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HMS



Hospital Management System

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Eng. Nourmeen lotfy Mohamed

Abstract

Medical projects are one of the most wanted programs in the world and there is no doubt about that because they serve a large group of citizens in the country, and this gives us the motivation to participate in this field of business.

Our project deals with a set of criteria to raise the efficiency of the health system in Egypt and promote it to a global level. Egyptian society suffers from many problems in the health sector like lack of medicines, congestion in governmental hospitals, and lack of cultural and medical awareness of citizens.

When we searched about the reasons for this, we reached that the main reason for that, there is no integration between governmental hospitals in the country. There is no system to manage hospitals and record all patient data.

So, our first goal is to make a system that integrates all governmental hospitals in the state, where any process or transaction that occurs in any hospital will record and appear in other hospitals.

The second goal is making a medical and personal account on this system for each citizen in the country, through the application or website

this account will record personal information like citizen's national ID, name, address, gender and age, the account will also record any medicines that citizen had, any surgery that has done to him and analysis and medical radiology of the citizen as well as demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory data, and radiology. This account will guarantee that medicines will reach to people who deserve them since any medicines the patient will take from any hospital or pharmacy will record in his account, so when he moves to another hospital or pharmacy to ask for medicine again, the pharmacist will check his account to see whether he deserve the medicines or not, the citizen also can receive an appointment with a physician in the hospital through his account on the system, so everyone will know the time he must go to the hospital to be examined by a physician, this will solve the problem of overcrowding in hospitals.

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List of abbreviations

HIS	Hospital information system
HMS	Hospital management system
QOS	Quality Of Service
IT	Information Technology
EHR	Electronic Health Records

ID	Identification
CDS	Clinical Decision Support
EMR	Electronic Medical Record
CPR	Computer-Based Patient Record
PHR	Personal Health Record
EPR	Electronic Patient Record
ROI	Return on Investment
HIMSS	Health Information and Management Systems Society
ISO	International Organization for Standardization
ISO/DTR	International Organization for Standardization/ Draft Technical Report
LIS	laboratory information system
RIS	radiology information system
PACS	picture archiving and communication system
HL7	Health level seven
OPD	Outpatient Department
CCR	Continuity of Care Record
MMS	Massachusetts Medical Society
HIMSS	Health Information and Management Systems Society
AAFP	American Academy of Family Physicians
OPD	OutPatient Department

Introduction :

Use of Information Technology (IT) is common in all areas, including healthcare and health management.

Many healthcare organizations use IT-enabled healthcare applications for simplifying healthcare processes such as administration, managing health records across departments, and billing.

Electronic websites and Smartphones have become the users' favorite companions over desktop computers.

Using smartphones and electronic websites to help doctors and facilitate the process of diagnosis and providing many services to the patient has become one of the most important challenges that will constitute a major transition in the medical world.

Using a mobile phone to facilitate the diagnosis of patients, as well as following the patients' health patient record

every day, and providing him with all the advice that he must follow During the treatment phase.

as well as providing a group of suitable appointments to book for going to doctors at any time and follow his health.

1.1 Problem Statements:

The provision of adequate health care services is a major problem in developing countries.

Increase in population, complemented with new and complex treatments for diseases, and involving multiple healthcare providers due to the complexity of the health problems have increased demand for better and more efficient healthcare services and health management globally.

Need for complete health information of a patient,such as patient's history, allergies, laboratory tests, medication, and so on,at one place for his/her better care is increasing.

Accordingly: Researchers have now realized that increased application of IT to healthcare and health management with Electronic Health Record (EHR) is a way to deal with these issues.

1.2 Project definition:

Our project is to build an accurate application and electronic website for all patients that included a single electronic health record for every individual in a nation. enables them to check on their health, booking appointments with doctors, at any time and from any location without the need to visit them to the hospital. The project includes a system for organizing medical procedures. The system is basically a hospital's website and has many functions. As the outer shell of the system, there is an application that can help users make better use of the system and make online reservations.

1.3 Goal of project :

The main goal is building a system for organizing health management in hospitals and to organize the entry of patients into the departments.

Nomination of the best clinics.

Abolishing the paper system and replacing it with the digital system. creating an account on the application for every patient to record personal information like citizen's national ID, name, address, gender, and age. the patient can access his profile that includes his entire past medical history on his account of the application by its national ID . Connecting public hospitals, building single electronic health record (EHR) for every individual in a nation and band assistance in emergencies, ensure the concept of cloud computing, reduce drug consumption,reduce drug theft, increase awareness of the medical field , thereby control the budget allocated to it and improve the QoS.

1.4 The targeted segment of society:

The system was designed for Egyptian government hospitals and Egyptian people in general including all categories (rich/poor), as well as consisting of a set of records include the entire health history of the patient, from birth to death.

1.5 Features of the website and application:

The main feature is the replacement of the paper system with the electronic system. The responsive application and website aim to promote the entire medical process. allowing patients to display on their personal files, As there are records for every individual or patient in the country that include the patient's complete health history. The patient can book an appointment with the doctor online, as the patient does not need to go to the hospital and it will reduce the crowding in hospitals. preventing manipulation of the quantity, usage, and price of drugs, allowing hospitals to contact each other to get the most benefit, and allowing doctors in different hospitals to view the patient's entire medical history. Help in emergencies, as there is an emergency department on the site or application that helps the patient quickly reach the emergency. The doctor writes the patient's prescription and it is uploaded to the patient's page, whether on the application or the site, and the patient can obtain the medicine in that prescription via the patient's national ID, so the pharmacist gives him the medicine in that prescription.

Additional features of our system:-

- HMS has 2 websites one for Dashboard.
- HMS has mobile application for visitors and patients.
- HMS has Desktop application for controlling and manage the powers for all employees.
- HMS has method which can easy Recommending a specific clinic for the patient by taken 2 or 3 Disease symptoms.
- HMS system has a Unified and unique ID for each patient which is his/her National ID that safe all history and easy to access it from any other where.
- This national ID HMS system uses better than Mail in case of government hospitals cuz it's reduces tapering in medicines.
- HMS Dashboard has a Financial control system.

1.6.1 Similar systems :

1.6.1 Health management System in United States.

the American management system is very similar to our targeted system, The system is concerned with organizing the health administration as well as health care.

Adroit Infosystems as shown in figure (1.1)-, is a South Jordan, United States-based Healthcare Software company with the vision to provide world-class healthcare software products at affordable prices.

the product portfolio includes electronic health system products eHospital, eClinic, ePharmacy, eLaboratory, and eRadiology Systems.

All software products are multi-lingual and come with a built-in on-screen editor that allows our implementation team to localize the software as per country-specific needs.

this website has EHR, TeleHealth Software, iOS, and Android Apps, Tablet Version of Nurse Station, Patient and Family Portal, Lab Device Integrations, Financial Software Integration (SAP, Microsoft Dynamics, QuickBooks)

eHospital Systems is a hospital management system software which includes OPD and IPD Management, Pharmacy, Laboratory, Radiology, Ward Management, Mobile Application, Online Appointments Scheduling, Secured Messaging, Doctor Portal, Patient and Family Portals, Medical Electronic Billing, Accounting, HR/Payroll, and HL7/Integrated PACS System.

eClinic Systems is a medical practice management software to manage all aspects of clinic operation. This customizable clinic information system is an integrated healthcare solution which includes OPD Management, Pharmacy, Laboratory, Radiology, Mobile Application, Online Appointments Scheduling, Secured Messaging, Doctor Portal, Patient and Family Portals, Medical Electronic Billing, Accounting, HR/Payroll, and HL7/Integrated PACS System.



Figure (1.1): Adroit infosystems website

1.6.2 Health management system in India:

Indian system has some criteria close to ours. **HMSDESK** as shown in figure (1.2)-, site is meant to seek out easily doctors, hospitals, treatment costs Etc. it helps find the best doctors at the simplest hospitals, at prices that fit your budget. site customer support team 24x7 helps the international patient for getting Visa, continuous support for each need like accommodation arrangements, and pre & post-treatment.

HMSDESK is one of the brands and projects developed and promoted by Logic Research and Solutions. HMSDESK is a platform for their patients that can get healthcare services from doctors, hospitals, clinics, and diagnostic centers in the easiest way. No one can say that when the person will need medical care for a serious health issue. Now each and everything is on fingertips online. HMSDESK will help to find perfect the hospital or doctor is easy so that you will get an idea where is quality medical care available, treatment cost as per your budget.

This site offers all of the pertinent information onto a single platform and makes it available to our patients so that they can focus on resolving their medical issues. Due to our great experience in travel industry services, the site can support the patient to get medical travel Visa, stay in a hotel for the patient's relative. Provide information about the tourist and visiting places so that patient or/and his/her relative can visit some of the places if possible before or after the treatment.

Site is working with over 1200+ Doctors and 150+ hospitals across India, irrespective of the state and region you want to obtain the consultation/ treatment. Almost all the hospitals the site is working with are JCI, NABH, NABL, and ISO accredited, strengthening its view of No-Compromise with our patient's health.

Along with Medical Tourism, this area of work includes Telemedicine, Hospital Management System, Lab Management System, and many others.



HMSDESK

HOME PRODUCTS SERVICES DOCTORS HOSPITALS DIAGNOSTICS KNOWLEDGE DASHBOARD Get A Quote

FEATURED TREATMENT ESTIMATES
Get featured treatment estimates for everyone that fits your budget.
Get Started

Medical Tourism
Get world-class treatment from the best hospitals and experienced Surgeons that fit your budget.

Hospital Listing
Find the best hospital in your city to get treatment costs, doctors, reviews, and surgery details.

Doctors Listing
Book an online doctor's appointment, medical second opinion to experts, consultation.

Diagnostic Listing
Get quick and reliable clinical laboratory tests and diagnostic procedures with a routine checkup.

Dentist
Top Hospitals

General Physician
Top Hospitals

Cardiologist
Heart Speciality

Neurologist
Project Engineer

Cardiologist
Heart Speciality

Neurologist
Project Engineer

Gastrology
Gastrology Hospitals

Oncology
Cancer Hospitals

Figure (1.2): HMSDESK website

1.7 HMS definition and benefits:

A Hospital Management System is an integrated information system for managing all aspects of a hospital's operations such as medical, financial, administrative, legal, and compliance. It includes electronic health records, business intelligence, and revenue cycle management. Hospitals and healthcare facilities improve the

quality of healthcare services, reduce operating costs, and improve the revenue cycle by using such hospital management systems. Hospital Management System typically includes Outpatient and Inpatient Management, Pharmacy, Laboratory, Radiology, Inventory, eClaim, Mobile Apps, Tablet Versions, Online Scheduling, Secured Messaging, Doctor and Patient Portals, Accounting, HR/Payroll, Blood Bank, Mortuary, Alert Software, Dietary, Feedback, Lab Machines, and Biometric Integration, HL7/Integrated PACS, and Business Intelligence.

Online Hospital Management System V/S Offline Hospital Management System

- Since the Online HMS is electronically digitized, a click in the appropriate button will give the enquiring person access to the data of a patient.
- In the earlier offline HMS, the names of the patients used to be recorded via alphabet synchronization. Finding the appropriate name in times of urgency was a tentative square.
- Online HMS offers improved access to patient data and transparent information about the care process involved. Through acute analysis of the methods, the level of care thus provided could easily be estimated.
- The online HMS involves much less cost and time effort than the earlier offline HMS.
- As the finding of data has been much more convenient, the efficiency level has certainly been enhanced.
- The manual recording leaves much more scopes of making errors. The implementation of online HMS has reduced the possibility of making errors.
- Since appropriate encryption has been involved in online HMS, the security of the data has been increased. The prospects of losing data are reduced to a large extent.

Hospital Management System necessary

- Enables tracking financials better: An appropriately integrated HMS helps in tracking revenues, outflows, debts, and receivables in a better way. The

financial report generated in the system helps the hospital administration avail an accurate scenario of the health of a hospital.

- Data Security: Unauthenticated people will never be able to steal data from the healthcare unit as everything will be secured with appropriate usernames and passwords. The possibility of data theft has reduced to almost zero.
- Eliminating Errors: As the system is entirely automated, the chance of human errors is null. This property has enhanced the confidentiality of the system manifold.
- Enhancing competency of the Laboratory management Systems: Implementation of the hospital management system has worked in increasing the skill of the diagnostics system too.
- The doctors are now getting faster access to patient records as the methods for testing has become more comfortable. With better results, overall clinical competency boosts up.
- Patients are much satisfied: Since the procedures and procedures at various stages of patient interaction, e.g., registration, billing, and discharge, have been improved, customers feel happier than earlier times.

Major Hospital Management System Features

- Digital archive and file classification management.
- Organizational and user management.
- Hospital Logo, Signature, initials and timestamp support.
- Well maintained and detailed reporting.
- Electronic document.
- Improved referral options.
- Access control and security.
- Search engine Friendly.
- Workflow design and management.
- Email integration.
- SMS integration.
- Built-in rich text editor.
- Warning system.
- Mandate system.
- Calendar module.

Benefits of a Hospital Management System

- The Hospital Management Information System Software allows easy access to patient data to generate various records, including classification based on demographic, gender, age, and so on. It is especially beneficial at the ambulatory point, hence enhancing continuity of care. Internet-based access improves the ability to access such data remotely.
- It helps as a decision support system for the hospital authorities for developing comprehensive health care policies.
- It efficiently engenders the running of finance, the diet of patients, and also the distribution of medical aid. It gives a vivid picture of future hospital growth.
- It reflects an improved drug usage monitoring system, including its effectiveness. It relegates adverse drug interaction to the background and gives a push to appropriate pharmaceutical utilization.
- Integrated Inventory Management keeps track of all hospital stocks from medicines to linens and helps you keep the optimum level of stock all the time. It also minimizes the lost stock due to theft and misplacement.
- It enhances information integrity by a reduction in transcription errors and duplication of information entries.
- Hospital Management System is easy to use and eliminates errors caused by handwriting.
- The latest technology gives perfect performance to pull up information from hosted or cloud servers.
- It provides all data in a single platform, hence enables Business Intelligence Module to provide valuable insights into hospital operations and the quality of patient care.
- It enhances the overall health care experience in a healthcare facility.
- It improves the communication and interaction of doctors with their patients.
- It reduces expenses of an organization because of less paperwork, improved safety, and reduced duplication of testing.

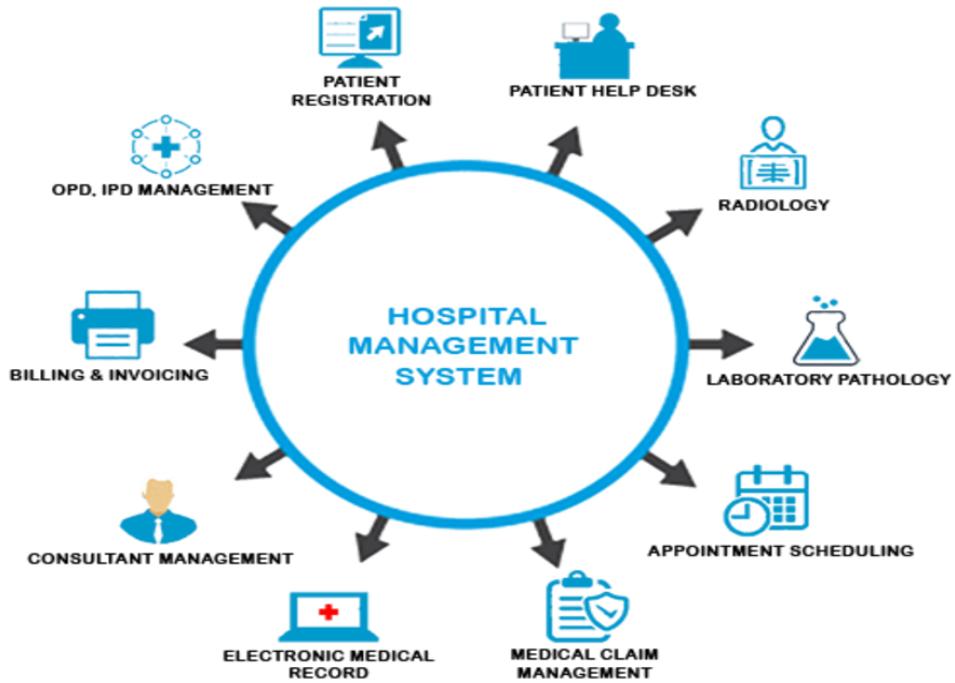


Figure (1.3). Hospital Management System (HMS)

1.8 Summary:

finally, Headlines in this chapter:

Problem Statements, Project definition, Goals of the project, the targeted segment of society, features of the website and application, Similar systems and HMS definition and benefits.

1.9 Document Organization:

Chapter 1: represents an introduction for our project that includes a discussion about the problems that can be solved by this project and the goal that we aim to achieve.

Chapter 2: this chapter offers an overview about Definition of EHR, Terminologies related to EHR, Functions and Significance of EHR, EHR standards, HIS definition and Benefits and Disadvantages of using HIS.

Chapter 3: Introduces our project's analysis that includes an observation for the functions to be used in our project and a bunch of diagrams that can help in establishing the analysis process of our project (use case, Activity, sequence...).

Chapter 4: this chapter contains a detailed explanation of the system design.

Chapter 5: describes the project's implementation process, its software requirements, the environment that has been used to accomplish this process, and the sequence that we followed to produce our project.

Chapter 6: Introduces the conclusion of our project and the future work that can be accomplished depending on this project as an infrastructure.

Background:

The concept of electronic health records (**EHR**) is closely related to our idea of the project.

EHR can be a comprehensive tool containing medical records or similar documentation of the past and present physical and mental state of health of an individual in electronic form, and providing better care.

The increase in the mobility of the population and of health professionals necessitates that health records are available on how and when' basis from more locations. EHRs have the potential to empower consumers and patients by providing them with easier access to their health information, allowing them to exert more control over their health records, thereby becoming more responsible and more active in their own care while facilitating communication with their health professional. an EHR includes contact information, allergies, family history, list of medications, information regarding previous surgeries and procedures, and other relevant patient information.

In general, there are two specific goals with the conventional medical records which are: Preserving course of a disease. Indicating probable cause of a disease.

The application of the EHR keeps these goals besides other goals such as: Securing and authorizing access to health information. Faster access to health records irrespective of place and time. Depicting healthcare workflow. Etc.

2.1 Definition of EHR:

1. Some definitions of EHR and associated terminologies as found in the literature are: 1. An Integrated Care EHR defined by ISO/DTR 20514: “A repository of information regarding the health of a subject of care in computer processable form, stored and transmitted securely, and accessible by multiple authorized users. It has a standardized information model, which is independent of EHR systems. Its primary purpose is the support of continuing efficient and quality integrated healthcare and it contains information, which is retrospective, concurrent, and prospective” [ISO/TR 20514].

2. An EHR defined by Health Information and Management Systems Society (HIMSS): “EHR is a longitudinal electronic record of patient health information generated by one or more encounters in any care delivery setting. Included in this information are patient demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory data, and radiology reports. The EHR automates and streamlines the clinician’s workflow. The EHR has the ability to generate a complete record of a clinical patient encounter, as well as supporting other care-related activities directly or indirectly via interface including evidence based decision support, quality management, and outcomes reporting” [HIMSS 2011].

The main elements of EHR shown in figure (2.1).



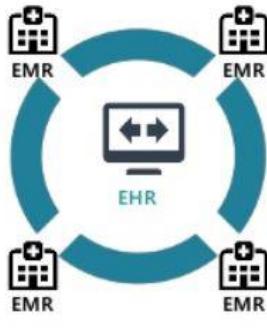
Figure (2.1): electronic health record (EHR)

DEFINITION OF EHR (CONT.)

There are many terminologies that have evolved together with EHR. These terminologies are either subsets of EHR or used by different groups to mean the same thing. Some of the commonly used related terminologies found in the literature are:

1. Electronic Medical Record (EMR): EMR is often used in parallel with EHR. It is a fully interoperable electronic health record of a patient within a healthcare organization. However, some people consider EMR as a set of records of a patient related to a single encounter or a single care episode. Accordingly, considers an EHR to be sum total of all EMRs of a patient where EMR in this case is a point-in-time view of a larger EHR
2. Computer-Based Patient Record (CPR): CPR was first used to conceptualize the idea of EHR. It is a lifetime health record of a patient, which includes information from all specialties. It requires full interoperability (potentially international interoperability) that may be achieved in the near future.
3. Electronic Patient Record (EPR): EPR is similar to CPR, but does not necessarily contain a lifetime record and focuses on relevant information only.
4. Personal Health Record (PHR): PHR is managed and controlled by a patient. It is mostly considered to be web-based. Usually, PHR is another patient-side view of an EHR/EMR maintained by a particular group of healthcare providers.

The difference between terminologies EHR , PHR and EMR shown in figure (2.2).

EMR vs. EHR vs. PHR

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**Figure (2.2): EHR VS PHR VS EMR**

2.2 Functions of EHR:

EHR as a system of hardware, software, people, policy, and processes that work together to collect data from multiple resources, thus providing information and decision support to multiple healthcare providers irrespective of time and place. [Margaret and Steven [2005]]

Accordingly, an EHR system should offer the following basic functions:

1. Health Information and Data:
 - Store and provide access to health information of patients to healthcare providers to take appropriate clinical decisions.
 - Integrate data from various sources and make it available to the people involved in the care of a patient.

2. Replicate the Workflow:
 - It should be able to work in-sync with the original workflow of the healthcare organization

3. Efficient Interaction:
 - It should be able to work effectively, saving time of care providers by keeping things concise.
4. Clinical Decision Support (CDS):
 - It should support provision of reminders, prompts, and alerts to help in improving clinical and preventive practices and reducing frequency of adverse events.
5. Patient Support:
 - It should empower patients to access their health information, enabling them to be involved in their own healthcare
6. Messaging and Data Processing Capability:
 - It should enable exchange of data in known/standard formats for interoperability of healthcare applications.
 - Additionally, it should enable processing of incoming data in known/standard formats.
 - a. Administrative Tools:
 - It should provide administrative tools, such as scheduling systems, for improving efficiency of clinical practices and timely service to patients.

2.3 Significance of EHR:

An EHR system helps to provide an integrated view of healthcare records by enabling integration of various healthcare applications such as Hospital Information Systems (HIS), Pharmaceutical Systems, Imaging Systems, and Health Insurance Systems. Therefore, offering the following advantages:

1. **Ease of Maintaining Health Information of Patients:**
 - Enables paperless medical treatment with less space required for storing health data of patients.
 - Also, with proper backup policies, the lifespan of EHRs can be increased.
2. **Efficient in Complex Environments:**

- An EHR system helps in improving clinical processes or workflow efficiency across the healthcare organization units.
- For example, it enables an administrator to obtain data for billing, a physician to see progress of treatments, a nurse to report an adverse reaction, and a researcher to analyze efficacy of medications on patients.

3. Better Patient Care:

- An EHR system allows sharing of the patient's information among the healthcare providers.
- Enables point-in-time data insertion, retrieval, and update, thereby providing immediate access of patient data from any specialty center whenever required.
- Availability of health information, such as past medical history, family medical history, and immunization, through EHR helps in taking preventive measures and managing chronic diseases more effectively

4. Improve Quality of Care:

- EHR helps to decrease reporting and charting time during treatment, thereby improving quality of care.
- EHR also helps in improving risk management and accurate diagnosis, thereby improving quality of care.

5. Reduce Healthcare Delivery Costs:

- Due to the availability of health information data from all healthcare organizations, a healthcare provider can refer to the required test reports, thus avoiding repetition of expensive tests.

6. Accelerates Research and Helps Build Effective Medical Practices:

- EHR provides a large database at one place, enabling its use for disease surveillance for providing preventive measures.
- Also helps in analyzing treatment patterns of medicine, providing new ideas and ways of drug discovery.
- Decision support with EHR enables effective medical practices.

7. Better Safety:

- Through access, audit, and authorization control mechanisms, an EHR system provides better safety to a patient's health records as compared to a paper-based system.

2.4 Factors affecting on EHR :

An EHR system needs to deal with multiple healthcare and health management applications and various types of healthcare providers. Hence, its implementation is a complex task that usually requires more time and effort than implementation of several other IT applications. The following factors usually affect the implementation of an EHR system and need to be dealt with properly:

1. Significant Changes in Clinical Workflow:

- Implementing an EHR system in a healthcare organization often requires significant changes in the organization's clinical workflow. It is always good to make EHR a part of the strategic vision of the organization. Design of the system needs involvement of clinical staff with inclusion of organization's policies and workflow processes. Clinical workflow varies from one specialty to another. Thus, an EHR having a specific workflow for practicing medicine is usually not adaptable easily.

2. Privacy and Security:

- An EHR implementation must deal with privacy and security issues with great care. Healthcare providers are concerned about alteration of EHR without their knowledge, and Patients are concerned about unauthorized access to their private data.
- An EHR system must also meet the privacy and security regulations for health data imposed by regulatory bodies in the country.

3. Unique Identification:

- While integrating patient's data that is often collected from various healthcare organizations, an EHR system must properly link all data of a patient to create his/her single EHR

4. Interoperability:

- The EHR system should enable interoperability among various healthcare applications and systems that are developed independently.
5. Consistent Use of Standards:
 - An EHR system requires consistent use of standards such as clinical vocabulary, standardized data formats and security and data integrity standards.
 - It must also be upgraded consistently to newly developed standards for addressing these issues.
 6. Ethical and Legal Issues:
 - An EHR system must also carefully handle ethical and legal issues that are linked to accuracy, confidentiality and access rights of healthcare data.
 7. Unknown Return on Investment (ROI):
 - Convincing an organization's decision makers to invest in implementing an EHR system on the basis of intangible benefits or related saving only is rather difficult.
 8. Difficult to Operate:
 - Some healthcare providers find it more difficult and time-consuming to use computers for data entry than handwriting.
 - Therefore, they need special training, which adds to the cost of implementing an EHR system.
 9. Some superior advantages of paper-based records:
 - Less structured and hence offer more flexibility in terms of writing text and putting diagrams.
 - Also, reading text on paper is 40% faster than reading text on a computer screen.

Despite all of these issues, the whole world is moving toward implementing the EHR system and several implementation issues are being addressed gradually.

2.5 HIS definition:

A **hospital information system (HIS)** is an element of health informatics that focuses mainly on the administrative needs of hospitals. In many implementations, a HIS is a comprehensive, integrated information system designed to manage all the aspects of a hospital's operation, such as medical, administrative, financial, and legal issues and the corresponding processing of services. Hospital information system is also known as **hospital management software (HMS)** or **hospital management system**.

Hospital information systems provide a common source of information about a patient's health history. The system has to keep data in a secure place and controls who can reach the data in certain circumstances. These systems enhance the ability of health care professionals to coordinate care by providing a patient's health information and visit history at the place and time that it is needed. Patient's laboratory test information also includes visual results such as **X-ray**, which may be reachable by professionals. HIS provide internal and external communication among health care providers. Portable devices such as **smartphones** and **tablet computers** may be used at the bedside.

Hospital information systems are often composed of one or several **software components** with specialty-specific extensions, as well as of a large variety of sub-systems in medical specialties from a multi-vendor market. Specialized implementations name for example **laboratory information system (LIS)**, Policy and Procedure Management System, **radiology information system (RIS)** or **picture archiving and communication system (PACS)**.

2.6 Potential benefits of hospital information systems include:

- Efficient and accurate administration of finance, diet of patient, engineering, and distribution of medical aid. It helps to view a broad picture of hospital growth
- Improved monitoring of drug usage, and study of effectiveness. This leads to the reduction of adverse drug interactions while promoting more appropriate pharmaceutical utilization.

- Enhances information integrity, reduces transcription errors, and reduces duplication of information entries.
- Hospital software is easy to use and eliminates error caused by handwriting. New technology computer systems give perfect performance to pull up information from server or cloud servers.

2.7 Disadvantages of using hospital information system (HIS):

Adding computers or going electronic can make everything from billing to keeping track of patient records quicker in a hospital, but computers also bring disadvantages to the hospital environment. As technology and computers become more advanced, additional elements will appear in the hospital setting, but whether the advances are really improvements is open for some debate. One of the biggest drawbacks of adding computers to hospitals is the cost. Computers cost money, and a large hospital needs many computers to keep the system running smoothly. Creating a network to transfer medical records or keep track of billing is an additional initial cost. Unlike paper records, which simply require a few more copies, electronic record keeping requires constant upkeep of computers, computer software and other electronic elements, which can cost even more. Another problem is, if your doctor or hospital is switching to computers or electronic record keeping, you're probably worried about the security of your medical records. Paper records are kept in a doctor's office or a warehouse, but once computers are added to a hospital, electronic record keeping typically follows. Once electronic record keeping is begun, medical information is usually added to a closed computer network, but as long as an Internet connection comes into the network, the system is vulnerable to outside sources, opening the debate to questions. One of the biggest disadvantages of adding computers and electronic records to a hospital is the lack of standardization through the medical field. Different hospitals use different shorthand abbreviations or symbols on medical records than Mutation in others. Even the codes called out during emergencies don't always mean the same thing in every hospital. If a medical record is transferred from another hospital or the system becomes open so hospitals can share information, the lack of standardization in hospital notes and records could cause problems when it comes to a medical professional's understanding of the medical record.

The main function of HIS shown in figure(2.3).

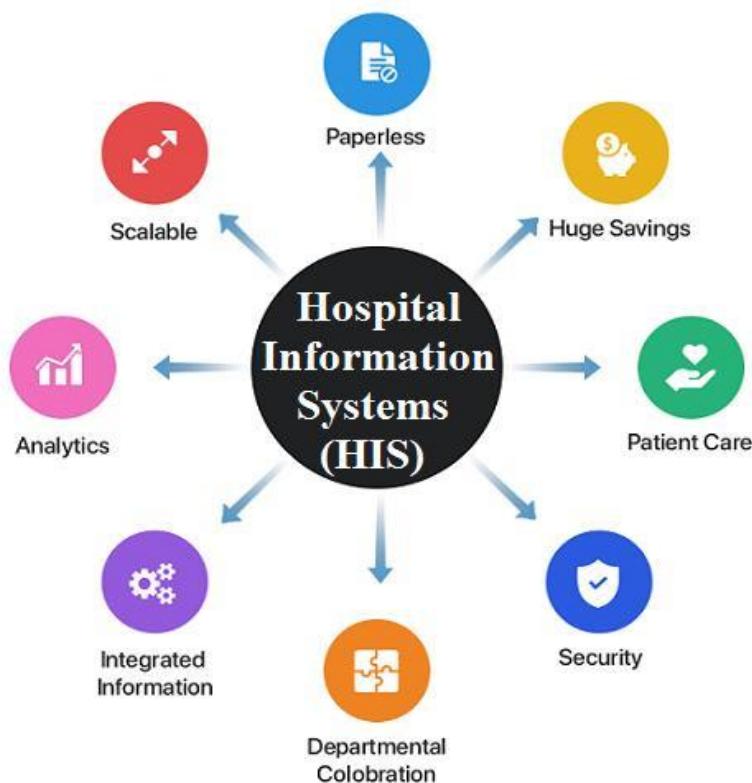


Figure (2.3):hospital information system (HIS)

2.8 Summary:

At the end of this chapter the reader will know exactly what is the EHR functions and types and what is the HIS, specifically pros and cons of usage.

3.1 Introduction about system Analysis:

Systems development is systematic process which includes phases such as planning, analysis, design, deployment, and maintenance. Here, in this tutorial, we will primarily focus on –

- Systems analysis
- Systems design

It is a process of collecting and interpreting facts, identifying the problems, and decomposition of a system into its components.

System analysis is conducted for the purpose of studying a system or its parts in order to identify its objectives. It is a problemsolving technique that improves the system and ensures that all the components of the system work efficiently to accomplish their purpose.

Analysis specifies **what the system should do.**

There are 3 methods for developing a system: Structured Analysis-SDLC-, Object oriented Analysis, Agile Analysis.

We'll use the structured Analysis method in our project.

3.2 System development life cycle (SDLC):

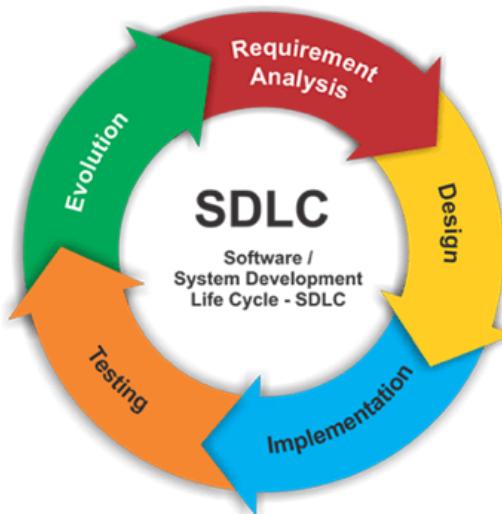


Figure (3.1): System development life cycle

The System Development Life Cycle is a process that involves conceptualizing, building, implementing, and improving hardware, software, or both. The System Development Life Cycle must take into consideration both the end user requirements and security concerns throughout all its phases. From banking to gaming, transportation to healthcare, the System Development Life Cycle is applicable to any field that requires computerized systems.

The systems development life cycle (SDLC) is a conceptual model used in project management that describes the stages involved in an information system development project, from an initial feasibility study through maintenance of the completed application. SDLC can apply to technical and non-technical systems. In most use cases, a system is an IT technology such as hardware and software. Project and program managers typically take part in SDLC, along with system and software engineers, development teams and end-users. Every hardware or software system will go through a development process which can be thought as an iterative process with multiple steps. SDLC is used to give a rigid structure and framework to define the phases and steps involved in the development of a system. SDLC is also an abbreviation for Synchronous Data Link Control and software development life cycle. Software development life cycle is a very similar process to systems development life cycle, but it focuses exclusively on the development life cycle of software.

3.3 Requirements:

Functional Needs:(Registration Process of Software Requirements Specification)

Purpose

The purpose is to describe all the requirements for the Hospital Management System. The following are some of the stake holders:

- Administrative staff.
- Doctors.
- Patient.
- Visitors.
- Receptionist.

3.3.1 Functional Requirements:

- **Adding Patients:** The Hospital Management allows the team in the front work desk to consist of brand-new clients to the system. They can Sign up on Website need Activation
- **Activation an ID to the patient:** The HMS enables the personnel in the front work desk to give an one-of-a-kind ID for each and every individual and then include them to the record sheet of the individual. The individuals can use the ID throughout their medical facility keep.
- **Deleting Patient:** The Top Manger of the Hospital can delete the patient from the system
- **Emergency Case:** In an emergency case, the administrative staff shall use system to assign an emergency room, doctors and nurses to the patient immediately.
- **Record procedure:** The whole treatment procedure for the patient shall be recorded by the system.

Database

- **Patient Mandatory Information**

Each patient shall have the following mandatory information: first name, last name, phone number, personal health number, address, postal code, city, country, patient identification number.

- **Update Patient Information**

The system shall allow the user to update any of the patient's information.

- **Search for Patient**

The system shall allow the user to search for patient's information by last name or PHN or National ID.

- **Staff Mandatory Information**

Each staff in hospital shall have the following mandatory information: identification number, first name, last name, phone number, address, postal code, city, country, employee type, duty schedule.

3.3.2 Non-functional

Requirements can be used to improve the functioning of the computer system, but not the management of the hospital as a whole:

- ✓ Safety
- ✓ Security
- ✓ Efficiency
- ✓ Maintainability
- ✓ Dependability
- ✓ Availability

1. Safety:

Patient Recognition: The system requires the individual to acknowledge herself or himself making use of the phone.

Logon ID: Any kind of customers that utilize the system require to hold a Logon ID as well as password.

Alterations: Any adjustments like insert, erase, update, etc. for the data source can be integrated promptly as well as executed only by the manager

Administrator legal rights: The manager can consider as well as alter any kind of info in the Health center Management System.

2. Efficiency:

Action Time: The system offers acknowledgment in simply one 2nd once the ‘individual’s details is inspected.

Capacity: The system needs to sustain at the very least 1,000,000,000 individuals at once. And more in feature.

Consistency: The system requires to make certain that the standards of the accessibilities are complied with.

3. Maintainability:

Back-Up: The system uses the efficiency servers for data back up.

Growing up: Using Evolution term to define the dynamic growth.

Mistakes: The system will certainly track every mistake along with maintain a log of it.

Feedback: Analysis Feedback from System Performance & Data.

4. Integrity:

Schedule: The system is offered constantly evolution.

Database: Related on (Website – Mobile – Desk).

5. Security:

Logon ID Any user who uses the system shall have a Logon ID and Password.

6. Modification:

Any modification (insert, delete, update) for the Database shall be synchronized and done only by the administrator in the ward.

7. Front Desk staff Rights:

Front Desk staff shall be able to view all information in system, add new patients to system but shall not be able to modify any information in it.

8. Administrators' Rights:

Administrators shall be able to view and modify all information in system.

9. Availability:

The system shall be available all the time.

3.4 UML Diagrams:

3.4.1 Unified Modelling Language (UML) is a modeling language in the field of software engineering which aims to set standard ways to visualize the design of a system. UML guides the creation of multiple types of diagrams such as interaction, structure and behavior diagrams.

- Structure Diagrams

Class Diagram

- Behavioral Diagrams
 - [Use Case Diagram](#)
 - [Activity Diagram](#)
 - [Sequence Diagram](#)

3.4.2 Data flow diagrams (DFDs):

Data flow diagram is traditional visual representation of the information flows within a system. By creating a Data Flow Diagram, you can tell the information provided by and delivered to someone who takes part in system processes, the information needed in order to complete the processes and the information needed to be stored and accessed.

3.4.3 Context Diagram:

A context diagram is a data flow diagram, with only one massive central process that subsumes everything inside the scope of the system. It shows how the system will receive and send data flows to the external entities involved

Symbols and Notations:

Entity/Source:

Represent a human, system or subsystem, we can show the entity as shapes in figure (3.2) or figure (3.3):



Figure (3.2): Entity Rectangle Symbol

OR



Figure (3.3): Entity Rounded Corners Rectangle Symbol

Process:

Business activity or function where the manipulation and transformation of data takes place, we present the process using these shapes shown in figure (3.4) or figure (3.5):

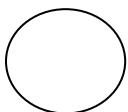


Figure (3.4): process Circle

OR

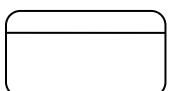


Figure (3.5): process symbol

Data flow:

Represents the flow of information, with its direction represented by an arrow head that shows at the end(s) of flow connector. Figure (3.6) shows the arrow used to represent the data flow through system.



Figure (3.6): Data flow Symbol

In this data flow diagram you will see the general process done in Hospital management. This will also serve as a guide as you go through the deeper processes of the Hospital management system data flow diagrams.

when you build the levels of data flow diagrams, the connections of the transactions and data also broadens and gets more specific. DFD for Hospital Management System Level 1 Next to the context diagram is the level 1 data flow diagram. The content of Hospital management system DFD level 1 must be single process node from the context diagram and is broken down into sub processes In this level,

the system must display or reveal further processing information. And the actors that are going to use this system is were the patients, hospital administrator and the hospital employees.

The following are the flows that the System can generate:

- Managing Patient
- Assigning Medicine
- Managing Employees /Doctors
- Assigning Facilities

• DFD for Hospital Management System Level 0

To start with, let us familiarize what is Hospital management system level 0.

The hospital management system level 0 is also known as context diagram. It's supposed to be an abstract view, with the mechanism represented as a single process with external parties.

This DFD for the system depicts the overall structure as a single bubble. It comes with incoming/outgoing indicators showing input and output data.

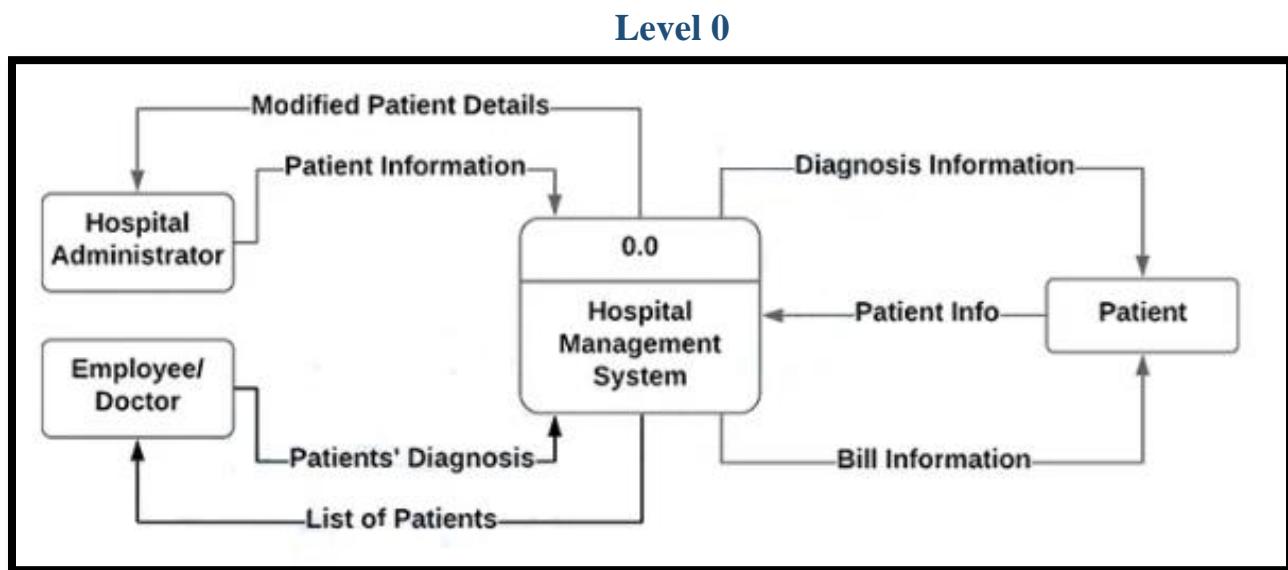


Figure (3.7): Context Diagram level 0

- **DFD for Hospital Management System Level 1**

Next to the context diagram is the level 1 data flow diagram.

The content of Hospital management system DFD level 1 must be single process node from the context diagram and is broken down into sub processes.

In this level, the system must display or reveal further processing information. And the actors that are going to use this system is were the patients, hospital administrator and the hospital employees.

The following are essential data to accommodate:

- Patient Information.
- Employees Information.
- Medicines.
- Facilities.

Level 1

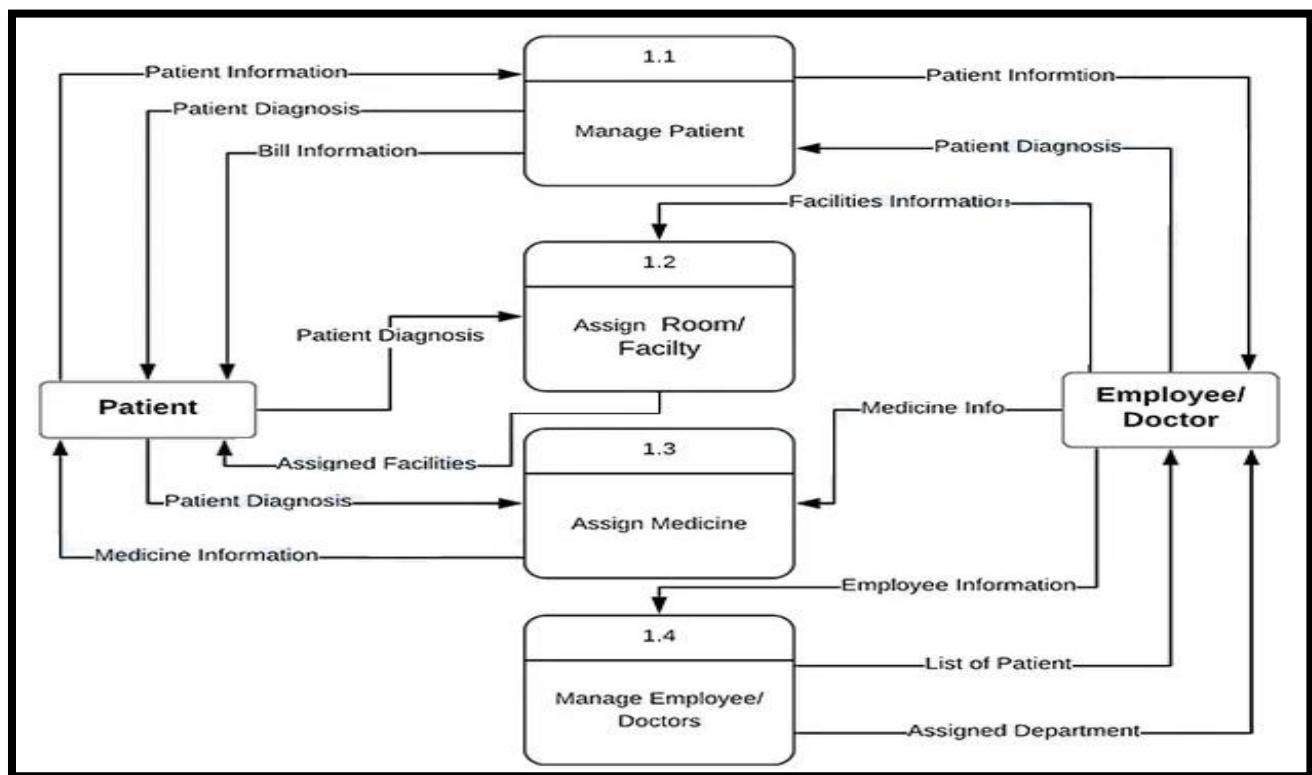


Figure (3.8): Context Diagram level 1

These procedures require information such as a list of patients, medicines, employees/doctors, and facilities from which served as the bases for admin to manage hospital transactions. This type of data is represented by a data store.

With being knowledgeable about the DFD level 1 of the Hospital Management System, you will know then its broaden context terms.

In addition to that, this may also serve as your reference on how the inputs or data fed on the system. Then you will be also informed about the outputs that the system gives.

These processes shown in the DFD were all based on the concept of Hospital Management System.

• **DFD for Hospital Management System Level 2**

After presenting the Hospital management system DFD levels 0 and 1, next to that is level 2.

Here's what you need to consider in creating data flow diagram level 2 for Hospital management system.

- The Level 2 DFD for the system should represent the basic modules as well as data flow between them.
- Since the DFD level 2 is the highest abstraction level, its Hospital management system processes must be detailed that is based on the DFD level 1.

Finally, after figuring the processes given in the system, the user will now have their request being processed.

The Processes that the system should prioritize are as follows:

- Managing Patient
- Assigning Medicine
- Managing Employees/Doctors
- Assigning Facilities

Level 2

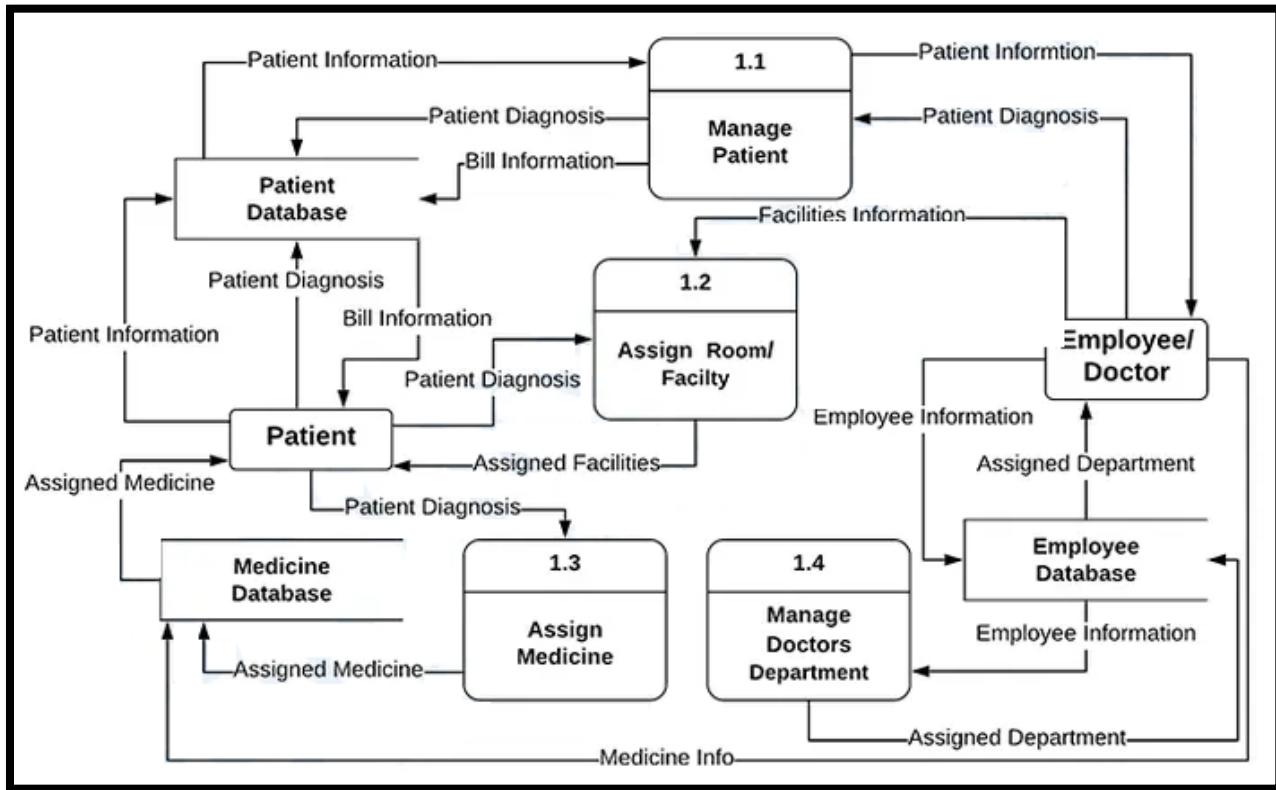


Figure (3.9): Context Diagram level 2

Use Case:

A use case is a methodology used in system analysis to identify, clarify, and organize system requirements.

use case diagram models different types of users interact with the system to solve a problem. As such, it describes the goals of the users, the interactions between the users and the system, and the required behavior of the system in satisfying these goals.

Use cases define interactions between external actors and the system to attain particular goals. A use case diagram contains four main components

it consists of a number of model elements. The most important model elements are:

Actor

Actors are usually individuals involved with the system defined according to their roles. The actor can be a human or other external system as **Show in figure (3.10)**

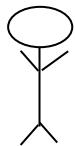


Figure (3.10): actor symbol

system boundary:

The system boundary defines the system of interest in relation to the world around it, its symbol show in figure (3.11).

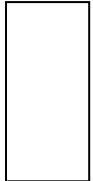


Figure (3.11): system boundary

Operation:

Function that done by actor, its symbol shown in Figure (3.12).

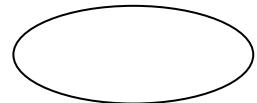


Figure (3.12): operation symbol

Relationships

The relationships between and among the actors and the use cases.

Association: link between an actor and the use case.

Its symbol show in figure (3.13)

Figure (3.13): association relation symbol

Generalization: relationship between one general operation and one specific operation, its symbol show in figure (3.14).

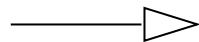


Figure (3.14): generalization relation symbol

The head of arrow toward the parent operation

<<include>> Use Case

The time to use the <<include>> relationship is after you have completed the first cut description of all your main Use Cases. You can now look at the Use Cases and identify common sequences of user-system interaction. **its symbol show in figure (3.15).**



Figure (3.15): include relation

The head of arrow toward the child use case -operation-

<<extend>> Use Case

An extending use case is, effectively, an alternate course of the base use case. The <<extend>> use case accomplishes this by conceptually inserting additional action sequences into the base use-case sequence, **its symbol show in figure (3.16)**.



Figure (3.16): extend relation symbol

The head of arrow is toward the parent-base-use case.

Hospital management system use case diagram has 5 actor deal with the system (patient, physician/doctor, Admin, receptionist, pharmacist) and has 4 process done between patient and physician through the system , where admin has 6 process in system such as (add doctor , and receptionist, add history, and patient) as shown in figure(3.17 & 3.18) .

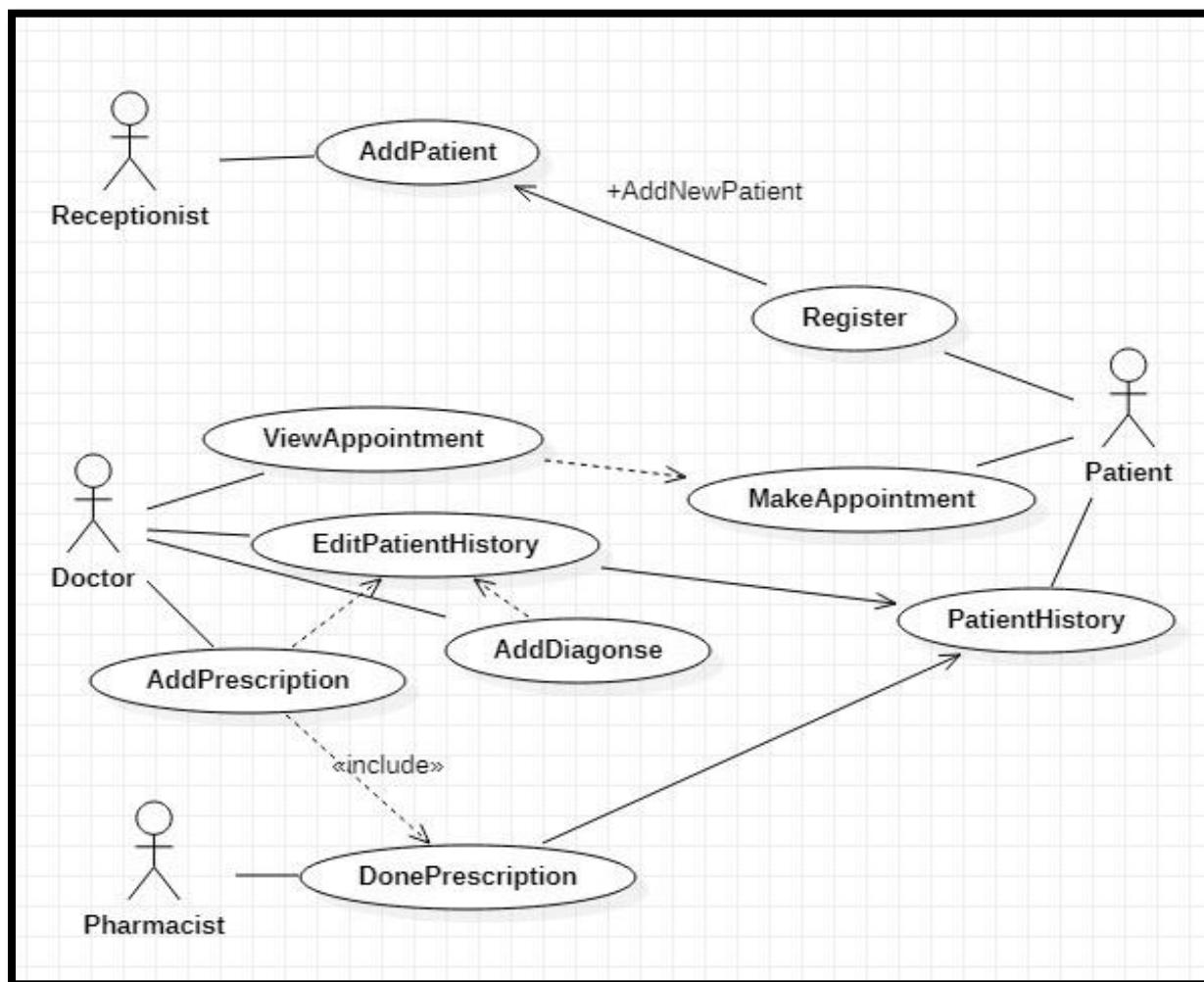


Figure (3.17): use case diagram

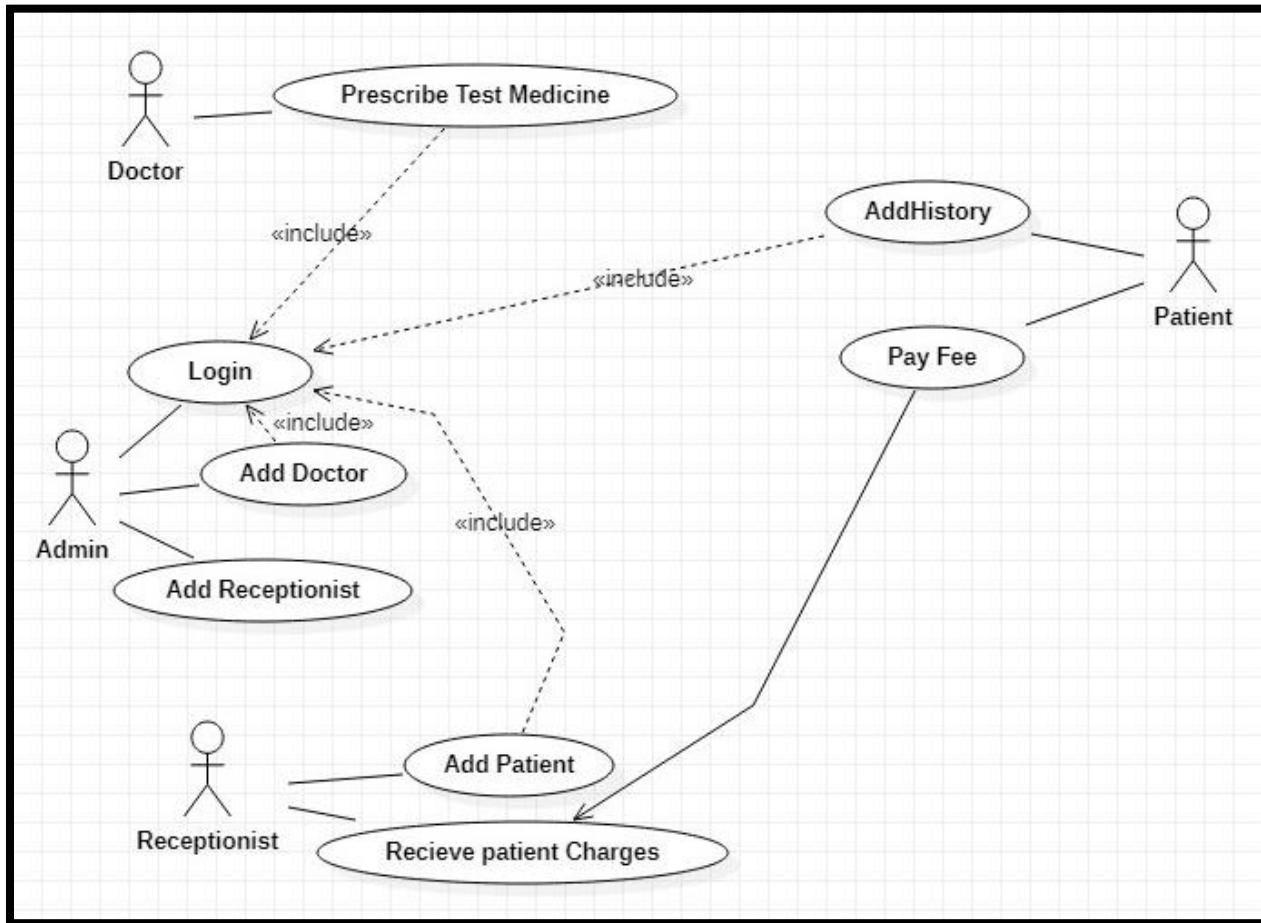


Figure (3.18): use case diagram

3.4.4 Sequence Diagrams

Sequence Diagrams

A sequence diagram simply depicts interaction between objects in a sequential order i.e. the order in which these interactions take place. We can also use the terms event diagrams or event scenarios to refer to a sequence diagram. Sequence diagrams describe how and in what order the objects in a system function. These diagrams are widely used by businessmen and software developers to document and understand requirements for new and existing systems.

Sequence Diagram Notations

Actors

An actor in a UML diagram represents a type of role where it interacts with the system and its objects. It is important to note here that an actor is always outside the scope of the system we aim to model using the UML diagram. , **its symbol represents in figure (3.19)**

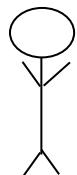


Figure (3.19): actor sequence symbol

Lifelines

A lifeline is a named element which depicts an individual participant in a sequence diagram. So basically each instance in a sequence diagram is represented by a lifeline. Lifeline elements are located at the top in a sequence diagram. The standard in UML for naming a lifeline follows the following format – Instance Name : Class Name, **the object's lifeline is shown in figure (3.20).**

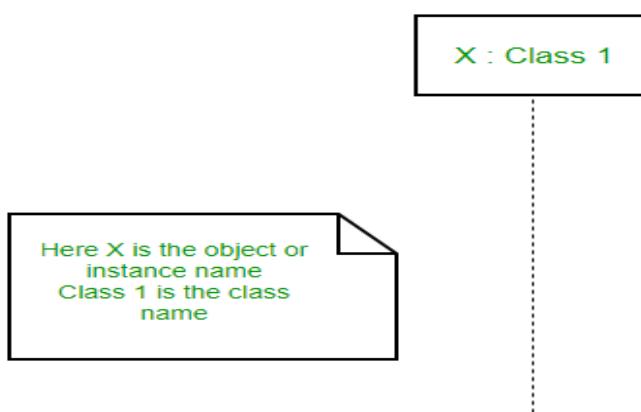


Figure (3.20): object's Lifeline

Activation: box over object's life line; drawn when object's method is on the stack, either that object is running its code, or it is on the stack waiting for another object's method to finish

Figure (3.21) shows the symbol activation form, while figure (3.22) shows the nested activation that uses to indicate recursion.

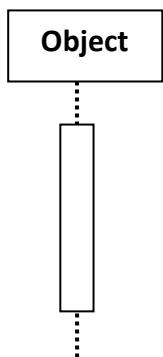


Figure (3.21): activation symbol

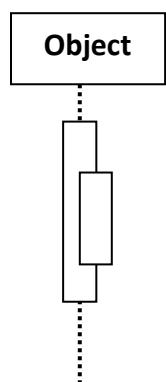


Figure (3.22): nested activation symbol

Message : Communication between active objectives.

Write the message name and arguments above the arrow.

Reply Message

Reply messages are used to show the message being sent from the receiver to the sender. We represent a return/reply message using an open arrowhead with a dotted line. The

interaction moves forward only when a reply message is sent by the receiver. **figure (3.23) represents return message symbol.**



Figure (3.23): Return message symbol

Synchronous messages

A synchronous message waits for a reply before the interaction can move forward. The sender waits until the receiver has completed the processing of the message. The caller continues only when it knows that the receiver has processed the previous message i.e. it receives a reply message. A large number of calls in object oriented programming are synchronous. We use a solid arrow head to represent a synchronous message. **figure (3.24) represents synchronous message symbol**



Figure (3.24): synchronous message symbol

Asynchronous Messages An asynchronous message does not wait for a reply from the receiver. The interaction moves forward irrespective of the receiver processing the previous message or not. We use a lined arrow head to represent an asynchronous message. , **figure (3.25) represents Asynchronous symbol.**



Figure (3.25): Asynchronous message symbol

Admin: make many operation such as (add, delete, update, view) in patient and physician.

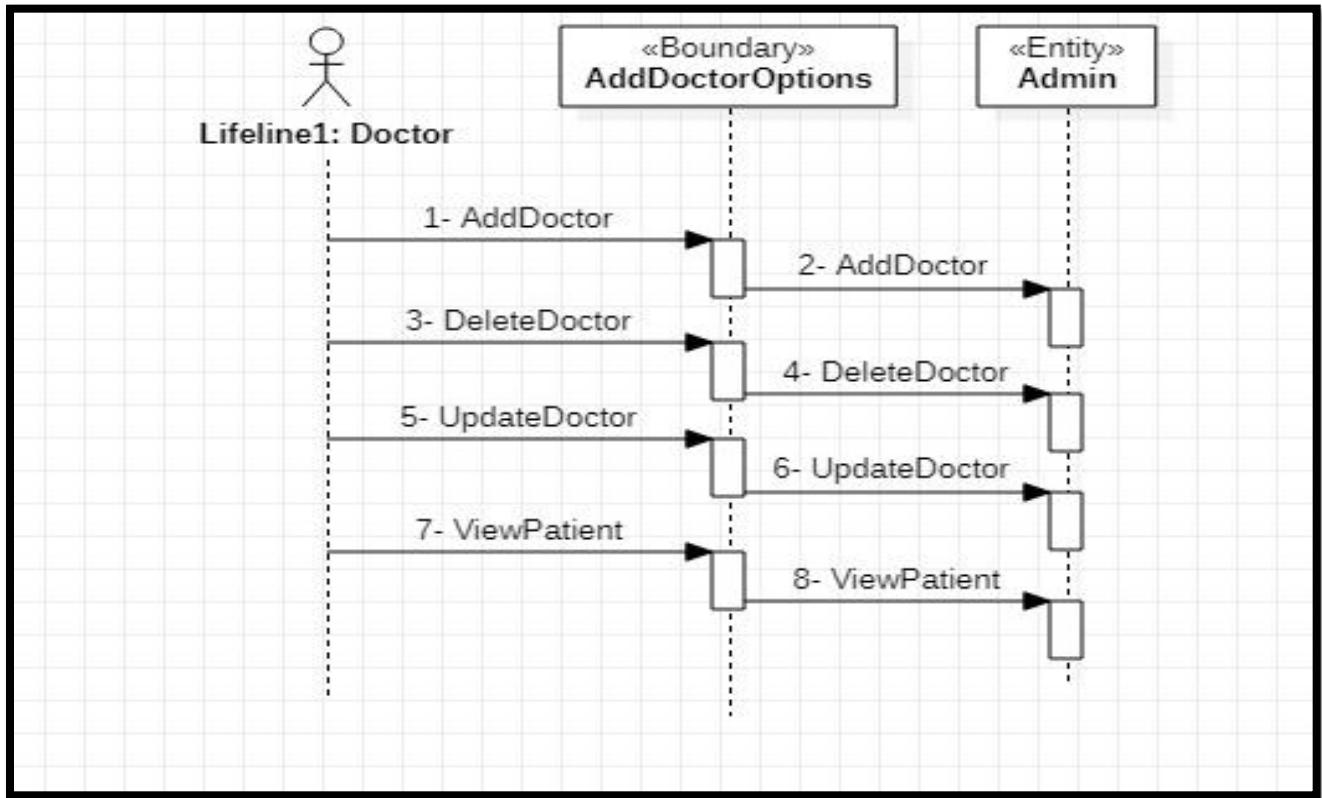


Figure (3.26):Admin sequences diagram

3.4.5 Flowchart Diagram:

A flow chart is a graphical or symbolic representation of a process. Each step in the process is represented by a different symbol and contains a short description of the process step. The flow chart symbols are linked together with arrows showing the process flow direction.

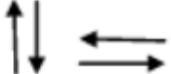
Symbol	Name	Function
	Process	Indicates any type of internal operation inside the Processor or Memory
	input/output	Used for any Input / Output (I/O) operation. Indicates that the computer is to obtain data or output results
	Decision	Used to ask a question that can be answered in a binary format (Yes/No, True/False)
	Connector	Allows the flowchart to be drawn without intersecting lines or without a reverse flow.
	Predefined Process	Used to invoke a subroutine or an Interrupt program.
	Terminal	Indicates the starting or ending of the program, process, or interrupt program
	Flow Lines	Shows direction of flow.

Figure (3.27): flowchart symbols

3.5 Matching algorithm flowchart in system:

The patient enters the symptoms of the disease and the system analyzes these symptoms and nominate the appropriate clinic for him based on the system databases.

In matching : the first symptom is matched against the second ,if a match is found ,it matches the first and second with the third (general case with a third symptom)

Ex: low blood pressure (general case, generated through matching two symptoms)
 + fast heart rate --> potential arrhythmia (this is considered a potential disease)

Algorithm (User side)

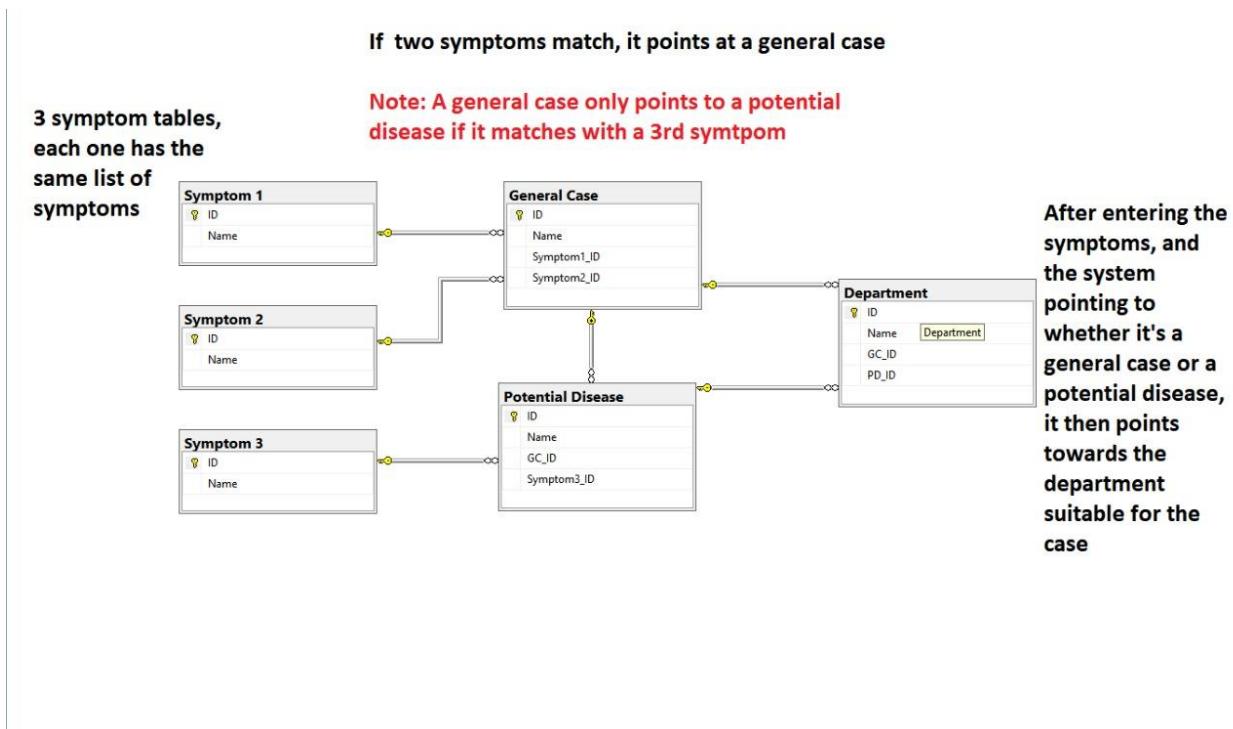
1. Start
 2. Enter 1st, 2nd and 3rd symptom
 3. Read matched department output
 4. End
-

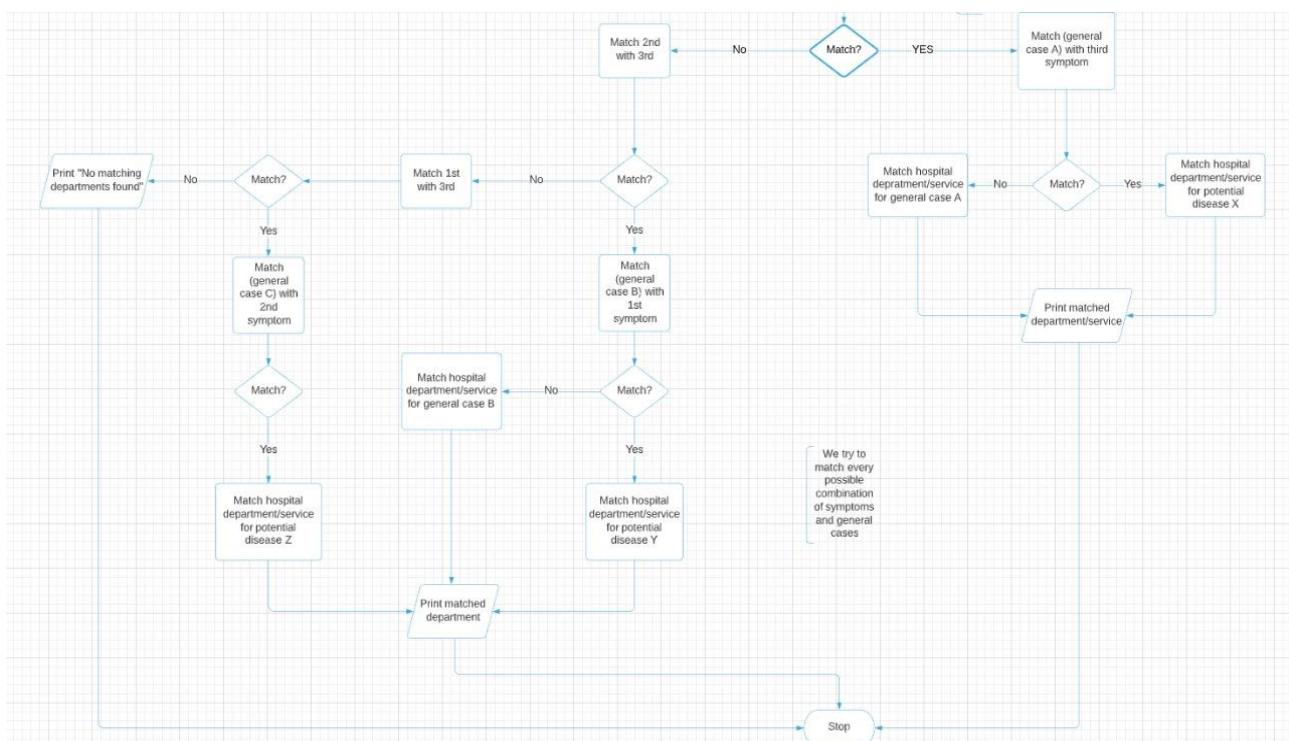
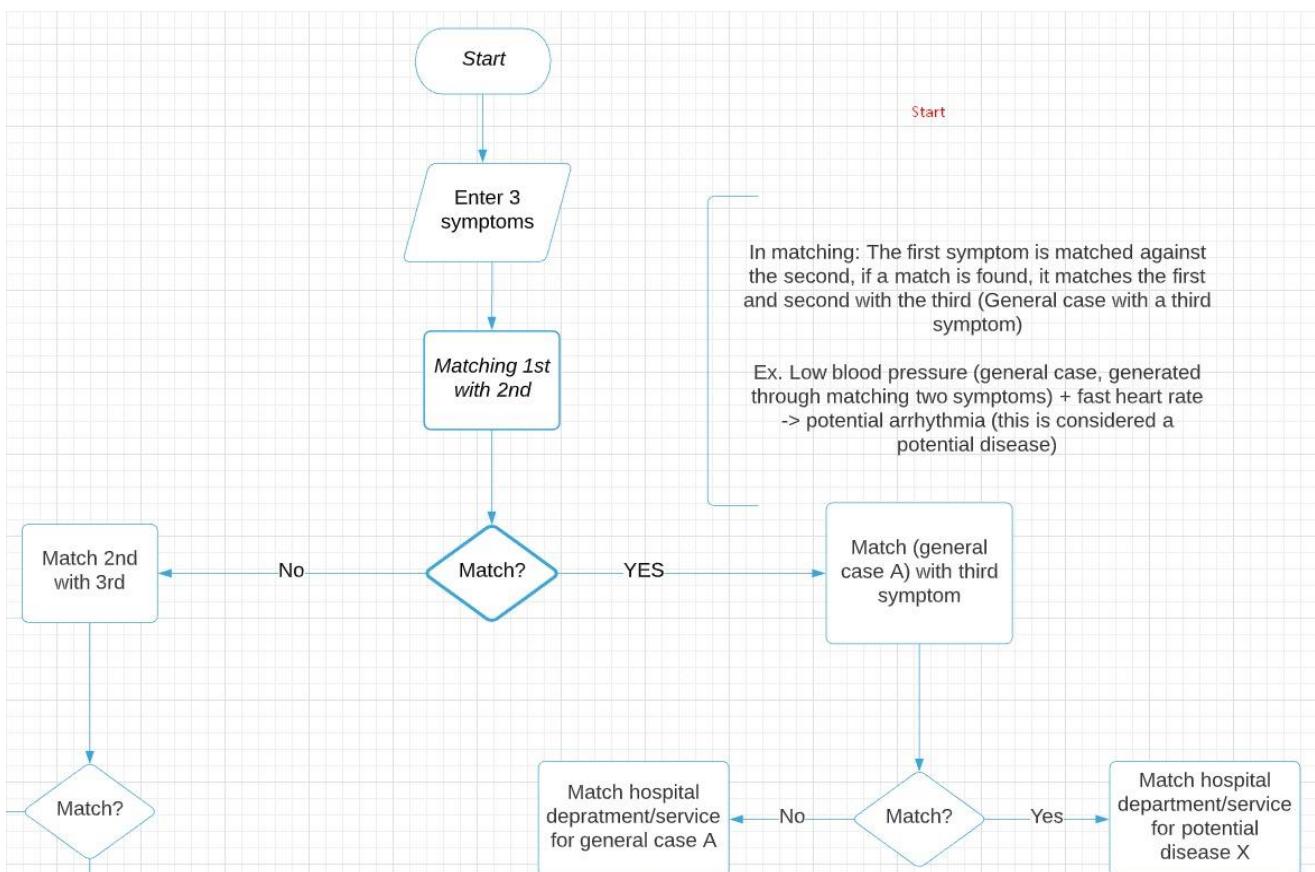
Algorithm (System side)

1. Start
2. Read 1st, 2nd and 3rd symptom
3. If 1st and 2nd symptoms match
 - a. Then
 - i. Read DB and summon the general case those two symptoms are indicative of, placeholder name DB_gc_A
 - ii. If DB_gc_A and 3rd symptom match
 1. Then
 - a. Read DB and summon the potential disease that the general case and third symptom are indicative of, Placeholder name DB_pd_X
 - b. Read DB and summon department for DB_pd_X
 - c. Print department
 2. Else
 - a. Read DB and summon the general case DB_gc_A
 - b. Read DB and summon department for DB_gc_A
 - c. Print department
 - b. Else if 2nd and 3rd symptoms match
 - i. Then

1. Read DB and summon the general case those two symptoms are indicative of, placeholder name DB_gc_B
2. If DB_gc_B and 1st symptom match
 - a. Then
 - i. Read DB and summon the potential disease that the general case and third symptom are indicative of, Placeholder name DB_pd_Y
 - ii. Read DB and summon department for DB_pd_Y
 - iii. Print department
 - b. Else
 - i. Read DB and summon the general case DB_gc_B
 - ii. Read DB and summon department for DB_gc_B
 - iii. Print department
- ii. Else if 1st and 3rd symptoms match
 1. Then
 - a. Read DB and summon the general case those two symptoms are indicative of, placeholder name DB_gc_C
 - b. If DB_gc_C and 2nd symptom match
 - i. Then
 1. Read DB and summon the potential disease that the general case and symptom are indicative of, Placeholder name DB_pd_Z
 2. Read DB and summon department for DB_pd_Z
 3. Print department
 - ii. Else

1. Read DB and summon the general case DB_gc_C
 2. Read DB and summon department for DB_gc_C
 3. Print department
2. Else
- a. Print “Could not find a suitable department, please check with a general physician”





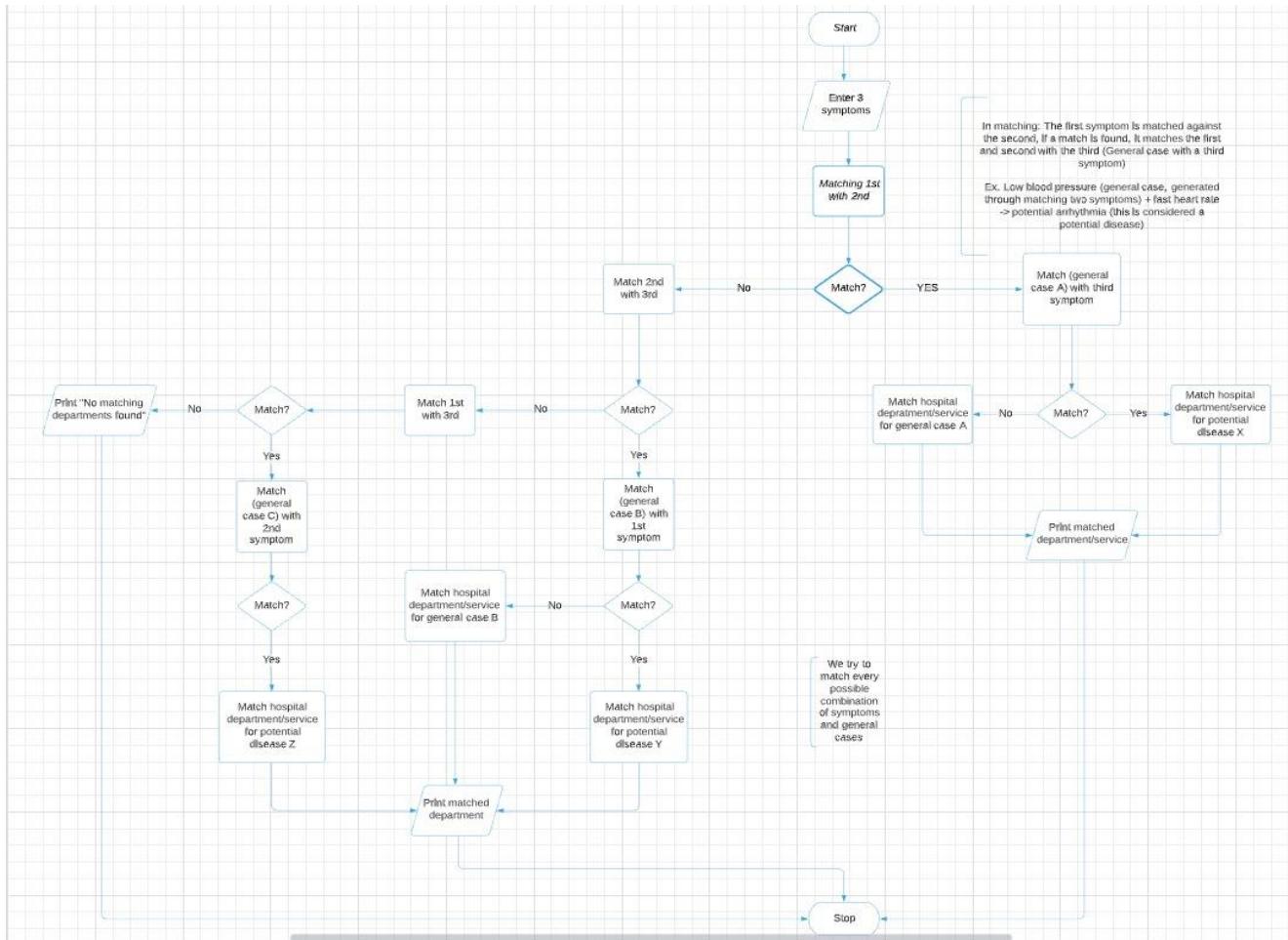


Figure (3.28): flowchart Diagram

3.6 Business Model

Business Model Canvas is one of the revolutionary tools that caters to the need for entrepreneurs to plan their projects and startups on paper before launching them, and it is a graphical visual method that can be used during the planning phase of the project in order to correct errors as much as possible.

The canvas has nine elements: Customer Segments: the targeted group (people/organization), Customer relationship: self/Automated service, Channels: the way you'll spread your idea with and communicate with customer segments,

Value Propositions: the benefits coming from solving this problem, Key activities: actions/activities, Key resources: physical materials and skills used to get results, Key partners: people/organizations participating as

Partner with contracts maybe to help, Cost structure: your budget and the things you'll pay for and revenue Stream: profits either material or morality

Key Partners	Key Activities	Value Propositions	Customer Relationships	Customer Segments
1- Government 2- Suppliers 3- Hospitals Staff 4- Hospitals Management	 <ul style="list-style-type: none"> * Editable User information page * Clinic Reservation * View & Edit Patient History & Prescriptions * Add/Delete/Edit :- Doctors - Receptionist- Directors -Admin * Create E-System * Train Employee  <ul style="list-style-type: none"> * Development Team * Server & Hosting Domain * Suppliers * Programming tools 	 <ul style="list-style-type: none"> * prevent medical theft- less crowding * EHR for Each Patient & one place for all diseases & drugs that they have previously been exposed to * Recommending a clinic for the patient * Prescription along patient's life * Online booking * Control the whole Organization actions by Administrations & Directors * Recommending a clinic for patient * Cost reduction- Organization * Citizen satisfaction * Improve QoS * Control all employees permissions 	 <ul style="list-style-type: none"> - (Self/Automated)service - Installing and Training for administration & Doctors - Testing and Maintenance periodically - Communicate with all users 	 <ul style="list-style-type: none"> a- Governmental Hospital b- Private Hospital c- Patients - citizens
Cost Structure		Revenue Streams		
 <ul style="list-style-type: none"> Development team salary ➤ Maintenance – Security – Digital Marketing ➤ Rent server & hosting domain 		 <ul style="list-style-type: none"> ➤ Automatic Reception department which saves the worker salary . ➤ Increase our health classification ➤ Advertisement on Website/Mob/Server . ➤ Doctors Recommendations ➤ Reducing the rate of mistake in diagnosing medicines & preserving patients' lives 		

Figure (3.29) business model

3.7 Summary:

We talked in this chapter about: Introduction about system Analysis, System development life cycle, UML Diagrams, DFD diagrams, Context diagram, Use case diagram, Sequence diagram and Flowchart diagram and matching algorithm in system.

To be continued the rest of diagrams that are related to DB and Design phase

4.1 Introduction about system design:

The third phase of SDLC. Coming after planning and analyzing the system, it also includes as the most creative and hard phase while working on the system.

The design phase bridges the gap between problem domain and the existing system in a manageable way” [6]”, by showing the user interface, forms, and reports that will be used; and the specific programs, databases, and files that will be needed.

The two main kind of design is: logical design which represents the data flow, inputs, and outputs of the system. And physical design that concerned with user interface, process design, and data design.

4.2 Entity Relationship Diagram ERD:

An entity relationship diagram (ERD) shows the relationships of entity sets stored in a database. An entity in this context is an object, a component of data. An entity set is a collection of similar entities. These entities can have attributes that define its properties.

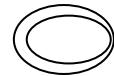
Entity is an object/concept about which you want to store information, represented by rectangle, attribute is characteristic of the entity, represented by oval shape:

- ✓ **Simple: having one value**



Simple attribute symbol

- ✓ **Multi value: having more than one value**



Multi value attribute symbol

- ✓ **Derived: based on another attribute**

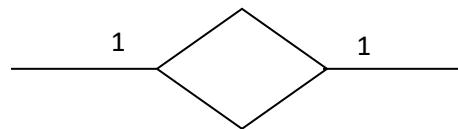


Derived attribute symbol

Relationship shows association between entities:

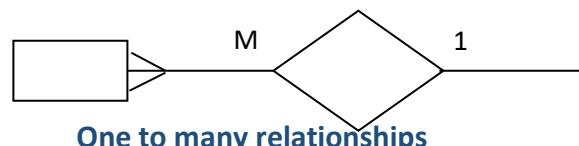
Cardinality:

- ✓ one to one relationship



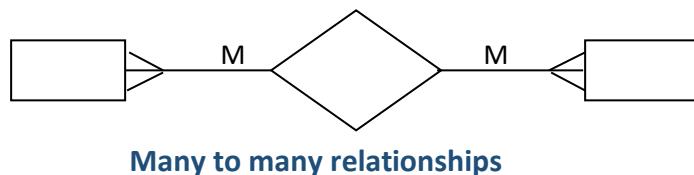
One to one relationship

- ✓ one to many relationships



One to many relationships

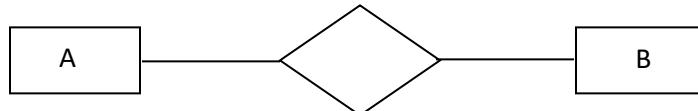
- ✓ many to many relationship



Many to many relationships

Participation:

- ✓ When A's occurrence doesn't depend on B's occurrence, it called “PARTIAL”:



Partial relationship

- ✓ When A's occurrence depends on B's occurrence, it called "Mandatory"

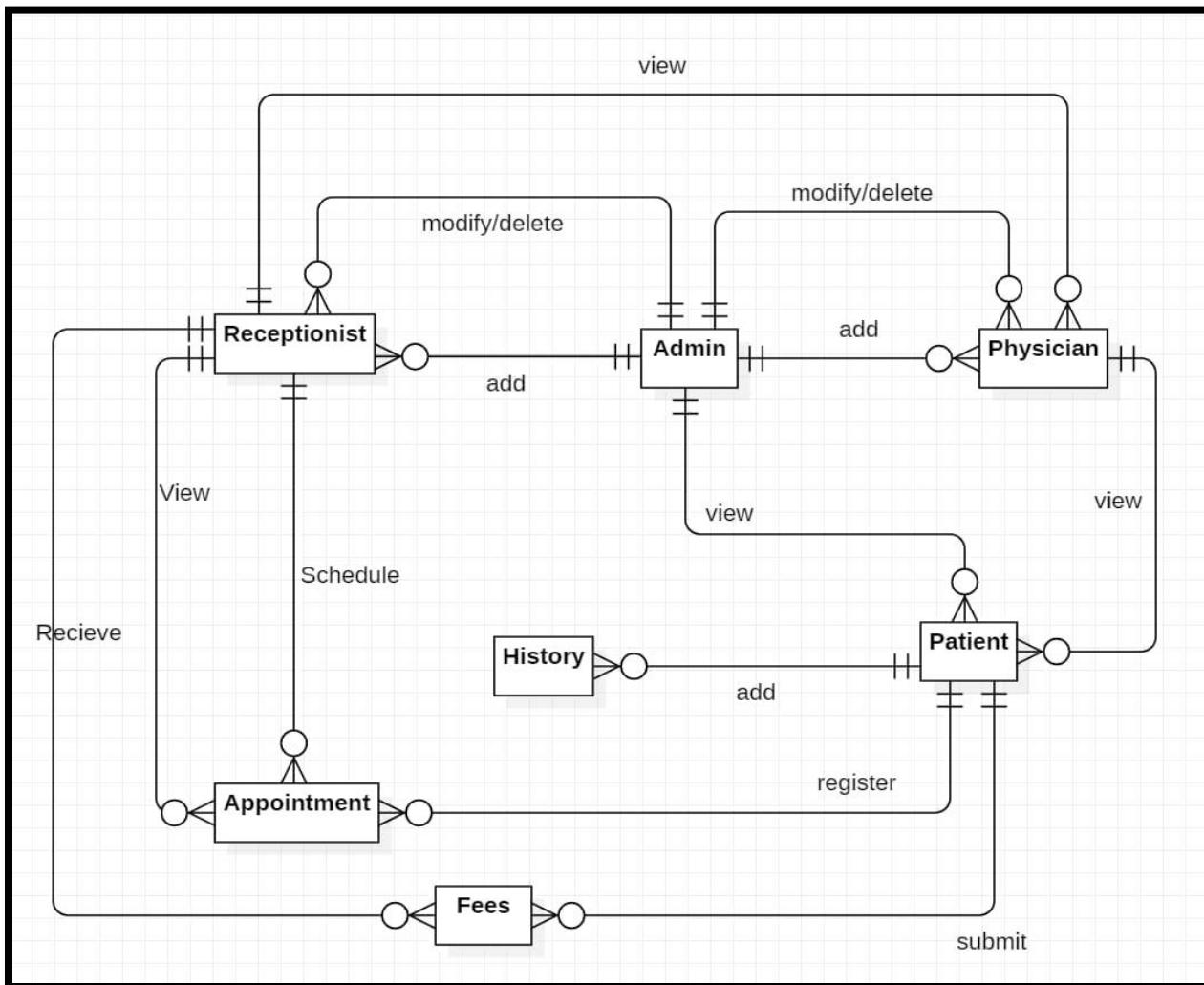
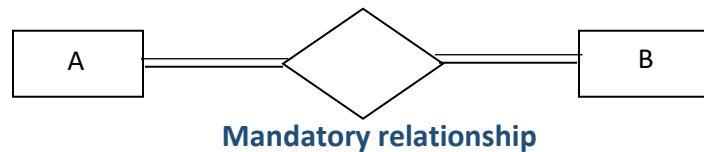


Figure (4.1) entity relationships diagram (ERD)

4.3 Class Diagram:

Class diagram is a structural UML diagram that show classes, relationships, interface, association, and collaboration.

Classes in the class diagram are the building blocks based on OOPs.

4.3.1 Structure of class:

- ✓ Class Name
- ✓ Attribute Structure shown in figure (4.2):
 - modifier: represent visibility.
 - +: Public
 - : Private
 - #: Protected
 - Attribute-variable- name.
 - attribute type (int, string ...)
 - Default value-optional-
 - other property.

Modifier attribute name: attribute type="default value" {other property}

Figure (4.2): Attribute Structure

- ✓ Operation Structure as shown in figure (4.3):
 - Modifier.
 - operation name.
 - parameters.
 - return value.

Modifier operation name (parameters): return value

Figure (4.3): Operation Structure

Here is the whole class structure shown in figure (4.4):

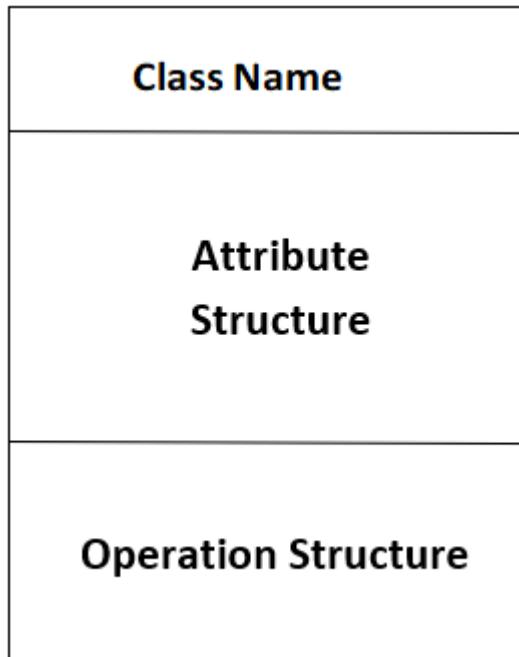


Figure (4.4): Class Structure

4.3.2 Relationships:

- ✓ association: relation between instances of two classes.
- ✓ generalization/inheritance: relation between one general (super class) and specific (sub class) classes -kind-of relationship-
- ✓ aggregation: “Has-a”/ “whole/part” relation.

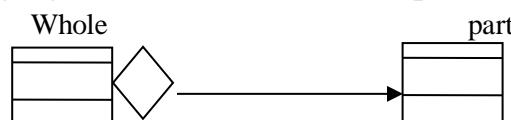


Figure (4.5): aggregation relationship

- ✓ composition: strong form of aggregation that implies ownership.

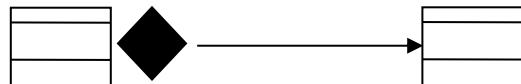


Figure (4.6): Composition relationship

This figure shows the class diagram of national health care system which contain 14 classes, each class has its own properties and relationships

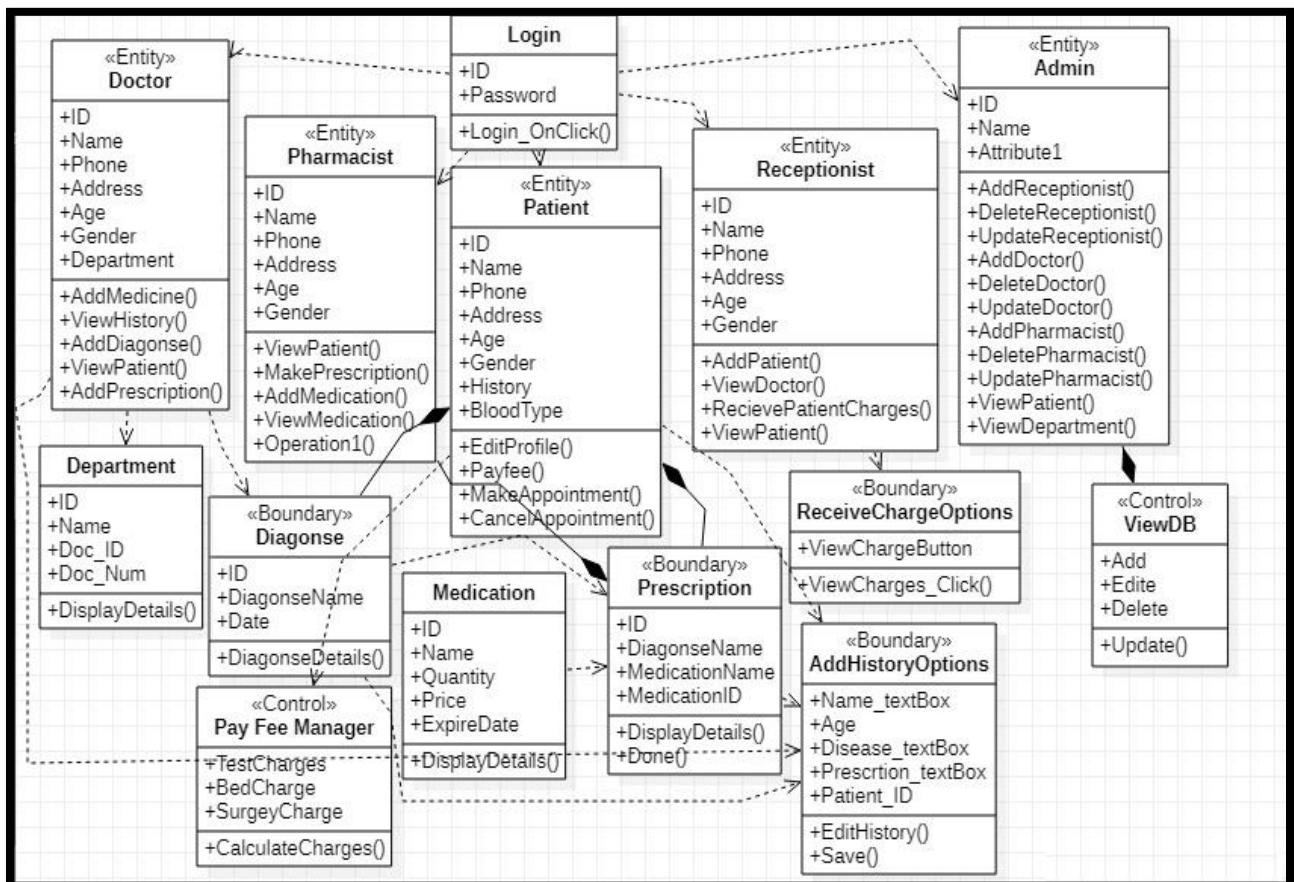


Figure (4.7) class diagram

4.4 Activity Diagram:

Activity diagram is a behavioral diagram used for business modeling and considered as an object oriented for flow chart and data flow, the basic notations used to draw activity diagram are:

- ✓ Initial/start state: shown in figure (4.8).



Figure (4.8): Initial state symbol

- ✓ Stop state: ending point, shown in figure (4.9).



Figure (4.9): stop state symbol

- ✓ Activity: task/process, shown in figure (4.10).



Figure (4.10): Activity symbol

- ✓ Decision: Boolean expression, shown in figure (4.11).

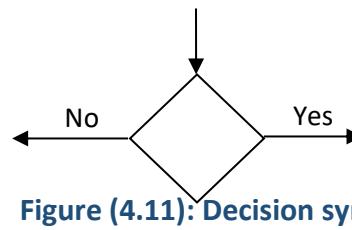


Figure (4.11): Decision symbol

- Fork: one incoming transition and two or more outgoing transitions, shown in figure (4.12).

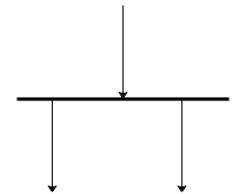


Figure (4.12): Fork symbol

- Join: several flow in, and one leaving, shown in figure (4.13).

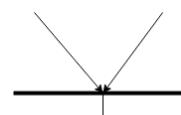


Figure (4.13): join symbol

- ✓ Merge: shown in figure (4.14).

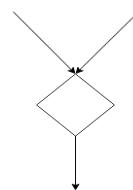


Figure (4.14): Merge symbol

The difference between merge and join is that the inputs must be executed first to execute the output in join, but executing only one activity from input made the output executed in merge.

- ✓ **Swimlane:** vertical/horizontal zone represent class/dept., shown in figure (4.15).

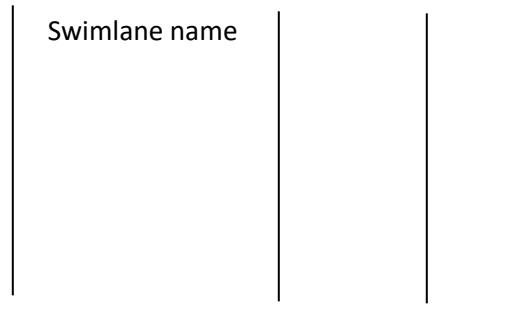


Figure (4.15): Swimlane symbol

The figure below shows the activity diagram that clarify the data flow and decisions taking through the system.

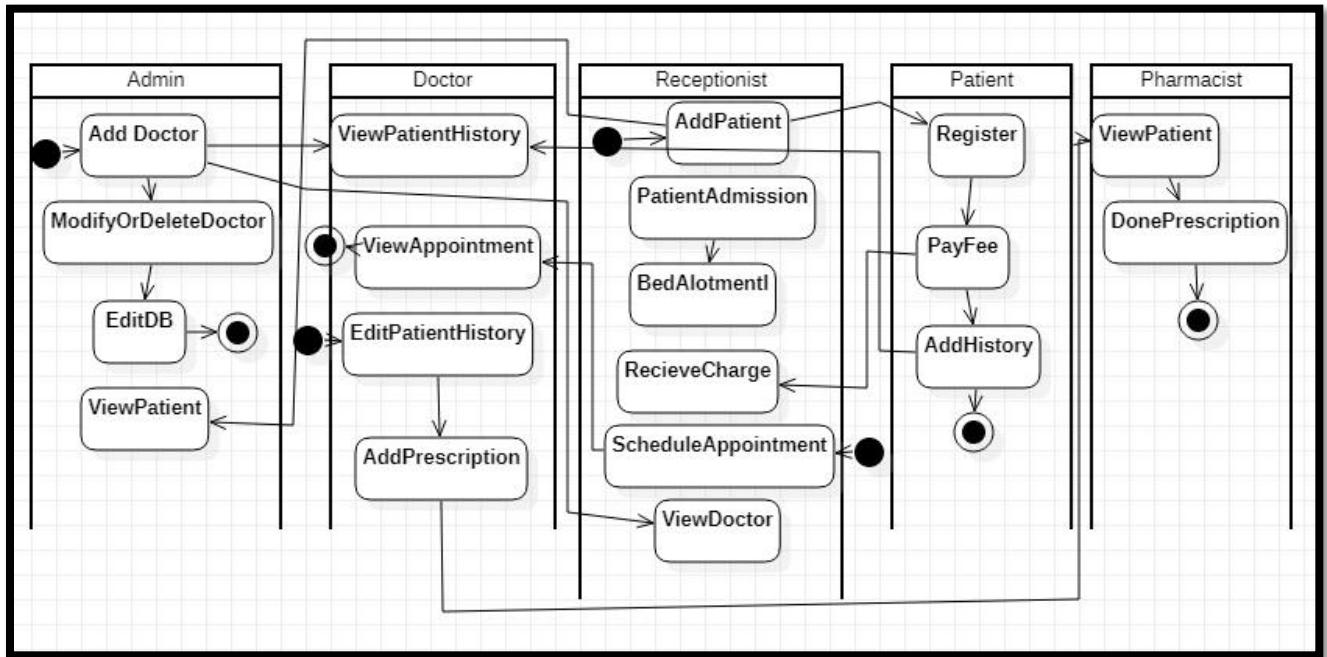


Figure (4.16) activity diagram

4.5 Summery:

Finally, we include the structural and behavioral diagrams to more explanation of the system, which is ready now to real implementation, and that what we going to show in the next chapter.

5.1 HMS pages (Website)

The figure (5.1) below shows the Home Page of Website
and The figure (5.2) below shows Our departments of Hospital management system

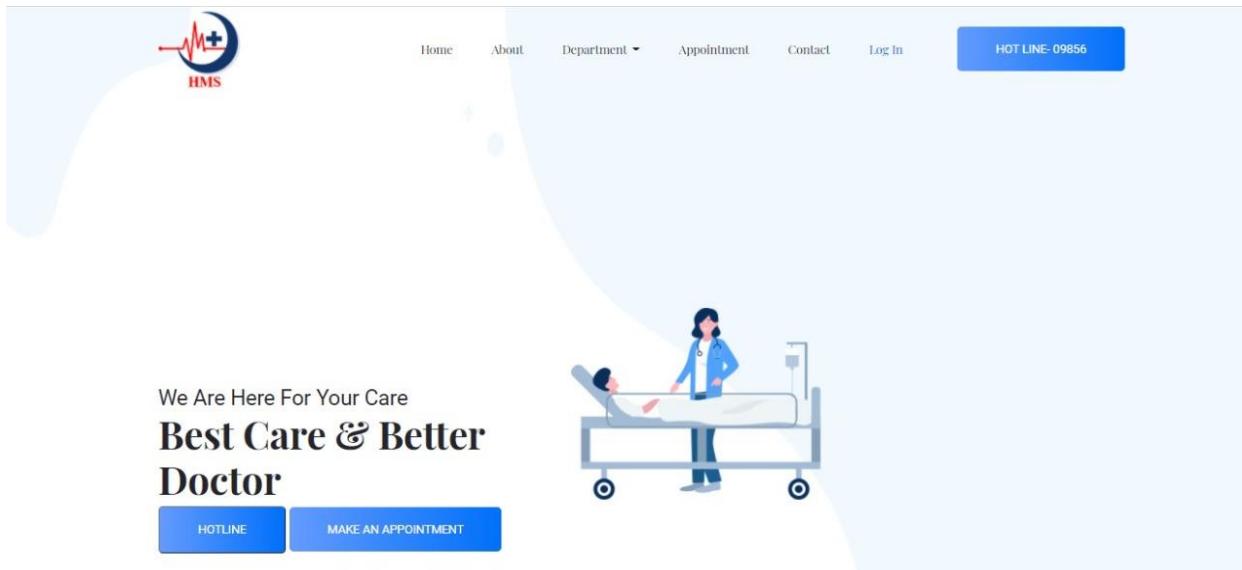


Figure (5.1): Home Page of Website

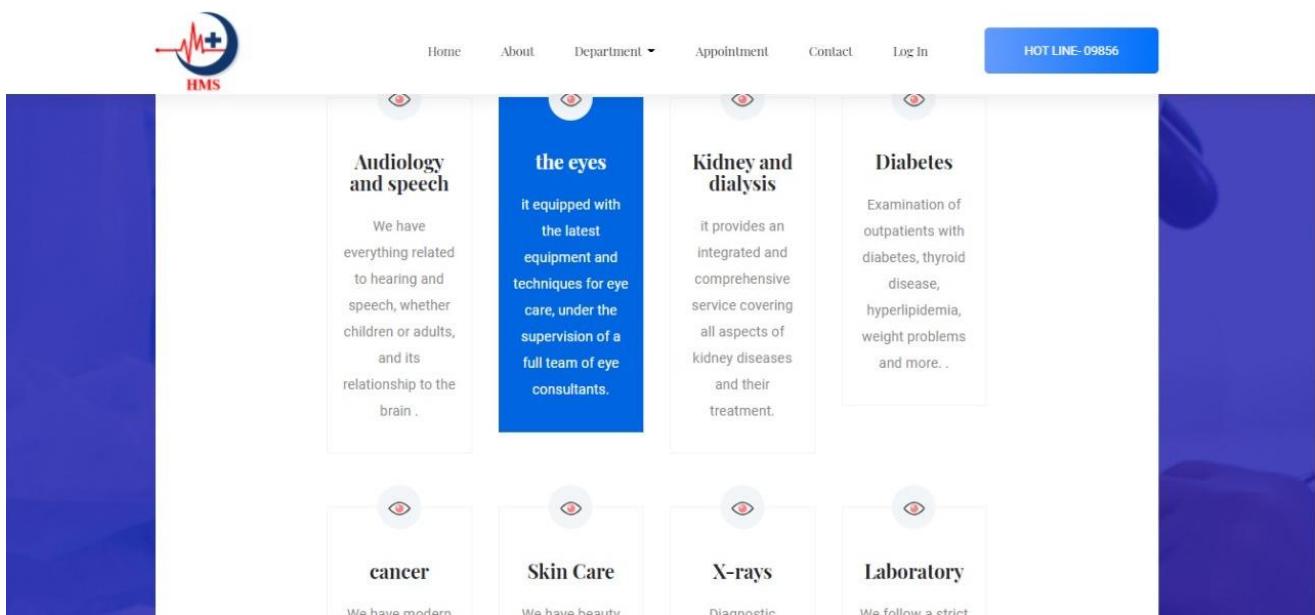


Figure (5.2): Our departments

**The figure (5.3) below shows Booking an appointment with your doctor and
The figure (5.4) below shows Login page**

Figure (5.3): Page for booking an Appointment

Figure (5.4): Login Page

The figures (5.5) and (5.6) below show Patient page on our website

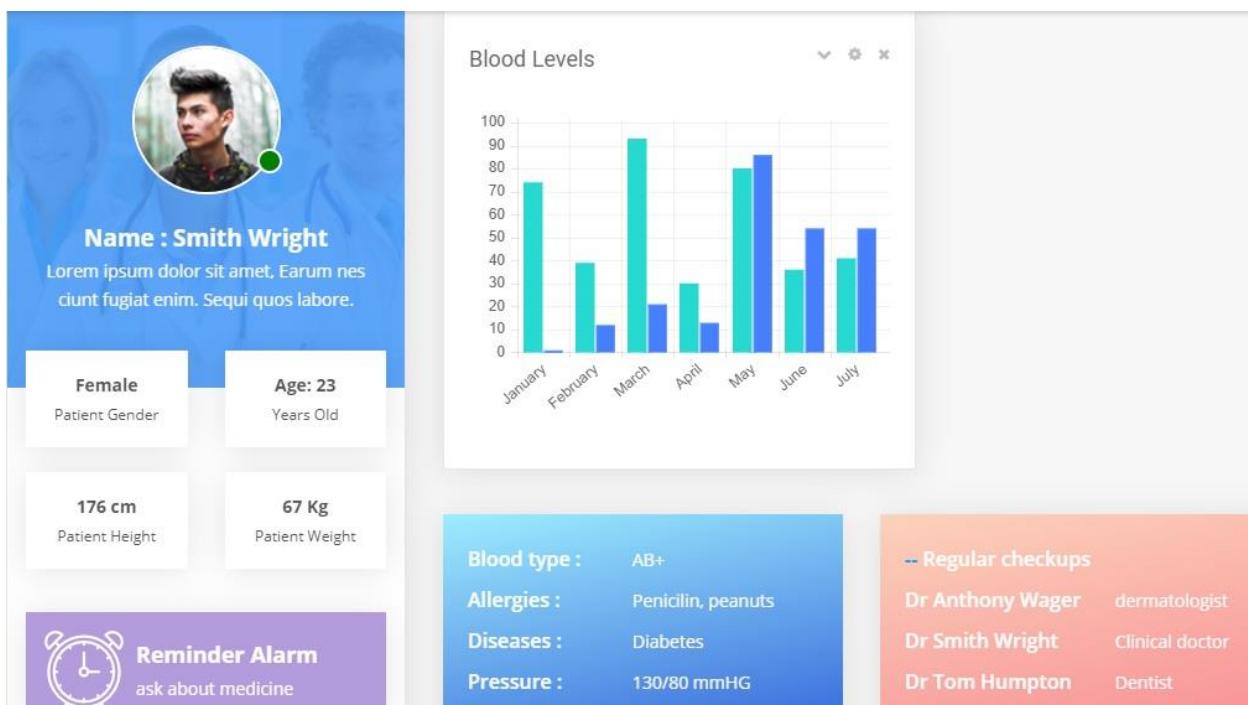


Figure (5.5): Patient Page



Figure (5.6): Patient Page

5.2 HMS pages (Desktop Application)

The figure (5.7) below shows Start Form when opening the application at first time and The figure (5.8) below shows doctor Login Form

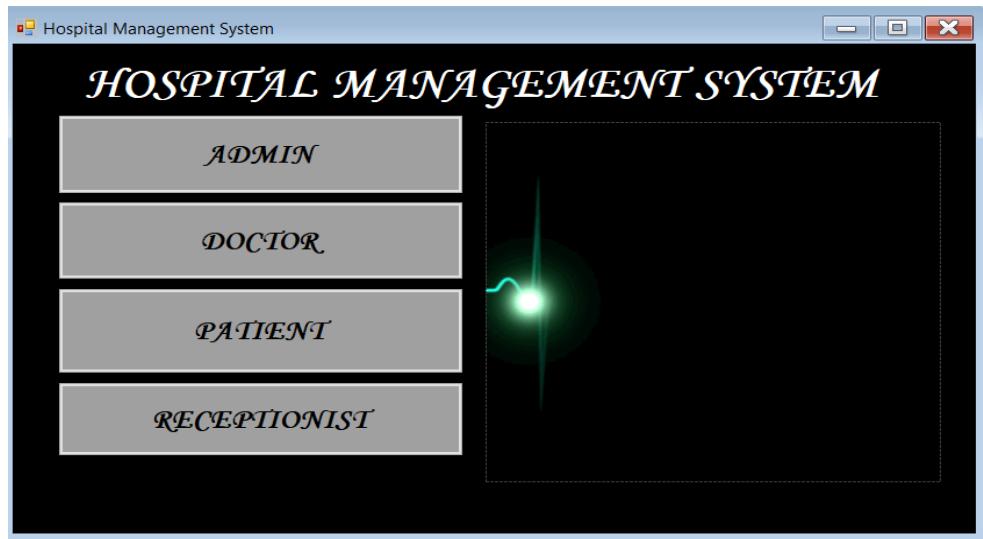


Figure (5.7): Start Form when opening HMS application at first time

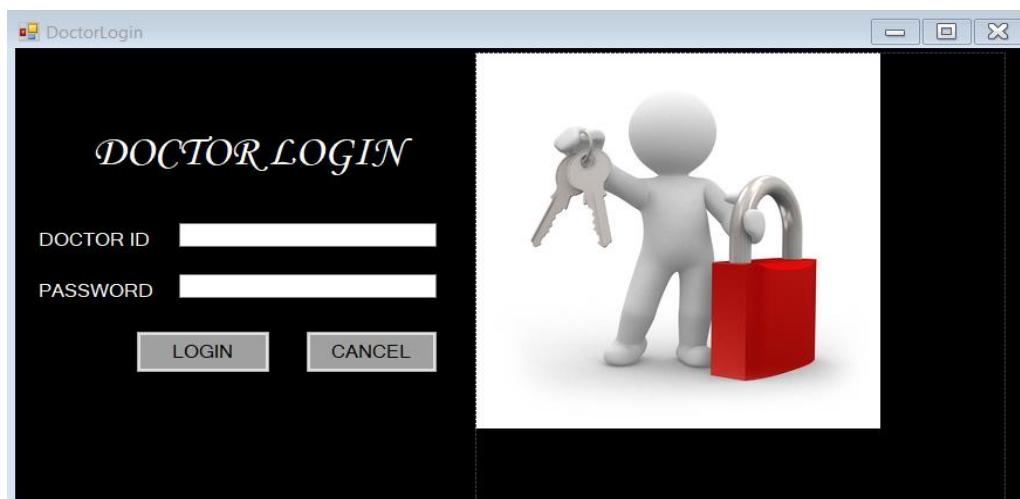


Figure (5.8): Doctor login Form

The figure (5.9) below shows Update Doctor Options Forms

and The figure (5.10) below shows Doctors view form for patient options



Figure (5.9): Update Doctor Options Forms

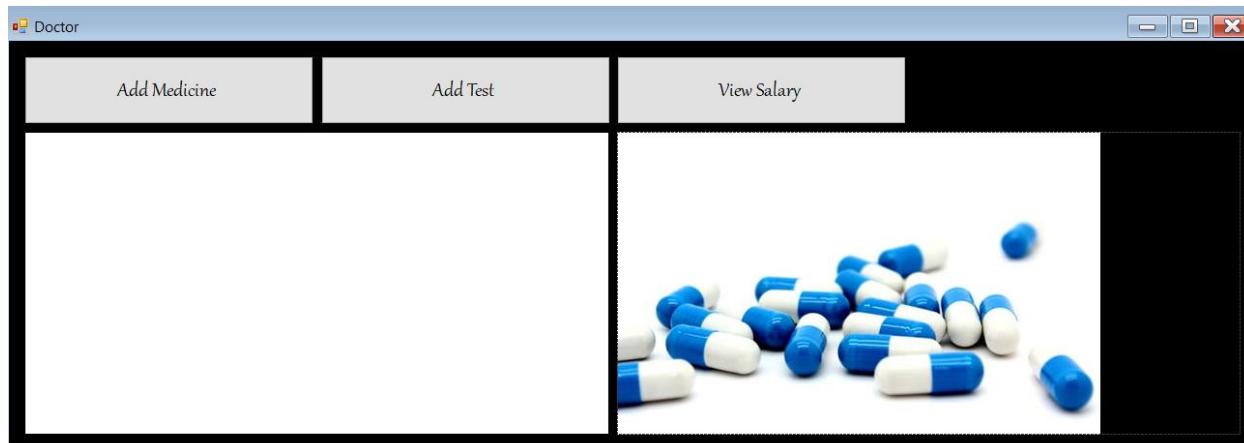


Figure (5.10): Doctors view form for patient options

The figure (5.11) below shows Add Test Options form and The figure (5.12) below shows Add History Options , to add disease for the patient's profile history

The screenshot shows a Windows application window titled "AddTestOptions". The interface has a black background with white text and light gray buttons. At the top, there are three standard window control buttons (minimize, maximize, close). Below the title bar, there are three dropdown menus labeled "Doctor ID", "Patient ID", and "Test". At the bottom of the window are three buttons: "View History", "Add Test", and "Cancel". A large, empty rectangular area is present in the center of the window.

Figure (5.11): Add Test Options form

The screenshot shows a Windows application window titled "AddHistoryOptions". The interface has a black background with white text and light gray buttons. At the top, there are three standard window control buttons (minimize, maximize, close). Below the title bar, there are four dropdown menus labeled "ID", "Disease", "Age", and "Inherital". At the bottom of the window are two buttons: "Add History" and "Cancel".

Figure (5.12): Add History Options form

the figure (5.13) below shows Add Medicine options Form and the figure (5.14) below shows Receptionist Login Form

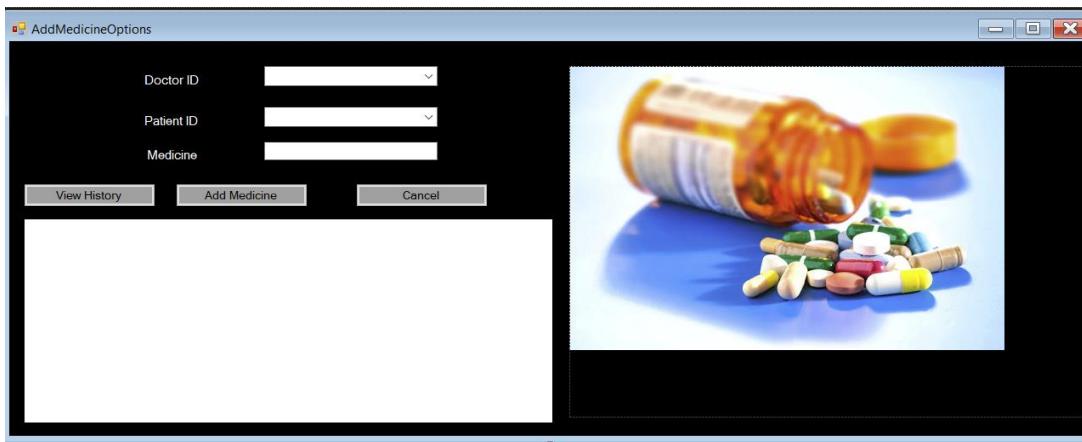


Figure (5.13): Add medicine form



Figure (5.14): Receptionist Login form

the figure (5.15) below shows Receptionist receiving money from the patient Form and the figure (5.16) below shows Admin Sing up Form



Figure (5.15): receive change form

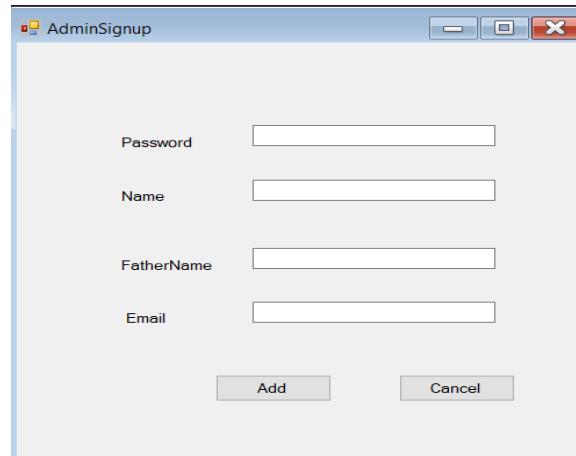


Figure (5.16): Admin Sing up Form

the figure (5.17) below shows Patient Login Form and the figure (5.18) below shows Patient powers he has on the application

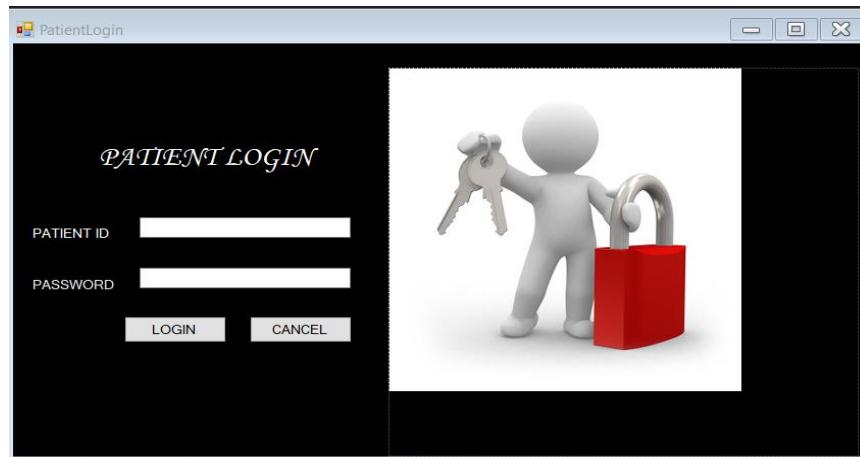


Figure (5.17): Patient Login Form

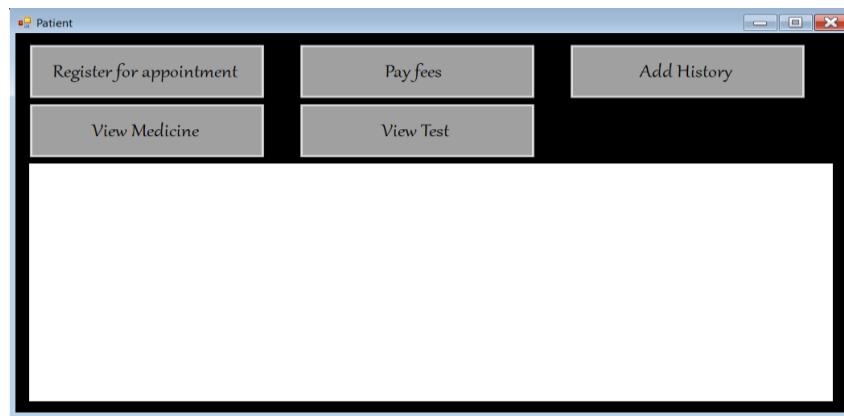


Figure (5.18): Patient powers Form

the figure (5.19) below shows Patient form for payfee and the figure (5.20) below shows Patient Appoinement form

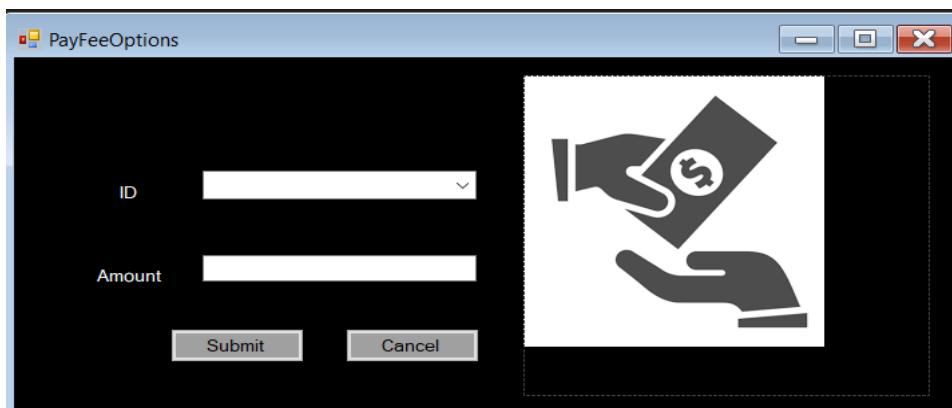


Figure (5.19): Patient Form for payfee

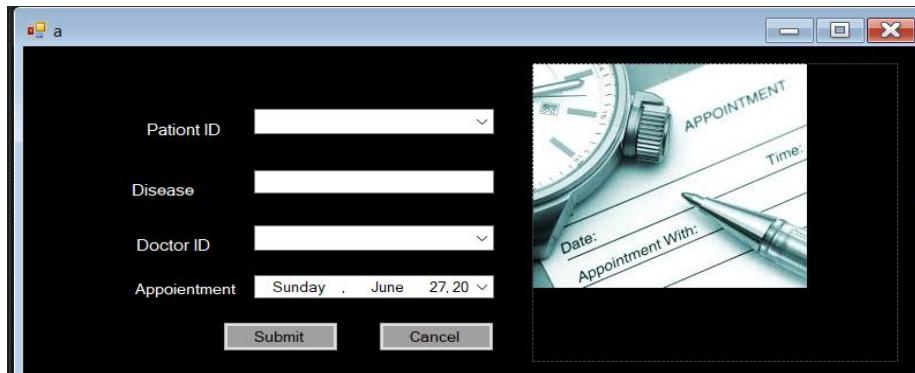


Figure (5.20): Patient Appoinement Form

5.3 HMS pages (UI Mobile Application)

The figure (5.21) below shows HMS Mobile Application Logo, the figure (5.22) below shows the Main Page of Mobile Application and The figure (5.23) below shows Booking a clinic Such as clinics of the heart and blood vessels



Figure (5.21): HMS Mobile Application Logo



Figure (5.22): Main of HMS Mobile Application

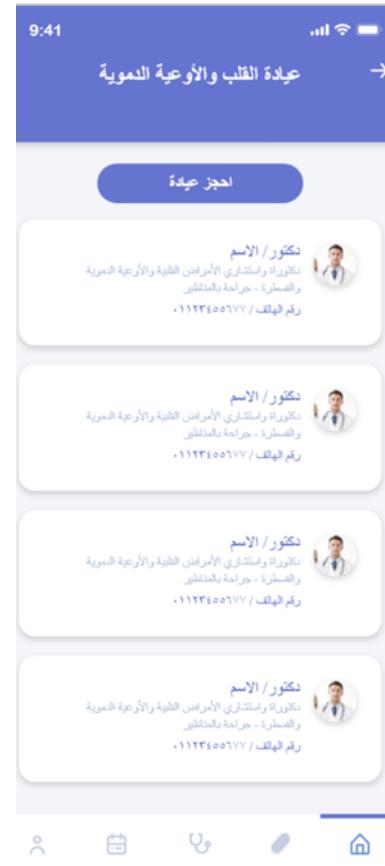
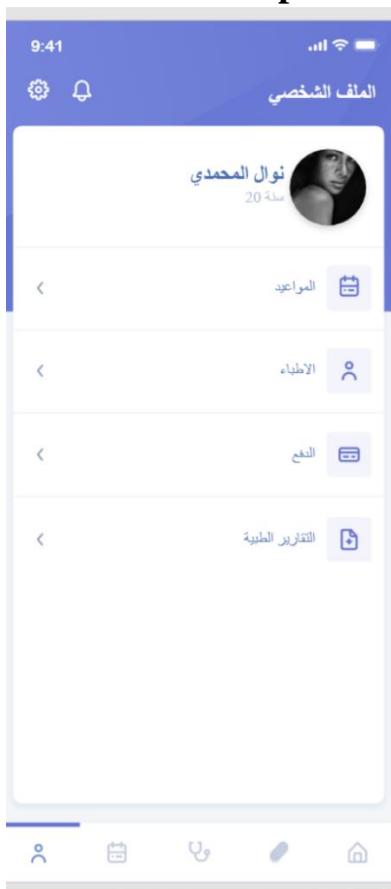


Figure (5.23): Booking a clinic

The figure (5.24) below shows Patient Profile and The figure (5.25) below shows medical reports of patient of HMS mobile application



9:41

التقارير الطبية

تحليل دم

12-11-2202

تحليل دم

أشعة منتظمة

12-11-2202

أشعة منتظمة

تحليل دم

12-11-2202

تحليل دم

أشعة منتظمة

12-11-2202

أشعة منتظمة

رفع ملف جديد

Figure (5.24): Patient Profile

Figure (5.25): medical reports of patient

The figure (5.26) below shows Createing an account and The figure (5.27) below shows Login page of HMS mobile application



Figure (5.26): Create an account



Figure (5.27): Login page

The figure (5.28) below shows pharmacy page and The figure (5.29) below shows Patient or user appointments page of HMS mobile application



Figure (5.28): pharmacy



Figure (5.29): user appointments page

The figure (5.30) below shows Help and support page and The figure (5.31) below shows Notification page of HMS mobile application



Figure (5.30): Help and support page



Figure (5.31): Notification page

5.4 HMS Database Tables

The table (5.1) below shows Admin Table and The table (5.2) below shows Appointment table to Taking a date for the visit

	Column Name	Data Type	Allow Nulls
1	Admin_ID	int	<input type="checkbox"/>
	Admin_Name	nvarchar(50)	<input checked="" type="checkbox"/>
	Admin_FatherName	nvarchar(50)	<input checked="" type="checkbox"/>
	Admin_Email	nvarchar(MAX)	<input checked="" type="checkbox"/>
	Admin_Password	nvarchar(MAX)	<input checked="" type="checkbox"/>
	Admin_ContactNumber	nvarchar(50)	<input checked="" type="checkbox"/>

Table (5.1): Admin Table

	Column Name	Data Type	Allow Nulls
1	Appointment_ID	int	<input type="checkbox"/>
	General_OPD_Patient_ID	int	<input checked="" type="checkbox"/>
	Appointment_Disease	nvarchar(50)	<input checked="" type="checkbox"/>
	Doctor_ID	int	<input checked="" type="checkbox"/>
	Appointment_DateTime	datetime	<input checked="" type="checkbox"/>
	Appointment_Price	decimal(18, 2)	<input checked="" type="checkbox"/>
	Department_ID	int	<input checked="" type="checkbox"/>

Table (5.2): Appoinment Table

The table (5.3) below shows Departements Tabel for all Doctors in the hospital and the table (5.4) below shows Doctors Tabel with their Attributes

Column Name	Data Type	Allow Nulls
Department_ID	int	<input type="checkbox"/>
Department_Name	nvarchar(50)	<input checked="" type="checkbox"/> <input type="checkbox"/>

Table (5.3): Departement Table

Column Name	Data Type	Allow Nulls
Doctor_ID	int	<input type="checkbox"/>
Doctor_Name	nvarchar(50)	<input checked="" type="checkbox"/>
Doctor_FatherName	nvarchar(50)	<input checked="" type="checkbox"/>
Doctor_Email	nvarchar(MAX)	<input checked="" type="checkbox"/>
Doctor_Age	int	<input checked="" type="checkbox"/>
Doctor_Password	nvarchar(MAX)	<input checked="" type="checkbox"/>
Doctor_Gender	bit	<input checked="" type="checkbox"/>
Doctor_ContactNumber	nvarchar(50)	<input checked="" type="checkbox"/>
Doctor_Salary	decimal(18, 2)	<input checked="" type="checkbox"/>
Doctor_Address	nvarchar(MAX)	<input checked="" type="checkbox"/>
Department_ID	int	<input checked="" type="checkbox"/>

Table (5.4): Doctor Table

The table (5.5) below shows Test Reports Tabel that doctors can add for patients and the table (5.6) below shows General Out Patient Clinics Tabel for Patients by their IDs

Column Name	Data Type	Allow Nulls
Doctor_Test_Report_ID	int	<input type="checkbox"/>
General_OPD_Patient_ID	int	<input checked="" type="checkbox"/>
Doctor_ID	int	<input checked="" type="checkbox"/>
Doctor_Test_Report_Details	nvarchar(MAX)	<input checked="" type="checkbox"/>
Appointment_ID	int	<input checked="" type="checkbox"/>

Table (5.5): Doctor test report Table

Column Name	Data Type	Allow Nulls
General_OPD_Patient_ID	int	<input type="checkbox"/>
General_OPD_Patient_Name	nvarchar(50)	<input checked="" type="checkbox"/>
General_OPD_Patient_FatherName	nvarchar(50)	<input checked="" type="checkbox"/>
General_OPD_Patient_Address	nvarchar(MAX)	<input checked="" type="checkbox"/>
General_OPD_Patient_Gender	bit	<input checked="" type="checkbox"/>
General_OPD_Patient_Age	int	<input checked="" type="checkbox"/>
General_OPD_Patient_ContactNu...	nvarchar(50)	<input checked="" type="checkbox"/>
General_OPD_Patient_Disease	nvarchar(50)	<input checked="" type="checkbox"/>
General_OPD_Patient_BloodType	nvarchar(50)	<input checked="" type="checkbox"/>
General_OPD_Patient_Email	nvarchar(MAX)	<input checked="" type="checkbox"/>
General_OPD_Patient_Password	nvarchar(MAX)	<input checked="" type="checkbox"/>

Table (5.6): General OPD patient Table

The table (5.7) below shows Tabel for Medicine in the hospital and the table (5.8) below shows How to select a medicine for a specified patient Tabel

Column Name	Data Type	Allow Nulls
Medicine_ID	int	<input type="checkbox"/>
Medicine_Name	nvarchar(50)	<input checked="" type="checkbox"/>
Medicine_Epire	datetime	<input checked="" type="checkbox"/>
Medicine_Price	decimal(18, 2)	<input checked="" type="checkbox"/>

Table (5.7): Medicine Table

Column Name	Data Type	Allow Nulls
Medicine_Selected_ID	int	<input type="checkbox"/>
Medicine_ID	int	<input checked="" type="checkbox"/>
General_OPD_Patient_ID	int	<input checked="" type="checkbox"/>
Doctor_ID	int	<input checked="" type="checkbox"/>

Table (5.8): Medicine selected Table

The table (5.9) below shows How the patient can pay on our system

and the table (5.10) below shows Receptionist attributes

Column Name	Data Type	Allow Nulls
PatientPayment_ID	int	<input type="checkbox"/>
General_OPD_Patient_ID	int	<input checked="" type="checkbox"/>
PatientPayment_DateTime	datetime	<input checked="" type="checkbox"/>
PatientPayment_Amount	decimal(18, 2)	<input checked="" type="checkbox"/>
Appointment_ID	int	<input checked="" type="checkbox"/>

Table (5.9): patient payment Table

Column Name	Data Type	Allow Nulls
Receptionist_ID	int	<input type="checkbox"/>
Receptionist_Name	nvarchar(50)	<input checked="" type="checkbox"/>
Receptionist_FatherName	nvarchar(50)	<input checked="" type="checkbox"/>
Receptionist_Email	nvarchar(MAX)	<input checked="" type="checkbox"/>
Receptionist_Password	nvarchar(MAX)	<input checked="" type="checkbox"/>
Receptionist_Gender	bit	<input checked="" type="checkbox"/>
Receptionist_Address	nvarchar(MAX)	<input checked="" type="checkbox"/>
Receptionist_Salary	decimal(18, 2)	<input checked="" type="checkbox"/>
Receptionist_ContactNumber	nvarchar(50)	<input checked="" type="checkbox"/>

Table (5.10): Receptionist Table

5.5 Methods and Technologies

Design

AI: Adobe Illustrator is a vector graphics editor developed and marketed by Adobe Inc. Originally designed for the Apple Macintosh



XD : Adobe XD is a vector-based user experience design tool for web apps and mobile apps, developed and published by Adobe Inc. It is available for macOS and Windows, although there are versions for iOS and Android to help preview the result of work directly on mobile devices. XD supports website wire framing and creating click-through prototypes



Backend:

My sql: A relational database management system that works with SQL. MySQL is an open source product



Php language: PHP is a popular general-purpose scripting language that is especially suited to web development. It was originally created by Danish-Canadian programmer Rasmus Lerdorf in 1994, the PHP reference implementation is now produced by The PHP Group. PHP originally stood for *Personal Home Page*, but it now stands for the recursive initialism *PHP*: Hypertext Preprocessor



Laravel framework: Laravel is a web application framework with expressive, elegant syntax. We've already laid the foundation — freeing you to create without sweating the small things.



C# : At the Build 2016 event, Microsoft made several exciting announcements and one of them was integrating Xamarin as a part of Visual Studio “15” and beyond. Now C# developers can build IOS and Android apps that can spit out native IOS and Android code.



Frontend

HTML: HTML5 is the latest version of Hypertext Markup Language, the code that describes web pages. It's actually three kinds of code: HTML, which provides the structure; Cascading Style Sheets (CSS), which take care of presentation; and JavaScript, which makes things happen



CSS stands for Cascading Style Sheets. CSS describes how HTML elements are to be displayed on screen, paper, or in other media. CSS saves a lot of work. It can control the layout of multiple web pages all at once. External style sheets are stored in CSS files.



Mobile Application

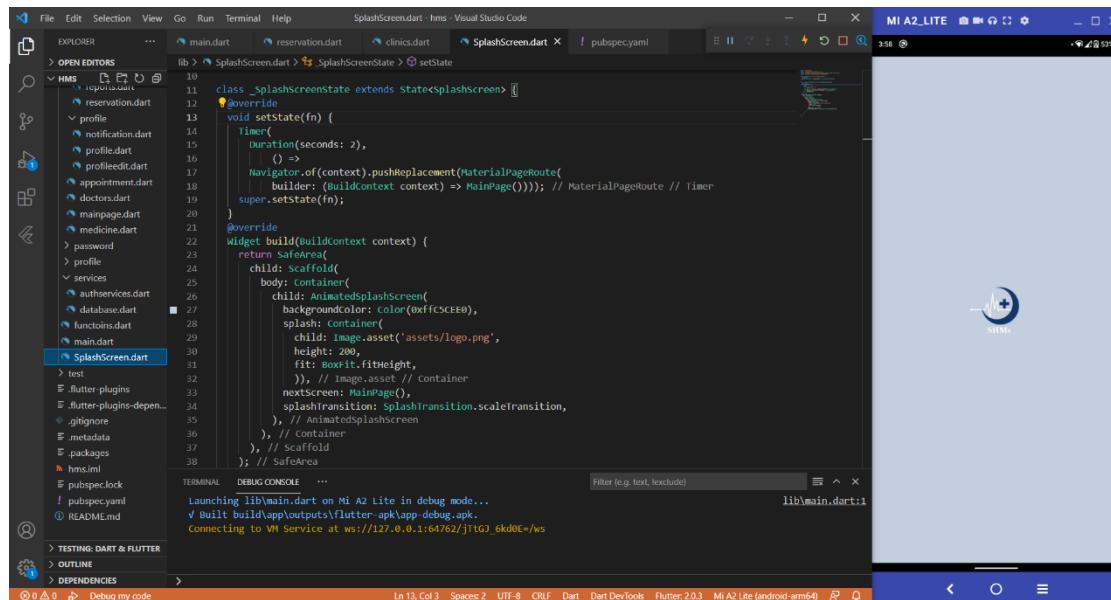
Flutter: Flutter is a free and open-source mobile UI framework created by Google and released in May 2017. In a few words, it allows you to create a native mobile application with only one codebase. This means that you can use one programming language and one codebase to create two different apps (for IOS and Android).



Library we use in the Project

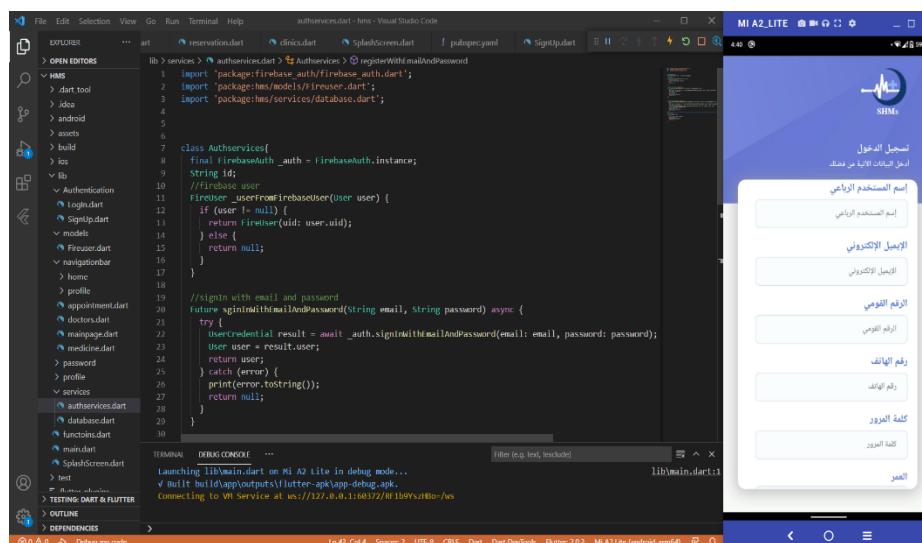
- Animated Splash Screen

We use it to make welcome page ,Dependencies: animated_splash_screen: ^1.1.0



- Firebase Authentication

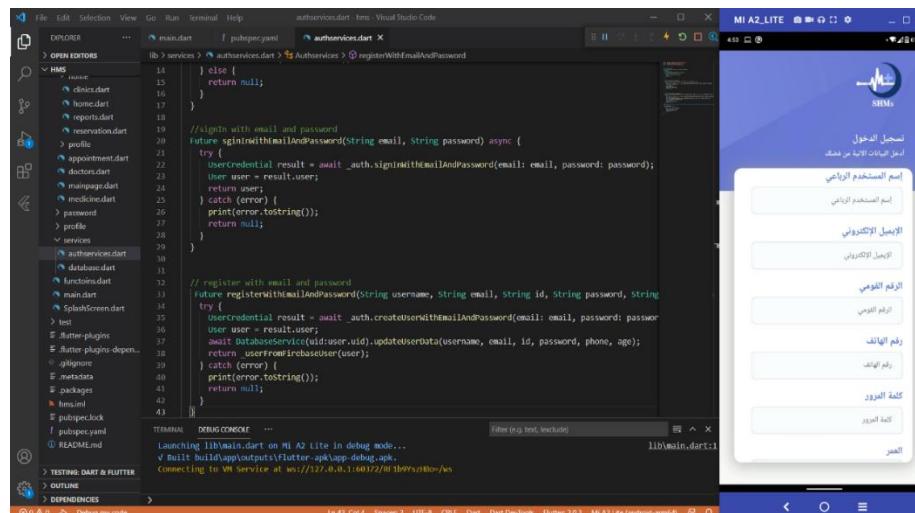
Authentication state Firebase Authentication provides many methods and utilities for enabling you to integrate secure authentication into your new or existing Flutter application. In many cases, you will need to know about the authentication state of your user, such as whether they're logged in or logged out. We use it in the Project to authentication the sign in and register an account dependencies: firebase_auth: ^1.4.1



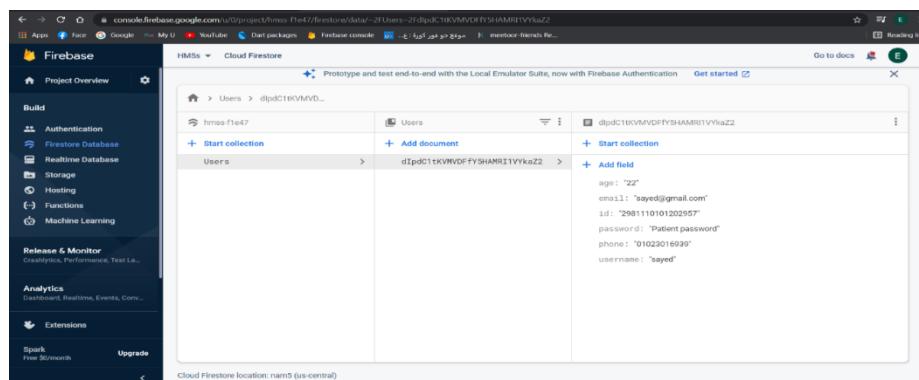
-Cloud Firestore

Collections & Documents

Firestore stores data within "documents", which are contained within "collections". Documents can also contain nested collections. For example, our users would each have their own "document" stored inside the "Users" collection. The collection method allows us to reference a collection within our code.
 dependencies: cloud_firestore: ^2.2.2

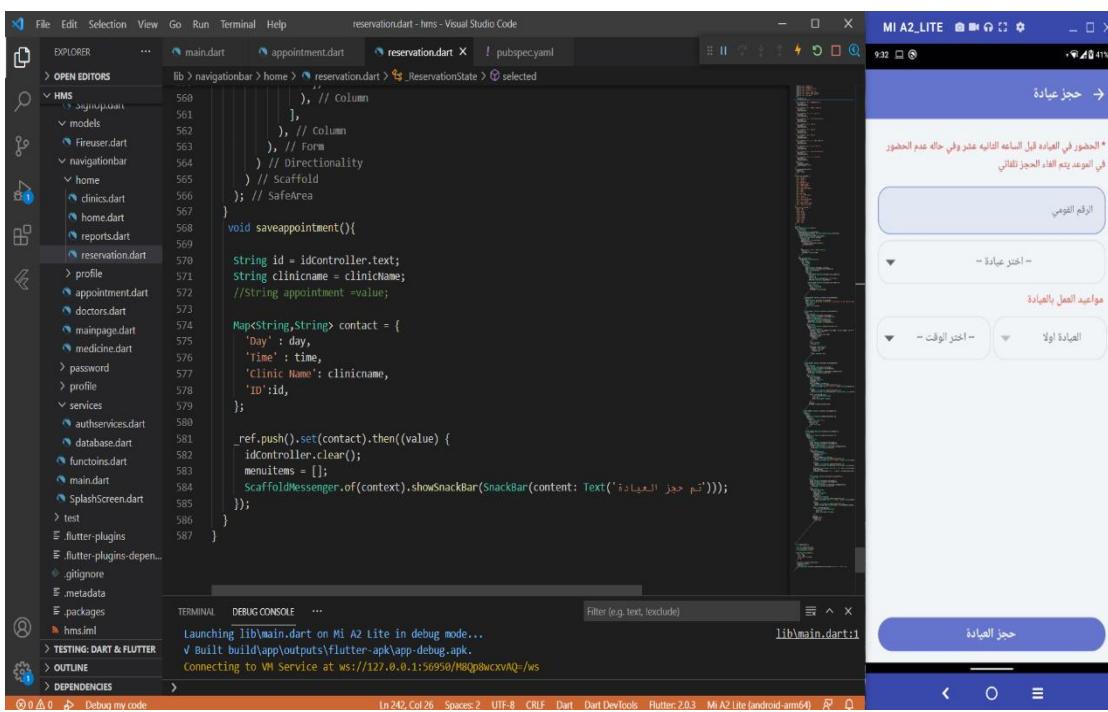


here we use `cloud_firestore` to store the input the user enter and there is an example for the registration output in firebase console

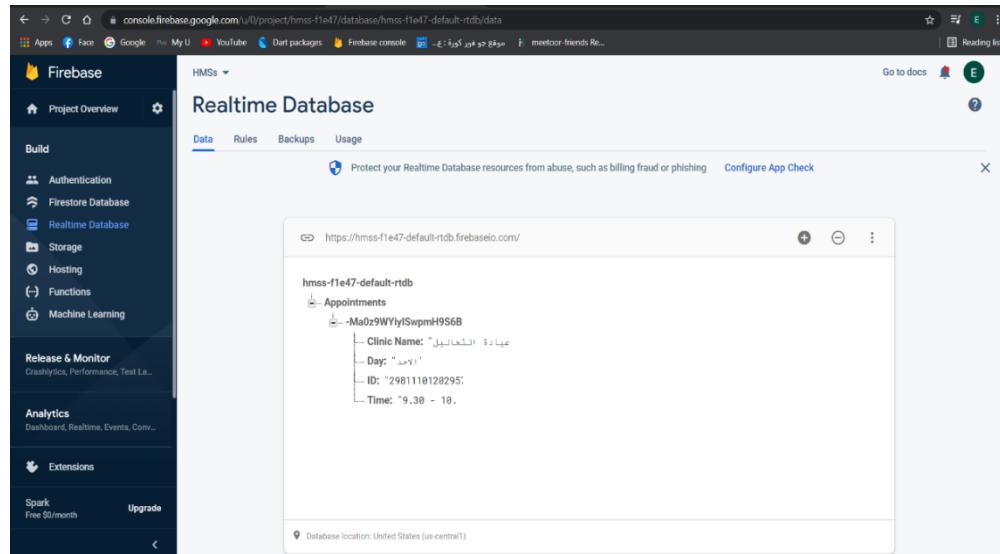


-Firebase database

We use this library in the project to store the reservation inputs into database to show them into an appointment page
 dependencies: firebase_database: ^7.1.1



All of inputs ID, clinic name, and appointment store in firebase database And the output



5.6 Summary

At the end of this chapter , we showed the database tables and pages of our website ,desktop application and UI mobile application , what is Adobe AI and XD , what is HTML , CSS , laravel, C# , MySQL and PHP, what is flutter and its libraries that we use in our project

6.1 Project Conclusions:

Hospital management system is a mobile application ,desktop application and electronic website that helping in the development of medical applications in Egypt and creates new possibilities in the medical field,

Our project for all patients that included a single electronic health record for every individual in a nation.

Enables them to check on their health, booking appointments with doctors, at any time and from any location without the need to visit them to the hospital.

The project includes a system for organizing medical procedures. The system is basically a hospital's website and has many functions. As the outer shell of the system, there is an application that can help users make better use of the system and make online reservations.

Result

- Empower patients to access their health information.
- Saving time of care providers.
- Enables an administrator to obtain data for billing, a physician to see progress of treatments, a nurse to report an adverse reaction.
- Better Patient Care & improve quality of care.

Profit

Companies can market their products in our system as sponsorship as well as private hospitals and doctors can market and advertise for themselves.

6.2 Project future work:

In our project we try to solve overcrowded problem in governmental hospital since citizen from his home can receive an appointment in hospital through application/EHR on website , but reservation process we implement it only in outpatient clinics so, our vision is to implement reservation process in emergency and major operations hospitals.

We strive to make our system contain all hospitals in our country, organize the whole investigation, billing ticket, reservation, and health caring process in all hospitals to increase employee efficiency.

The final vision of us is to make our project the best and most wanted software in the world.

we seek to implement HL7 standard as it contains important functions in hospital management from many different views.

- ✓ HL7 is a not-for-profit, ANSI-accredited standards developing organization.
- ✓ The main objective of developing HL7 v2.x standard was to support electronic exchange of healthcare data across various healthcare applications supporting different communication environments.
- ✓ It supports exchange of healthcare data among different departments of a hospital, chain of hospitals, regional/national healthcare framework.
- ✓ HL7 v2.x serves as a way of communication between inherently disparate applications having disparate data architectures and operating in a heterogeneous system environment.
- ✓ HL7 v2.x represents message structures for different functions in healthcare environment.

we will work with version 2.5 of the HL7 standard for further discussion.

There are in general 12 different functions of healthcare environment supported by ANSI HL7 v2.5 standard.

These functions are:

1. Patient Administration (ADT)
2. Order Entry
3. Financial Management
4. Observation Reporting
5. Master Files
6. Medical Records Management
7. Scheduling
8. Patient Referral
9. Patient Care
10. Clinical Laboratory Automation
11. Application Management
12. Personal Management

1- Patient Administration (ADT):

It consists of messages containing information related to patients during various healthcare events such as Patient Admit, Visit, Discharge, Change Patient Status, Update Patient Demographics, Merge Patient, Query Patient, and so on. These messages are used to either notify change or query the status of a patient.

2- Order Entry:

It consists of messages for request, update, or query orders that are given by physicians to avail a health service. Orders are meant for patients and may include orders related to medications, clinical observations, laboratory tests, diagnostic images, and so on

3- Financial Management:

It consists of messages for billing, insurance payments, and accounts management.

4- Observation Reporting:

It consists of messages for searching, querying, and reporting of laboratory test results or clinical observations.

5-Master Files:

Master files are maintained for preserving information of different entities involved in healthcare information transactions, namely, medical staff, practitioners, location of health organization, medical equipment location, patient status master, and so on. Any addition or update in such master files needs to be communicated to all the available healthcare applications involved in the healthcare environment to synchronize information about the specified entities.

6-Medical Records Management:

It consists of messages related to document management that can be used to maintain documents related to patient consent, chart location and tracking, and so on. The messages support functions to append, archive, cancel, authenticate, and thereby maintain status of documents such as new, updated, obsolete, restricted, revised, and so on

7-Scheduling:

It consists of messages for scheduling of various resources existing in the healthcare environment. The schedule can be for a service, staff, or practitioner.

8-Patient Referral:

It consists of messages for referring a patient across healthcare organizations and transferring the patient information during such a referral.

9. Patient Care:

It consists of messages related to the health problem of a patient. It supports exchange of health problems, goals set during treatment, pathway to carry out treatments, and so on.

10. Clinical Laboratory Automation:

It consists of messages for interfacing medical equipment with a Laboratory Information System (LIS). The information transferred in these messages includes device status, specimen status, patient orders and related results, and so on.

11. Application Management:

It consists of messages related to application level information exchange. The information regarding software versions, system clock, migration of file system, and so on can be transferred using these messages.

12. Personal Management:

It consists of messages related to administrative activities in healthcare environment such as recruitment and relieving of medical staff, permission change to access master files for a specific user, and so on.

We have to follow, study and put some other important standard in our considerations as CCR standard.

Clinical and other medical data that are available while referring, transferring, or discharging a patient must be recorded.

Moreover, to ensure interoperability, it is wise to follow a specification or guideline for recording such data.

CCR standard specification was developed to address this need by ASTM International, MMS, HIMSS, and AAFP

The CCR standard enables export or import of relevant data from EHR systems as Patient Health Summary. This helps to minimize disruption during transfer of a patient. It describes relevant medical information as the minimum data set required for representing health summary of the patient.

The CCR standard defines specifications that facilitate exchange of clinical information by way of summary notes. It helps: In providing a specification of clinician's note like, consultation note, progress note, or discharge summary, In further treatment of a patient. The next clinician in understanding the previous treatment of the patient, follow-ups, and care plan given by the referring clinician.

The structure of a CCR Document consists of six sections, each of which can have extensions depending on requirements.

1. Header or Document Identifying Information: This section describes the referring clinician, referred clinician, date, and purpose of the document.
2. Patient Identifying Information: This section includes the minimum information required to uniquely identify a patient across hospitals. It neither defines a distributed system nor specifies any kind of patient identification scheme. It only provides the minimum available information required to uniquely identify a patient.
3. Patient's Insurance and Financial Information: This section describes the information related to health insurance of a patient. It describes the minimum data elements for this information, such as Insurance Company Name, Subscriber's Name, Subscriber's Date of Birth, Subscriber's Member ID, and so on.
4. Health Status of Patient: The CCR standard describes the health status of patients by including several types of records. It includes diagnoses, problems, adverse reactions/alerts, current medications, immunizations, vital

signs, laboratory results, procedures, and assessments with a provision for extension of record types, depending on the need of specific medical specialty. The extensions available are Medical Specialty-specific Information, Disease Management specific Information, and Personal Health Record Information Documented by patient.

5. Care Documentation: The CCR standard includes links to previous encounters along with date and time of patient with clinicians. The extensions available are Medical Specialty-Specific Information, Disease Management Specific Information, Institute-specific Information, Care Documentation for Payers (Attachments), and Personal Health Record Information Documented by a patient.

Care Plan Recommendation:

This section includes the details of medication plans, tests, and treatment description. It allows free text so that clinicians can provide free-form description of a diagnosis.

Along with these mandatory sections, the CCR standard provides for the following five extensions:

- Institution-Specific Information
- Medical Specialties for providing the minimal data set
- Specific Disease Management Information
- Personal Health Record Information to enable a patient to keep private information
- Payer-Specific Information (in case of insurance)

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