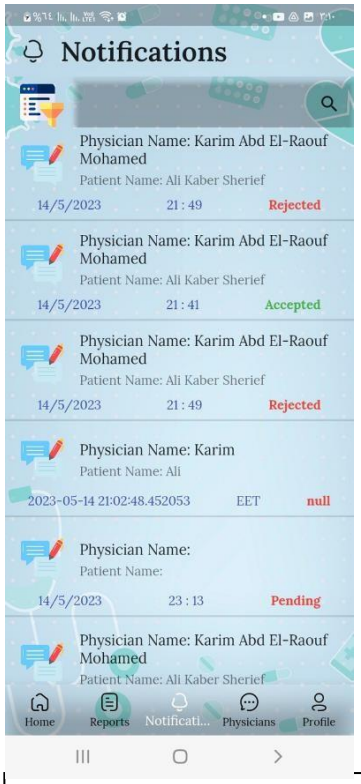

Fig 4.7 Notification screen: The pharmacist receives all replies and any notification in the notification center.

4.9 Notification set

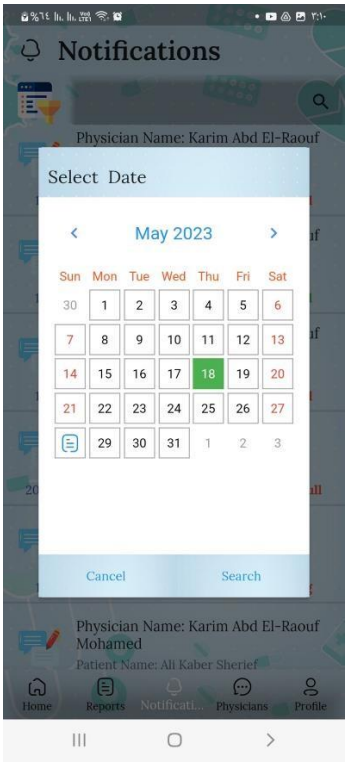

Fig. 4.8 Notification set: Select the date of the required notification to review it.

4.10 Daily

Fig. 4.9 Daily report: Showing a short list of all reports to review them or search for a specific residents by them names.

4.11 Date setting

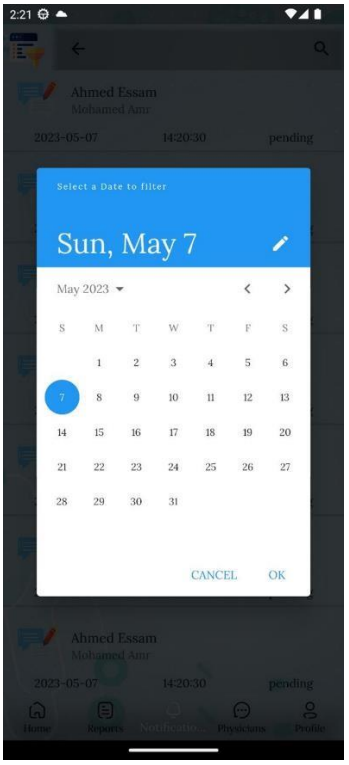

Fig. 4.10 Date setting: To specify the desired report date and review it to check the operations that have been processed.

4.12 Searching screen

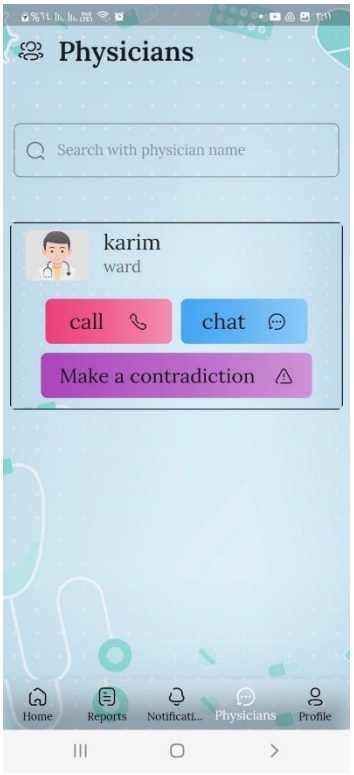

Fig. 4.11 Searching Screen: Searching for the physician's name to start a process (call, chat or make contradiction).

4.13 Calling screen

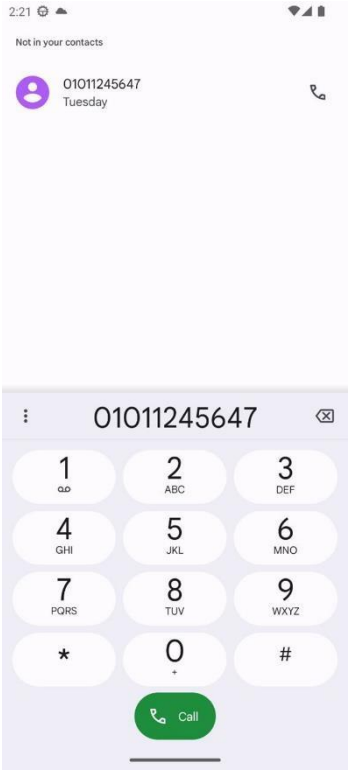

Fig. 4.12 Calling screen: to start a call.

4.14 Chat screen

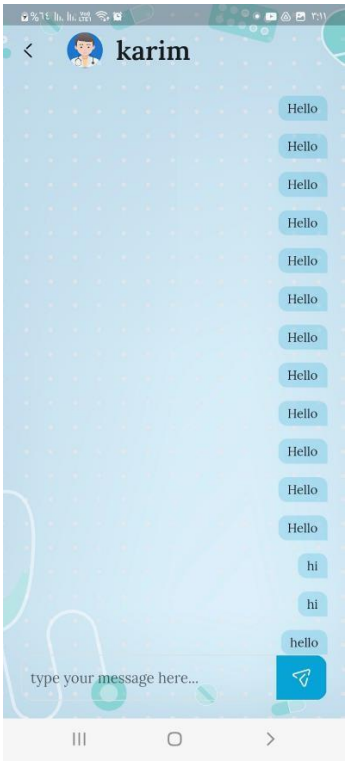

Fig. 4.13 Chat screen: To start chat to discuss.

4.15 Resident information

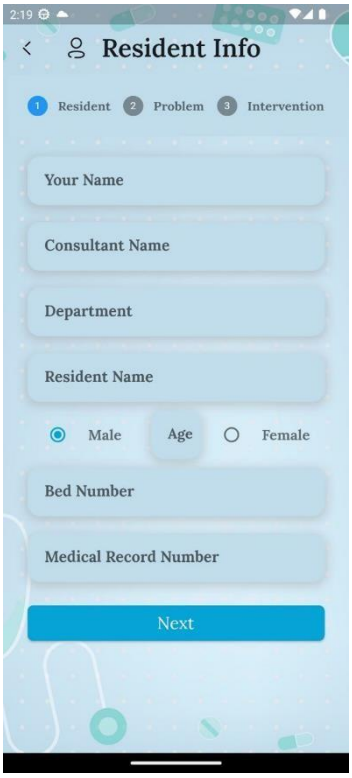

Fig. 4.14 Resident information: fill al the information of the resident to write the intervention.

4.16 Problems

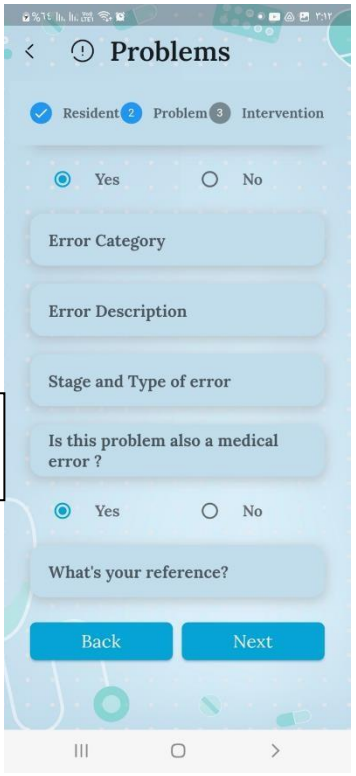

Fig. 4.15 Problems: fill the details about the problem with source clarify.

4.17 Intervention

Fig. 4.16 Intervention: The pharmacist write the suggested intervention with details of the drugs to confirm and send it to the doctor or go back.

4.18 Confirm sending

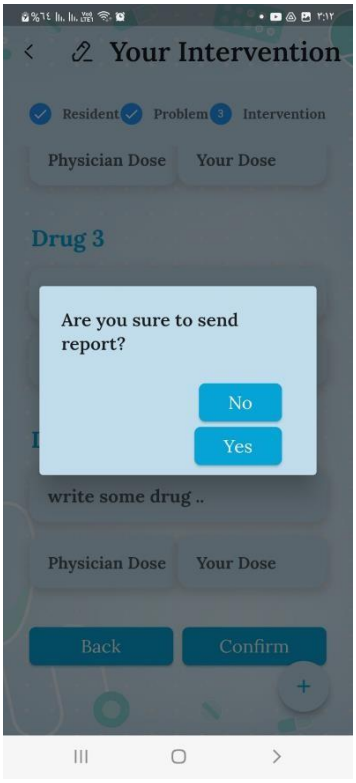

Fig. 4.17 Confirm Sending: take the confirmation from the pharmacist before sending the intervention.

4.19 Confirming report

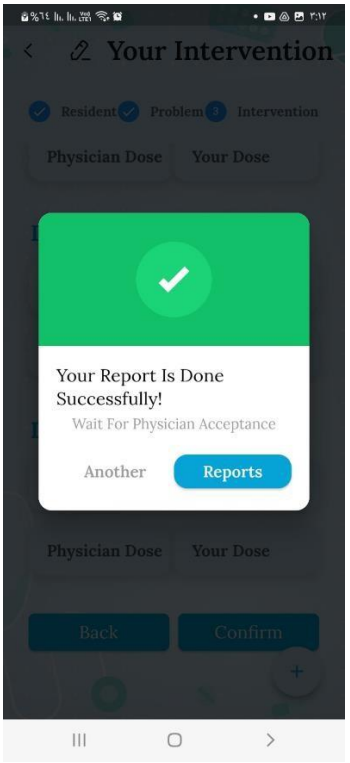

Fig. 4.18 Confirming the report has sent: Message confirm that the report has been extracted , sent to the physician and saved to the system.
pharmacist can go to views them reports or make another invention.

4.20 Adding phone number

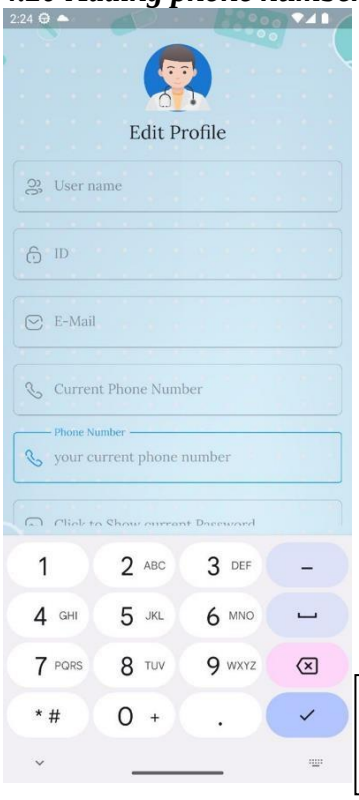

Fig. 4.19 Adding phone number in the profile information, so they can call each other's easily.

4.21 Editing profiles

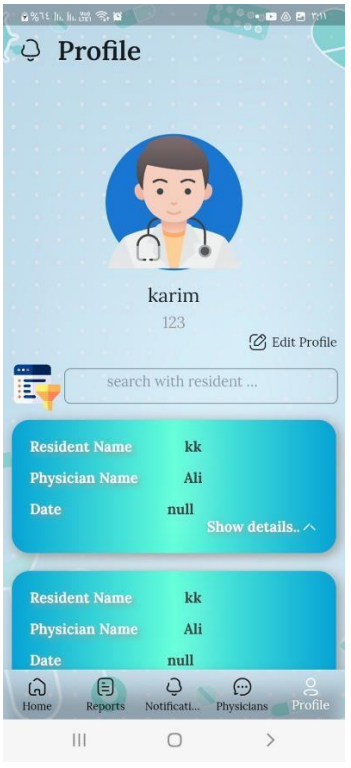

Fig. 4.20 Editing Profiles: to search for the physician or pharmacist profile to edit them personal details.

4.22 Physicians list

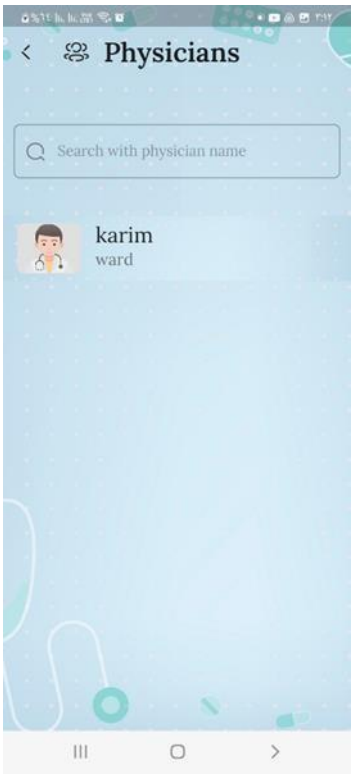

Fig. 4.21 Choose the physicians name after starting to make a report.

4.23 Email

Fig. 4.22 Email: Sending a contradiction to the manger by email address.

Chapter Five

" Conclusion &Future work"

Chapter Five
Conclusion & Future Work

5-1 Conclusion

The most significant problem was collecting clinical pharmacists' reports, which they were doing on paper and adding to an Excel sheet in the Ministry of Health each month. We are resolving this issue with a mobile app that simplifies the clinical pharmacist's role and holds this data. The hospital management was having trouble calculating cost reductions, so we developed a manager application that allows managers to access cost reductions for their hospitals. In addition, we established a facility with physicians where we developed an application to send recommendation responses to clinical pharmacists.

So we didn’t cancel paper, but we made a system that is able to work with the paper work of clinical pharmacists because if we cancel paper and make pharmacists use applications only, it may cause problems with system use or errors. This system will help most Egyptian hospitals, and it can be customized for any hospital with all clinical pharmacists, physicians, and managers.

We made the manager know the role of each clinical pharmacist and physician and the recommendation of the clinical pharmacist specifically. The clinical pharmacist can contact and chat with physicians to have medical discussions, and in the future we will add video calls between them because, in reality, this is what happens.

5-2 Future Work

- Use multiple phone numbers for the same account.
- Upload his/her photo in profile settings.
- Allow to login with username, e-mail, phone number and the verification on the login process.
- Recommendation can be manually written and uploaded to our app by capture and upload.
- Image processing and enhancement on uploaded photo to make text normalization, and image – to – text for recommendation.
- Save the uploaded photo in DB.
- Implementation e-mail service into our app (not use external)
- Video call if needed between physicians and pharmacists.
- Voice search.

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   [https://www.javatpoint.com/software-engineering-agile-model]

3. **Elpassion Website**

   [https://www.elpassion.com/blog/most-popular-types-of-healthcare-software]

4. **Figma Website**

   [https://www.figma.com/]

5. **Software Engineering 9th Edition by Ian Sommerville**

   [https://engineering.futureuniversity.com/BOOKS%20FOR%20IT/Software-Engineering-9th-Edition-by-Ian-Sommerville.pdf]

6. **Flutter documentation**

   [https://docs.flutter.dev/]

Appendices

Appendices

Appendix 1 … File 1

(Standard Excel Sheet from the Egyptian Ministry of Health)

[https://docs.google.com/spreadsheets/d/11iLfbsWFCq6IixDYuQgs3r1Gj6vVyrEn/edit?usp=sharing&ouid=105837446535407743719&rtpof=true&sd=true]

Appendix 2 … File 2

(Project management and estimation)

[https://drive.google.com/file/d/17cMlgYdb0z5s2I6uSoslyfezCSKF81uU/view?usp=sharing]