Common Gateway for Medical Devices Interoperability

Final Year Project

Session 2018-2022

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Plagiarism Free Certificate

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Project Report

Common Gateway for Medical Devices Interoperability

Change Record

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APPROVAL

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PROJECT MANAGER

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HEAD OF THE DEPARTMENT

Comments: _____

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Dedication

This work is specially dedicated to all those people in my life who supported me and prayed for me in my tough times. To all those people who wanted me to succeed in my life. Especially my parents who made me this capable and helped me in my hardships. All the teachers who always Helped us with every problem, especially Sir Saleem Mustafa our Supervisor, his dedication and guidance towards us is really unmatchable.

Acknowledgements

Throughout the working on this documentation we have received a great numbers of support and guidance. We would like to thank to our supervisor, **Professor Saleem Mustafa**, whose guidance was brilliant in the completion of this documentation and development of our Final Year Project. His wise feedback make us to sharpen our thinking and bring our work to an upper and great level. We would also like to thank to our beloved teachers for their great guidance during our studies. They've guided us with the tools and technologies that lead us to choose the right path and successfully complete our Final Year Project. We would also like to thank our beloved parents for their great counselling. At the end we could not able completed this Final Year Project without the collaboration of our friends, who always do discussions as well as happy gatherings to make our mind fresh.

Executive Summary

In order for the solutions to these issues to be clear, the majority of people desired a quick, highly sociable living with lightweight computer platforms running a range of applications. How many distinct medical devices there are and how they interact with one another are still unknown. As a result, there are a lot of issues and these systems are installed widely.

Currently, the focus is on connecting medical devices with EHRs, and this specialty requires a combination of knowledge and skills in both healthcare administration and information technologies. These sections will discuss core ideas; details, the interoperability of several devices, and the storage of medical device data in systems will not be the focus. Details of the installations of various devices are not provided in this text because nearly every installation is distinct and different.

We will focus on the necessities and problems of connecting today's (EHR) devices with a variety of medical devices. The initiative to connect medical devices with (EHR) devices is becoming even more extensive, and this is recognized as medical device interoperability. However, there are still a number of issues with interconnecting medical devices to (EHR) devices, such as who will design the primary system and who will bear sole responsibility for it.

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Chapter 1

Introduction

Chapter 1: Introduction

The initiative of (EHR) systems has caused many healthcare organizations are shifting from paper-based patient health records to digital levels, signifying a recent standard shift in the healthcare system. Results, patient information, patient data history, hospital notes, laboratory test results, therapies, letters, x-ray results, and bill results are just few examples of the information stored. By sharing the same patient information throughout hospital facilities, the EHR systems will be able to perform duplication or numerous tests, which will reduce costs and improve the standard of treatment. Since hospitals and healthcare groups can readily share patient information with one another thanks to the installation of EHR, they may make better healthcare decisions without any reluctance.

Healthcare interoperability has some advantages which are:

i) Easy access of patients records with the help of monitored (EHR) devices.

ii) Medical errors will be reduce and improvement will increased.

iii) Healthcare cost will be reduced.

iv) Medal healthcare systems delays will finished.

The major goal of this study is to provide a logic-based healthcare cooperation framework that will offer a multisystem information sharing platform between various hospital healthcare systems and be understandable by both machines and people.

1.1. Background

Interoperability can be achieved by different ways and at different levels. The first level is the highest level, data is stored in a format that can be understand by the computer and computer should operate on, On the other hand in the lowest type of interoperability, the data is stored in a format that can be viewed, so that the data information is available and understandable for

a human to read and understand. Paper records can be considered interoperable in the way that they make data to be read and expound by a human. However, we will not discuss interoperability in this sense; but we will focus on digital interoperability, that first level of the interoperability is nonstructural viewable digital data data. When ther is an unstructured data, a doctor would have to find useful or correct information by scanning the different information of the patients. The quality of viewable data is increased if the data is stored in a structured way so that information is stored in each category and data can be easy to find. At the highest level.

1.2. Motivations and Challenges

- Managing unknown information across the different multiple sources.
- Verify digital requests for patient information and data.
- Reduce the organizational resistance to sharing data.
- The large number of cost of hiring specialists for the management of interoperability.
- Make surety that the data will always available is now a requirement.

1.3. Goals and Objectives

Our main goal is for Data Objects to flow across Health IT Systems and their HIE Integration Components supporting Health Business Value Chains; where,

- A Common Health Interoperability Model (CHIM) is the foundation of an authoritative architectural model of the health information landscape and benchmark for health IT standards; and where,
- We instantiate the Open Group IT4IT Value Chain and Reference Architecture with HL7 EHR related System Models, System Components and Integration Components.

1.4. Literature Review/Existing Solutions

Different stakeholders may describe the central idea of medical device interoperability in different ways. To advance the acceptability of medical device interoperability and improve patient safety and device effectiveness, stakeholders have come together to create this paper. Interoperability must be precisely specified in terms of requirements, advantages, and difficulties. By collaborating with linked systems of electronic medical devices and exchanging information with electronic health records, interoperability will allow clinicians to provide better patient care. It might be the maker of the medical device, it might be the system integrator, or it might be the healthcare provider. However, the maker of the original medical device should be the one to design and construct the product with various interoperable functionalities. Even between comparable components connected by various stakeholders for various objectives, varying functionalities, features, and data can be shared or transferred in distinct interoperability developments. the security of patients, effectiveness, and system connectivity. Before we can consider what to construct and how to maintain the systems, we must first specify the sort of interoperability wanted and its qualities or properties.

Inspirations:

- Expenses related to unwanted testing
- Expenses associated with the time spent manually entering information by clinicians
- Additional expenses brought on by longer stays
- Diagnostic Errors

1.5. Gap Analysis:

1.5.1 Current State

A 35-year-old man with weakness arrives at the emergency room. On the basis of bedside monitoring, a nurse detects an irregular cardiac rhythm. An ER doctor examines printed heart rate strip while admitting the patient for observation and cardiology consultation The diagnostic pulse strip isn't provided when customer has been seen by a cardiac the next day. ECGs taken repeatedly are not diagnostic. To replicate the heartbeat, further test done, but it has no effect. Without any help, the patient is sent home, and when they come back 72 hours later, their problems have gotten worse.

1.5.2 Future State

The results of heart rate tracking be store electronically and presented to the cardiologist at the appropriate moment via automated push of information to the EHR, enabling the proper diagnosis and treatment.

1.6. Proposed Solution

Any medical device connectivity with the (EHR) solution's primary purpose is to set up the different data communications. Understanding comes next when data transmission is successfully established.

1.7. Project Plan

With the development of (EHR) systems, many healthcare institutions have moved patient medical records from paper to digital format, causing a standard change in the health sector. Results, patient information, a patient's medical history, hospital notes, laboratory test findings, therapies, letters, x-ray results, and bill results are just a few examples of the data that can be

stored. The EHR systems will be able to perform redundant or numerous tests by sharing the same patient information amongst medical facilities, which would produce findings at a cheap cost and also improve healthcare quality. As a result of the use of EHR, hospitals and other healthcare facilities may readily communicate patient data, enabling them to make more informed healthcare choices.

Healthcare interoperability has some advantages which are:

i. With the help of monitored (EHR) devices, patient records are easily accessible.

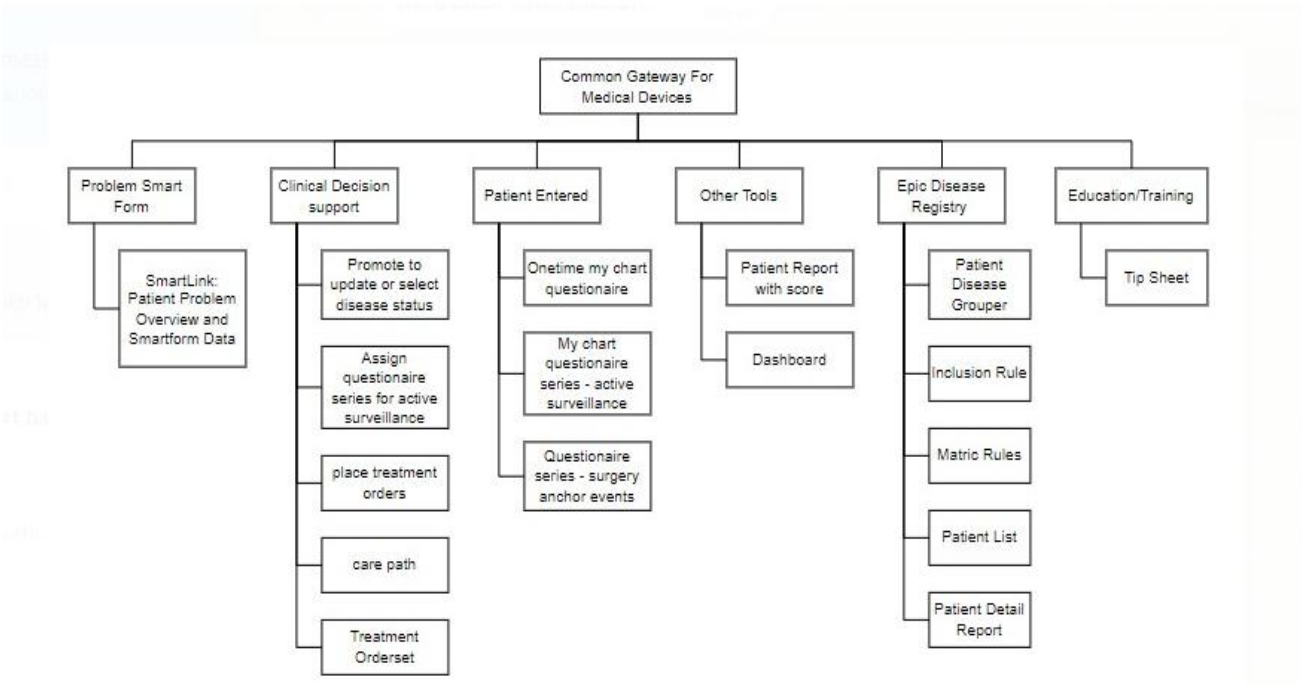
ii. Medical errors will be reduce and improvement will increased.

iii. Healthcare cost will be reduced.

iv. Medal healthcare systems delays will finished.

This paper's primary goal is to provide a logic-based framework for healthcare cooperation that will offer a multi-system information exchange platform between various hospital healthcare systems and be understandable by both machines and people.

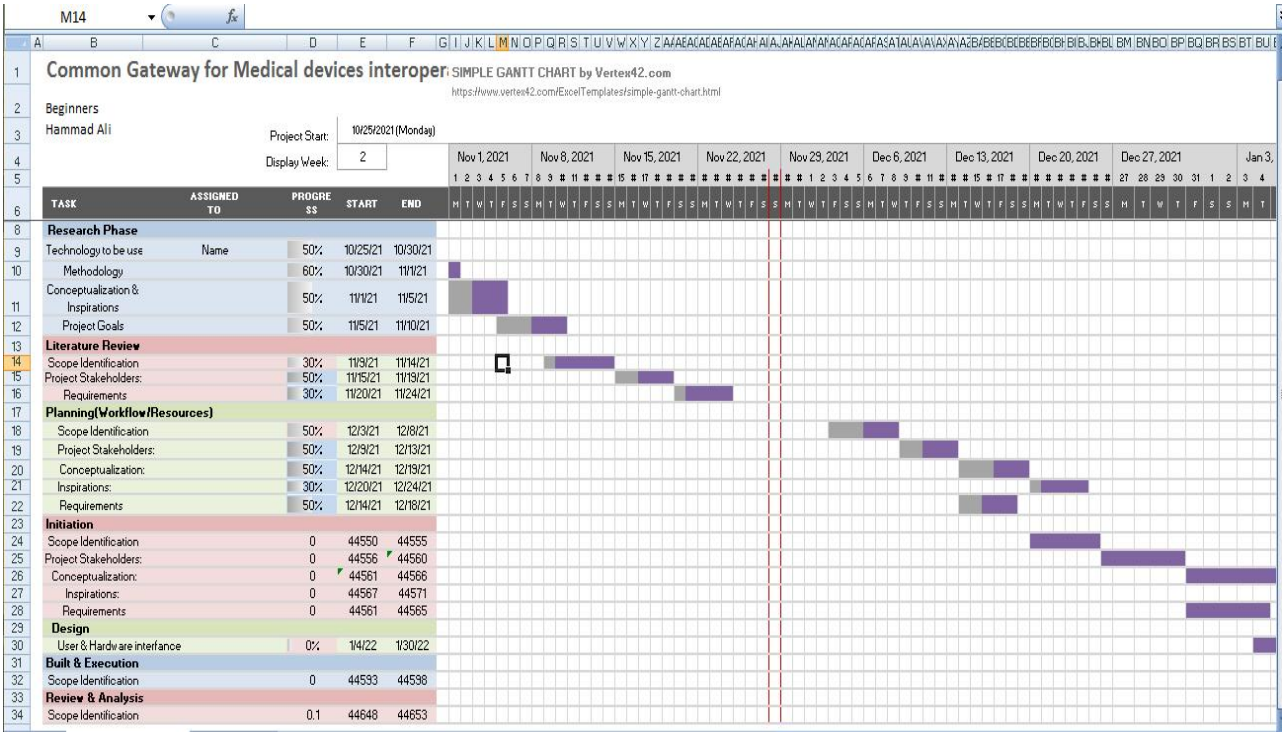
1.7.1. Work Breakdown Structure



1.7.2. Roles & Responsibility Matrix

WBS #	WBS Deliverable	Activity #	Activity to Complete the Deliverable	Duration (# of Days)	Responsible Team Member(s) & Role(s)
1	Research		On university	5	Hammad Ali(Leader),M.Awais and Rehan Ali
2	Literature Review		On university	5	Hammad Ali(Leader),M.Awais and Rehan Ali
3	Feasibility		On university	4	Hammad Ali(Leader),M.Awais and Rehan Ali
4	Planning (Workflow/Resources)		On university	5	Hammad Ali(Leader),M.Awais and Rehan Ali
5	Initiation		On university	4	Hammad Ali(Leader),M.Awais and Rehan Ali
6	Design		On university	7	Hammad Ali(Leader),M.Awais and Rehan Ali
7	Build & Execution		On university	8	Hammad Ali(Leader),M.Awais and Rehan Ali
8	Review & Analysis		On university	8	Hammad Ali(Leader),M.Awais and Rehan Ali
9	Closure		On university	4	Hammad Ali(Leader),M.Awais and Rehan Ali

1.7.3. Gantt Chart



Chapter 2

Software Requirement Specifications

Chapter 2: Software Requirement Specifications

2.1. Introduction

2.1.1. **Purpose**

Different stakeholders have defined the idea of medical device interoperability in a variety of ways. In order to advance the use of medical device interoperability and improve patient safety and healthcare effectiveness, stakeholders collaborated to create this White Paper. For this reason, it's critical that interoperability be precisely defined in terms of needs, functions, advantages, and difficulties. The ability to work with integrated systems of diagnostic and therapeutic devices and share data with electronic health records (EHRs) will, in general, enable clinicians to improve patient care. This will allow them to provide better clinical-decision support, safely and effectively.

2.1.2. **Document Conventions**

Interoperability may be carried out through numerous exceptional parties:

- the clinical tool producer
- the EDI vendor, the machine(monitor) integrator
- the Organization delivery healthcare (ODH)
- the physician. Preferably

However, the authentic clinical tool producer needs to layout and construct the product with interoperable capabilities.

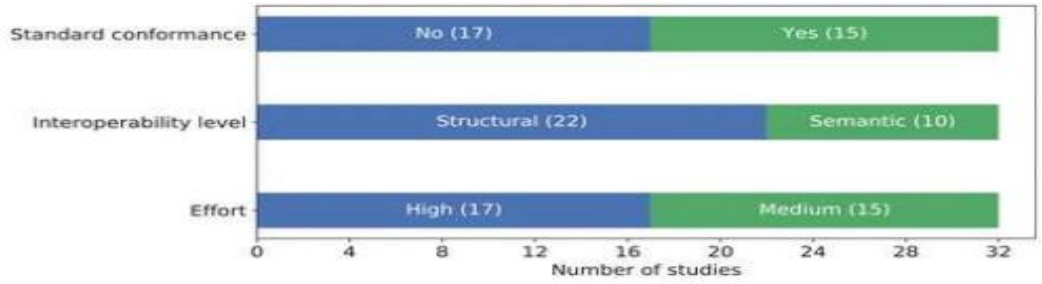
2.1.3. Intended Audience and Reading Suggestions

- EHR technology and Electronic systems personal (such as analysts, CIOs, directors, engineers, managers, and technologists) from HDOs (Healthcare Delivery Organizations) are involved in the integration of medical devices.
- Clinical staff from HDOs (Healthcare Delivery Organizations), particularly those who specialize in information/data like patient association and mappings, such as nurses, doctors, respiratory therapists, clinical decision support specialists, informaticians, and programmers, design or build CDS (clinical decision support) tools using medical device data. When making choices about a patient's treatment based on the data stored in information systems, providers need at least a high-level awareness of the properties of medical device data.
- In Industries such as; Understanding the various difficulties will be useful for manufacturers of medical equipment, connectivity, integration solutions, consultants, and other Facilities involved in device interoperability and EHR implementations.

2.1.4. Product Scope

To provide preventive medicine for multiple usage scenarios, health data module is intended. Knowledge management about health services is one of the key focuses. When it comes to the need for health data from many systems, including hospital information systems, medical imaging systems, physiological monitoring devices, and more, integration is necessary. We examined and retrieved the data depending on a number of methods' attributes, such as conformance to interoperability standards, degree of compatibility, and integration effort, which are listed in Table. Interoperability standards are crucial for health data exchange, analysis, and sharing. Integrating would be less hard to carry out if the health data met these

standards. The approach may not currently apply standards or may not require the compatibility of a standard, which could be one rationale.



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2.2. Overall Description

2.2.1. Product Perspective

This CGM is basically designed to facilitate the patients who feels tired and unable to wait to long for their checkup results so we launched a system in which the patients should sent there record to medical devices in the hospital through a common gateway or a middleware in which user can sent there data to medical devices easily through devices like EHR and EH7 etc.

2.2.2. Product Functions:

The application comprises of three kind of users with different functionalities mentioned below:

Patient:

- Sign up
- Log in

- Create Profile
- Update Profile
- Select clinic location find the nearest one
- Clinic Contacts
- Upload Documents

Doctor:

- Sign up
- Log in
- Create Progress notes
- Update Progress notes
- Enter number of views he/she was able to generate
- Get paid once the services is done

Administration:

- Sign up
- Log in
- Check Patients
- Check Doctors
- Take payments from Patients
- Release Payment to Doctors

2.2.3. User Classes and Characteristics

The User classes are given below:

Nurse	The nurse will take appointments and check the data of the patient that in which time she will take appointment
Medical Attendant(MA)	Medical Attendant will save all the data of the clinic of the hospital include medicine, injection , no of sales etc
Senior Doctor	Senior doctor will check the condition of the patient in the medical devices. And give medicine and advise accordingly
Patient	Patient will sent his data to the medical devices of the hospital through the gateway devices like EH7 and HER
Program Leader	Program leader is responsible for the data of the devices and patient and he has authority to update data
Data analyst	Data analyst will check all the data of the hospital and responsible to remove trash data which was not in use.

2.2.4. Operating Environment

In particular, in production versus research systems, many HDOs require the desired ability to send medical device data to multiple systems or environments at once. It is advisable to choose the architecture early on if data transmission to multiple systems is necessary.

2.2.5. Design and Implementation Constraints

Design guidelines and profiling are relatively similar in that they are both focused, have been cleared of implementation limitations, and typically draw upon already-existing standards. However, there are some obvious differences. Both the clinical engineering industry and the

Continua Health Alliance use design guidelines for PnP interoperability. They are manufacturing using systems engineering ideas, which is a great industrial strategy. The job was based on a thorough scenario, use cases, user interactions, and procedures. Design rules cover both functional and non-functional needs. This top-down approach could result in assured non-functional qualities like dependability and safety.

2.2.6. User Documentation

User documentation will be provided in the website for the user if he wants any help or user manual or guide for the usage of the website the user can get this facility by click on the help option and the system will give a proper guidance about the website for the user.

2.2.7. Assumptions and Dependencies

The following assumptions and dependencies are given below:

- The user must have a good and stable internet connection.
- To use the system the user need to connect the internet to the system
- TCP/IP protocol must installed in the system for the communication with medical devices
- The accuracy of the system of the information of user is responsibility of all users
- User computer must have Windows 7 and higher version of the windows series and internet explorer or version 5.5.

2.3. External Interface Requirements

2.3.1. User Interfaces

The Software Interface layer tackles the specifications and guidelines that govern the development of relationships and business for eHealth Systems. The most popular user interfaces right now are web apps and phone apps. Apps and e - healthcare systems are linked through rise to a variety so that health data can be transferred to a central database. The UAI is linked to medical devices within the wireless personal area network (PAN) via the Bluetooth or ZigBee protocols.

2.3.2. Hardware Interfaces

The different parts of the intended WMG are shown in the block diagram in Fig. 3: Medical Gateway. The basis development board for this solution is the BeagleBone Black (BBB) hardware. A BT-HDP based adaptor is used to integrate the BT interface into the BBB. Through a USB interface, this adaptor is linked to BBB. Since Stollmann Inc. is the company that makes this adapter, it shall henceforth be referred to as a "Stollmann adapter" throughout this thesis. The Blood Pressure Monitor (BPM), which the BBB may connect to in order to receive data taken from the human body, can be connected using the Stollmann adaptor. The BBB's Ethernet port is wired via a LAN cable. To load the binary software image onto the BBB, a surface-soldered J-tag header is present. The BBB includes a serial port, and you can use a serial to USB converter to attach it to any host system. A 5V DC adaptor powers the WMG.

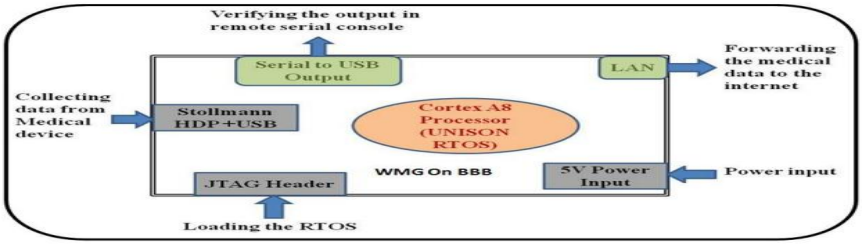


Fig-3 : Medical Gateway Block Diagram

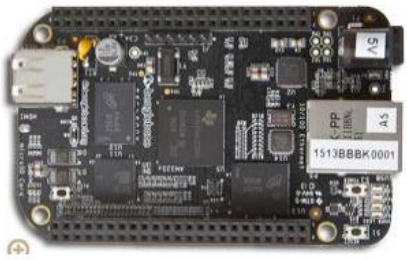


Fig-4 : BeagleBone Black

BBB is a highly capable, tiny computer that is also energy-efficient. BBB was chosen as the implementation platform for this prototyping endeavor because it contains open-source libraries and a cheap development platform. BBB has an 8-bit embedded multi-media card, 512MB DDR3 SDRAM, 4GB ROM, Ethernet, USB, HDMI, UART, and mini USB ports. It is powered by a TI-Sitara AM335x ARM Cortex-A8 processor. 5V DC is used to power the BBB. This board supports more UNIX-based OSs and ships with the open-source UNIX operating system Angstrom. Real-time Unison OS had to be transferred to the BBB and used as the OS in the WMG implementation, nevertheless, because the study involved an industry partner and our research center.

Fig-5 : Stollmann Adapter

Since 1999, the German company Stollmann has been creating serial and USB BT adapters as well as standard modules. Any PC with a typical USB slot can add Health Device Profile (HDP)

and Serial Port Profile (SPP) 21 capability with the help of a proprietary BT adaptor made by Stollmann. Any MD who has received Continua certification and the WMG can communicate via HDP by utilizing this adaptor. To connect with MDs, the Stollmann adaptor employs the Local Transport Protocol (LTP) recommended by Continua.

2.3.3. Software Interfaces

- Real-Time Unison Operating System (RTOS)
- The module BT-CC
- Online(Internet) Communication Module

2.3.4. Communications Interfaces

A serial communications port or two are present on many medical equipment that lack network access. Although less common formats (RS-422) are also used, these ports are generally RS-232. Medical equipment that produces image and video data but doesn't have a network connection, such surgical, endoscopic, or other procedural imaging equipment, is fundamentally similar to equipment having serial ports. Procedural imaging technology produces standards-based image or video data instead of serial data and communication methods based on standards (like RS-232) (e.g., video graphics array [VGA], high-definition multimedia interface [HDMI]). The fundamentals of both forms of communication are the same: data are generated, transferred, decoded, presented, understood by a clinician, saved, and retrieved (as needed). The discussion that follows focuses on serial communication (primarily because that is where the majority of EHR adoption initiatives are concentrated), but the same principles also apply to procedural imaging technology.

2.4. System Features

Our Website will help Patients and Hospitals or clinical staff to directly connect with one another without any hurdles. In this Website both Hospitals or clinical staff and business owners can sign up, after that patients can select a location address depending upon which is nearest one and they'll be connected with MA of the selected clinic. A communication channel will be created in order for them to communicate. Clinical staff will provide a set of appointment time that they'll share on the website. After that the patient reach to the clinic at the given time frame and get their services accordingly.

2.4.1. Login:

2.4.1.1. Description and Priority

In this Website the stakeholders such as the Patients and Clinical staff will their own login. This features will verify that a stakeholder exists in our database or not. The identity of each stakeholder will be verified before logging in. This feature has a high priority and feature risk scale is high. This feature is not concerned with the level of stakeholder, it must verity if stakeholder has a valid email and password.

2.4.1.2. Stimulus/Response Sequences

The stakeholder will start by entering the email and password they used to register. The Firebase Login Authentication system will validate and verify the email and password. The stakeholder will proceed to the subsequent activity if the validation and verification are finished. The system will issue an message and deny access if validation and verification are unsuccessful.

2.4.1.3 Functional Requirements

REQ-SF1-1: This feature will have two input types: Email and Password.

REQ-SF1-2: This feature will have one button for login action.

REQ-SF1-3: This feature will firstly check if the user has entered Email and Password or has left it black.

REQ-SF1-4: Then it will check if the validation of Email and Password.

REQ-SF1-5: If the Email and Password are not validated it will send an error toast to the user.

REQ-SF1-6: If the Email and Password is verified the user will be displayed a success toast and will move to its Dashboard.

2.4.2. Patient Registration:

2.4.2.1. Description and Priority

In this feature the Patients will create an account. This feature will firstly check if the user has created a previous login or not. Afterwards it will verify if the Email and Password given are acceptable or not. This feature has high priority. The feature risk in terms of scale is high. This feature should not mix the stakeholder level and must verify if stakeholder email and password is valid.

2.4.2.2. Stimulus/Response Sequences

First the stakeholder will enter Email and Password into the input text boxes. The system will validate and verify the Email and Password from Firebase Authentication that email already exists or not. If the validation and verification is complete, the stakeholder will move to next activity. If not, the system will give him an alert message.

2.4.2.3. Functional Requirements

REQ-SF2-1: This feature will have three input type Email, Password and confirm password.

REQ-SF2-2: This feature will have one button for registration action.

REQ-SF2-3: This feature will firstly check if the Password and Confirm Password field matches or not.

REQ-SF2-4: If the Password and Confirm Password fields do not match, it will give an error toast to the stakeholder.

REQ-SF2-5: After this another check is put in-place if the stakeholder has entered minimum 6 characters in his/her Password field.

REQ-SF2-6: Then the feature will check the validation of Email and Password.

REQ-SF2-7: If the Email and Password is not validated will give an error.

REQ-SF2-8: This feature will check if the Email already exists in database or not.

REQ-SF2-9: If the Email already exists, it will give an error.

2.4.3. Doctor Registration:

2.4.3.1. Description and Priority

In this feature the Clinical staff will create an account. This feature will firstly check if the user has created a previous login or not. Afterwards it will verify if the Email and Password given are acceptable or not. This feature has high priority. The feature risk in terms of scale is high. This feature should not mix the stakeholder level and must verify if stakeholder email and password is valid.

2.4.3.2. Stimulus/Response Sequences

First the stakeholder will enter Email and Password into the input text boxes. The system will validate and verify the Email and Password from Firebase Authentication that email already

exists or not. If the validation and verification is complete, the stakeholder will move to next activity. If not, the system will give him an alert message.

2.4.3.3. Functional Requirements

REQ-SF2-1: This feature will have three input type Email, Password and confirm password.

REQ-SF2-2: This feature will have one button for registration action.

REQ-SF2-3: This feature will firstly check if the Password and Confirm Password field matches or not.

REQ-SF2-4: If the Password and Confirm Password fields do not match, it will give an error toast to the stakeholder.

REQ-SF2-5: After this another check is put in-place if the stakeholder has entered minimum 6 characters in his/her Password field.

REQ-SF2-6: Then the feature will check the validation of Email and Password.

REQ-SF2-7: If the Email and Password is not validated will give an error.

REQ-SF2-8: This feature will check if the Email already exists in database or not.

REQ-SF2-9: If the Email already exists, it will give an error.

2.5. Other Nonfunctional Requirements

2.5.1. Performance Requirements

- Under all anticipated circumstances, the system will provide precise medical system data capture (right measure, value, unit, time, and patient).
- The system will facilitate the recording, visual display, and validation of data from medical equipment in a user-selectable unit of measure.
- Through the use of OEM gateways and third-party connectivity options, the system will provide precise medical device data gathering.

- The system will allow a configurable mechanism for the elimination of undesired medical electronic data at a user- or system-wide determined fixed time (e.g., adjusted to patient acuity, admission, discharge, location).

2.5.2. Safety Requirements

- The information wouldn't be lost if lab testing equipment immediately filled the EHR. Giving the prior ECG for comparison, allowing the clinician to assess existing vs new abnormalities, would prevent repeat testing as well as the cancellation of the surgical case.
- The automatic push of data to the EHR would enable accurate diagnosis and treatment by saving an electronic version of the heart rhythm monitoring results and presenting them to the cardiologist at the right moment.

2.5.3. Security Requirements

- Security assaults against medical devices have been relatively unusual up until now, but as IMDs become more prevalent, the motivations to do so for financial gain grow.
- Furthermore, upholding the confidentiality and privacy of patient information is required by law, in part because of regulations like the US Health Insurance Portability and Accountability Act (HIPAA).

2.5.4. Software Quality Attributes

- In order to identify and report in which medical devices have and are currently connected, the system will support a process (provide developers, model, serial number, and software revision level).
- The system will facilitate a procedure to identify which connected medical devices have software that is incompatible or has not been thoroughly tested.

- The system will facilitate a procedure to identify the connected medical devices that need to be serviced or are past due.

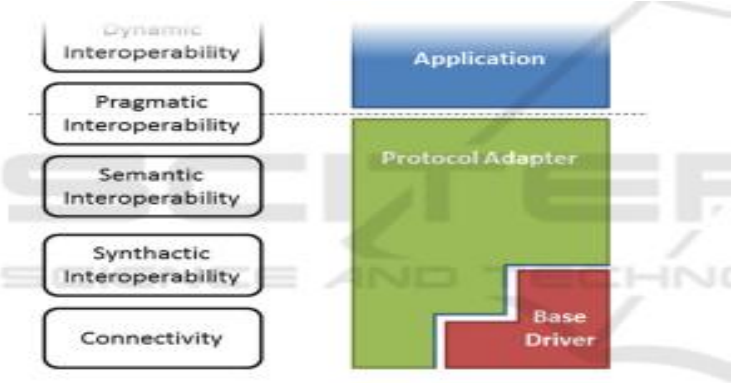
2.5.5. Business Rules

Organizations in the healthcare sector are constantly looking for ways to enhance patient care. EMRs and EHRs can be useful in many ways, including:

- Enhancing communication
- Patient records are easier to access.
- Using data to inform clinical judgments
- Improved effectiveness.

2.6. Other Requirements

Functional requirements for the PA were initially derived from the FI-STAR pilot documentation using the business goal statement that was previously described. A reference model for communication interoperability based on Tolk's (Tolk et al., 2007) work was adopted because this project is focused on this subject. The PA's effects on communication interoperability are shown in Fig.

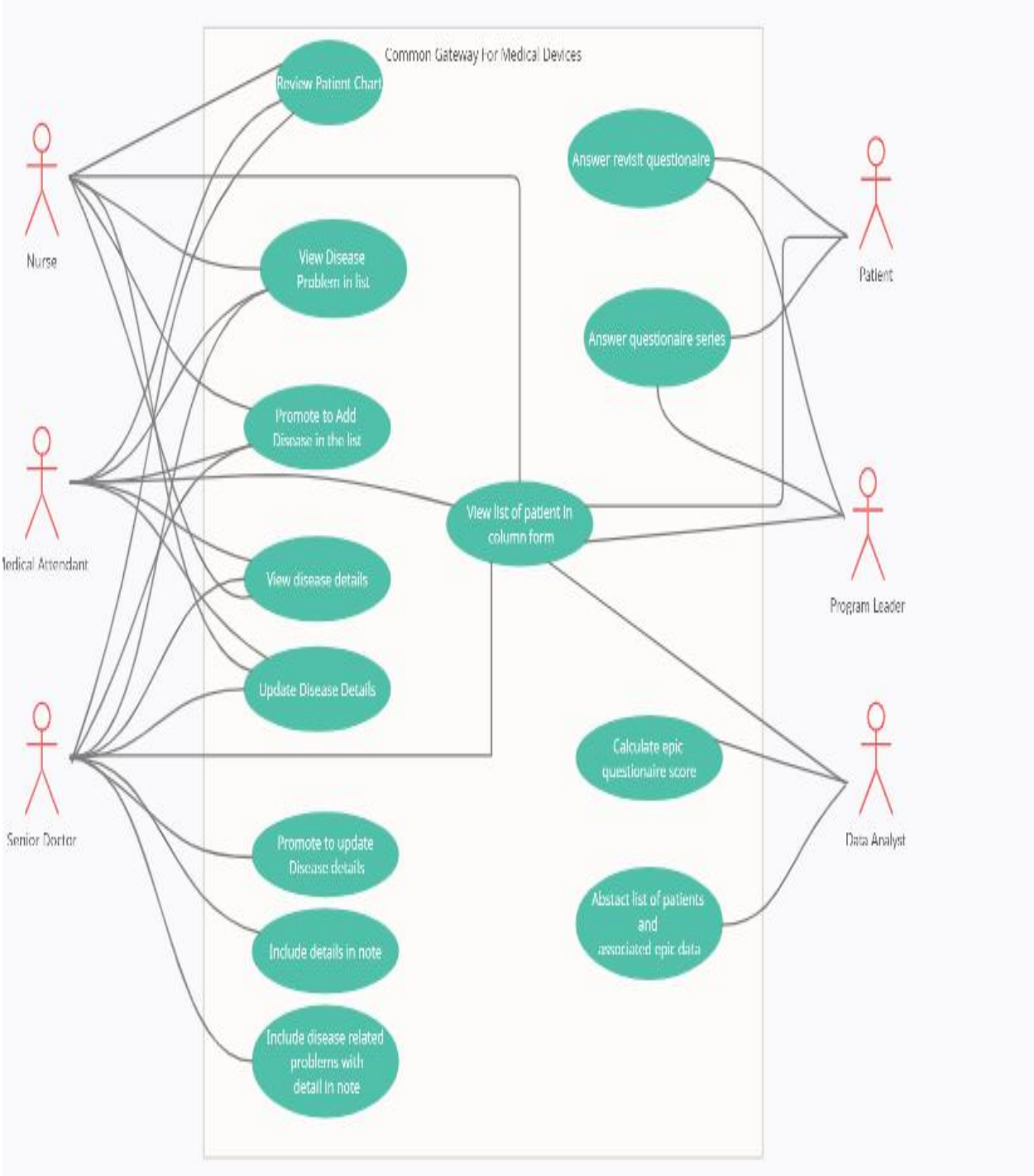


Chapter 3

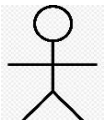
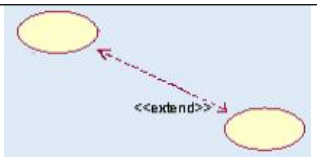
Use Case Analysis

Chapter 3: System Analysis

3.1. Use Case Model



3.2. Use Case Descriptions

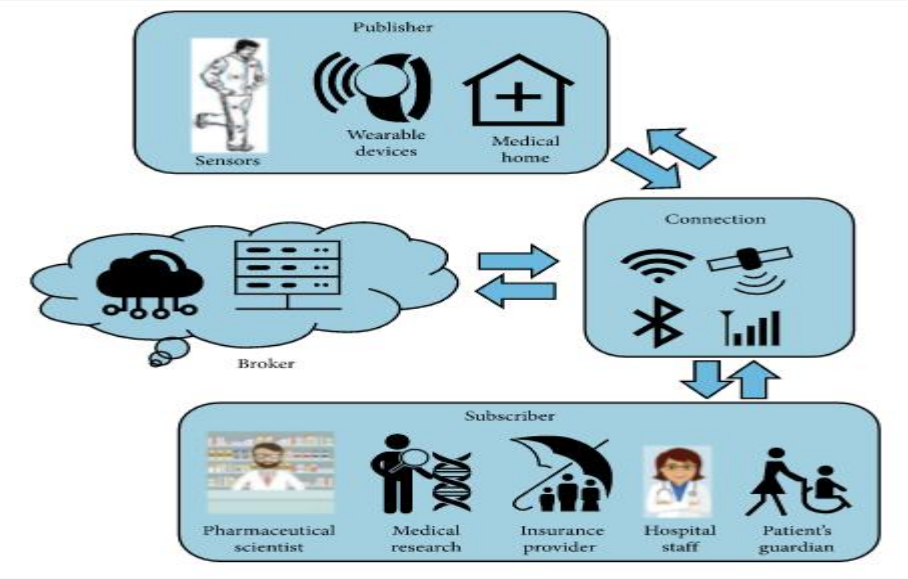
No	Name	Description	Components
1	Usecase	A user's activities within the system to accomplish a goal are listed in a use case.	
2	Actor	Actors in a system are people that interact with the system according to their roles.	
3	Undirectional Associaion	The relationships between and among the actors and the use cases.	
4	Include	Include is a directed connection that connects two use cases to demonstrate how the behavior of the included use case (the addition) is included in the behavior of the including use case (the base).	
5	Extent	When one first-class use case conditionally adds steps to another, the term extend is employed.	

Chapter 4

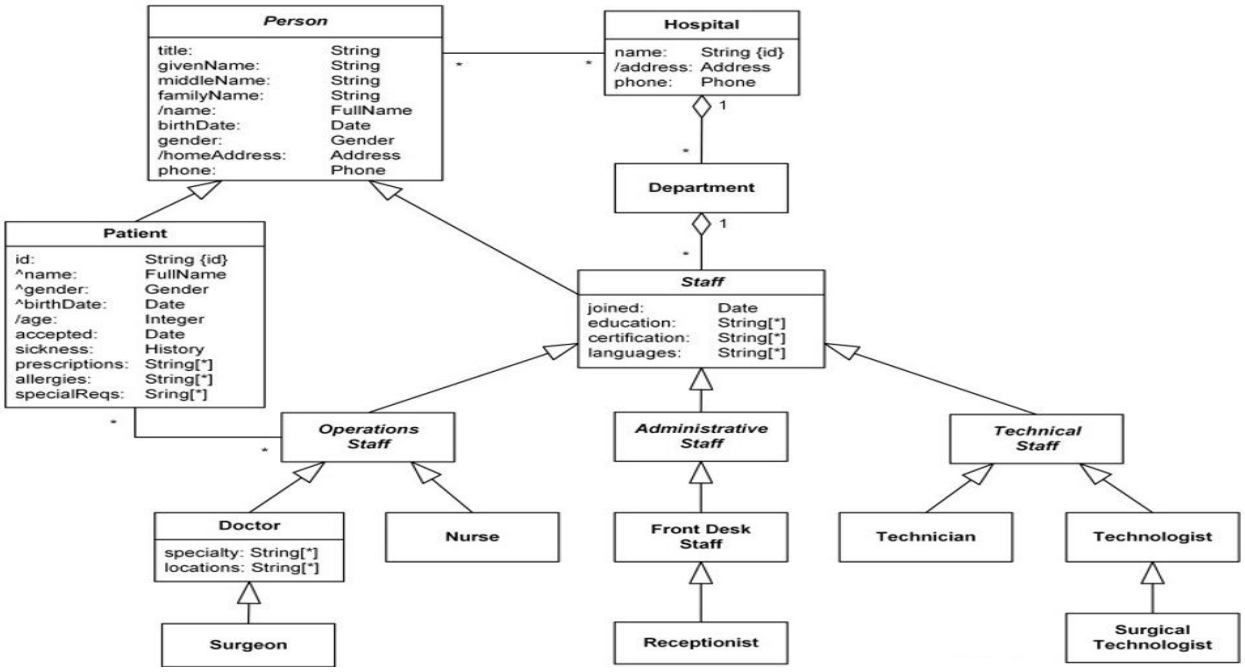
System Design

Chapter 4: System Design

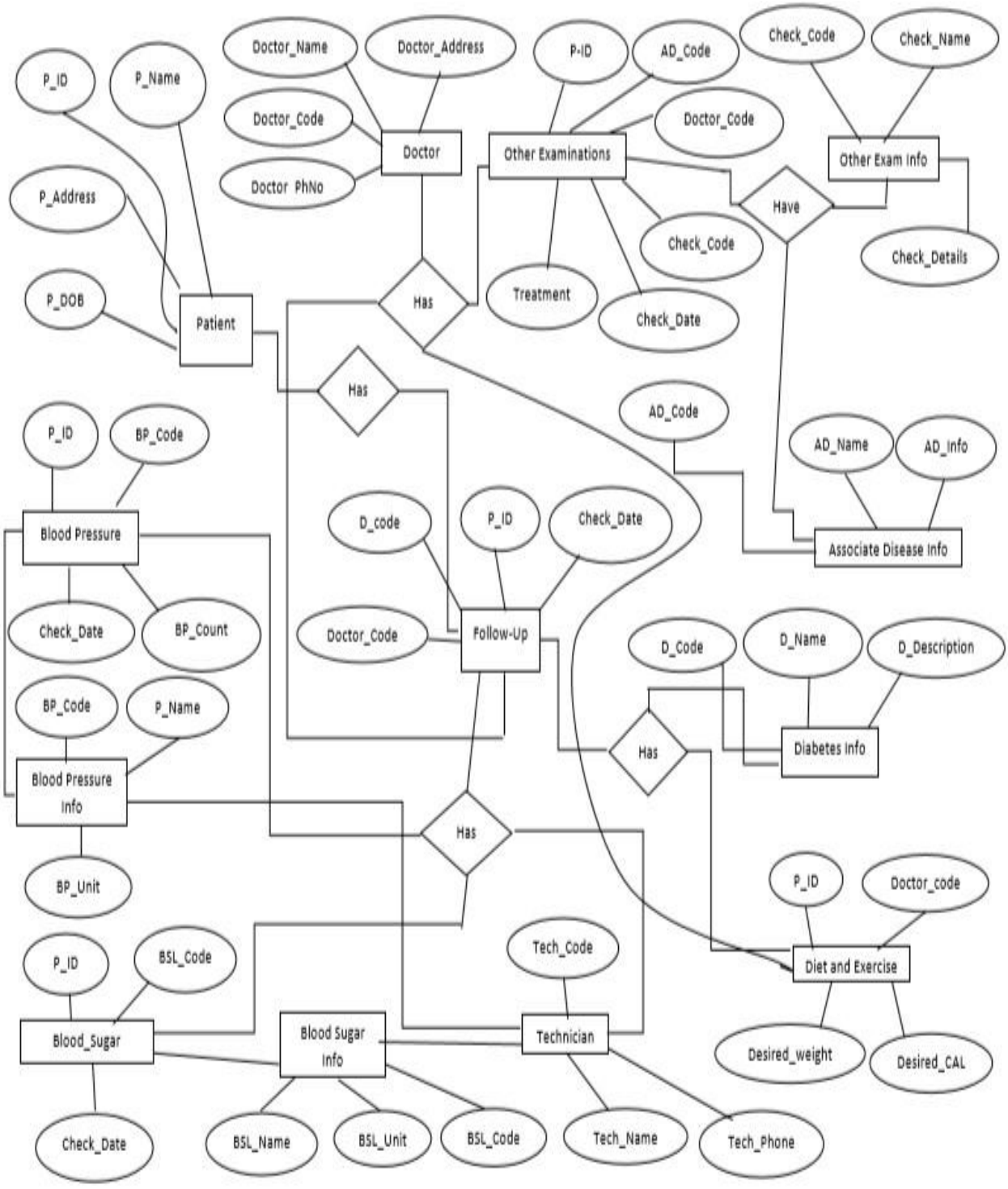
4.1. Architecture Diagram



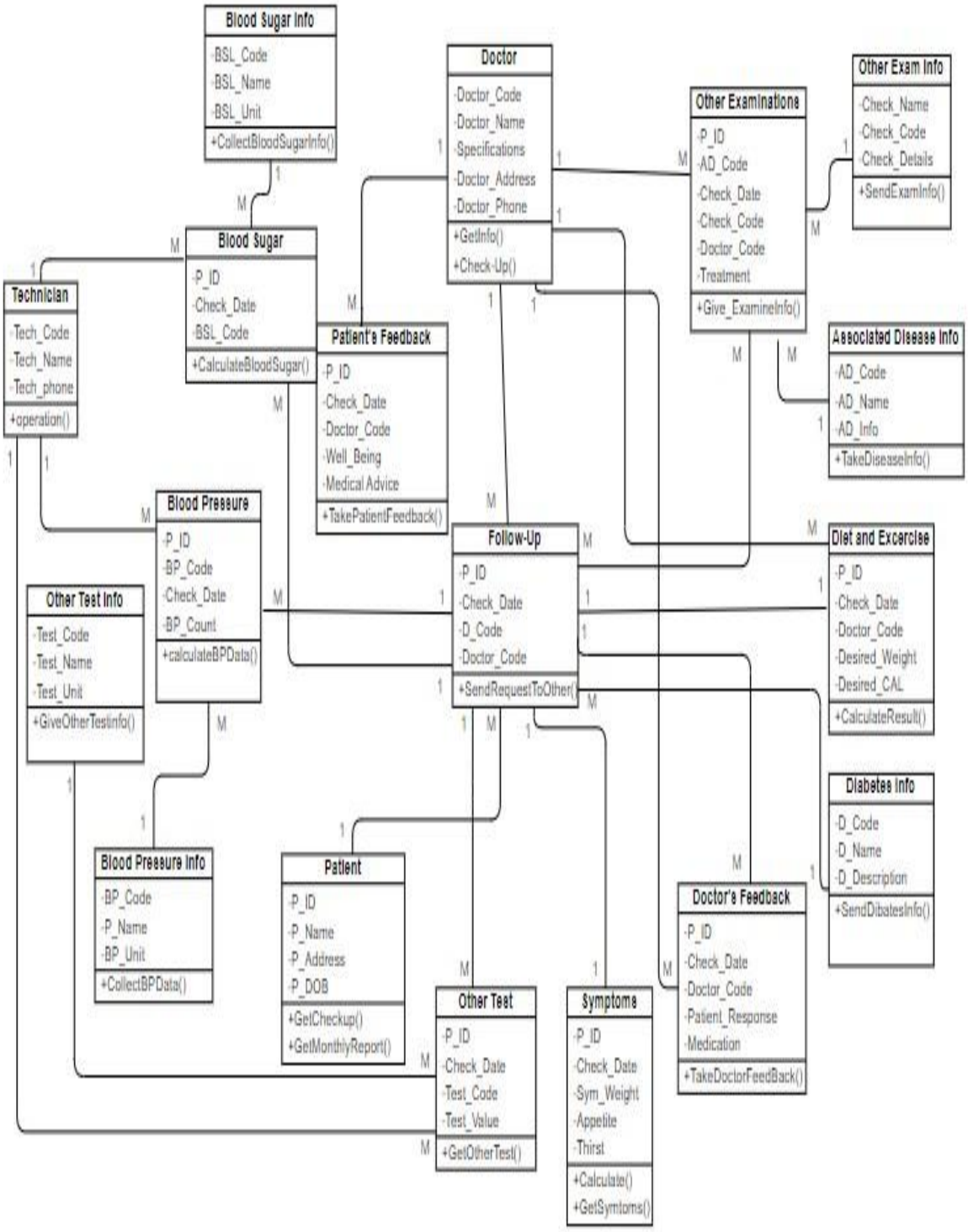
4.2. Domain Model



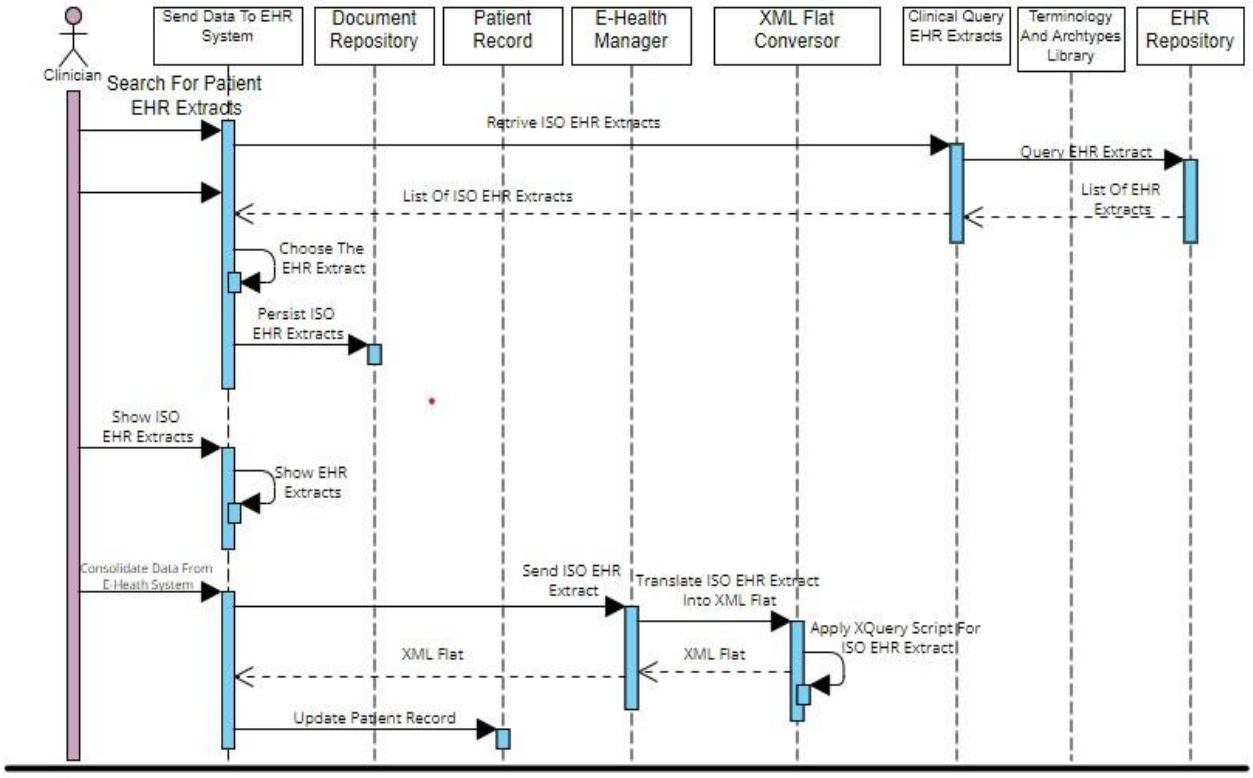
4.3. Entity Relationship Diagram with data dictionary



4.4. Class Diagram



4.5. Sequence / Collaboration Diagram



4.6. Operation contracts

4.6.1. Login:

Operation Name:

- Login (Email, Password)

Cross Reference:

- Use-Case: Use-Case Model

Pre-Condition:

- User needs to have a login interface

Post Condition:

- Handle operations according to backend functionalities (Email Authentication)

4.6.2. Registration:

Operation Name:

- Register (Email, Password, Repeat Password)

Cross Reference:

- Use-Case: Use-Case Model

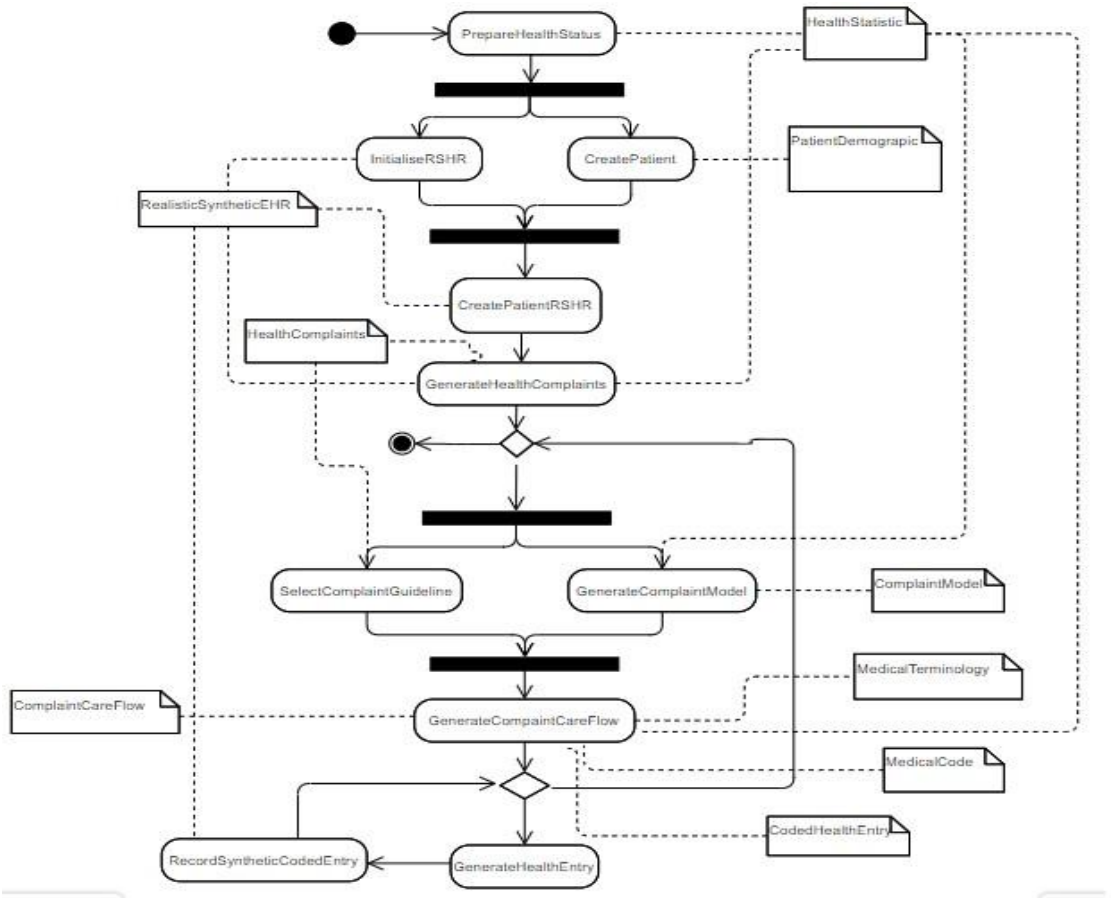
Pre-Condition:

- User needs to interact with field of Email, Password and Repeat Password

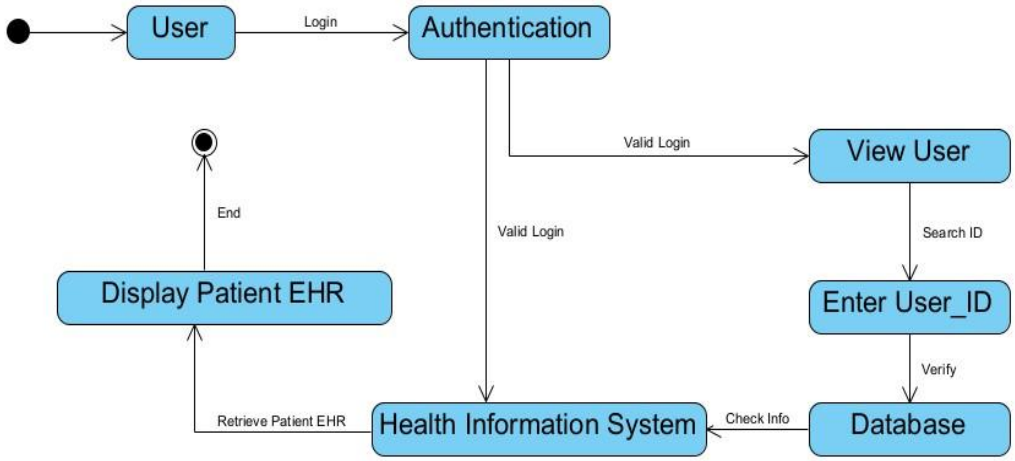
Post Condition:

- Handle operations according to backend functionalities(User is created in Database)

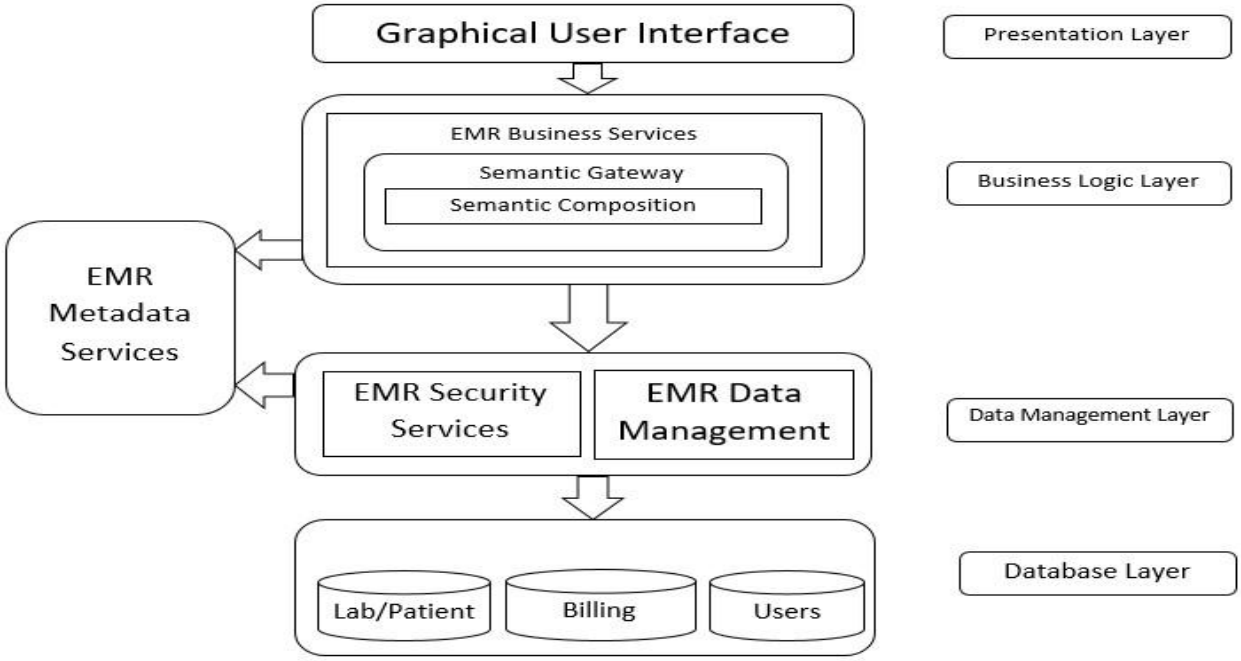
4.7. Activity Diagram



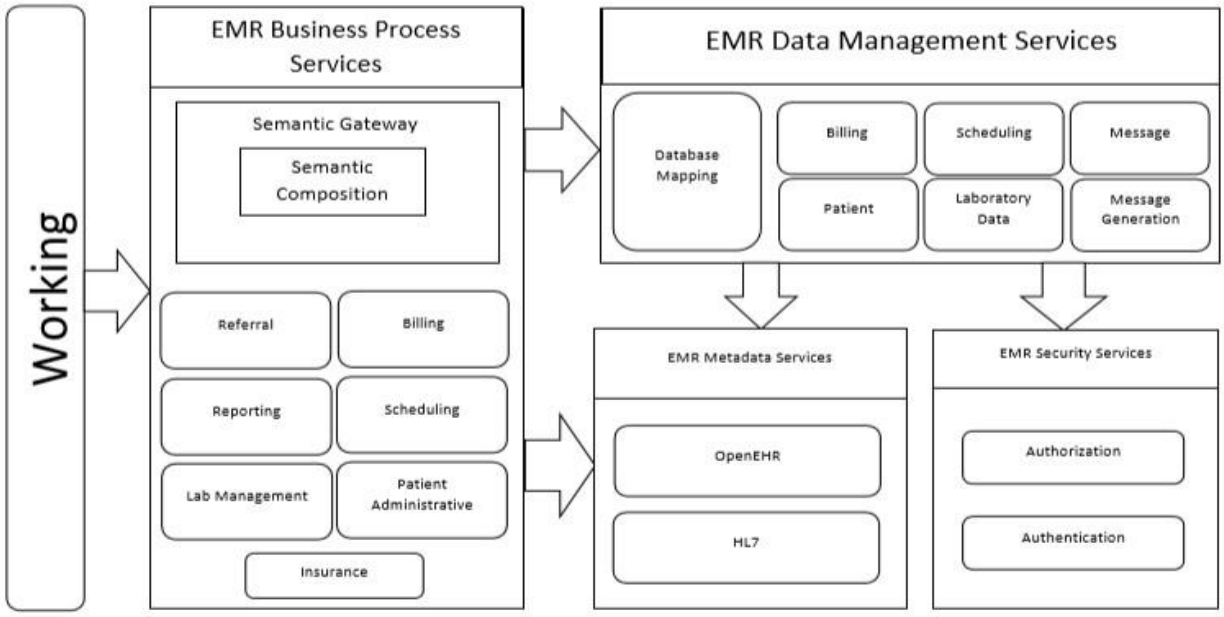
4.8. State_Transition Diagram



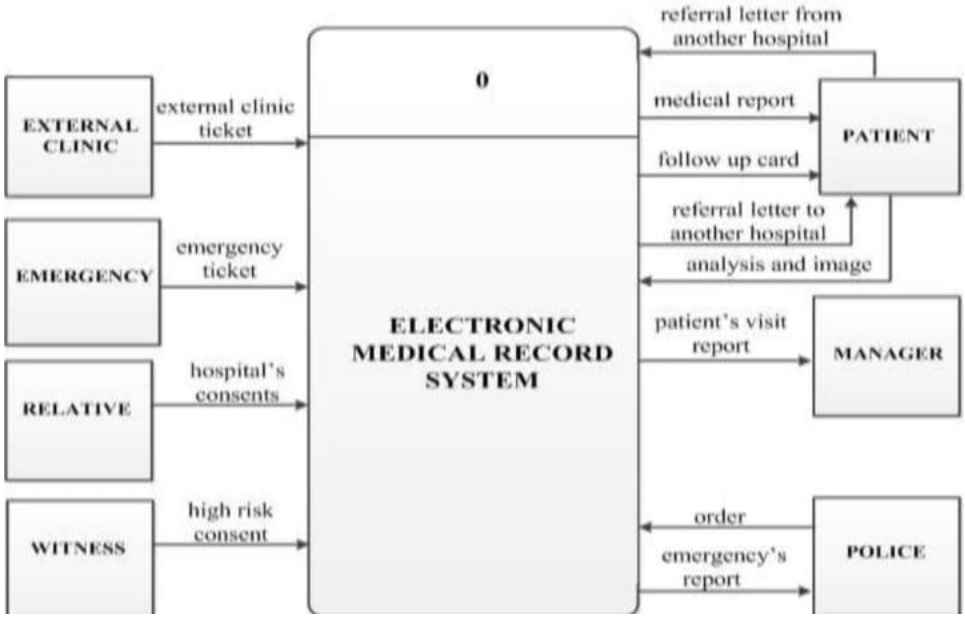
4.9. Component Diagram



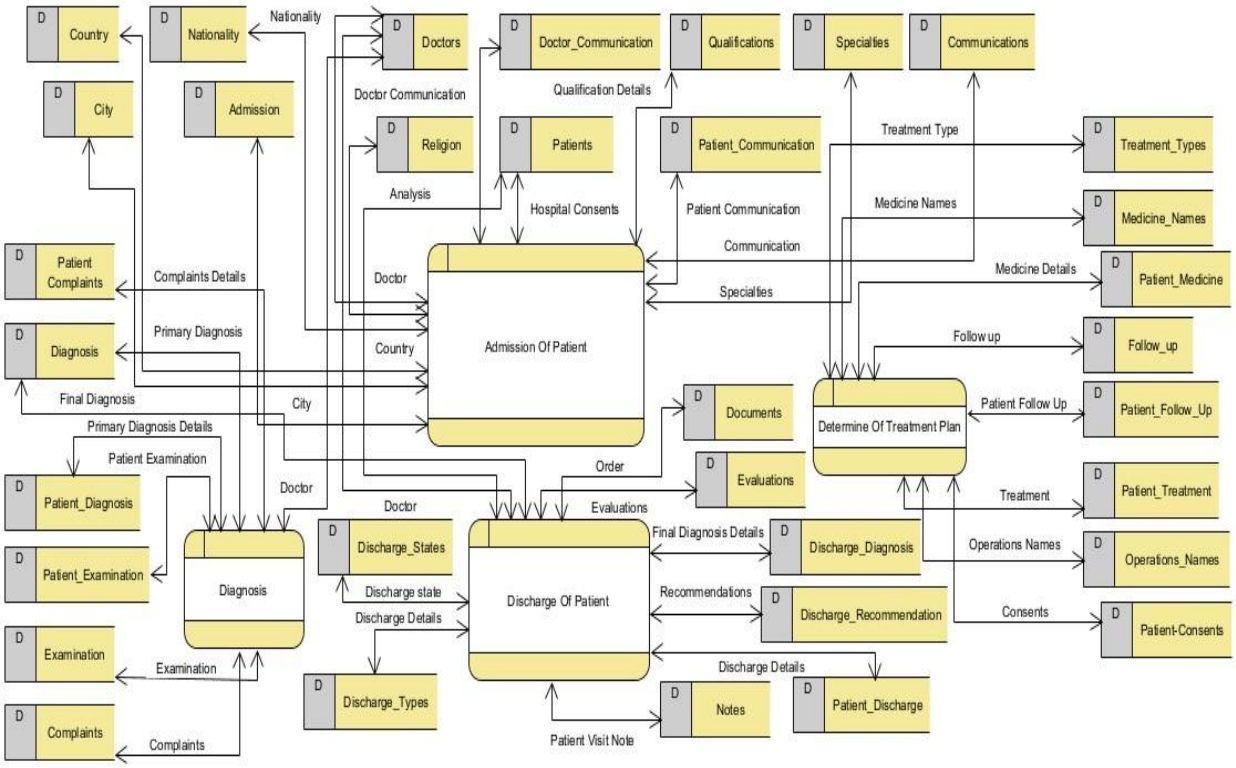
4.10. Deployment Diagram



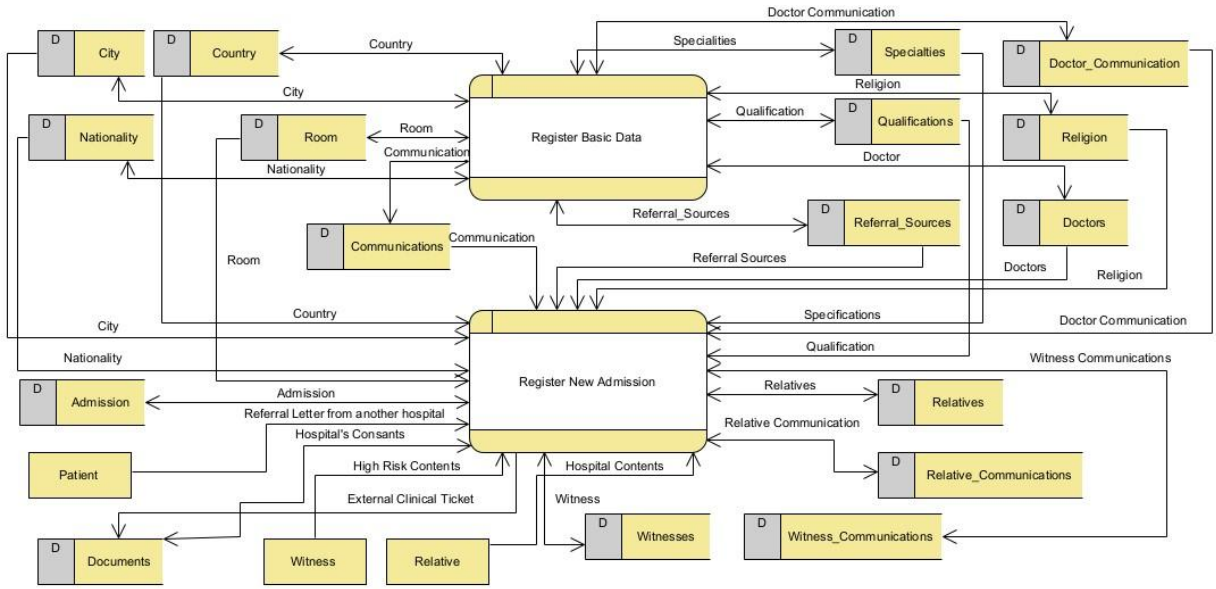
4.11. Data Flow diagram [*only if structured approach is used - Level 0 and 1*]



Level 0:



Level 1:



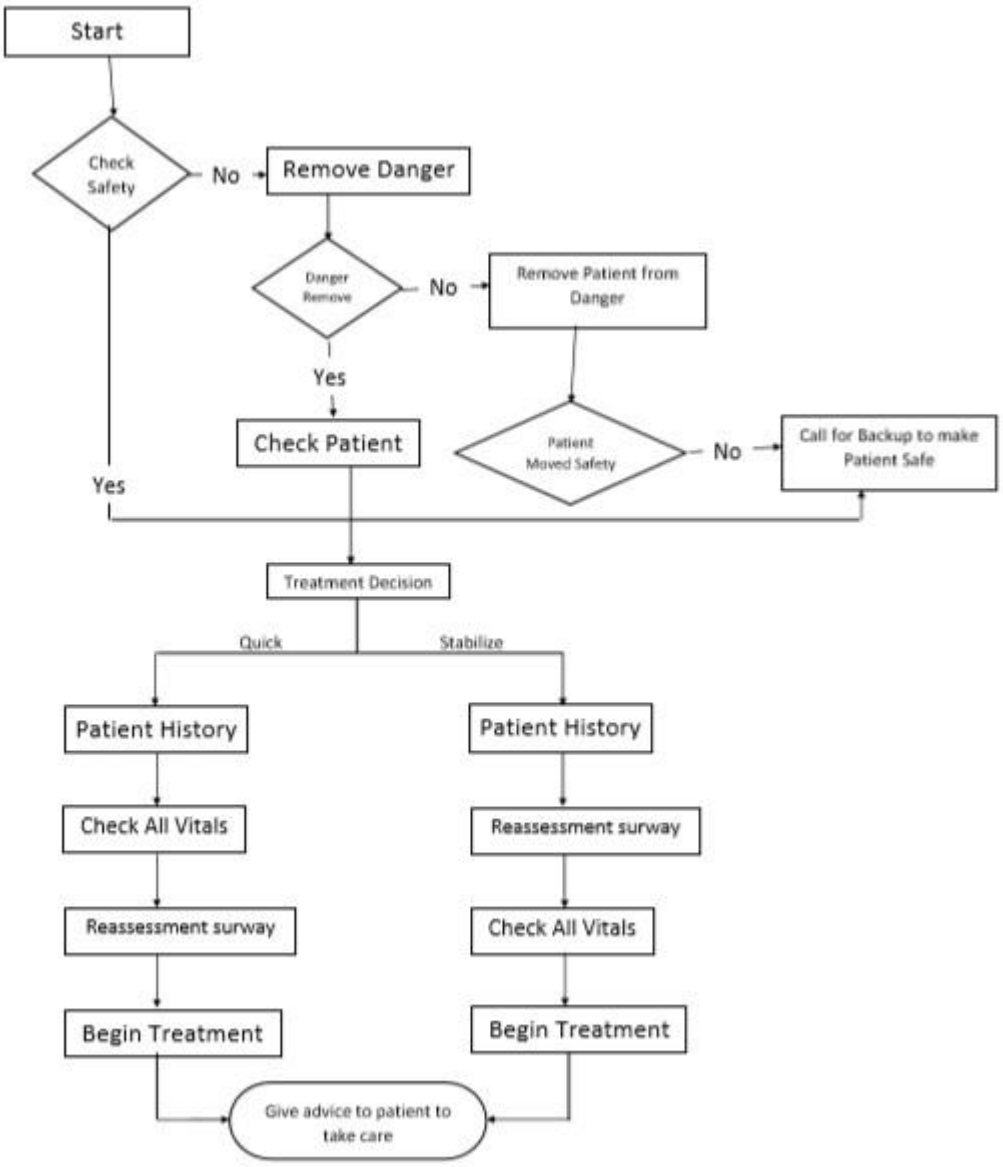
Chapter 5

Implementation

Chapter 5: Implementation

There is a wide range of modules used in this Web application such as Signing-up of users, how Healthcare services work and dashboards of Client as well as Providers. In this chapter will walk through about every fundamental module and try to visualize the flow of advancing in this Web application of CGM.

5.1. Important Flow Control/Pseudo codes



5.2. Components, Libraries, Web Services and stubs

Following are the list of components used in this application:

- EHR's (Electronic Health Records)
- Google Authentication
- Facebook and Instagram APIs
- Live Chat Widgets

5.3. Deployment Environment

Following are the deployment environments for CGM web Application:

- Web-site (CGM)
- Electronic Healthcare Records (EHRs)

5.4. Tools and Techniques

The following methods and techniques are applied in the creation of CGM are listed below:

- React Js
- Php
- My Sql
- Microsoft Visual Code
- JDK

5.5. Best Practices / Coding Standards

Following are the practices and coding standards followed for the development of CGM Web Application:

- Improvement of Web-Site on the basis of user feedback
- User friendly design
- Simple coding conventions followed
- Everything is sorted in either files or folders