



Sudan University of Science and Technology

**College of Computer Science and Information
Technology**

Information Systems and Information Technology Department

Electronic Health Record (EHR)

**A project submitted as one of the requirement for obtaining a bachelor of honor in
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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

Sudan University of Science and Technology

College of Computer Science and Information Technology

Information Systems and Information Technology Department

Electronic Health Record

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الاية

قال تعالى :

(قَالُوا سُبْحَانَكَ لَا عِلْمَ لَنَا إِلَّا مَا عَلَّمْتَنَا
إِنَّكَ أَنْتَ الْعَلِيمُ الْحَكِيمُ)

سورة البقرة (32)

الحمد لله

الحمد لله الذي منَّ عَلَيْنَا بِالْإِسْلَامِ، الْحَمْدُ لِلَّهِ رَبِّ الْعَالَمِينَ، الْحَمْدُ لِلَّهِ الَّذِي لَهُ مَا فِي السَّمَوَاتِ وَمَا فِي الْأَرْضِ وَلَهُ الْحَمْدُ فِي الْآخِرَةِ وَهُوَ الْحَكِيمُ الْخَبِيرُ، الْحَمْدُ لِلَّهِ فَاطِرِ السَّمَوَاتِ وَالْأَرْضِ، الْحَمْدُ لِلَّهِ الَّذِي أَنْزَلَ عَلَى عَبْدِهِ الْكِتَابَ وَلَمْ يَجْعَلْ لَهُ عِوَجًا الْحَمْدُ لِلَّهِ الَّذِي لَمْ يَتَّخِذْ صَاحِبَةً وَلَا وَلَدًا وَلَمْ يَكُنْ لَهُ شَرِيكٌ اللَّهْمَّ لَكَ الْحَمْدُ أَنْتَ نُورُ السَّمَوَاتِ وَالْأَرْضِ وَمَنْ فِي الْمَلَكِ وَلَمْ يَكُنْ لَهُ وَلِيٌّ مِنَ الذُّلِّ وَكِبْرَهُ تَكْبِيرًا فِيهِنَّ، وَلَكَ الْحَمْدُ، أَنْتَ قِيَمُ السَّمَوَاتِ وَالْأَرْضِ وَمَنْ فِيهِنَّ، وَلَكَ الْحَمْدُ، أَنْتَ مَلِكُ السَّمَوَاتِ وَالْأَرْضِ وَمَنْ فِيهِنَّ، وَلَكَ الْحَمْدُ أَنْتَ الْحَقُّ، وَوَعْدُكَ حَقٌّ، وَقَوْلُكَ حَقٌّ وَلِقَاؤُكَ حَقٌّ، وَالْجَنَّةُ حَقٌّ، وَالنَّارُ حَقٌّ وَالسَّاعَةُ حَقٌّ، وَالنَّبِيُّونَ حَقٌّ، وَمُحَمَّدٌ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ حَقٌّ .

الحمد لله الذي علم بالقلم، علم الإنسان ما لم يعلم، أحمده حمد الشاكرين، وأثني عليه بما هو أهله، والصلاة والسلام على معلم الناس الخير، وعلى آله وصحبه، وكل من دعا بدعوته واقتفى أثره إلى يوم الدين .

الحمد لله أقصى مَبْلَغِ الْحَمْدِ ... وَالشُّكْرُ لِلَّهِ مِنْ قَبْلِ وَمِنْ بَعْدِ

الحمد لله عن سَمْعٍ وَعَنْ بَصَرٍ ... الْحَمْدُ لِلَّهِ عَنْ عَقْلِ وَعَنْ جَسَدِ

الحمد لله في سِرِّيَّ وَفِي عَلَنِي ... وَالْحَمْدُ لِلَّهِ فِي حُزْنِي وَفِي سَعْدِي

الحمد لله عَمَّا كُنْتُ أَعْلَمُهُ ... وَالْحَمْدُ لِلَّهِ عَمَّا غَابَ عَنِّي خَلْدِي

الحمد لله من عَمَّتْ فَضَائِلُهُ ... وَأَنْعُمُ اللَّهِ أُعِيَتْ مِنْطِقُ الْعَدَدِ

المستخلص

هنا لمحة عامة للسجل الصحي الإلكتروني وما يقدمه للعاملين وغيرهم في مجال الرعاية الصحية، جنباً إلى جنب مع نظرة سريعة على جوانب أخرى من تكنولوجيا المعلومات الصحية (صحة تكنولوجيا المعلومات).

السجل الإلكتروني الصحي هو أبسط نسخة رقمية (المحوسب) من الخرائط الورقية للمرضى. تحتوي على معلومات عن تاريخ المريض الطبي والتي تشمل التشخيص، والمختبر ونتائج الاختبارات .

النظام المقترح هو قاعدة ويب تساعد المرضى من الوصول إلى السجل المرضى الخاص بهم من خلال واجهة رسومية، ويحتوي الموقع على مجموعة من قواعد بيانات مستشفيات أخرى حيث يوفر تكامل للبيانات يساعد المريض على معرفة سجله الصحي كما أنه يساعد الأطباء في تشخيص المرضى بصوره دقيقة وكذلك يعرفهم بالتاريخ (السجل) المرضى للمريض ، لقد قمنا بتحليل النظام لتحديد مدى كفاءته وجودته.

ABSTRACT

Here is an Electronic Health Record overview for providers and other health care professionals, along with a quick look at other aspects of the new wave of health information technology (health IT).

Electronic Health Record is a simplest digital (computerized) version of patients' paper charts. Contain information about a patient's medical history, diagnoses, and lab and test results.

The proposed system is a Web-base that helps patients access to their medical records through the graphical interface, the application contains a range of other hospitals databases hence it provides a complete integration of the data which helps the patients to know their health record information and it also helps doctors to diagnose patients.

We made an analysis of the system to determine the efficiency and quality of its safety.

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LIST OF KEY TERM

| Abbreviation | Description |
|---------------------|------------------------------------|
| EHR | Electronic Health Record |
| EMR | Electronic Medical Record |
| PHR | Personal Health Record |
| MRS | Medical Records System |
| HRS | Health Records System |
| EHRs | Electronic Health Record System |
| IDE | Integrated Development Environment |
| JDK | Java development kit |
| J2EE | Java 2 Enterprise Edition |
| JSP | Java Server Pages |
| ASF | Apache Software Foundation |
| UML | Unified Modeling Language |

CHAPTER ONE: INTRODUCTION

1.1 INTRODUCTION

Hospitals and health care facilities are where patients go when it concerns about their health. So a good medical care relies on a good record keeping and also relies on high-quality facilities and equipment. Good records care also ensures that hospital's administration runs smoothly and shows hospital's accountability. Good saved records can be found quickly, saving time and resources. They can form a key source of data for medical research, statistical, reports and health information systems. Lastly a good health record can only be prepared by exchange information from more than one health facility in a meaningful way.

1.2 PROBLEM STATEMENT

This research came to determine the next step after EMRs. EMRs in hospitals; people give information about themselves to be saved on hospitals, but they can't access their information except they return to the same hospital.

This causes waste time and difficulty in obtaining information. We tried to enhance this trouble for patients to take best care.

1.3 RESEARCH QUESTION

- Are all Sudan hospitals computerized?
- How patient's information is taken?
- Did stored information available all the time to patients?
- Is EHR important?
- Why using EHR web-base?
- Who will benefit from EHR? And how?
- Is it easy to use?
- Is it confidential?

1.4 RESEARCH OBJECTIVE

EHR objective is to enhance and develop the EMR's and also make a wise use of information. It enable patient to take higher healthcare; accesses their records which exists on multiple Electronic Medical Record.

- Provide information exchange between EMR's(health care facilities).
- Information available online all time.
- Help doctors to better known of their patients.
- Help researchers by providing them a pool of health and medical information.
- Enable doctors and researchers to practice their work on fast and flexible way.

1.5 RESEARCH SCOPE

In this research, we are aiming to create a system that consist of a wide range of information which will be gathered from more than one health care facility systems in Khartoum, the system will be completed in about six to ten month .The whole project will contain two EMR systems and the main system(EHR) with their databases.

1.6 EXPECTED CONTRIBUTION

The EHR contribute in extract medical records and exchange this information between EMRs. Participate in integrity of information and data accurately.

1.7 THESIS OUTLINES

Chapter 2: Literature Review. First, will introduce the EHR in the past definition and (EMR). Second will offer the evidence that help to know more about topic. Finally, will show some difference between these systems and tell how they relate to our study.

Chapter 3: The Research Methodology. Will talk about the proposed system how to build the EHR app (web-based application) and what tools and techniques will be used. Also will present aspect of improvement and how systems fix problems.

Chapter 4: The System Analysis. The notions of system using enterprise architect program components use case, sequence and activity. Illustrate how the system process and system running.

Chapter 5: The System Implementation. Will cover how the system works by give illustrate design to the system. Show the most important system parts and their characteristics and also will demonstrate database structures used in system.

Chapter 6: The Conclusion and Recommendations. This chapter will summarize what has/has not been accomplished within the EHR delivered app and the EHR documentation and what are the recommendations that should be worked out later to help develop the system in the future.

CHAPTER TWO: LITERATURE REVIEW

2.1 INTRODUCTION

In This chapter we will cover the (EHR) In terms of definition, features key, components of the system and its role in patient care, as well as services provided by electronic medical records, however we will give examples of the types of medical records and the way in which data is stored.

Later we will review some previous studies relevant in the field of health care systems and electronic health records, reached by the results and Statistics collected during the study.

2.2 ELECTRONIC HEALTH RECORD (EHR)

In the past concept ‘EHR is at their simplest digital (computerized) versions of patient’s paper charts, but when they fully up and running are so much more than that.’^[1]

The screenshot displays a patient's chart view for SUITEMED, MERRY (17544). The patient's information includes: DOB: 01/02/1951, Age: 64 Yr 1 Mo, Gender: Female, Race: Hispanic, Address: Street 14068 Thayer MD 65791, Last Visit: 01/27/15, Next Appt.: 07/27/15, Balance: 38.00 Cr, Weight: 145 lbs 0 oz [09/24/09], Insurance: SOCS OF ILLINOIS ITS AREA (16) 4 HEALTH NETWORK AMERICA (8) 8, Allergy: No Known Drug Allergies, and Note: (empty).

The main area shows a list of medical records with the following columns: Category, Date, Sensitivity, Priority, Description, Status, Visit Date, Sent/Rec, and SO Note. The records are as follows:

| Category | Date | Sensitivity | Priority | Description | Status | Visit Date | Sent/Rec | SO Note |
|--------------------------------|----------|-------------|----------|-----------------------------------|---------|------------|----------|---------|
| 1. RADIOLOGY (SOAPWARE) | 02/09/15 | | Medium | | Pending | | Received | |
| 2. FUNDIUS PHOTO (DIAGNOSTICS) | 02/09/15 | | Medium | Diabetic Retinopathy | Pending | | Received | |
| 3. Signed Form | 01/27/15 | | | HIPAA RECEIPT AND ACKNOWLEDGEMENT | | 01/27/15 | | |
| 4. Visit Note | 01/27/15 | | | General | | 01/27/15 | | |
| 5. GENERAL (GENERAL) | 12/19/14 | | Medium | Comea | Pending | | Received | |
| 6. GENERAL (GENERAL) | 12/19/14 | Normal | High | Melanoma | Pending | | Received | |
| 7. Visit Note | 12/19/14 | | | Eye Injury | | 12/19/14 | | |
| 8. MEDICAL RECORDS (GENERAL) | 03/07/14 | Moderate | Medium | neuro eval | Pending | | Received | |
| 9. Signed Form | 03/07/14 | | | | | 03/07/14 | | |
| 10. Visit Note | 03/07/14 | | | Eye Injury | | 03/07/14 | | |
| 11. MEDICAL RECORDS (GENERAL) | 01/16/14 | | Medium | | Pending | | Received | |
| 12. MEDICAL RECORDS (GENERAL) | 01/16/14 | | Medium | | Pending | | Received | |
| 13. MEDICAL RECORDS | 01/16/14 | Urgent | High | images | Done | | Received | |

At the bottom of the table, it shows 'No. of Document(s): 58' and 'SO = Sign Off'.

Figure 2.1: Electronic Health Record.

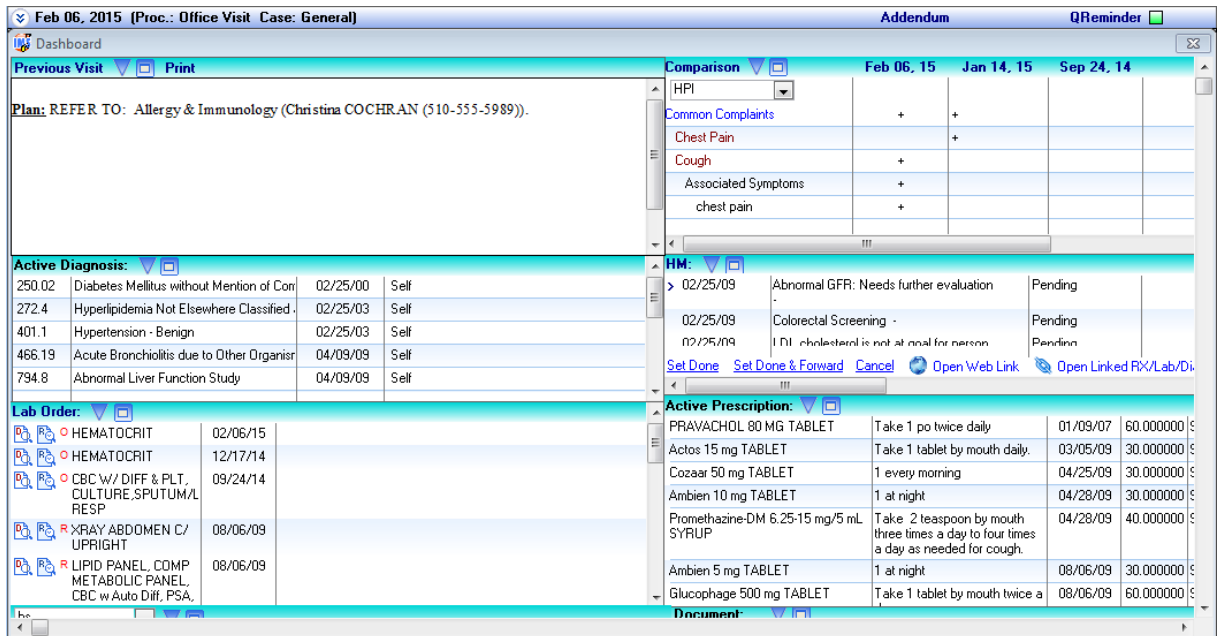


Figure 2.2: Electronic Health Record and Patient Chart.

EHR is real-time patient-centered records. It makes information available instantly, ‘whenever and wherever it is needed’. And it also brings together in one place everything about a patient's health.

2.2.1 What EHR Provide?

- 1) Patient Data.
- 2) Laboratory results.
- 3) Personal Health Record.

It provides medical health record of the patient and includes all therapeutic operations carried out in various hospitals as well as the patient's topographic data.

2.2.2 Electronic Health Records Limitation

Minority of EMRs (computerized systems); EHR depends on computerized systems in the first place. The patient’s data found in the place where only was treated. Other countries find the data but there is no connection between health facilities (no integration).

2.2.3 Electronic Health Records in Sudan

Environment in Sudan is currently inadequate for the development and localization of the electronic health records industry because of the restrictions imposed on the country. But there are great efforts to build and develop health systems in the Sudan to achieve the desired goal in the care of patients.

2.2.4 Electronic Health Records Modules

EHR consist of two modules:

- Patient module.
- Medical report module.

2.3 ELECTRONIC MEDICAL RECORD (EMR)

“An electronic medical record (EMR) is a digital version of a paper chart that contains all of a patient’s medical history from one practice. An EMR contains the standard medical and clinical data gathered in one provider’s office.”^[2]

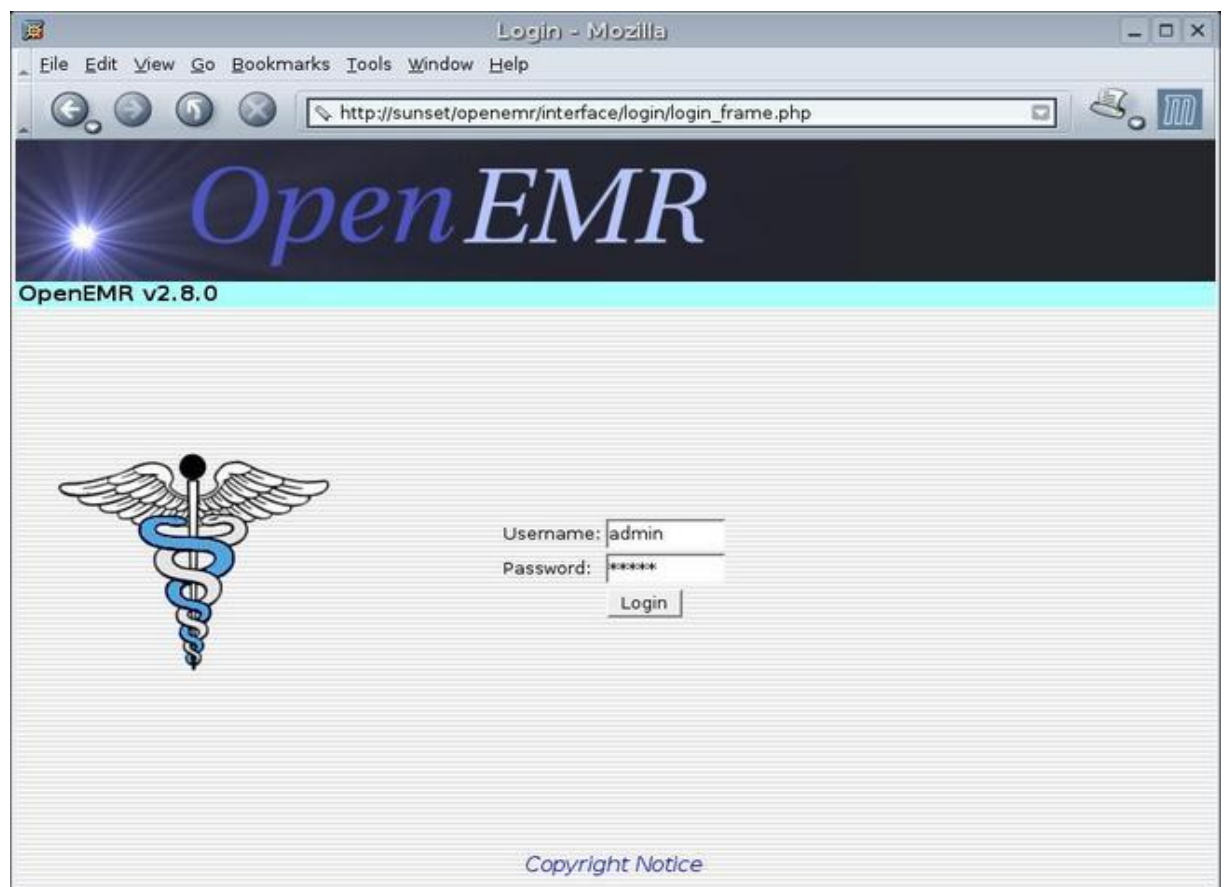


FIGURE 2.4: ELECTRONIC MEDICAL RECORD.

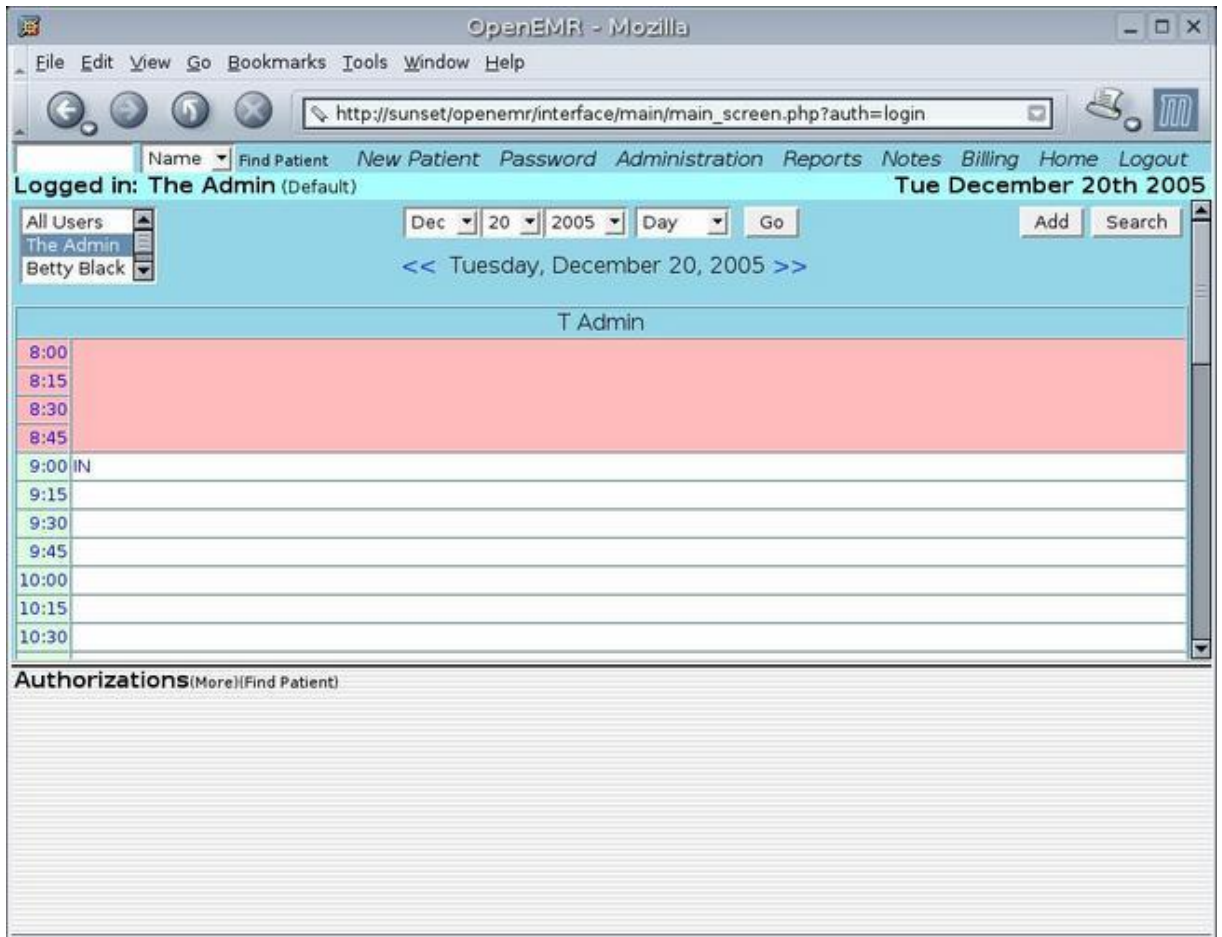


FIGURE 2.5: ELECTRONIC MEDICAL RECORD AND PATIENT INTERFACE

2.3.1 Electronic Medical Record Modules

EMR consist of many modules including:

- Lab module.
- Diagnosis module.
- Medicine module.
- Treatment module.

2.3.2 What Electronic Medical Record Provides?

It provides medical health record of the patient and includes all therapeutic operations carried out in the same hospital as well as the patient's topographic data.

2.3.3 Electronic Medical Record Limitations

The main reason the economic decline and the embargo on the country, there is no interest from the relevant agencies to develop the medical area; by computerizing the hospital systems, and also lack of sufficient expertise in this area.

Table 2.1: The Table Below Clarifies the Differences or Similarities between EHR and EMR.

| Character | EMR | EHR |
|-----------------------------|---|--|
| Contain | Contain notes and information collected by and for the clinicians in that office, clinic or hospital. | Contain information from all the clinicians involved in patient's care. |
| Access | Mostly used by providers for diagnosis and treatment. | By all the clinicians involved in patient's care and all authorized clinicians involved in patient's care. |
| Managed by | The facility. | An organization. |
| Security level | Needed High. | Needed high. |
| Information exchange | Through the facility permission. | Through organization permission. |

2.4SUMMARY OF PREVIOUS STUDIES

In the topic below we summarized the previous studies and their result.

1- Gladwin and Others (2003) 'Implementing a New Health Management Information System In Uganda'^[3]

This study revealed that most of the reasons for the problems of information management and the development of health management information system in Low-income countries are caused by the gap between changes in information systems and the associated organizational and managerial changes in the organization.

➤ Whatlearned from the study:

When building a system, two things need to be considered:

1- Considering the budget of any proposed system cost in all its aspects on the one hand and the budget available to the concerned authority on the proposed system on the other hand.

2 - Comparison of the proposed system with the existing systems in terms of the possibility of coordination or linkage between the new systems and old systems to take advantage of the mechanism of data exchange and the possibilities of available systems.

Based on this study and since Sudan is a developing country, we have established this system according to the state budget.

2- SawarAldahb (2005)

'Evaluation of Health Information Management System in Health Centers in Khartoum'^[4]

The study aimed to assess the current status of the information system in Sudan in order to establish a database so that to contribute on improving health services in the state.

➤ What learned from the study:

By the time of the study there were no database systems on the field of healthcare sector,gathering information on one data center will surely be beneficial.

Based on this study and as it concerned on information gathering theoretically, we did applied it in a real application.

3- Schoen And Others(2012)

'A survey of Primary Care Doctors in Ten Countries Shows Progress in Use of Health Information Technology , Less in Other Areas'^[5]

An international survey of primary health care physicians in 10 countries to measure the extent to which these physicians use the computerized health information system and how it affects their public performance.

- What learned from the study:
 - Progress in the use of health information technology in primary health care practices.
 - A high proportion of primary care physicians in all 10 countries have not received information routinely from specialists or hospitals.
 - Most doctors noted the importance of a change in the primary care system.

Based on this study we have reached the need to establish a computerized health care system in order to reduce the burden of doctors and help them to perform their health care duties with ease and Pleasure, and also help on providing a great number of data on patients.

Discussion of the Previous Studies:

As we have seen from previous studies, there is a similarity in most of the results of the research with the interest in improving the performance in the field of health care by calculating and also benefiting from the resulting information.

The majority of previous studies are related to this research each by its unique perspective, some conducted studies on existence of such systems compared to non-existence and other concerned about the cost and budget of computerization of health care systems, while another study examined the satisfaction of these systems users.

From all that came above, we have concluded that such systems should be applied taking into account all the above, with the use of modern technologies that comforted our lives and contributed on facilitating our daily lives.

2.5 SUMMARY

This chapter will enable you to understand the electronic health record and electronic medical record by how work in the past time and how information is entered in electronic medical record.

EHR and EMR used desktop, laptop, and tablets are all examples of computer workstations. Internet offer a number of advantages compared to local networks.

The system in hospitals dedicated on it. That means the patient must go to the hospital or any healthcare center to take a look to his record, this is so long and waste time.

Finally, we offered a summary of previous studies and what are the results that we have acquired them. In the next chapter we will propose a new system improves the concept of electronic records system.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 INTRODUCTION

Electronic Health Record systems (EHR) are increasingly being deployed within healthcare institutions to reduce the problems and limitations, but its deployment has been slow.

In this research, an Electronic Health Record (EHR) will be design, implement and analyze to work for retrieving of patients records. The Central database acts as the unified data (e.g. banks) for all the collaborating hospitals, the middleware provides a common platform for all the EHR systems between remote hospitals while an authentication server grants access to authorized users and denies unauthorized users access to records or resources on the system.

This chapter will present EHR in new concept (as an integrated system) and offers improvement in patient care; then will introducing the system propose and how increase to give faster service, after that will show the system structure.

Lastly, will present the tools and technics that help us to achieve this system and provide a brief about this chapter.

3.2 ASPECTS OF IMPROVEMENT

The system made it easier for providers and patients to use and share information. Electronic health record (EHR) can help to do a better job, gain time and accelerates the process of access to patient data. Provide full history records to patient anywhere. Using web-base that means platform independent "No Installation required".

These issues have inspired us to research in electronic medical record to propose an electronic health record that overcomes the limitations of stand-alone systems (EMR).

3.3 PROPOSED SOLUTION

The proposed system is a web application that contain more than one EMR, it store patients data in a central database (integrated system); so that it can be retrieved over the net though connecting to the server via internet and using different database vendor to simulate the EMR in hospitals.

Our system reduced webserver load, allow your webserver to serve pages without wasting CPU cycles for maintaining a search index. "How, by reducing traffic and server pay load when polling".

3.4 Proposed Solution Advantages

1. Doctor can view his record and patient's record.
2. The Researchers will find valuable information.
3. When system under development the old system will be working until update done. (Means by old system when add a new hospital EMR already have system).

3.5 Proposed Solution Main Components

Electronic health record has multiple components. It's including MYSQL as DBMS as main store, also using Oracle and MYSQL databases (DBMSs) as separate system (EMR); moreover we using web technique to beauty our system.

3.6 Developments Methodology

We visited a number of hospitals of various kinds, whether public or private to identify the systems used and how patient's data enter when comes. Many questions have been asked to understand the current systems and how they work, which enable us to identify shortcomings in them so that we can analyzed and structure the proposed system.

3.7 EHR WEB-BASED

EHR Web based is more comprehensive and user friendly (include all treatment, easy to use for everyone; It isn't as complicated as other systems). When you want to access the data you do not have difficulty, because the process cursive does not need to bother once you enter your national number shows you're all the information.

3.8 EMPLOYED TECHNIQUES

We used several techniques such as:

3.8.1 WEB APPLICATION

Users can access the application from any computer connected to the Internet using a standard browser, instead of using an application that has been installed on their local computer.

Why web application not desktop or any of the alternatives e.g. (Executable or mobile applications)?

- **Accessible anywhere.**
- **Easily customizable.** (Modify or build according to enterprise specifications needs or requirements).

3.8.2 Java Server Pages (JSP 2.0)

“JSP technology is used to create web application just like Servlet technology. It is an integral part of Java EE, a complete platform for enterprise class applications.”^[6]

- Using JSP to create our systems, this language desirable in the labor market and the high security degree. Creating all pages and connection to database through.

3.8.3 MYSQL 5.0

“MySQL is a powerful, free open-source database management system that has been around for years. It is very stable and has a big community that helps maintain debugs and upgrades it.”^[7]

- Our system is based on MYSQL as main database, and also using it as EMR or hospital.

3.8.4 ORACLE 11g

“An Oracle database, or Oracle DB, is a type of database developed by Oracle and designed for use with Oracle software. It consists of schemas and tables, like most other databases.”^[8]

- We use Oracle as EMR or hospital as different vendor of database.

3.8.5 APACHE TOMCAT 8.0

“Apache Tomcat is an open-source web server and servlet container developed by the Apache Software Foundation (ASF). Tomcat implements several Java EE specifications including Java Servlet, Java Server Pages (JSP), Java EL, and Web Socket and provides a "pure Java" HTTP web server environment for Java code to run in.”^[9]

- Our server Apache Tomcat because is compatible with JAVA easier, flexible and easy to use.

3.8.6 JAVA SCRIPT 1.8

We use JavaScript in pages intentionally to validation.

3.8.7 BOOTSTRAP 2.3

Bootstrap is a front end framework; it gives our design attractively form and beautiful appearance.

3.8.8 ENTERPRISE ARCHITECT 7.0

“Enterprise Architect is Visual Modeling Platform for Comprehensive UML analysis and design tool, modeling for business, software and systems. It provides full life cycle modeling and traceability for requirements analysis and design effective, verification and validation.”^[10]

- UML is tools Support class diagrams, use case diagrams and other UML types in the field of software engineering. Using this tools to analysis our system through enterprise architect.

3.9 SUMMARY

In this chapter, a brief introduction to electronic health record was presented. It gave, also an illustration to the aspects of implements. Also discussed the proposed solution, with an explanation to its features and clarified the system architecture.

Finally, the chapter explains the employed techniques and development tools used for developing.

In the next chapter will offer the analysis of the proposed system. Describe the electronic health record system component and functionality to clarify system processes using Unified Modeling Language UML illustrate in use case, sequence and activity.

CHAPTER FOUR: SYSTEM ANALYSIS AND DESIGN

4.1 INTRODUCTION

The previous chapter discussed the methodology of system determination result. The requirements definition defines what the system is to do. In this chapter, we will discuss how these requirements are further refined into a set of use cases, sequences and activities that provide more detail on the processes by which the system is to meet these requirements and the data needs to capture and store.

Analysis of Electronic Health Record system describing system components and functionality to clarify system processes as the Unified Modeling Language.

4.2 EHR ANALYSIS

Two Primary Groups of Stakeholders:

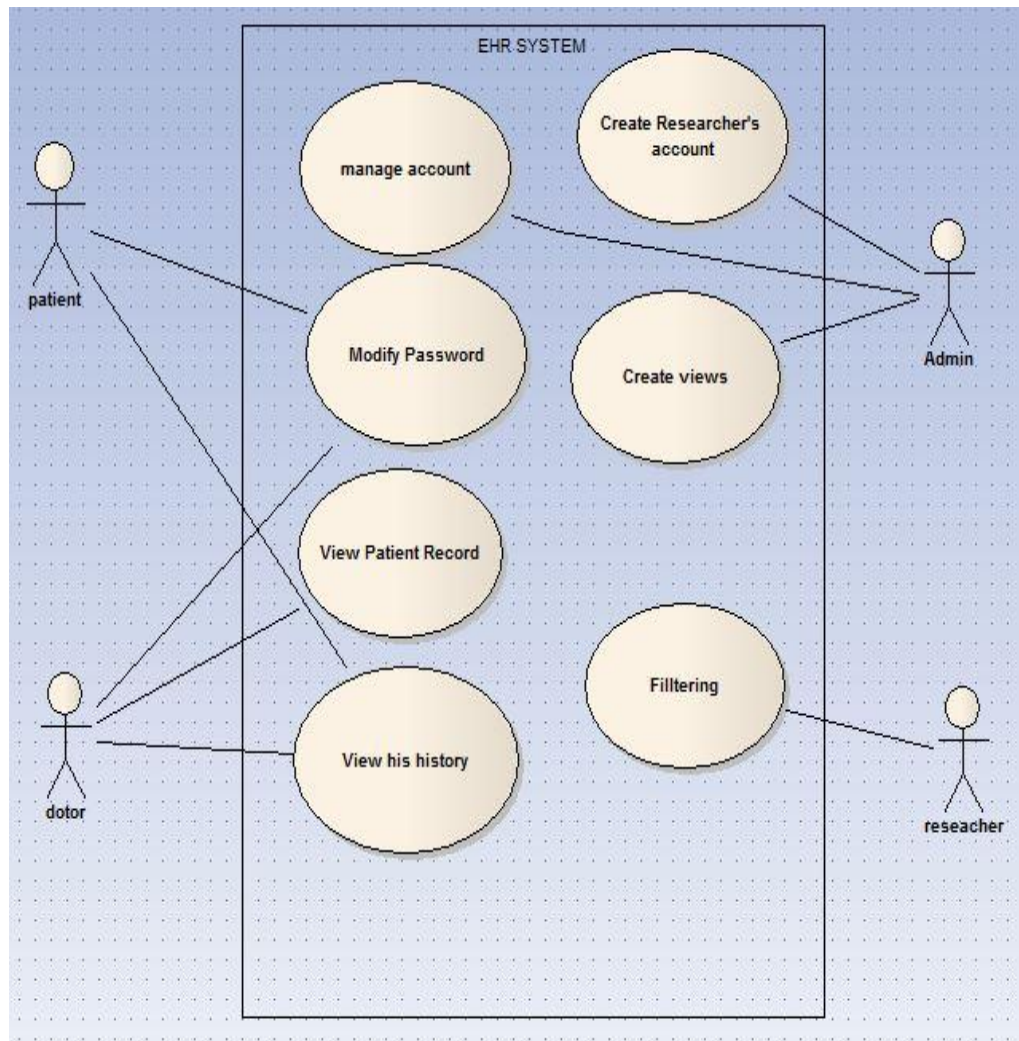
- Users (system users).
- Administrator (ensure system operation).

4.2.1 Use Case

Figure 4.1: Describe The Operations That Can Be Performed By System Users.

- **Patient operations include:**
 - Login, View Record and manage his account.
- **Doctor operations include:**
 - Login, View Health Record History, View Patient's record and manage his account.
- **Researcher operations include:**
 - Login and searching in records (patient's Health records).
- **The Administrator operations include:**
 - System Maintaining.

- Login, Create account for Researcher, manages accounts.
- Insert new EMR Information like DB connection String.



4.3 system design:

4.3.1 Entity Relationship Diagram (ERD)

Figure 4.2: Illustrate Entity Relationship Diagram for EHR database

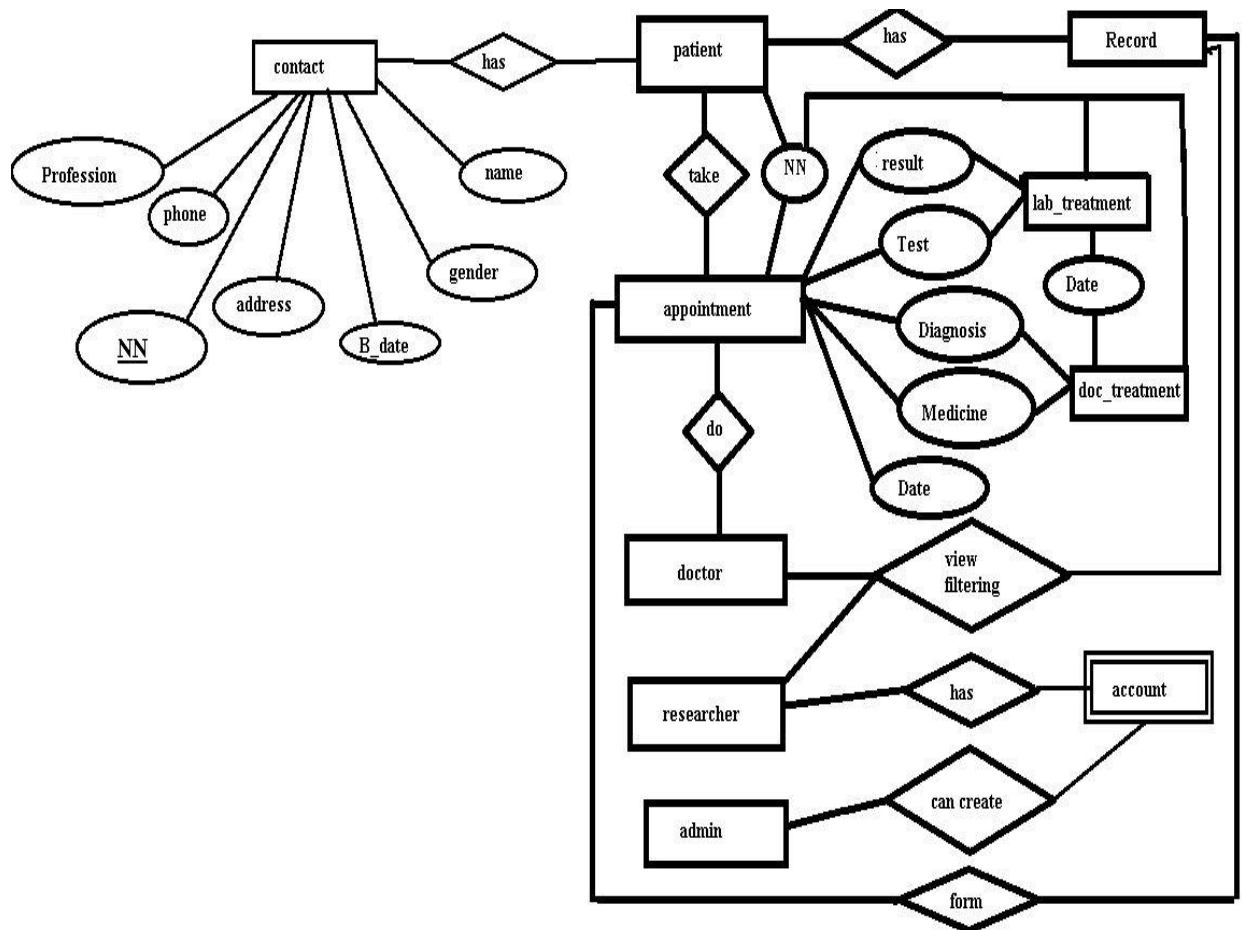
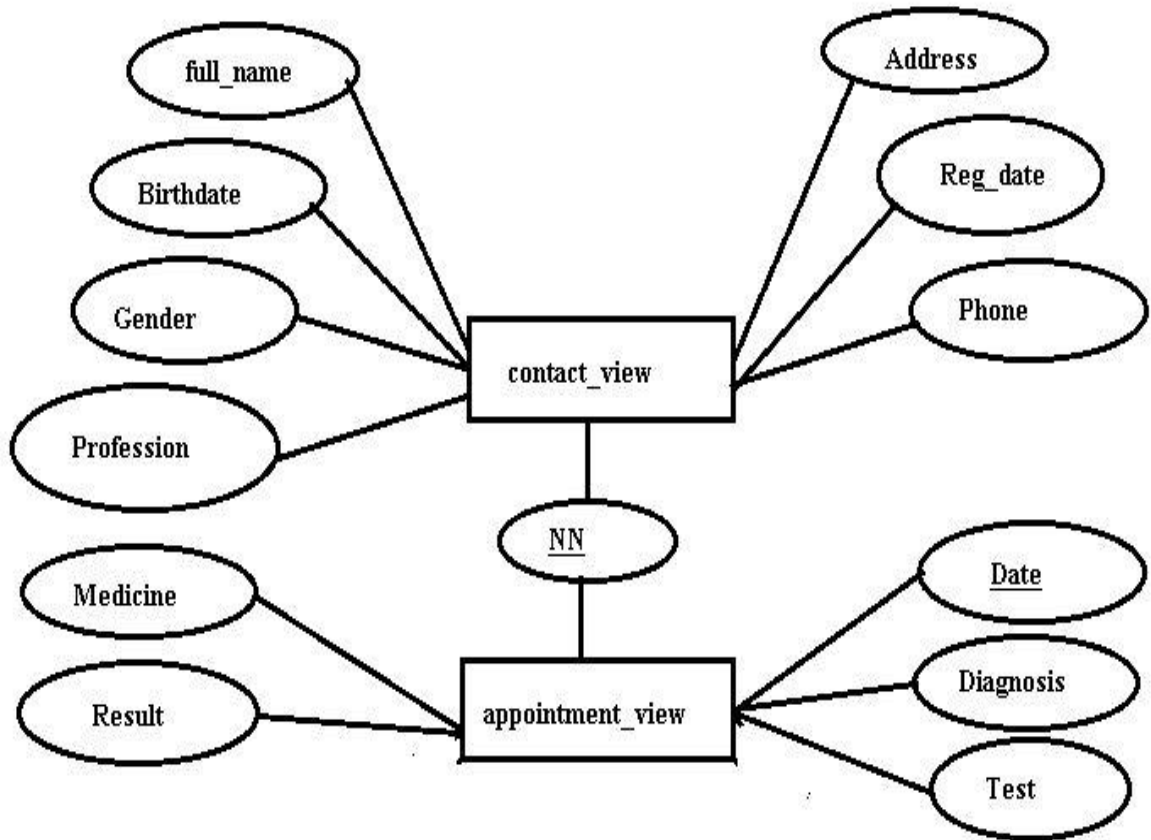


Figure 4.3: Illustrate Entity Relationship Diagram for EMR database



4.3.2 Sequence Diagrams

Figure 4.4: Illustrates How to Create View from EMR.

- A view is a virtual table based on the result-set of an SQL statement, contains rows and columns, just like a real table. The fields in the view are fields from one or more real tables in the database.
- Admin insert (EMR) connection information.
- And then save connection information into (EHR) after ensure it is availability.
- This procedure occurs only one time for every EMR.

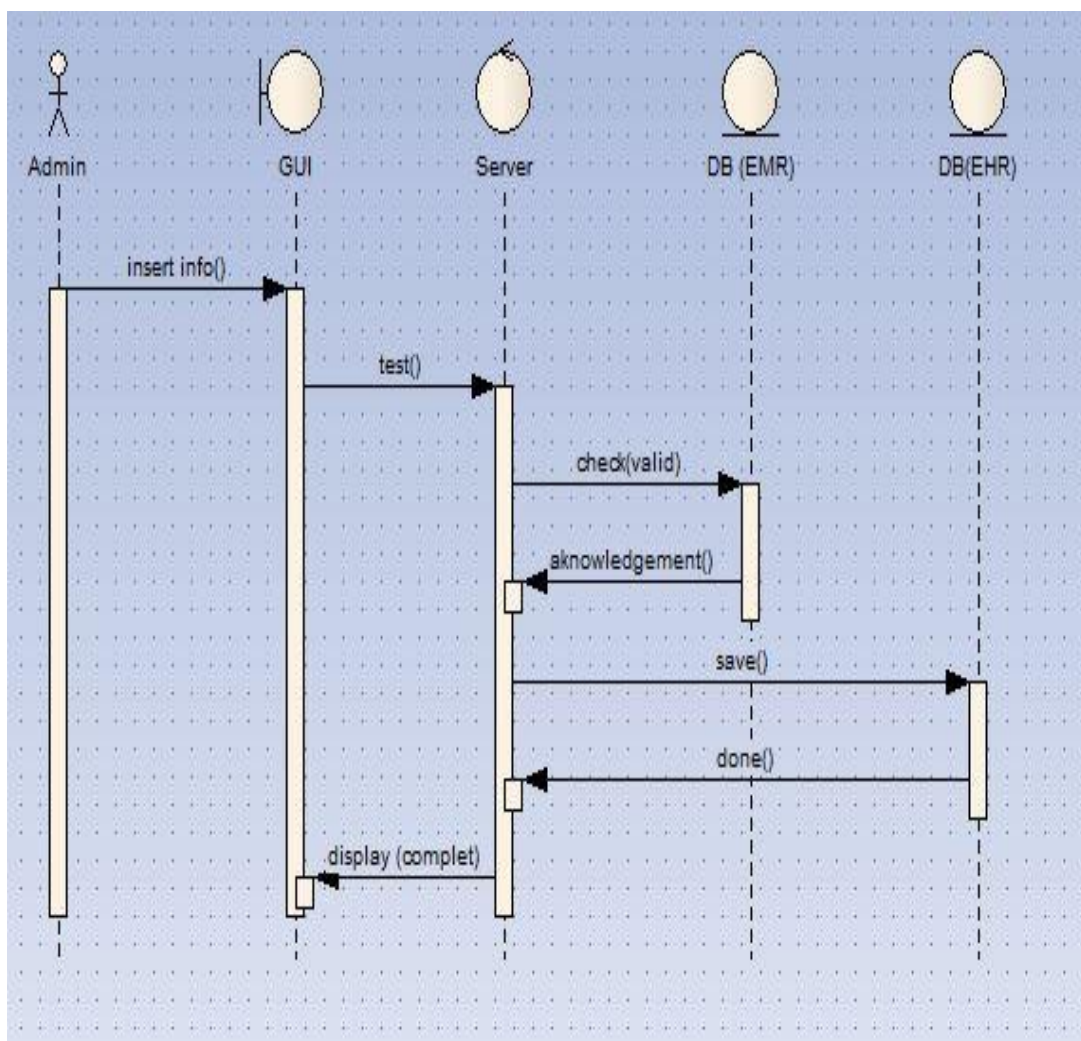


Figure 4.5: Illustrates How to send password to users.

- When the user wants to access his record needs to insert user name and password.
- Password and username, Generate from admin.
- Admin enter phone number into GUI.
- GUI process and send the password and username through Protocol.
- The Protocol is a company given service provides sending SMS.
- In the same time the password and username is store in database.
- Finally, announce the admin password and username has been created.

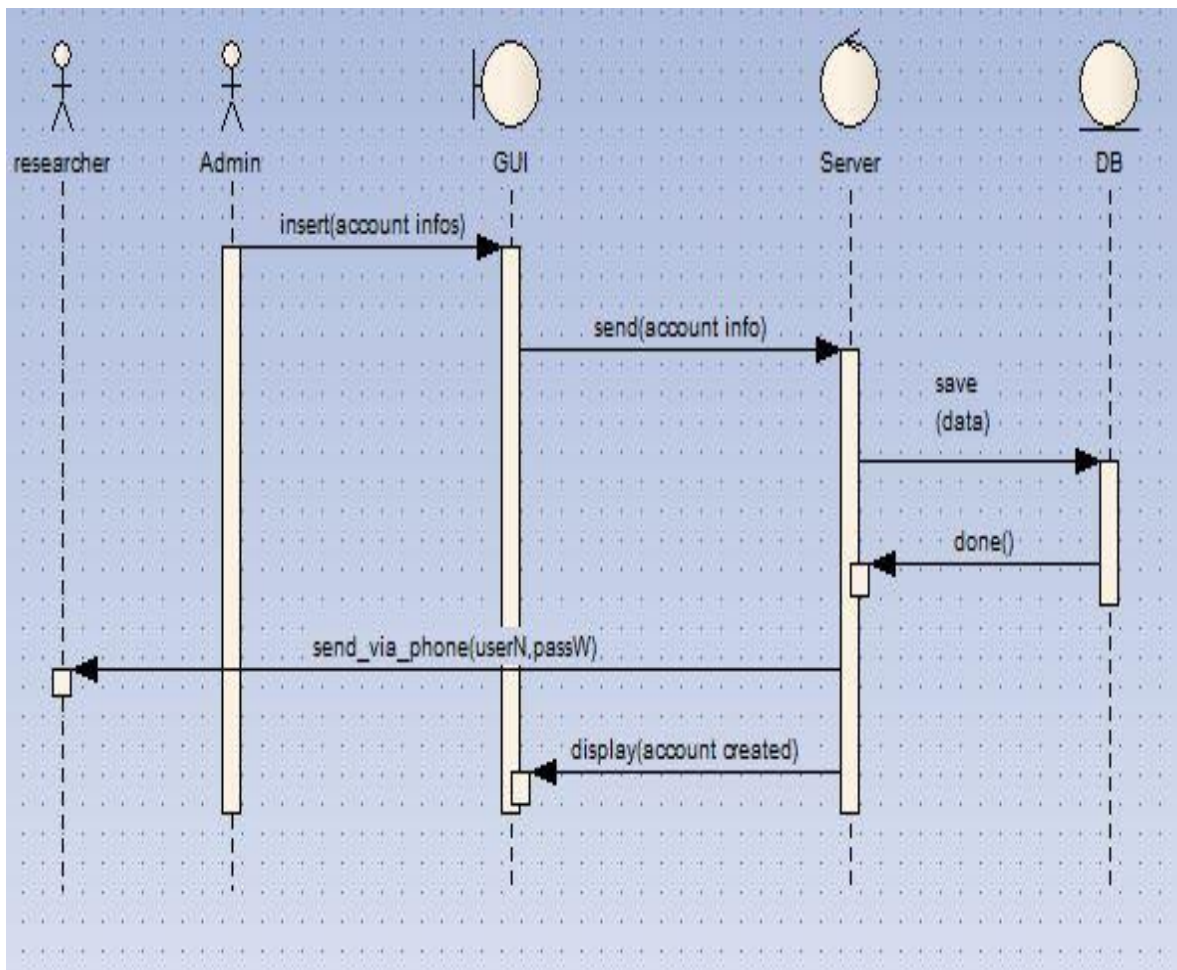


Figure 4.6: Illustrates The Sequence Login Process.

- Users(Administrator, Patient, Doctor and Researcher)enter their Login info (Username and Password) into a GUI.
- The Server checks authority by searching to allow or deny login.

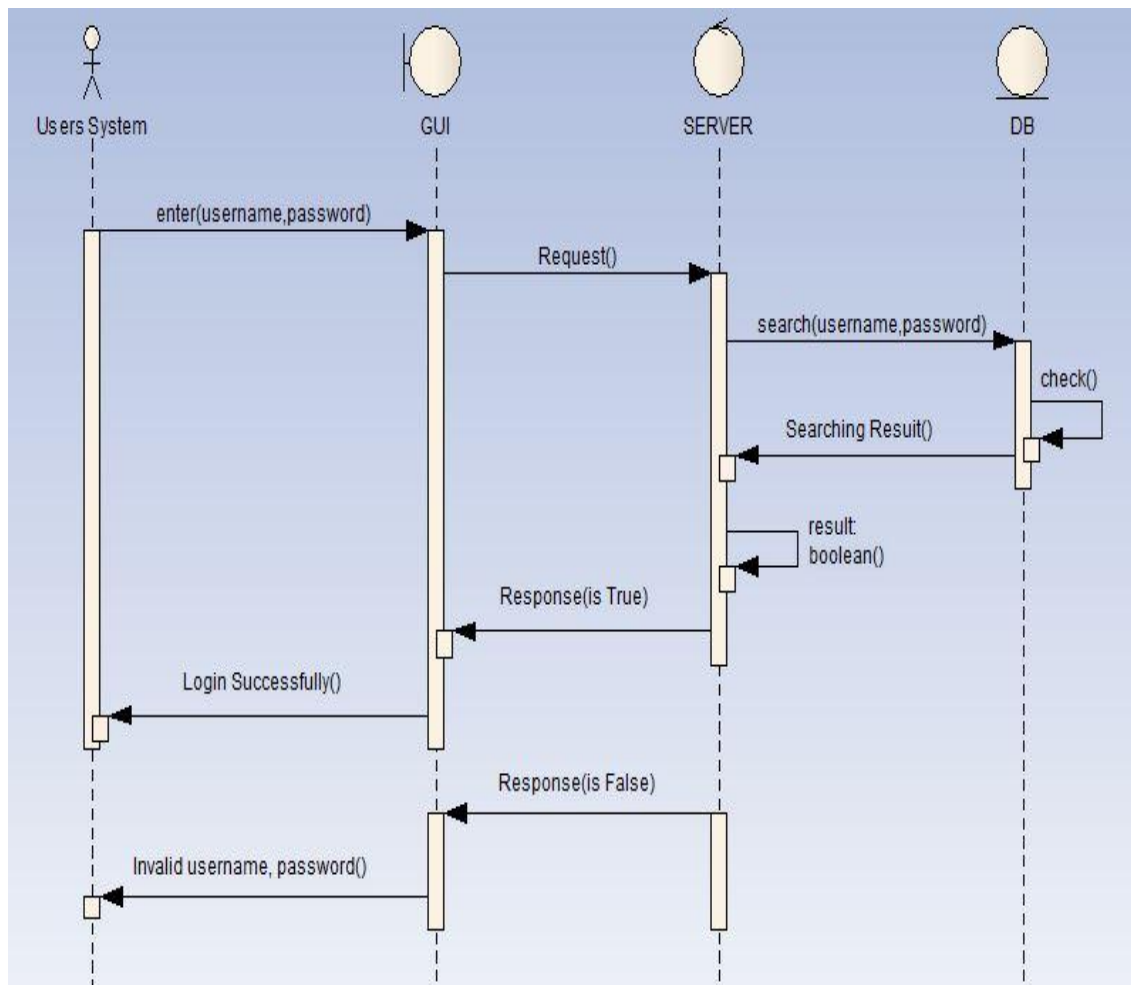


Figure 4.7: Illustrates View Record Of Patient/Doctor and Basic Operations.

- After login process patient/Doctor can display their healthrecords.

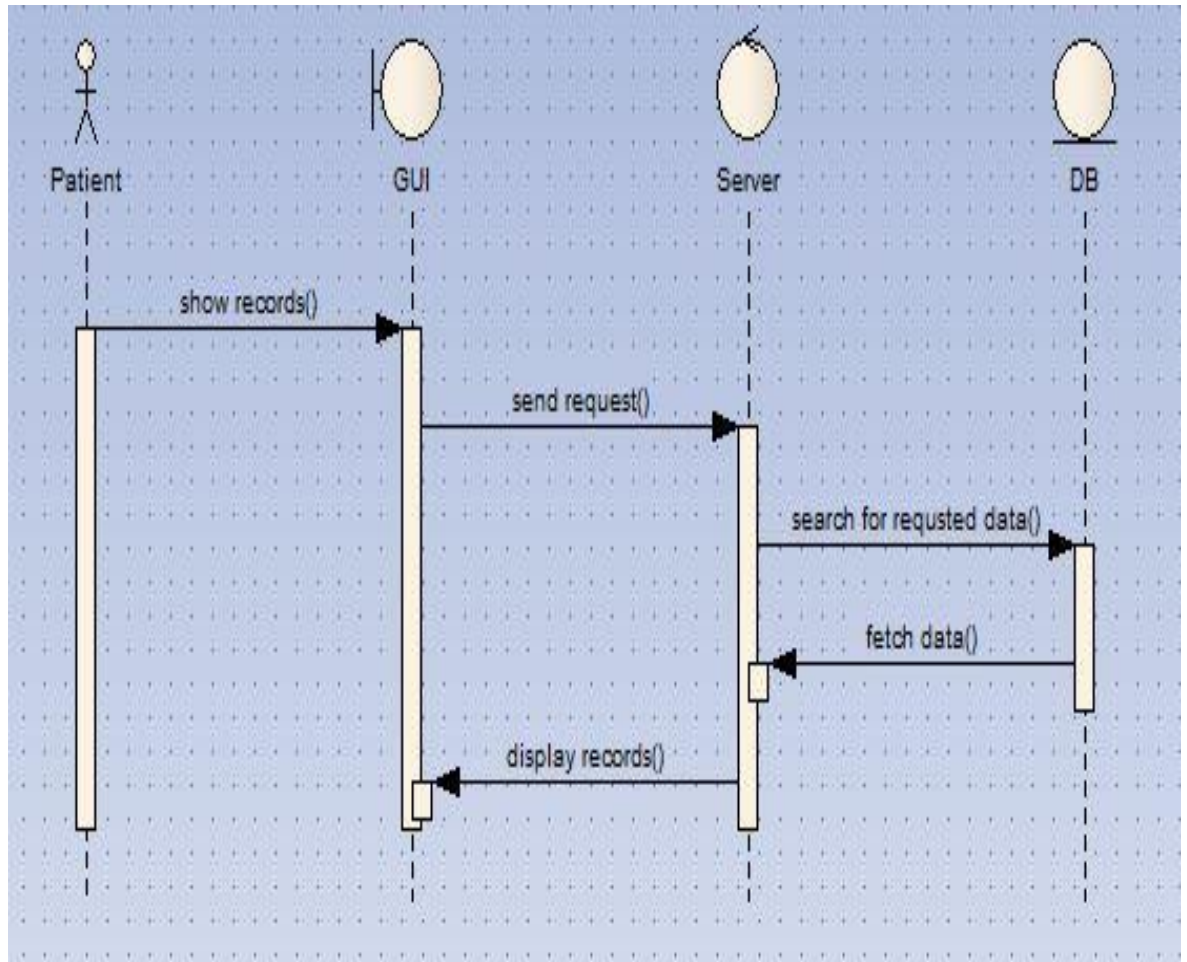


Figure 4.8: Illustrates Sequence of Doctor Viewing Patient's Record.

- When patient comes to the doctor, the doctor can view his record to know more details about his patient. Steps to view patient record:
 - o Doctor enter patient's National Number (NN) to GUI.
 - o GUI send Request to Server, to check if the NN is available in Database or not.
 - o After that if it exist show patient's record if available.

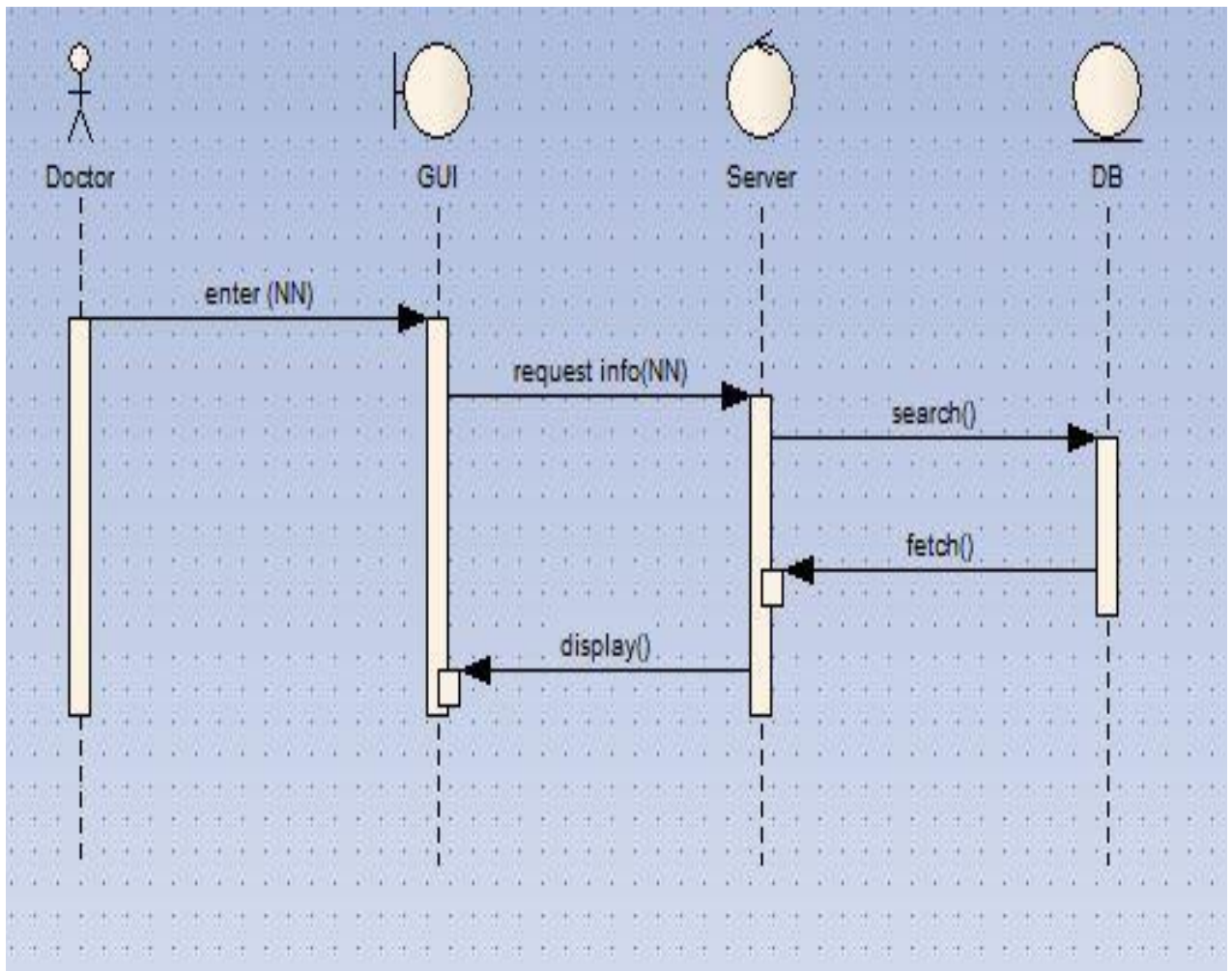
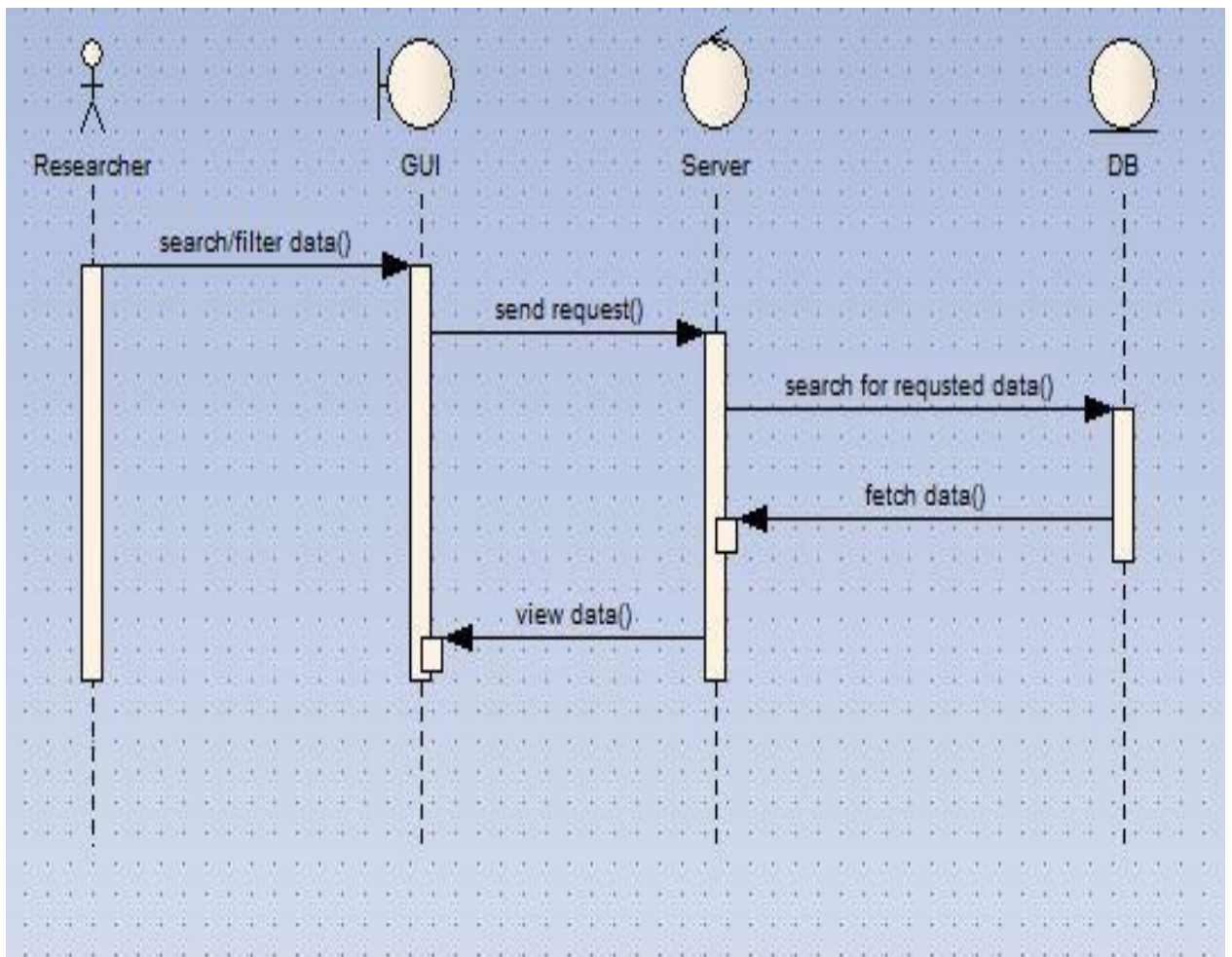


Figure 4.9: Illustrates Procedures of Researcher.

- After the Researcher login to his account he can either search or filter health records.



4.3.3 Activity diagram

Figure 4.10 Illustrates Activity of Patient.

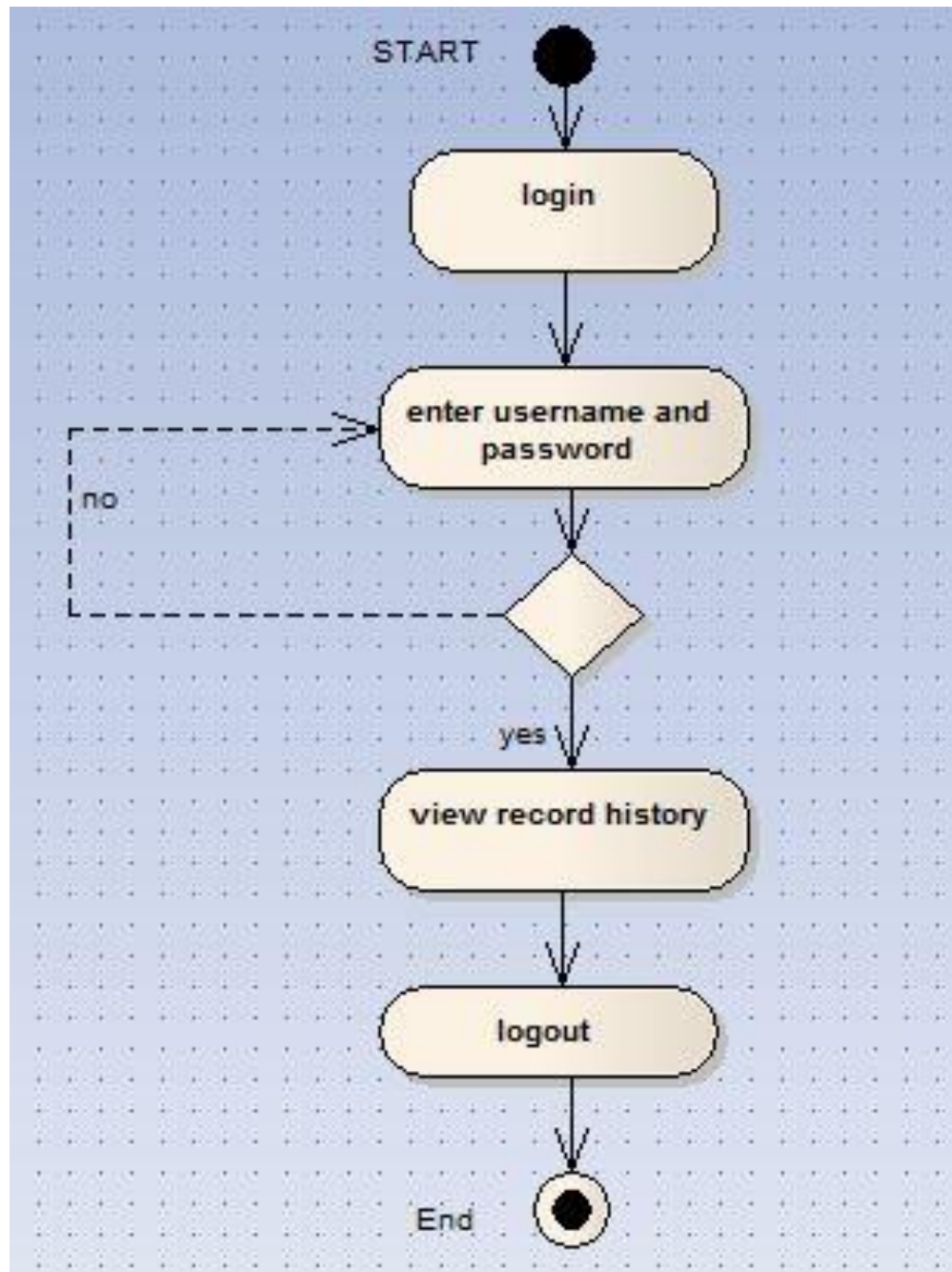


Figure 4.11: Illustrates Activity of Doctor.

-view record patient

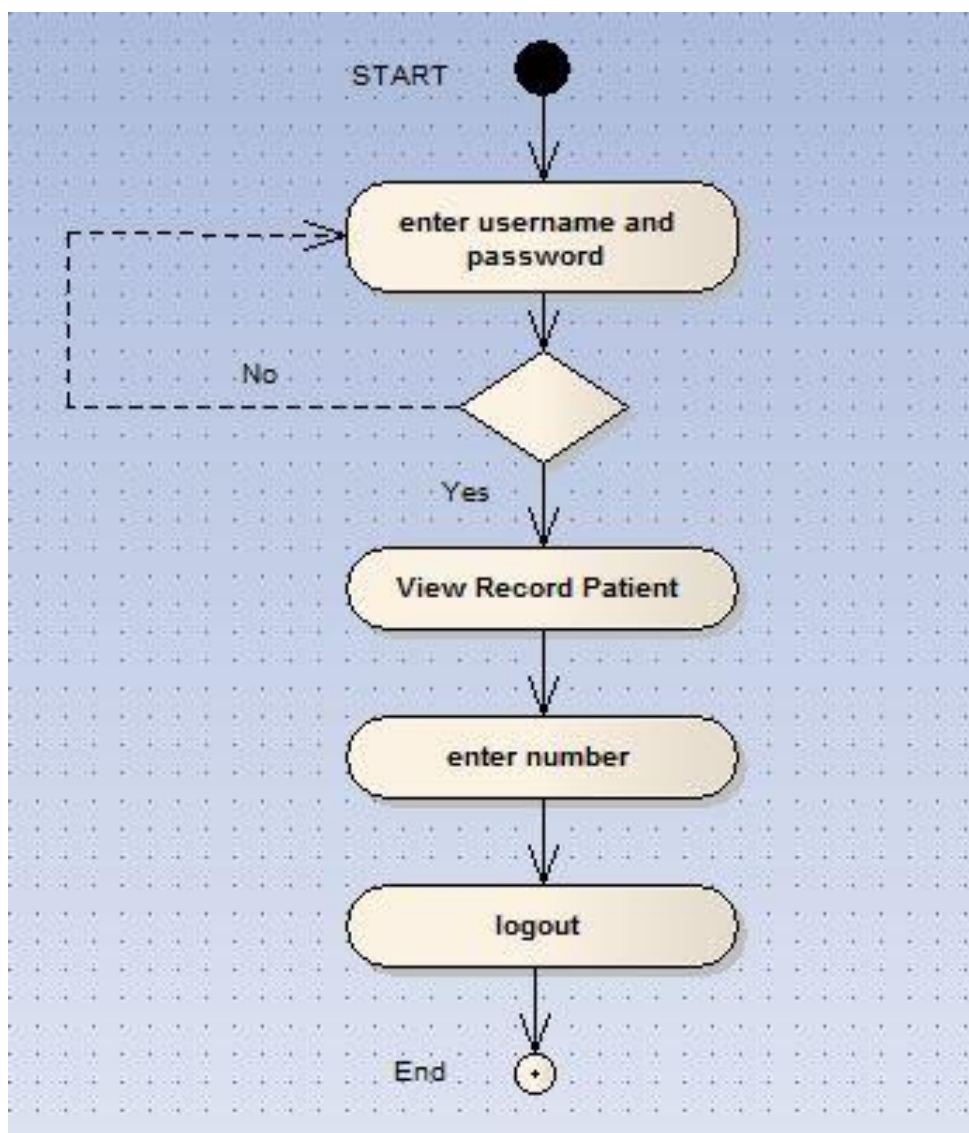


Figure 4.12: Illustrates Activity of Doctor 2.

- Modify password.

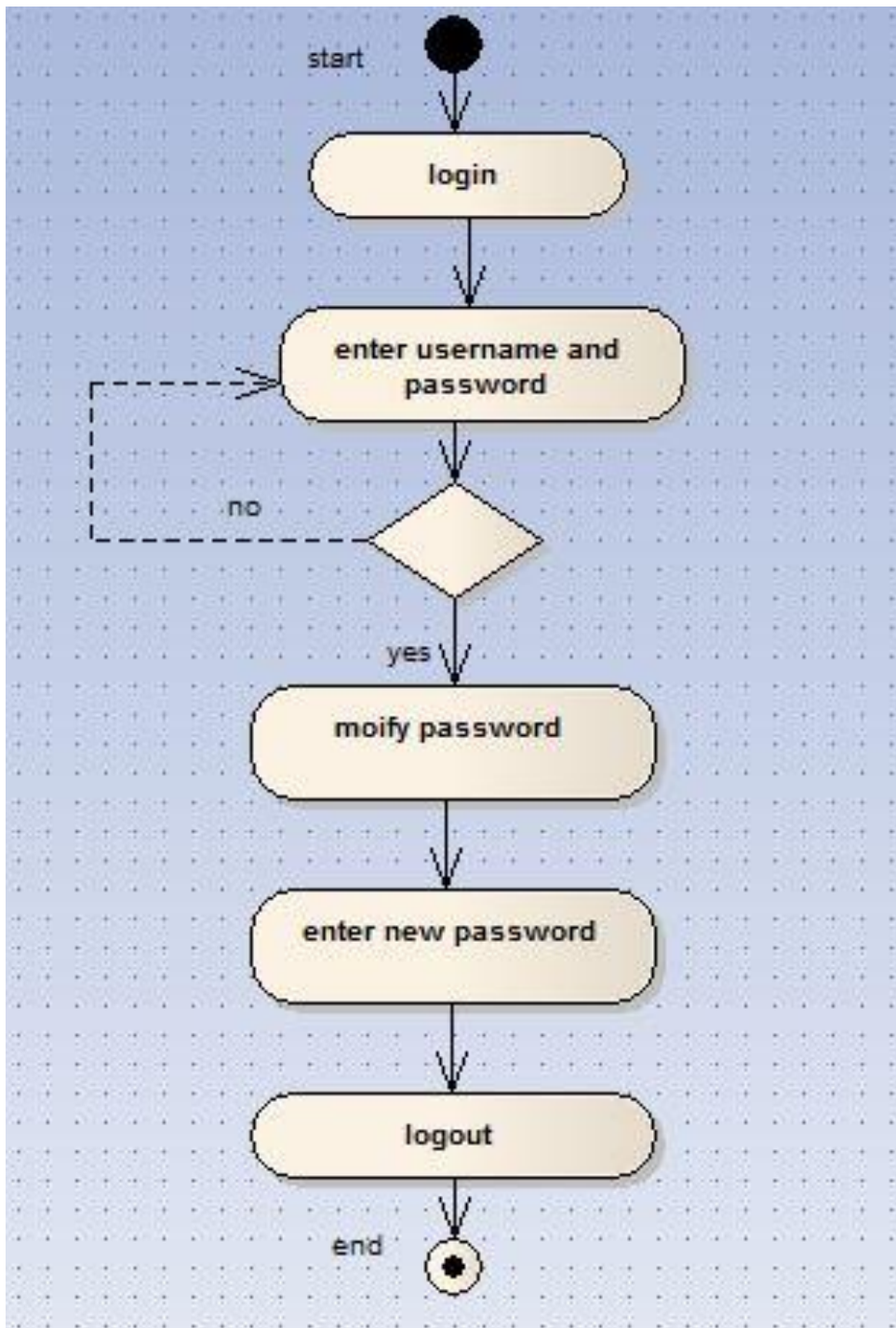


Figure 4.13: Illustrates Activity of Researcher.

- Filter (searching records with options).
- View all patients' record.

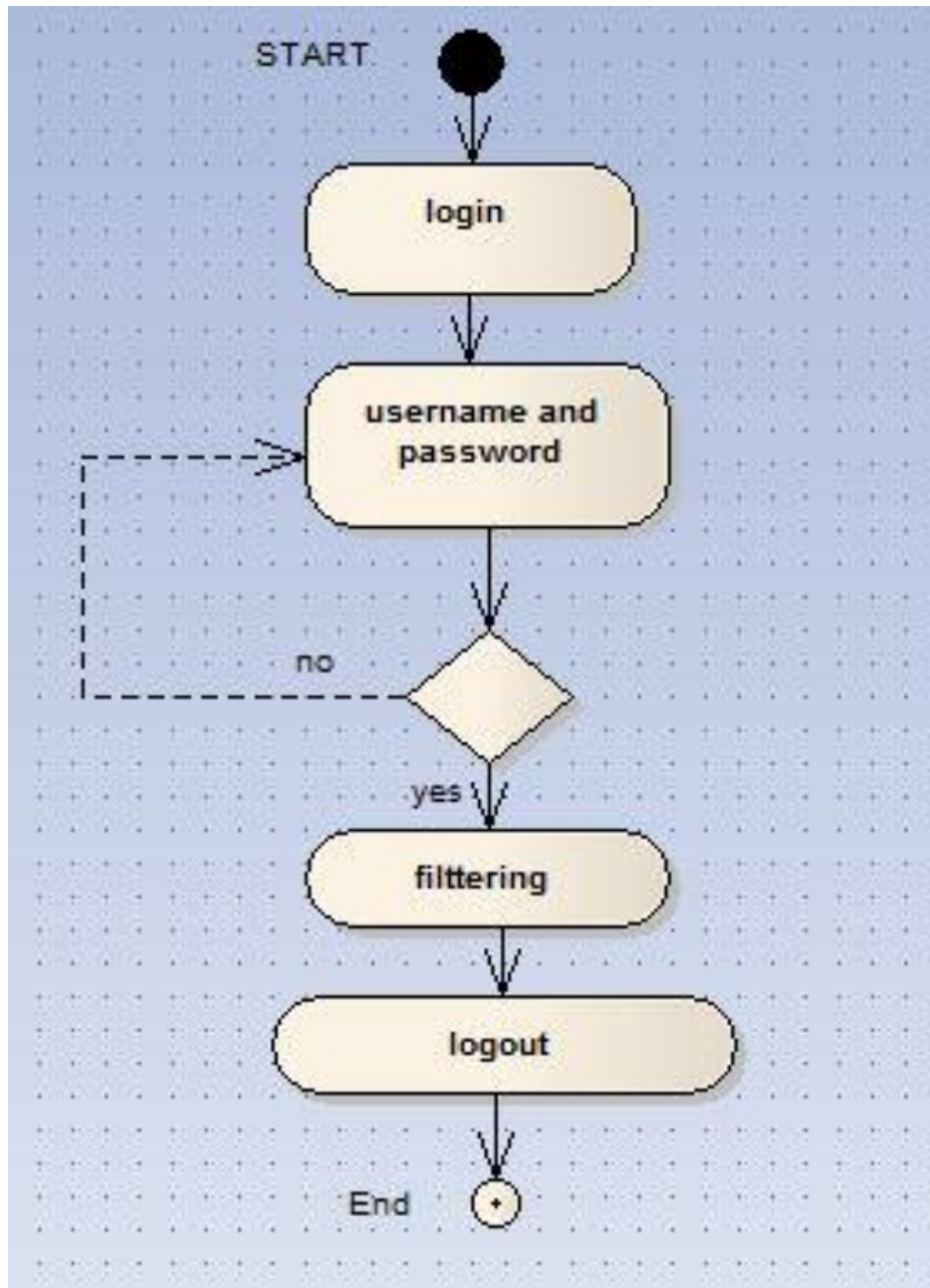


Figure 4.14: Illustrates Activity of Administrator

- Administrator creates researcher account.

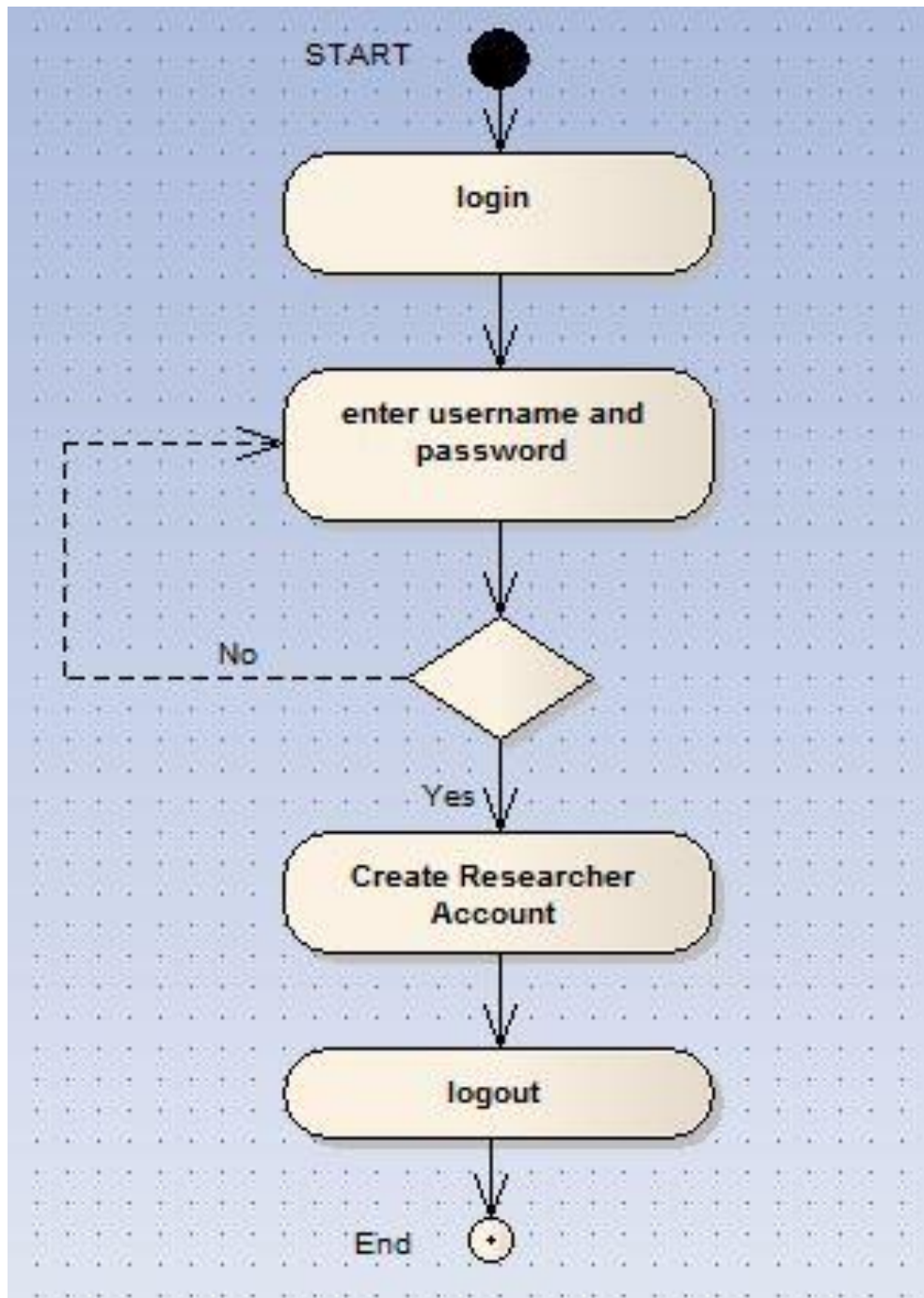


Figure 4.15: Illustrates Activity of Administrator

- create view

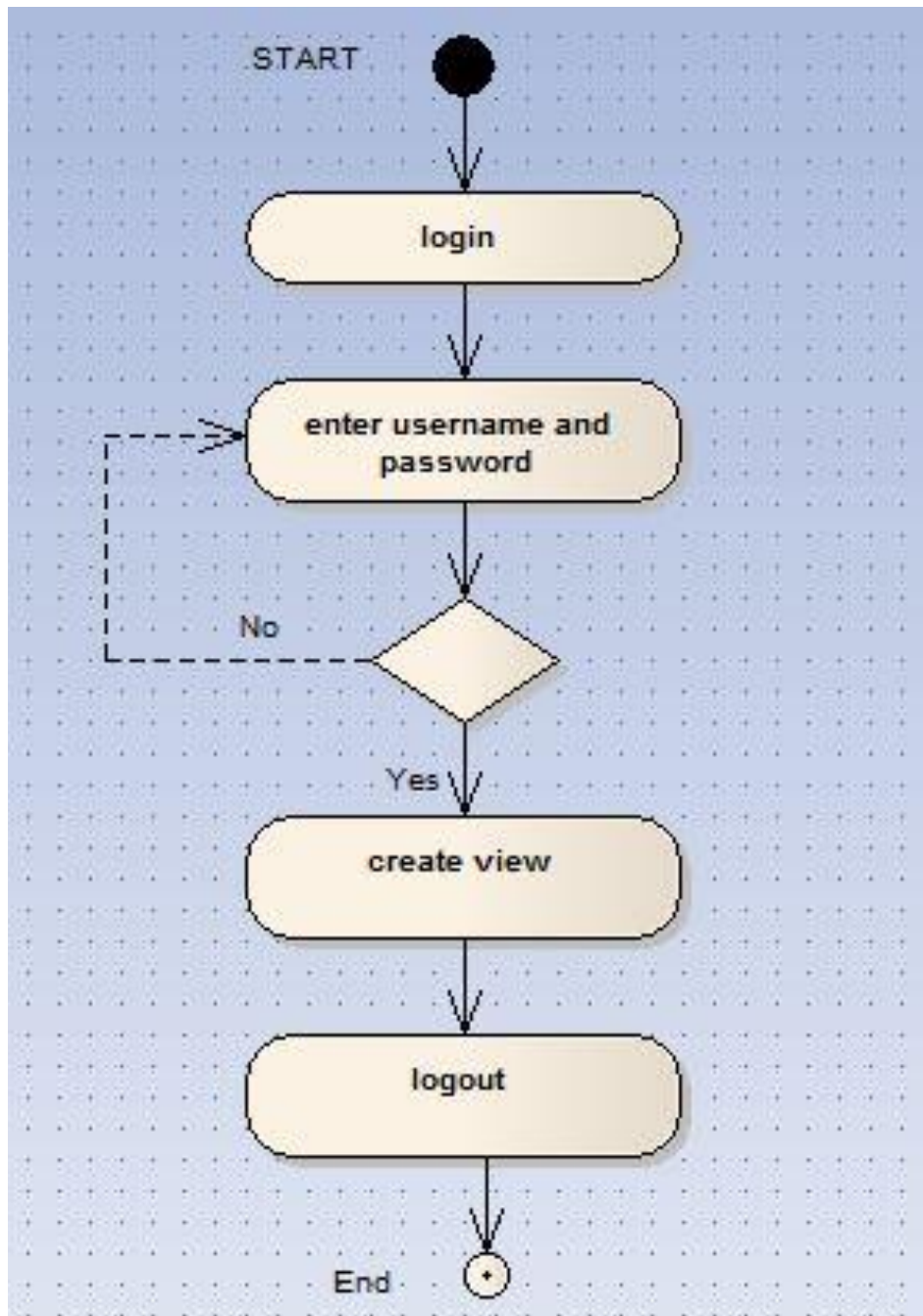
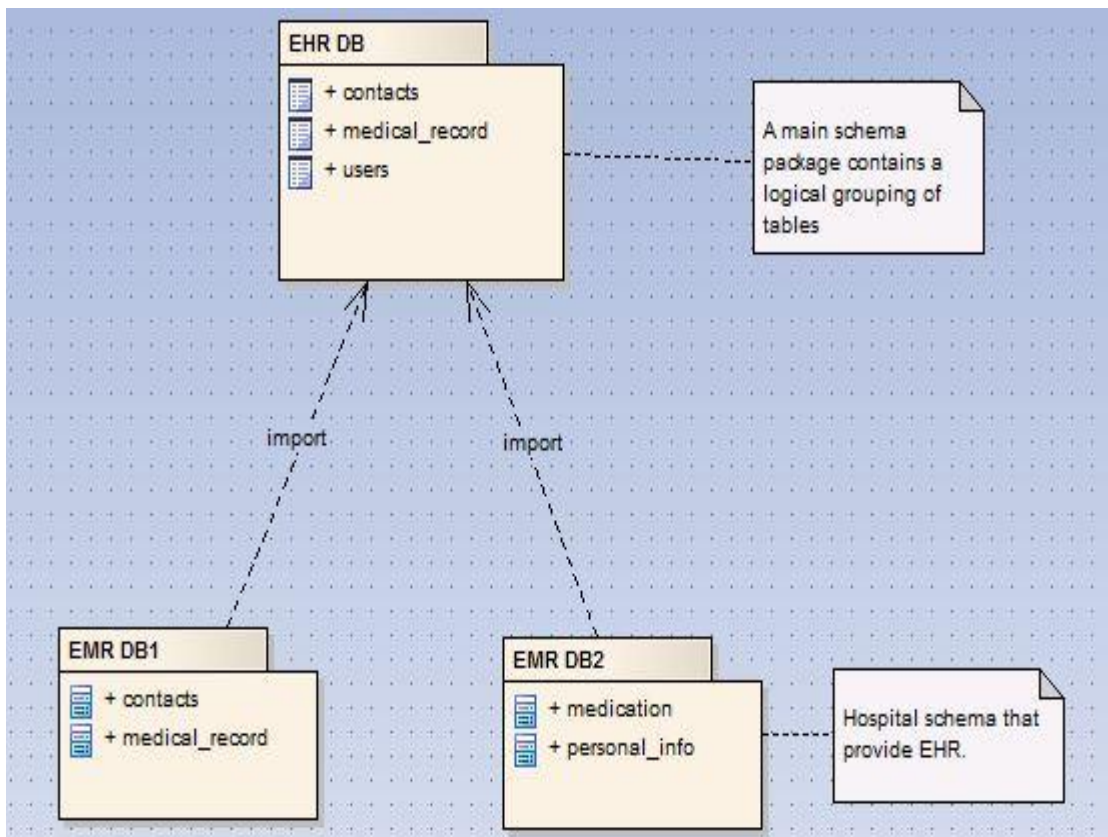


Figure 4.16: Illustrates System Integration

- The integration process: integrate the data fetched from EMR and store them in EHR. This process is carried out by the system, for example, at 3:00 am.



4.3.4 EMR SCHEMA

Table 4.1: Contact

| Column | DATATYPE | PK | NN | UQ | FK |
|------------|-------------|-----|-----|----|-----|
| NN | VARCHAR(20) | yes | Yes | | Yes |
| full_name | VARCHAR(45) | | Yes | | |
| Birthdate | Date | | Yes | | |
| Gander | VARCHAR(10) | | Yes | | |
| Address | VARCHAR(45) | | Yes | | |
| Profession | VARCHAR(30) | | | | |
| Phone | VARCHAR(20) | | Yes | | |
| Reg_date | Date | | Yes | | |

Table 4. 2: Doc_treatment

| Column | DATATYPE | PK | NN | UQ | FK |
|------------|-------------|-----|-----|----|-----|
| NN | VARCHAR(20) | Yes | Yes | | Yes |
| begin_date | Date | | Yes | | |
| Diagnosis | VARCHAR(45) | | Yes | | |
| Medicine | VARCHAR(45) | | | | |
| Note | Mediumtext | | | | |
| end_date | Date | Yes | Yes | | |

Table 4.3: Lab_treatment

| Column | DATATYPE | PK | NN | UQ | FK |
|--------|-------------|-----|-----|----|-----|
| NN | VARCHAR(20) | yes | Yes | | Yes |
| Test | VARCHAR(45) | | | | |
| Result | VARCHAR(45) | | | | |
| Date | Date | Yes | Yes | | |

Table 4.4: Appointment_view

| Column | DATATYPE | PK | NN | UQ | FK |
|-----------|-------------|-----|-----|----|-----|
| NN | VARCHAR(20) | Yes | Yes | | Yes |
| Diagnosis | VARCHAR(45) | | Yes | | |
| Test | VARCHAR(45) | | Yes | | |
| Result | VARCHAR(45) | | Yes | | |
| Medicine | VARCHAR(45) | | | | |
| Date | Date | Yes | Yes | | |

4.3.5 EHR SCHEMA

Table 4.5: db_connection

| Column | DATATYPE | PK | NN | AI |
|---------------|--------------|-----|-----|-----|
| ID | Int | Yes | yes | Yes |
| Emr_user | VARCHAR(100) | | Yes | |
| Emr_password | VARCHAR(45) | | Yes | |
| Hospital_name | VARCHAR(150) | | Yes | |
| Database_name | VARCHAR(100) | | Yes | |
| Server | VARCHAR(100) | | Yes | |
| Port | VARCHAR(50) | | Yes | |
| Reg_date | Date | | Yes | |

Table 4.6: Users

| COLUMN | DATATYPE | PK | NN | FK |
|----------|--------------|-----|-----|----|
| NN | VARCHAR(100) | Yes | Yes | |
| PHONE | VARCHAR(45) | | Yes | |
| PASSWORD | VARCHAR(45) | | yes | |
| TYPE | VARCHAR(45) | | Yes | |

Table 4.7: sync_errors

| Column | DATATYPE | PK | NN | AI |
|------------|-------------|-----|-----|-----|
| ID | Int | Yes | yes | Yes |
| Error | Text | | Yes | |
| Sync_date | VARCHAR(50) | | Yes | |
| Db_name | VARCHAR(80) | | Yes | |
| Sever | VARCHAR(60) | | Yes | |
| Correction | VARCHAR(30) | | yes | |

Table 4.8: Contact

| Column | DATATYPE | PK | NN | UQ |
|------------|--------------|-----|-----|-----|
| ID | Int(11) | | yes | Yes |
| NN | VARCHAR(20) | Yes | Yes | |
| Full_Name | VARCHAR(150) | | Yes | |
| Gender | VARCHAR(50) | | Yes | |
| DOB | Date | | Yes | |
| Address | VARCHAR(150) | | Yes | |
| Profession | VARCHAR(150) | | | |
| Phone | VARCHAR(20) | | Yes | |
| Reg_date | Date | | | |

Table 4.9: treatment

| COLUMN | DATATYPE | PK | NN | AI |
|-----------|--------------|-----|-----|-----|
| ID | VARCHAR(20) | | Yes | Yes |
| NN | VARCHAR(20) | Yes | | |
| Diagnosis | VARCHAR(100) | | Yes | |
| Test | VARCHAR(100) | | | |
| Result | VARCHAR(100) | | | |
| Medicine | VARCHAR(100) | | | |
| Date | Date | | Yes | |

Table 4.10: Log files

| COLUMN | DATATYPE | PK | NN | FK | AI |
|------------|-------------|-----|-----|----|-----|
| Id | VARCHAR(20) | YES | YES | | YES |
| Doc_ssn | VARCHAR(25) | | YES | | |
| Viewed_ssn | VARCHAR(25) | | YES | | |
| Date | DATE | | YES | | |

4.4 SUMMARY

This chapter discussed system analysis as the process of studying a procedure to identify its goals and purposes, create system and procedures that will achieve them in an efficient way. The system is fragmented into parts; to show how these parts work and interact to accomplish their purpose.

Next chapter will illustrate the implementation of EHR system. The chapter will presents interfaces of EHR design and the procedure of system.

CHAPTER FIVE: IMPLEMENTATION

5.1 INTRODUCTION

This chapter discusses the implementation of electronic health record. Provides the screens about the system, including software design decisions taken.

Structure of the system, showing the various directories. It reviews explains the organization and design of the system. There are several interfaces used in the EHR and these are explained along with an example. This section also covers the components activities of the system.

5.2 SYSTEM IMPLEMENTATION

Figure 5.1: Illustrate Electronic Health Records Home Page.

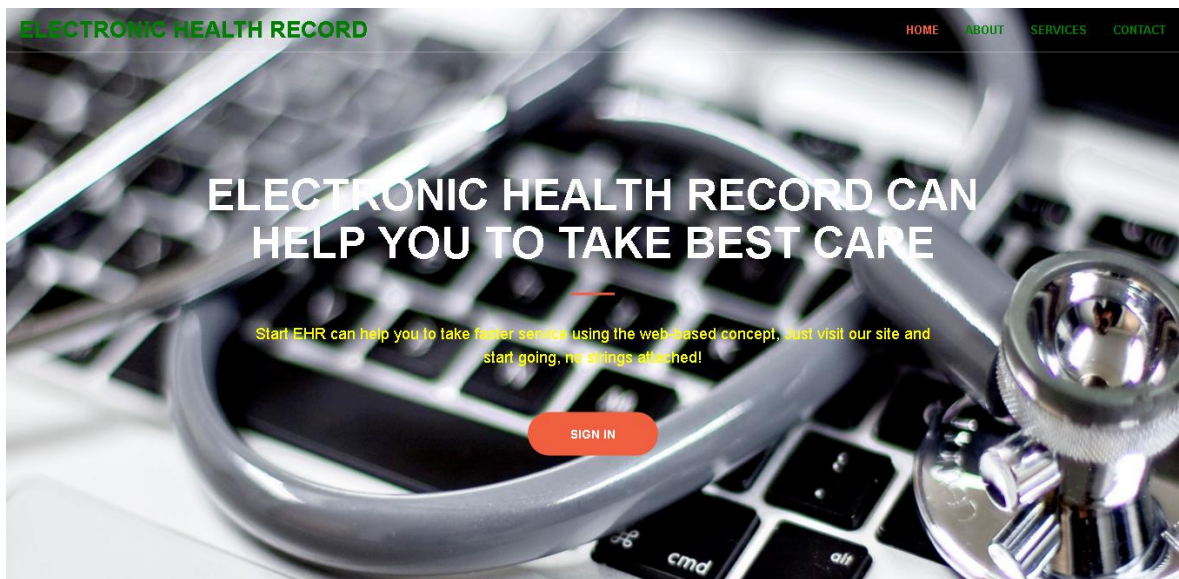


Figure 5.2: Illustrate About us Page.

- This page contains a brief that we are or our website.

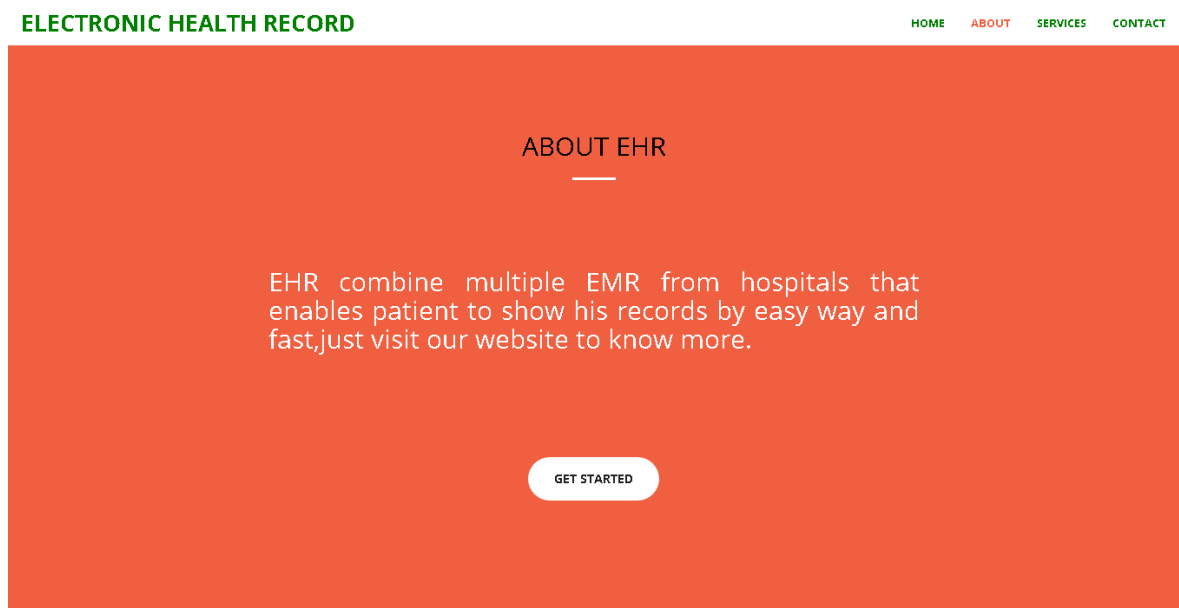


Figure 5.3: Illustrate Our Services Page.

- Which service provides this website?

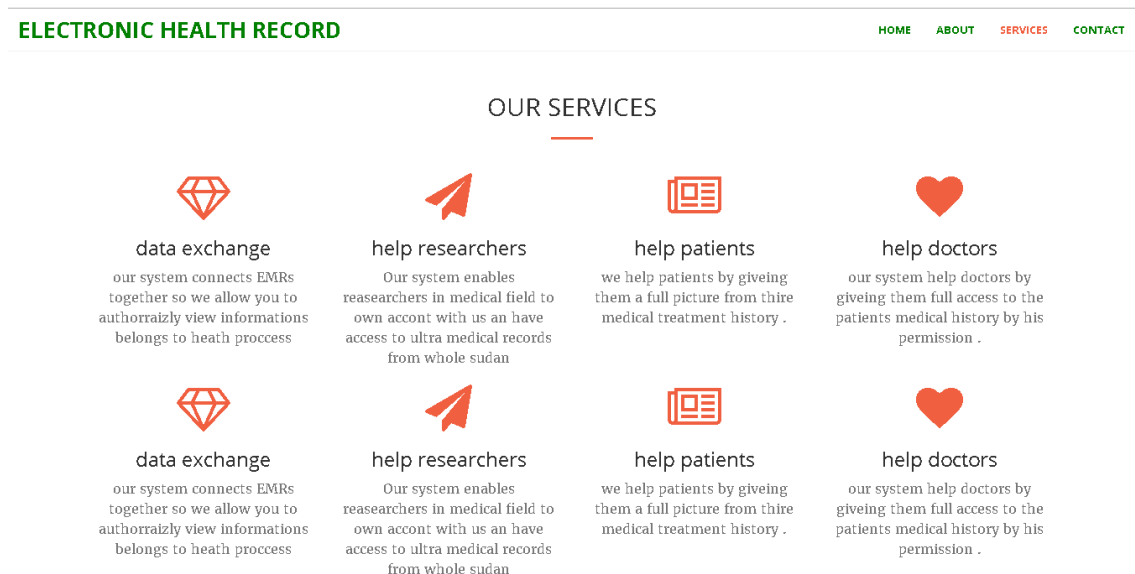


Figure 5.4: Illustrate Contact us Page.

- How you can reach us.

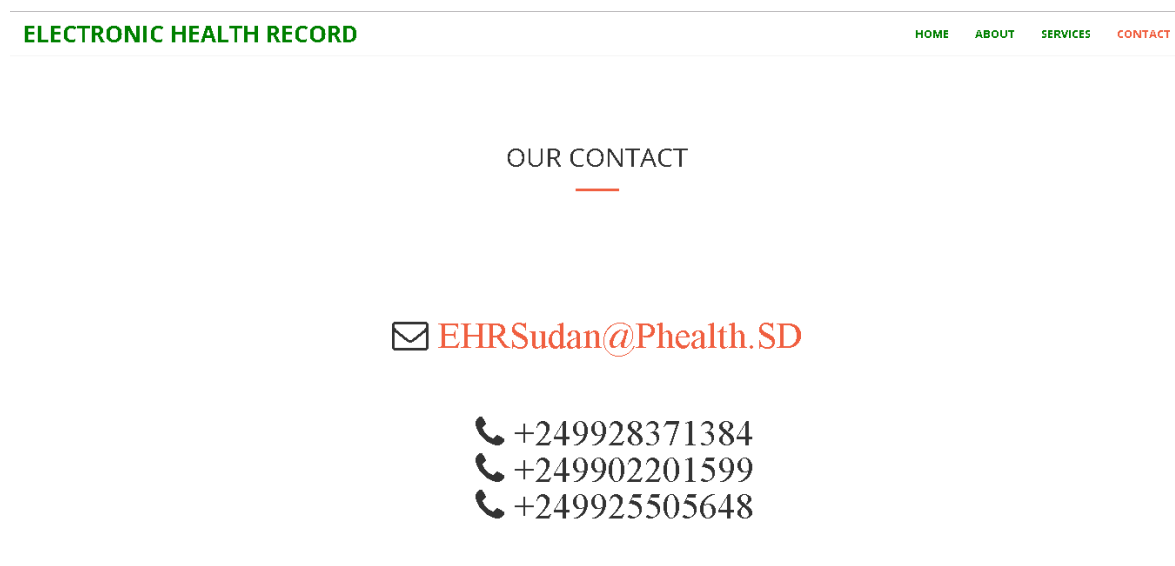


Figure 5.5: Illustrate Patient medical record page.

- When patient login first his medical record page will show up.

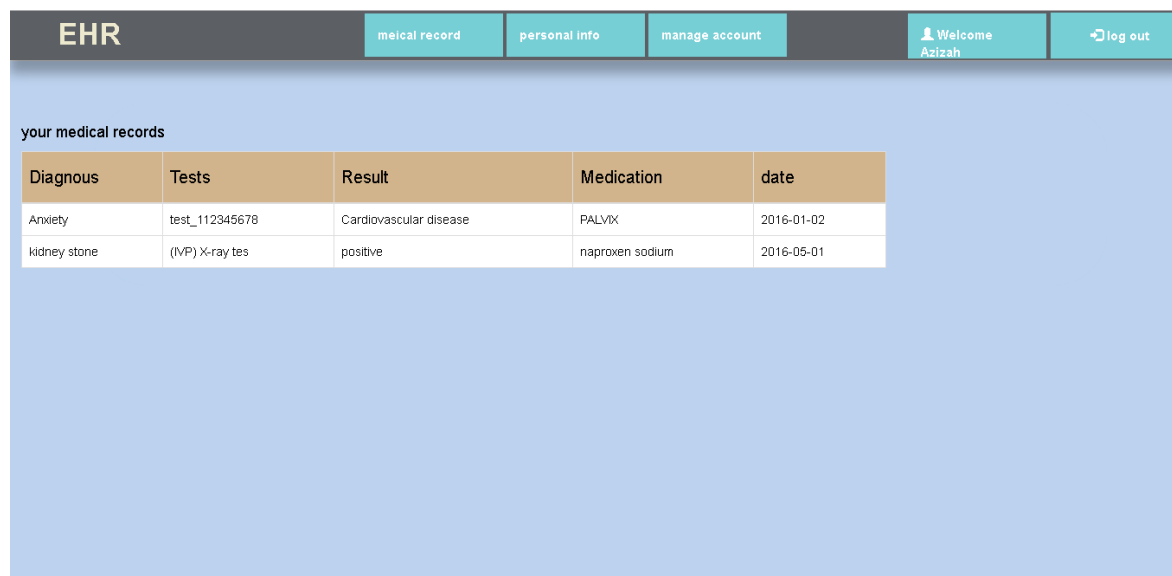


Figure 5.6: Illustrate Patient Personal Information Page.

- Show patient's personal information.

The screenshot shows the 'personal info' tab selected in the EHR system. The page displays the following patient information:

- 1 - user ID : 112345678
- 2 - user name : Azizah
- 3 - gender : 1990-01-01
- 4 - birth date : FEMALE
- 5 - address : BAHRI
- 6 - profession : Investor Factors Liason
- 7 - phone number : 0938474657

At the bottom of the information list, there is a blue button with a pencil icon labeled 'Edit info'.

Figure 5.7: Illustrate Users (patient/doctor) Manage Account Page.

- Modify (patient/doctor) account.

The screenshot shows the 'manage account' tab selected in the EHR system. A modal dialog box titled 'Manage Account Password' is displayed in the center. The dialog contains three input fields for password management:

- Current Password
- New Password
- Confirm Password

At the bottom of the dialog, there are two buttons: 'cancel' and 'Save Changes'.

Figure 5.8: Illustrate Doctor View Patient Record Page.

- By enter patient's NN to the search field.
- Show to the doctor records about the patient in front of him.
- Will view doctor action, doctor page the same as patient when his show personal, medical record and manage account.

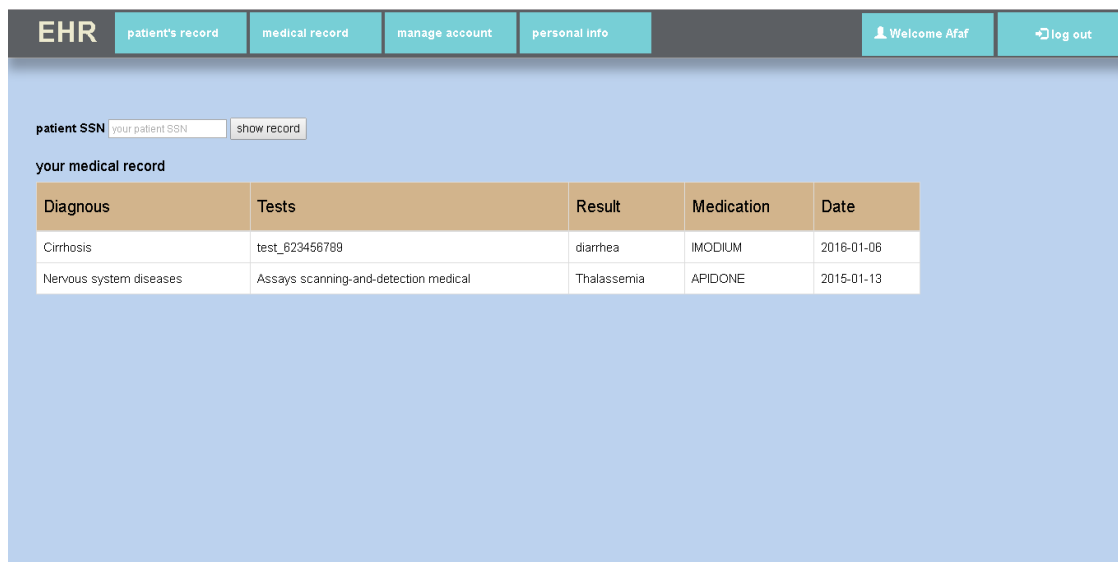


Figure 5.9: Illustrate Researcher Home Page.

- This page enable researcher to take statistic data from EHR data.

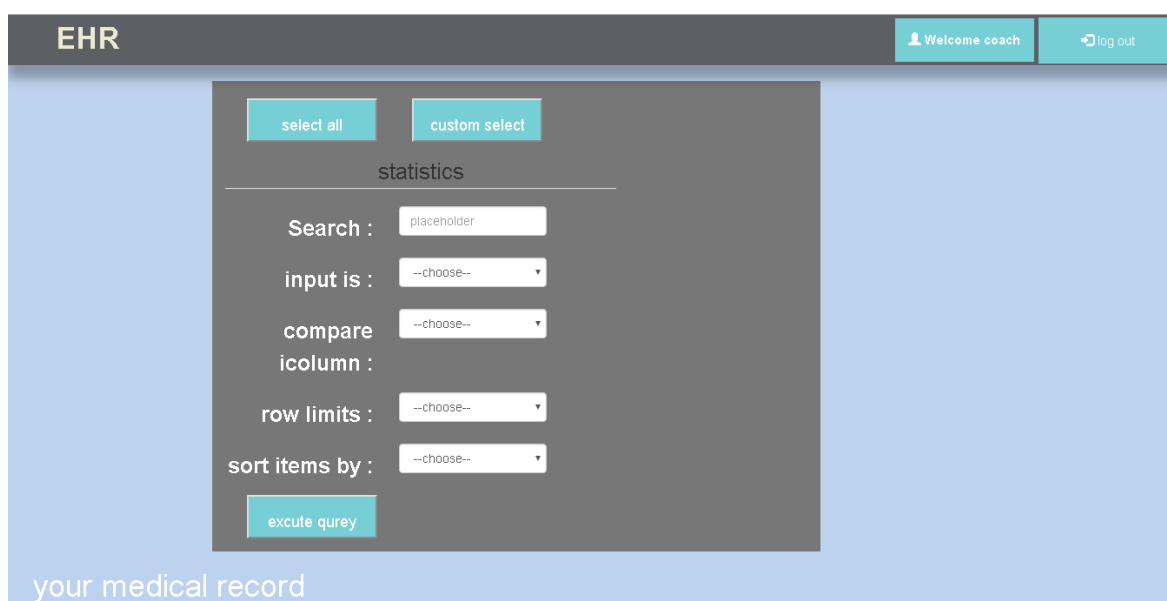


Figure 5.10: Illustrate Administrator Home Page.

- The first thing that the admin see is his medical history.

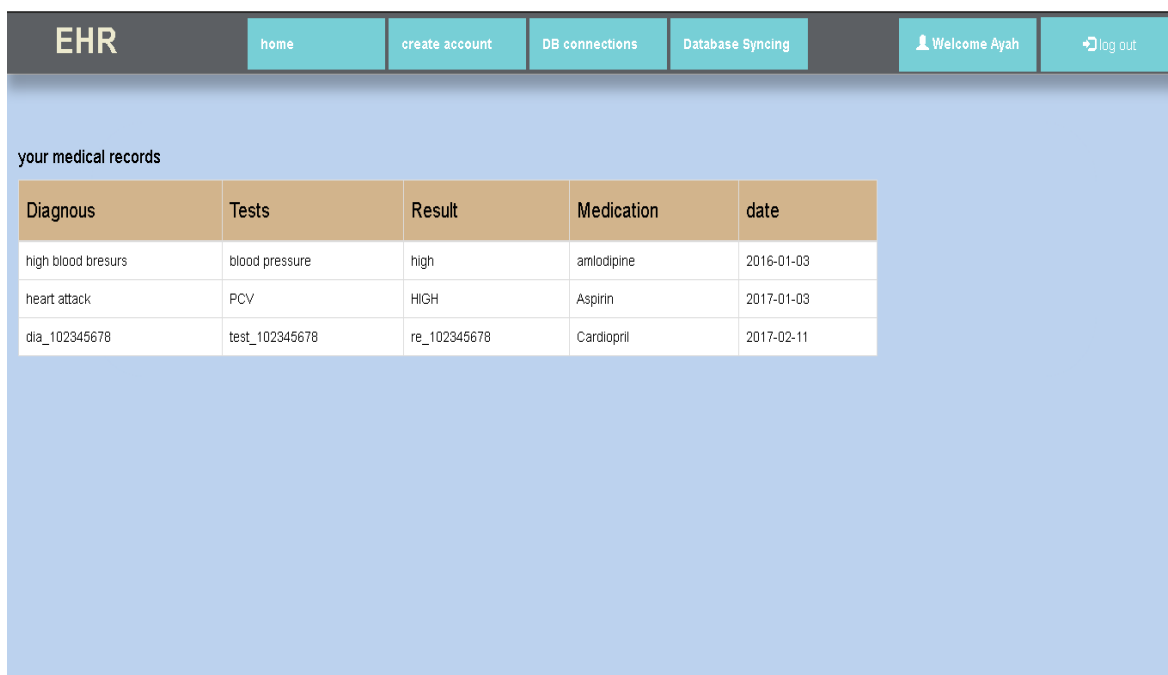


Figure 5.11: Illustrate Admin Create Account to Researcher Home Page.

- Admin create account to Researcher.

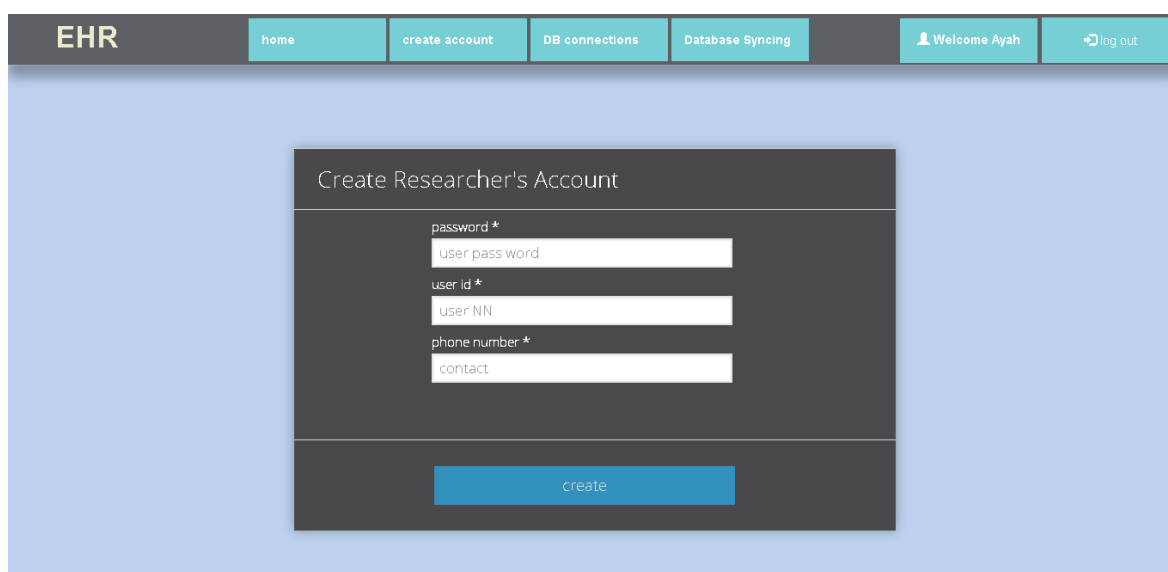


Figure 5.12: Illustrate How Admin Add Connection.

- Admin insert a new connection.

The screenshot shows the EHR admin interface with a sidebar on the left containing 'insert', 'view', 'update', and 'delete' buttons. The main content area is titled 'Connection Establishment information' and contains a form with the following fields:

- hospital name* (text input)
- host machine* (text input)
- database schema* (text input)
- database type* (text input, value: oracle)
- database port* (text input)
- EMR user name* (text input)
- EHR password* (text input)

At the bottom of the form are two buttons: 'Cancel' (red) and 'Save' (blue).

Figure 5.13: Illustrate All Connections.

- Admin show available connections.

The screenshot shows the EHR admin interface with a sidebar on the left containing 'insert', 'view', 'update', and 'delete' buttons. The main content area displays a table of connections:

| ID | emr User | password | hospital name | database name | server | port | reg date |
|----|----------|----------|---------------|---------------|-----------|------|------------|
| 1 | root | 1234 | hospital_A | emr | localhost | 3306 | 2017-02-17 |
| 2 | adam | 1234 | hospital_B | adam | localhost | 1521 | 2017-02-17 |

Figure 5.14: Illustrate How to Update Connection.

- Admin update connection information.

The screenshot shows the EHR admin interface. At the top, there is a navigation bar with the following items: 'EHR', 'home', 'create account', 'DB connections', 'Database Syncing', 'Welcome Ayah', and 'log out'. On the left side, there is a vertical menu with buttons for 'insert', 'view', 'update', and 'delete'. The main content area displays a form for updating a connection. It includes a text input field labeled 'enter the id', a dropdown menu labeled 'change:' with the selected option 'chosed old value', and another text input field labeled 'TO : new value'. Below these fields is an 'update' button.

Figure 5.15: Illustrate How to Delete Connection.

- Admin delete connection.

The screenshot shows the EHR admin interface. At the top, there is a navigation bar with the following items: 'EHR', 'home', 'create account', 'DB connections', 'Database Syncing', 'Welcome Ayah', and 'log out'. On the left side, there is a vertical menu with buttons for 'insert', 'view', 'update', and 'delete'. The main content area displays a form for deleting a connection. It includes a text input field labeled 'enter the id', a red 'delete' button, and a green 'cancel' button.

Figure 5.16: Illustrate Database Synchronization

- Admin monitor the database synchronizing status.
- He can re-synchronize the data and also can clear the well synchronizing history.

The screenshot shows the 'Database Syncing' section of an EHR application. At the top, there is a navigation bar with 'EHR' on the left and 'home', 'create account', 'DB connections', 'Database Syncing', 'Welcome Ayah', and 'log out' on the right. Below the navigation bar, there are two buttons: 're-syncing' and 'clear table'. The main content area features a table with the following data:

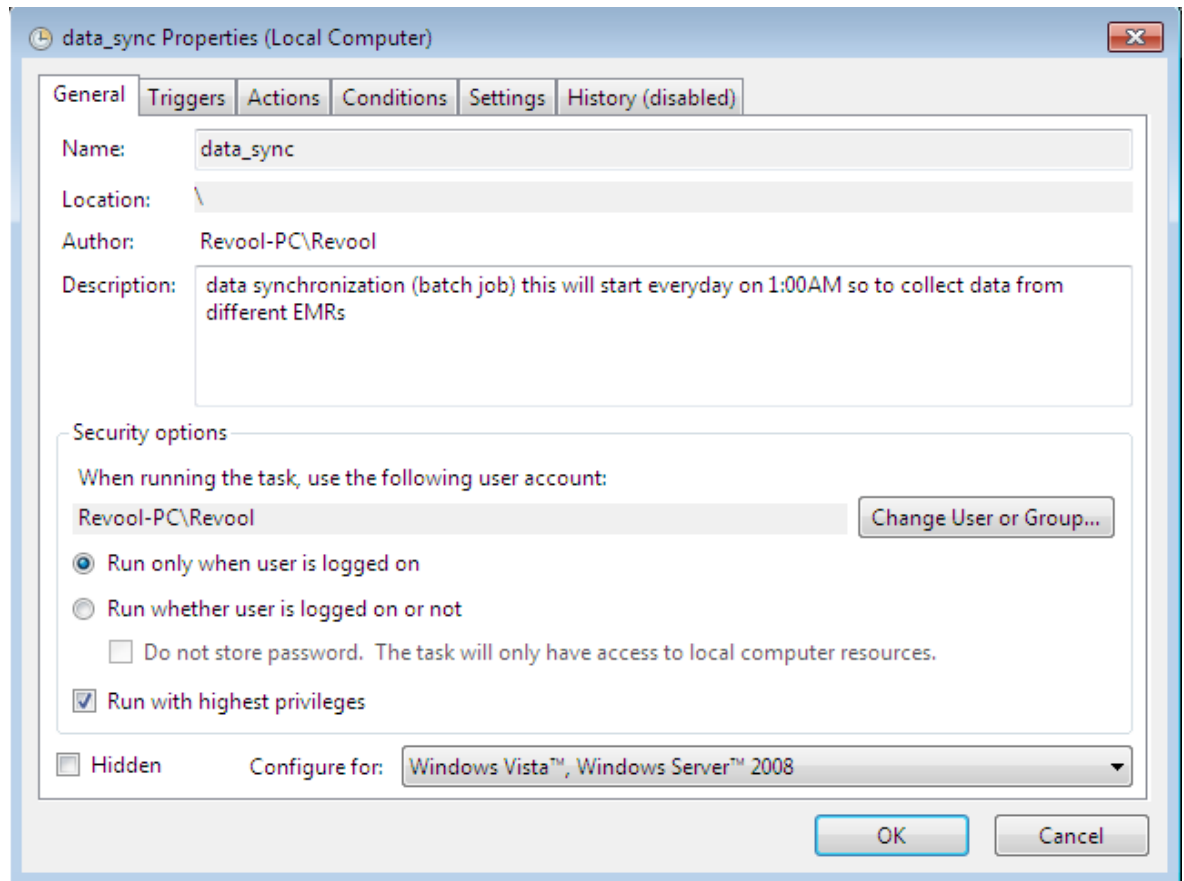
| error | date | target database | server name | correction |
|--------------------------|------------|-----------------|-------------|--------------|
| no data came from_Oracle | 2017-03-24 | adam | oracle | un_sync |
| no data came from_Oracle | 2017-03-24 | adam | oracle | un_sync |
| all is well | 2017-03-24 | all well | all well | syncing done |
| all is well | 2017-03-25 | all well | all well | syncing done |
| all is well | 2017-03-25 | all well | all well | syncing done |
| no data came from_Oracle | 2017-03-25 | adam | oracle | un_sync |
| all is well | 2017-03-25 | all well | all well | syncing done |
| all is well | 2017-03-25 | all well | all well | syncing done |

Figure 5.17: Illustrate data synchronization (batch job)

- This task will automatically open a chosen file with specific code which will cause data synchronization to happen.
- When Triggers are satisfied an Action will happen under specific Condition.
- When time is 1:00AM from everyday then

Start 'C:\Users\admin\Desktop\EHR_files\task.java'

- The file task.java contain a code written to fetch new and/or updated data from remote databases



5.5 SUMMARY

This chapter provided a description of the electronic health record project, including its design. As with many projects, summarizes the major lessons learned from successful EHR implementation. This is necessary due to the fact that it is a new concept of EHR to be learning. In this chapter, the design of the EHR was discussed, along with details of the lesson structure. Sample interfaces were provided for the various directories.

CHAPTER SIX:

CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

This thesis presented new concept of integrated electronic health record that enable patients to take care in fast and easy way. And after implementing the system we concluded that the:

- Internet availability is important.
- The system needs continuous monitoring (according to the data update, backup scheduling).

6.2 RECOMMENDATIONS AND FUTURE WORK

Oursuggestions to develop EHR are:

Obtain an android application for the System to support all kind of smart phone users.

We also suggest obtaining API (Application programming interface) for the System so that it will help others on benefiting from EHR database resources in different ways and also will open new doors (e.g.:data mining) on the health sector.

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