A
Project Design Report
on

# "Securing and Managing Patient Data of Rural Healthcare System Through Cloud Environment."

Submitted by

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Under The Guidance of
Prof. N. M. Sawant

For The Award of The Degree of
Bachelor of Engineering


DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
SKN SINHGAD COLLEGE OF ENGINEERING

(PUNYASHLOK AHILYADEVI HOLKAR, SOLAPUR UNIVERSITY)

2020-2021

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

# SKN Sinhgad College of Engineering, Korti, Pandharpur.


## __CERTIFICATE__

This is to certify that, the project design report entitled

"Securing and Managing Patient Data of Rural Healthcare System Through Cloud Environment"

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In the partial full fillment for the award of the Degree of Bachelor of Engineering

This Project design work is a record of student's own work carried out by them under my supervision and guidance during the academic year __2020-2021__

Prof. N. M. Sawant
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## ABSTRACT

Rural healthcare system in India is managing patient data in a traditional paper based system. Most of the rural hospitals in India are lacking in resources to maintain and manage the patient health data. As the world moves towards digitization, one of the key challenges in developing countries like India is in making the healthcare data accessible from rural to urban in digital form. Advancement in IT technology in healthcare sector has made it possible to maintain and manage the patient data in digital form in all levels of healthcare system. Cloud computing has emerged as a main in providing healthcare IT solution. Therefore, rural healthcare organizations should move towards building their own private cloud infrastructure which could be an excellent solution for the country's needs to have improved healthcare in rural areas.

In private cloud, medical data is stored in databases in which some of the data in a medical database is sensitive in nature and access to this data should be limited to authorized persons. In this project we are going to propose a secure cloud architecture by building private cloud. To reduce the risk of the health information leakage and safeguard the health data, hash and the encryption operation are performed before transmitting to the cloud database. With this technique, path for a third party to obtain the sensitive information stored in the cloud is being blocked. Therefore the proposed framework provides better secured services to the users

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# Chapter 1

# Introduction

The world's population is growing rapidly. Developed countries have been facing the trend of population aging, escalating costs, inconsistent provision of care, and a high burden of chronic diseases related to health behaviors. This situation makes healthcare management more and more important to all types of healthcare organizations. Health care is delivered mainly through Primary Healthcare Centre (PHC), Secondary Care Centre (SHC), and Tertiary Care Centre (THC). The different levels of healthcare system is depicted in Fig. 1.1 The primary healthcare centre deal with patients whose medical condition can be managed

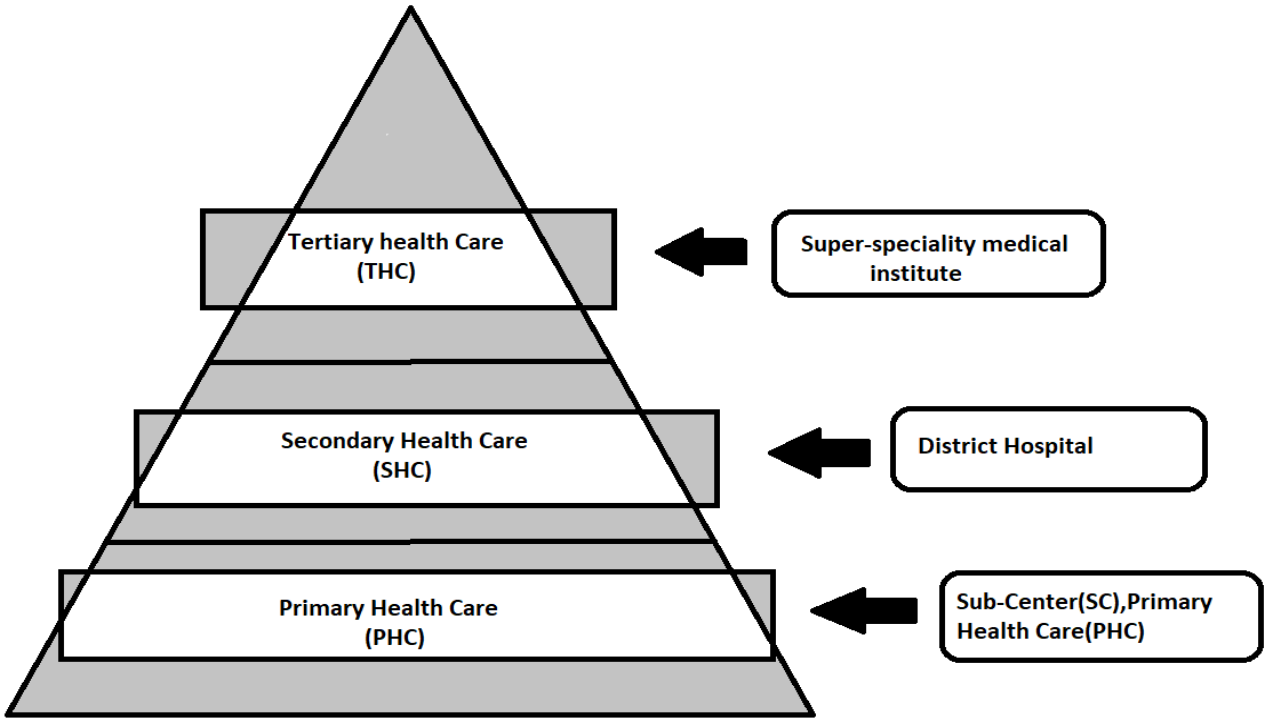


Fig. 1.1 Different Levels of health-care system

The secondary healthcare usually deals with acute care hospitals whereas tertiary care requires the resources of a sophisticated medical center. Healthcare ecosystem consists of physicians, nurse, pharmacist, radiologist, lab technician, and patient. Cloud computing helps in organizing the medical record at different levels of healthcare setting. Cloud computing is a promising and emerging technology for the users of the healthcare by connecting many health information management systems together with laboratory, pharmacy, radiology etc. The main obstacles and serious problem towards the rapid growth of cloud computing are data security and privacy issues. Most of the healthcare users of private cloud do not fully trust the inside threat of the healthcare organization for safeguarding sensitive health information4 data because there is no governance about how this information can be used by them and whether the healthcare organization actually control their information.

As part of the field study, hospitals at different healthcare levels namely Primary Healthcare Centre (PHC), Secondary Care Centre (SHC), and Tertiary Care Centre (THC) in Solapur district visited. Field study was conducted to understand the IT-infrastructure facility used for managing and maintaining the patient information. In this study it was observed that, in PHC levels, namely sub center, primary health center and. community healthcare center are maintaining yearly paper-based records such as registration book, examination book and treatment book. In the record room only current five years of patient data is maintained and previous ones are discarded. Because of this the continuous health data about the patient is lost. Hence present requirement for Indian healthcare scenario is to capture lifelong summary of the patient from pre-birth to post-death with better IT infrastructure facility. So in this project we are going to manage all data(Previous one and new) of patient regarding health and medical

# Chapter 2
# Related Work

- Robert Birke discussed about how corporate data centers uses virtualization as a mainstream technology in current scenario and explained about how virtualization allows efficient and safe resource sharing in data Center. Author additionally discussed about changes in VM patterns by configuring memory and process settings of the VM. David Freet , proposed effective cloud based computing services for cloud based applications. They used varieties of hypervisors such as XEN, KVM and ESX for cloud deployment model. They also analyzed the performance of hypervisor by allowing simultaneous execution of entire OS instances. Repu Daman proposed an architecture for health cloud infrastructure in terms of security models. They discussed about how to protect patient data in private public cloud environment and also discussed security mechanism namely role based access control , data encryption, digital signature and time to time security audits for healthcare data

- Wang discussed about how in-formation technology can be adopted in the healthcare to automate the process flow from old technology. They also discussed about the use of service-oriented architecture (SOA) during implementation of web-based healthcare platform techniques, and also considers some of the implementation factor which requires active recommendation and customization in health care services.

- Khanand Sakamura proposed a Discretionary Access Control (DAC) framework that provides healthcare organizations against security attacks and ascertains confidentiality of patient data. A trust-aware RBAC model has been used to demonstrate social healthcare networks application in a cloud environment. A similar cryptographic RBAC mode as also been designed that considers inheritance of the roles as well their hierarchy in the evaluation of trust worthiness of the users and how it can be deployed on the cloud.
- Yu, Wang Ren and Lu have combined Attribute-based encryption, proxy re-encryption and lazy re-encryption to achieve user access privilege confidentiality and secret key accountability of the users . An emergency medical system has also been developed to enable ubiquitous access to medical services. Besides access control systems, efforts have also been to ensure that records have been stored after encryption and that data is transferred over a secure connection.
- Zhifeng Xiao identified five most important security and privacy attributes such as integrity, availability, confidentiality, accountability and privacy preserve. In addition , author described about administrative and technical safeguard. Using administrative safeguards unauthorized disclosure of patient data through inappropriate email are prevented. In technical safeguard, access controls mechanism is incorporated to prevent unauthorized access to patient information.

# Chapter 3
# Proposed Work

The efficient implementation to manage data of patient through cloud environment will helps us to manage medical data of patient as well as availability of data at any time.

# Chapter 4

# Methodology

This section discusses about managing the patient data by building a private/public cloud with proposed security mechanism

## 4.1 Private cloud solution to manage patient data in rural healthcare system:

Fig. 4.1 shows the architecture of proposed model which describes one simple application of IaaS on private cloud using AWS. All the necessary setup we are going to built and an instance was going to launch with the windows server 2016. Then by launching server instance using remote desktop connection to get accessible with web application.

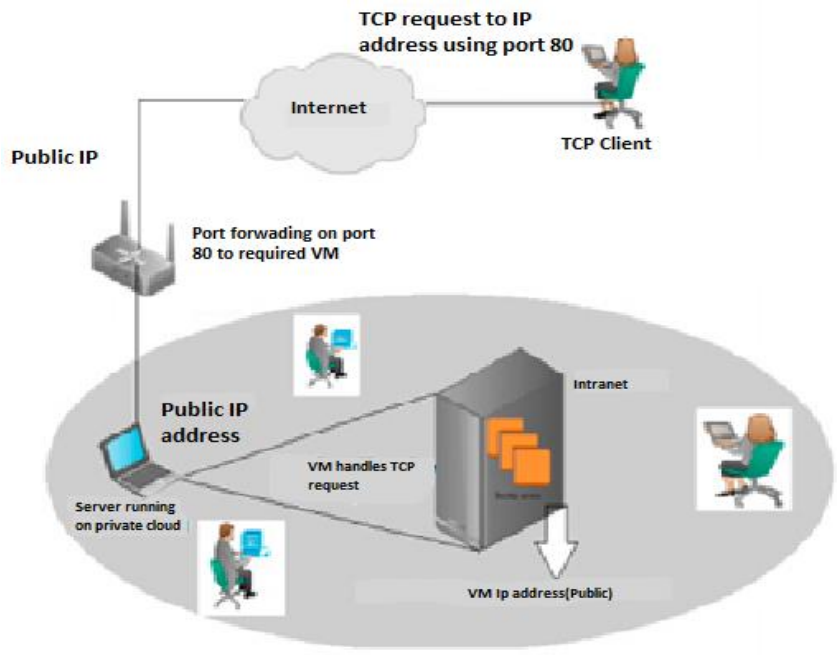


Figure 4.1: Open source methodology for managing patient data in rural healthcare system

It may be necessary to provide access to the private cloud from outside the intranet (Internet) so that all necessary configuration are made to access VM form anywhere. VM can be accessed using remote desktop connection(For Maintenance Purpose). Private cloud is mainly built for accessing the data from the intranet of the organization. The provision is given to the user to access the private data remotely using port forwarding techniques as shown in the Fig. 4.2. This concept was tested on the private cloud using a single public IP address. The server running the private cloud was connected to the INTERNET using a router. A VM was started on the cloud with a local intranet IP which had the public address assigned to it was configured to forward all requests on port 80 to the VMs local IP address. Now from the INTERNET, an TCP request was sent to the public IP address.

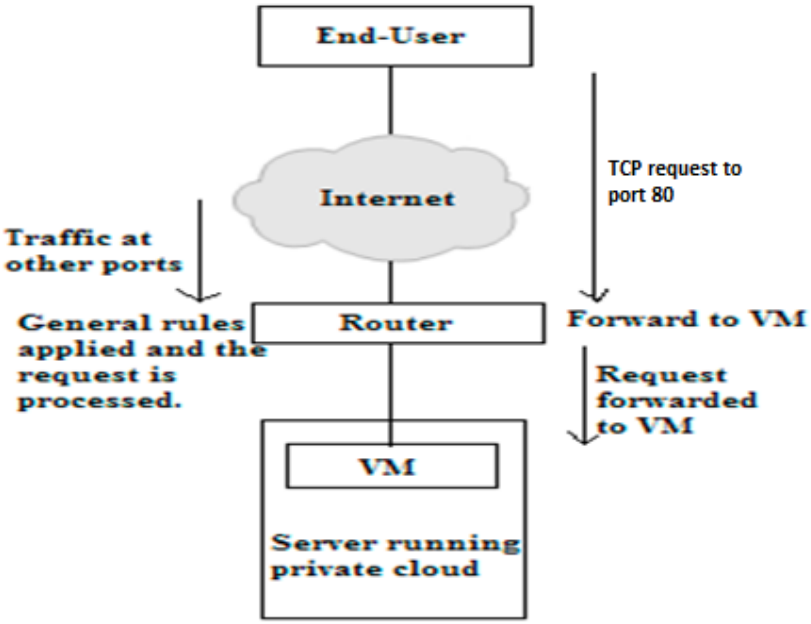


Figure 4.1: Access the private data remotely using port forwarding techniques

The request now reaches the VM which handles it and responds back to the IP address from which the request was generated. Apart from this, the private cloud was used to host a simple website as well by using port forwarding on port 80.

### 4.2 Supporting infrastructure for sustainability :

The proposed private cloud model ensures or going to supports high availability as shown in the Fig. 4.3. The model is durable and likely to operate continuously without failure for a long time. Also fault tolerance characteristics features allows to remain in operation even if some of the component used to build the system fail. Major building blocks of high availability architectures are healthcare user, load balancer, availability zone, snapshot and replication layer. The healthcare users are requesting health care services from the health information system and going to receive response from the system.

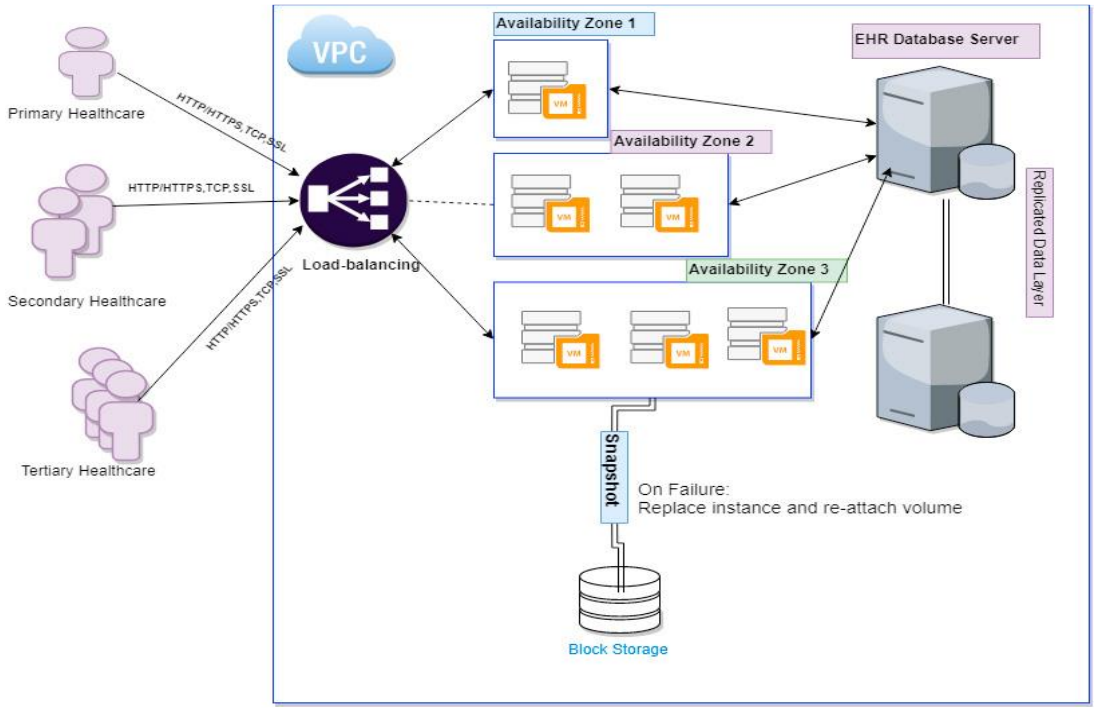


Figure 4.2: High availability architecture for rural healthcare system

### 4.3 Testing for sustainability of the system :

The network connectivity is ensured by using the dedicated high speed optical networks, which connects all rural facilities including sub centre, primary health centre and community health centre. The private/Hybrid cloud services are created by using co-locating our server in Data Center (Institute TIER IV Certified).With this network connectivity is attained in all levels of healthcare system.

### 4.4 Authorization model for proposed private cloud model :

Authorization services include policy management, role management, and role-based access control. Cloud based EHR(Electronic Health Record) for authorization as shown in Fig.4.4. Authorization model contains four rows for representing user (browser), application, Authorization server and resource server. User or browser own the resources which is stored in the remote server or remote database. If user wants to access the resources, first he/she has to enter the credentials such as user-name and password. User credential validation is done at the authorization server where after validation, it is redirected back to user for further access to the resources. On behalf of the user application, the token (Aadhar number) is obtained and returned to the application. Using this token, application talk to the resource server and get required data to access. The presentation page is displayed to the user to view the data.

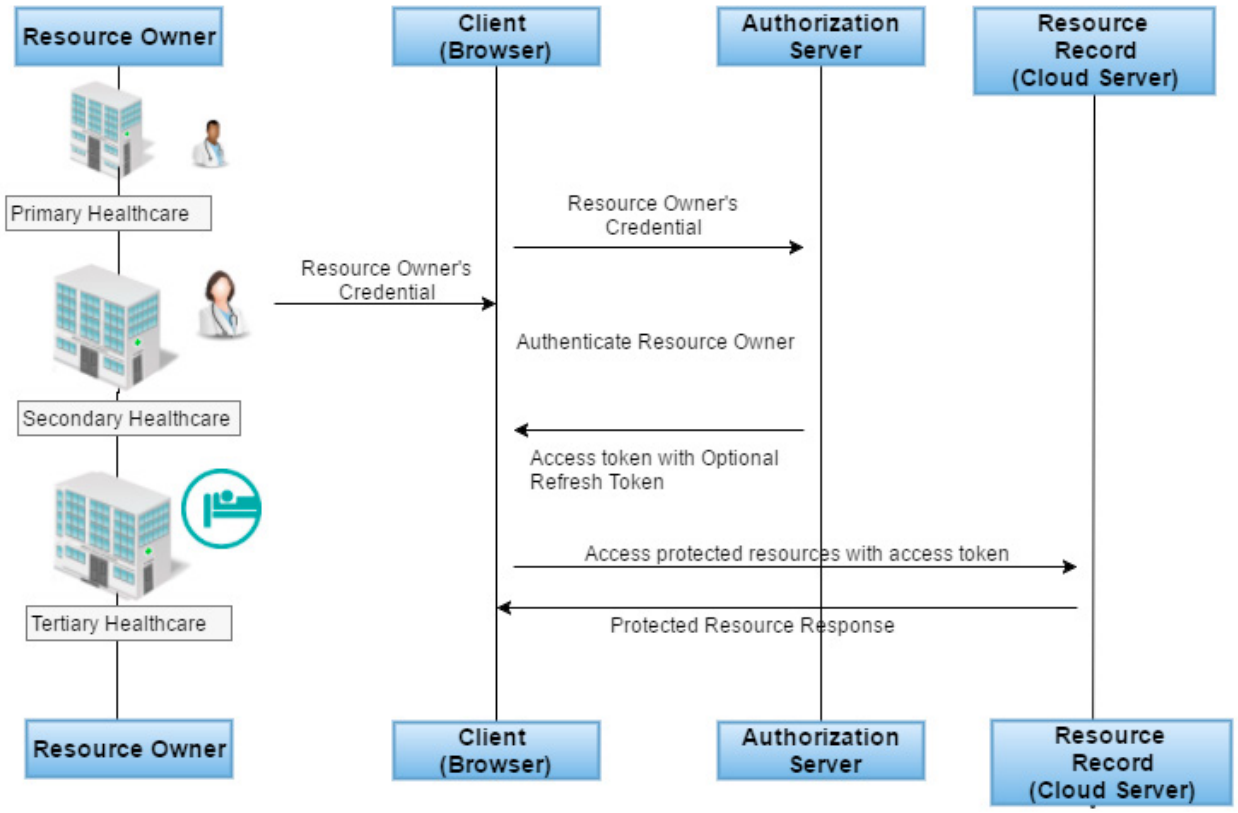


Figure 4.4: Authorization Model for healthcare system

**Algorithm** :

1) Registration of doctors.
2) Verification of doctors by admin/authorized person.
3) Registration of patients via doctors.
4) Encryption and decryption of data (eg – credentials of doctors, Patient).
5) Managing all patient data (Insert, Update, Delete).
6) Doctor's information management(Update, Delete).

- Cloud computing is a broad term which refers to a collection of services that offer businesses a cost-effective solution to increase their IT capacity and functionality.

- Depending on their specific requirements, businesses can choose where, when and how they use cloud computing to ensure an efficient and reliable IT solution.

- Below we explore the different types of cloud computing, including the three main deployment models and the cloud services that can be hosted within these environments

**Types of cloud environment shown in below fig :**

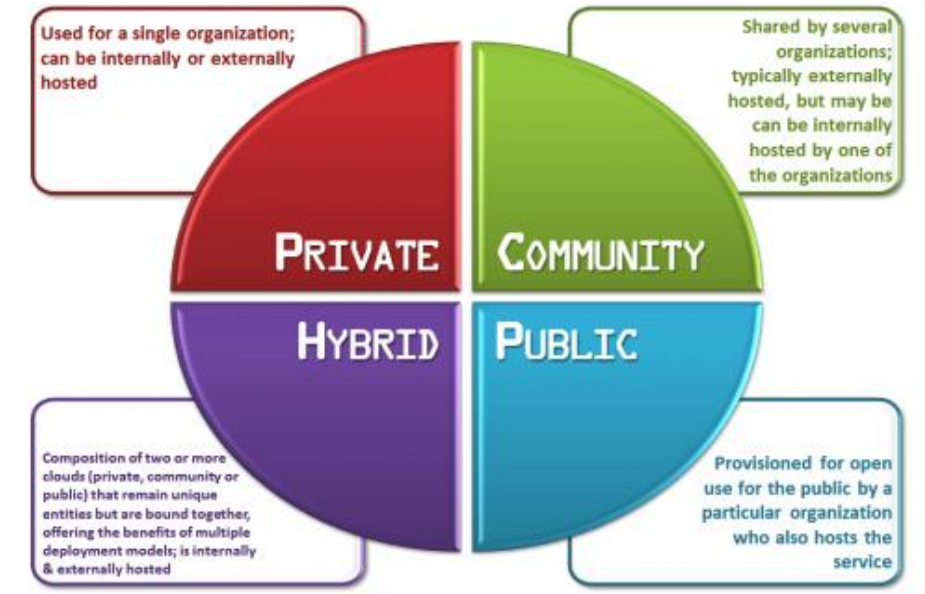


Figure 4.5: Types of cloud environment available.

**Cloud service models available in fig :**

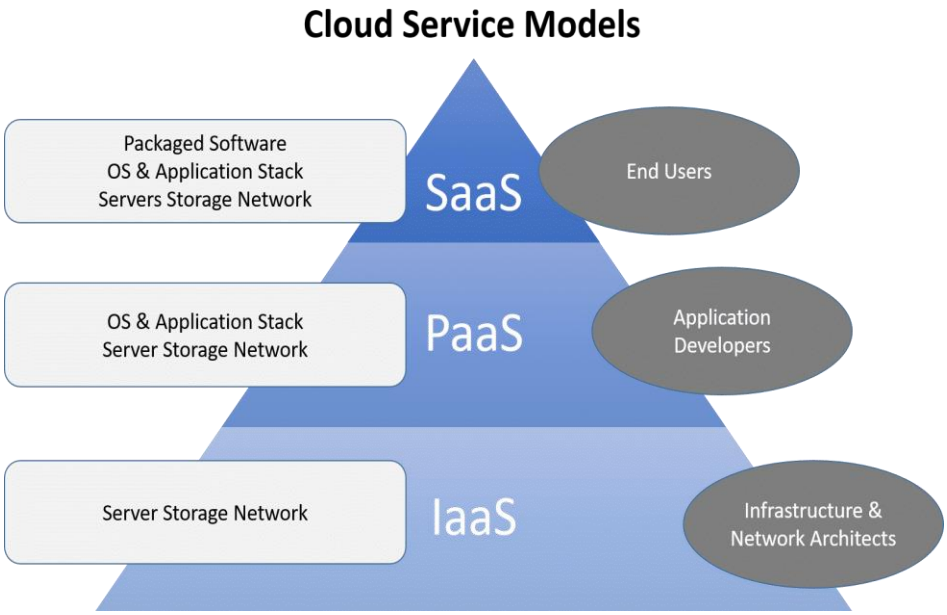


Figure 4.6: Cloud service models available.

# Chapter 5
# UML Diagrams

The Unified Modeling Language is a standard visual modeling language intended to be used for modeling business and similar processes, analysis, design, and implementation of software-based systems.

**Goals of UML**

There are a number of goals for developing UML but the most important is to de ne some general purpose modeling language which all modelers can use and also it needs to be made simple to understand and use. UML diagrams are not only made for developers but also for business users, common people and anybody interested to understand the system. The system can be a software or non software. So it must be clear that UML is not a development method rather it accompanies with processes to make a successful.

At the conclusion the goal of UML can be defined as a simple modeling mechanism to model all possible practical systems in today's complex environment. UML diagrams are the ultimate output of the entire discussion. All the elements, relationships are used to make a complete UML diagram and the diagram represents a system.

- ER Diagram
- Data flow diagram
- Usecase Diagram
- Class Diagram
- Sequence Diagram
- Activity Diagram

## 5.1 Entity Relationship Diagram

ER Model is represented by means of an ER diagram. Any object, for example, entities, attributes of an entity, relationship sets, and attributes of relationship sets, can be represented with the help of an ER diagram.

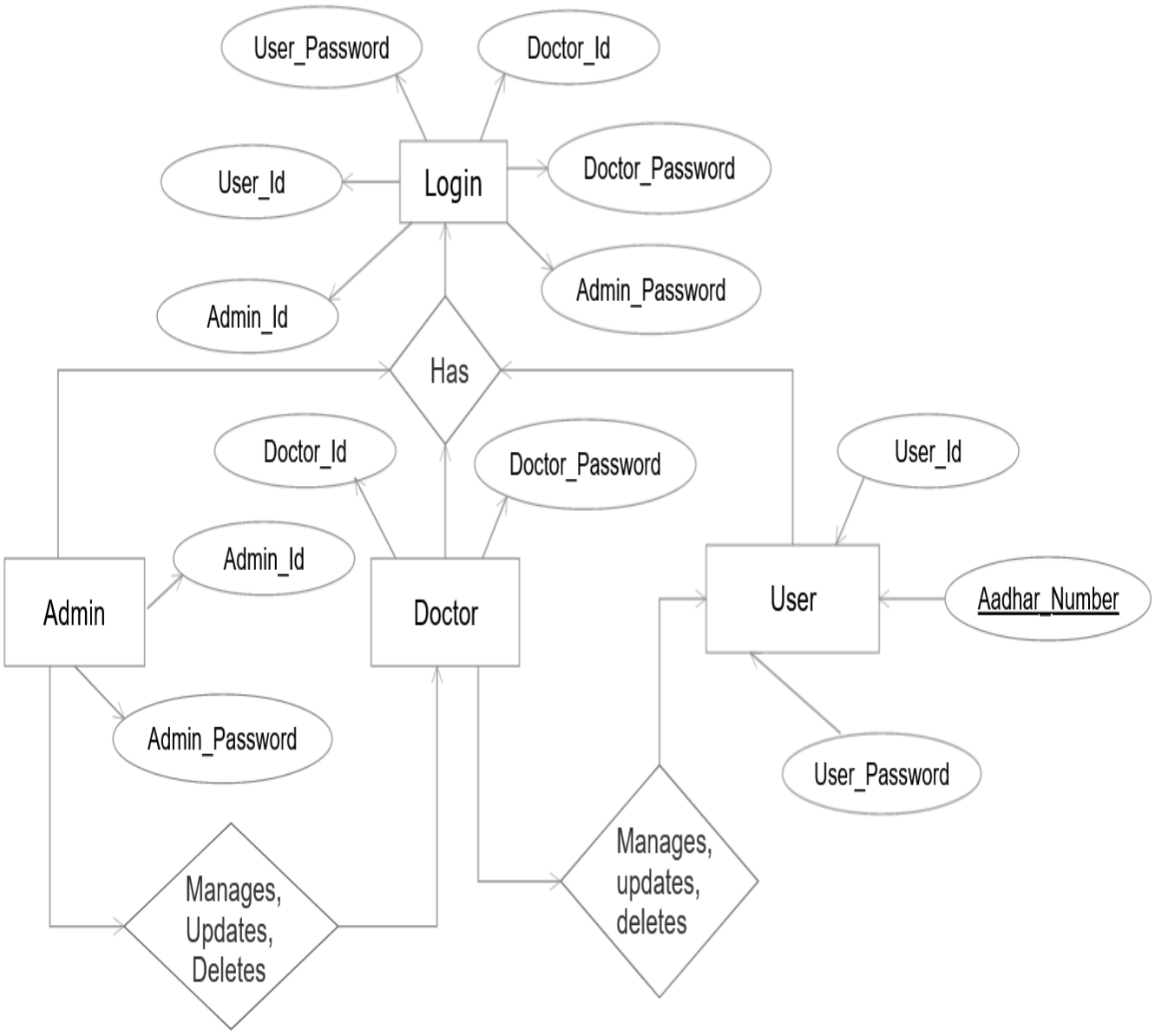


Fig 5.1 ER (Entity Relationship) diagram.

## 5.2 Data Flow Diagram

Data flow diagrams are used to graphically represent the flow of data in a business information system. DFD describes the processes that are involved in a system to transfer data from the input to the file storage and reports generation.

### Data Flow Diagram level 0

DFD Level 0 is also called a Context Diagram. It's a basic overview of the whole system or process being analyzed or modeled. It's designed to be an at-a-glance view, showing the system as a single high-level process, with its relationship to external entities.

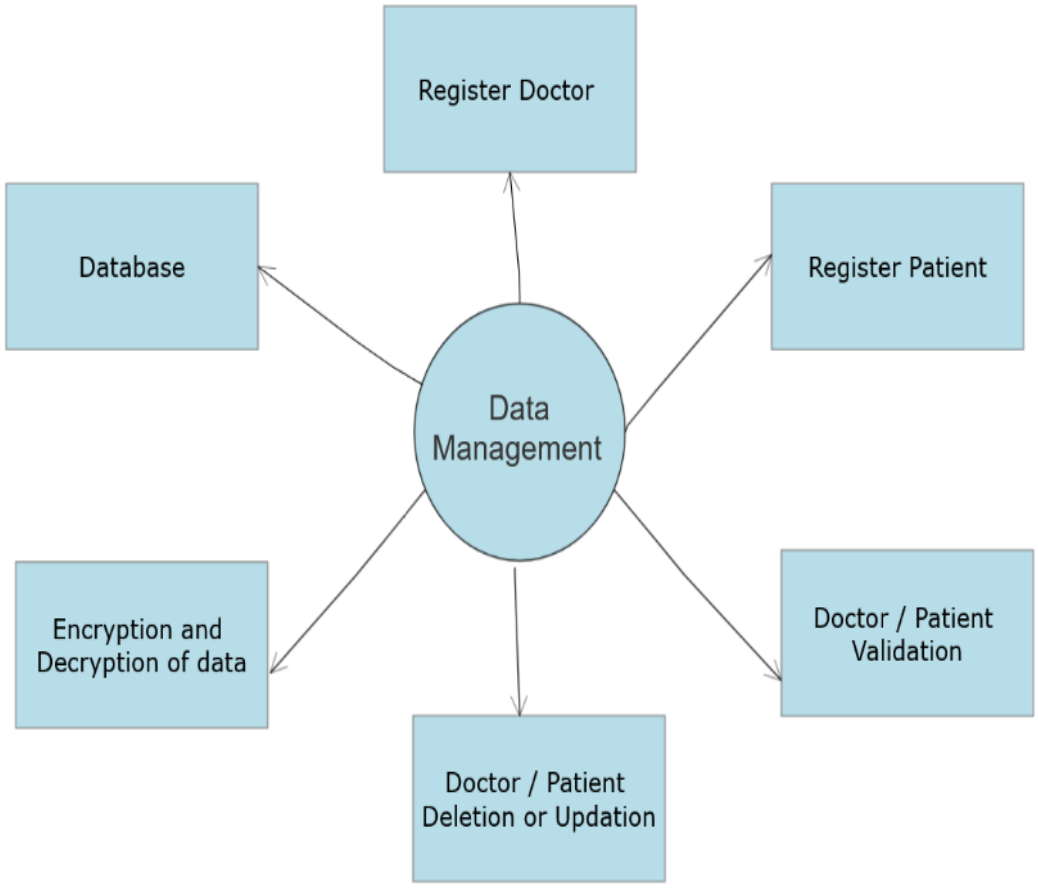


Fig 5.2 Data Flow Diagram.(Level 0)

**Data Flow Diagram level 1**

Context diagrams (level 0 DFDs) are diagrams where the whole system is represented as a single process. A level 1 DFD notates each of the main sub-processes that together form the complete system. We can think of a level 1 DFD as an "exploded view" of the context diagram.

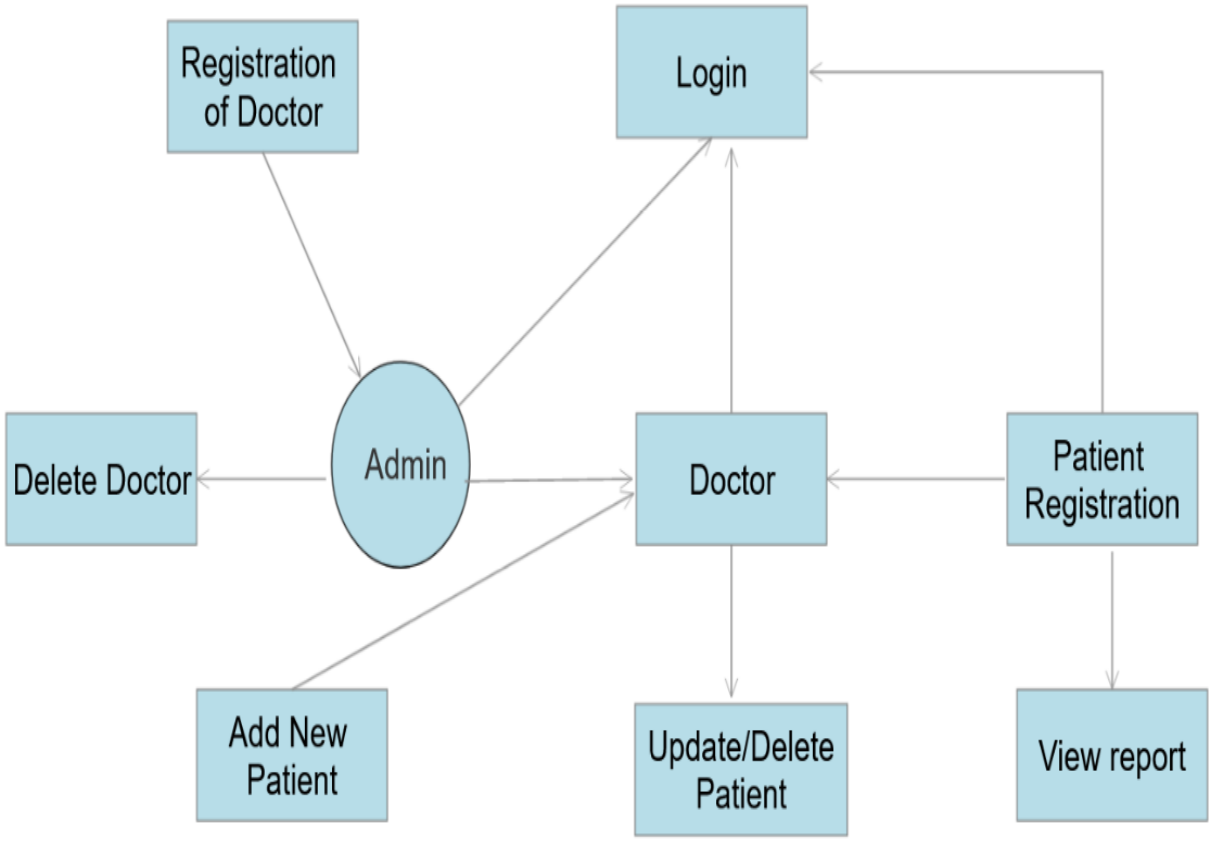


Fig 5.2 Data Flow Diagram.(Level 1)

## 5.3 Usecase Diagram

A use case diagram at its simplest is a representation of a user's interaction with the system that shows the relationship between the user and the different use cases in which the user is involved.

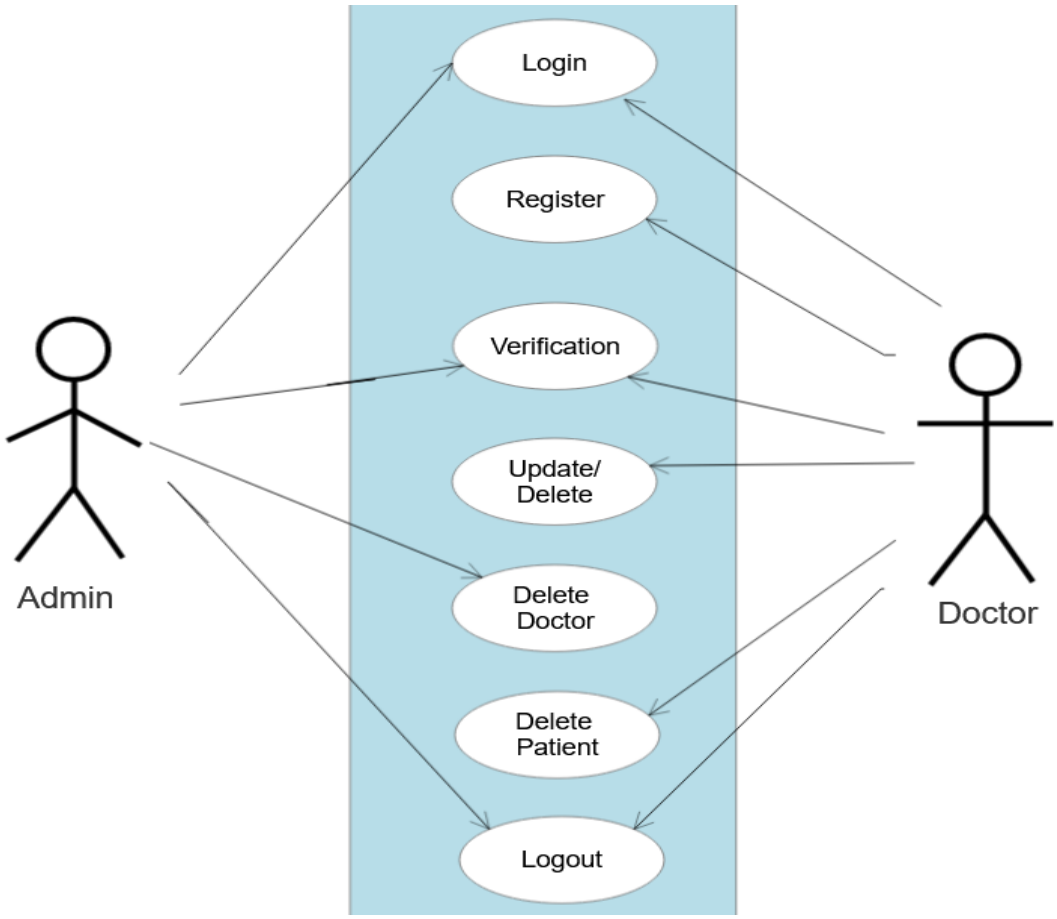


Figure 5.3 System Usecase Diagram

In System Usecase Diagram Doctor will perform all the operation on patient's data. Doctor will able to create account of new patient, and add details of patient. Along with this Doctor can add new disease, delete disease and update other details of patient on basic of current Situation of patient.

## 5.4 Activity Diagram

An activity diagram illustrates one individual activity. In our context, an activity represents a business process. Fundamental elements of the activity are actions and control elements (decision, division, merge, initiation, end, etc.).

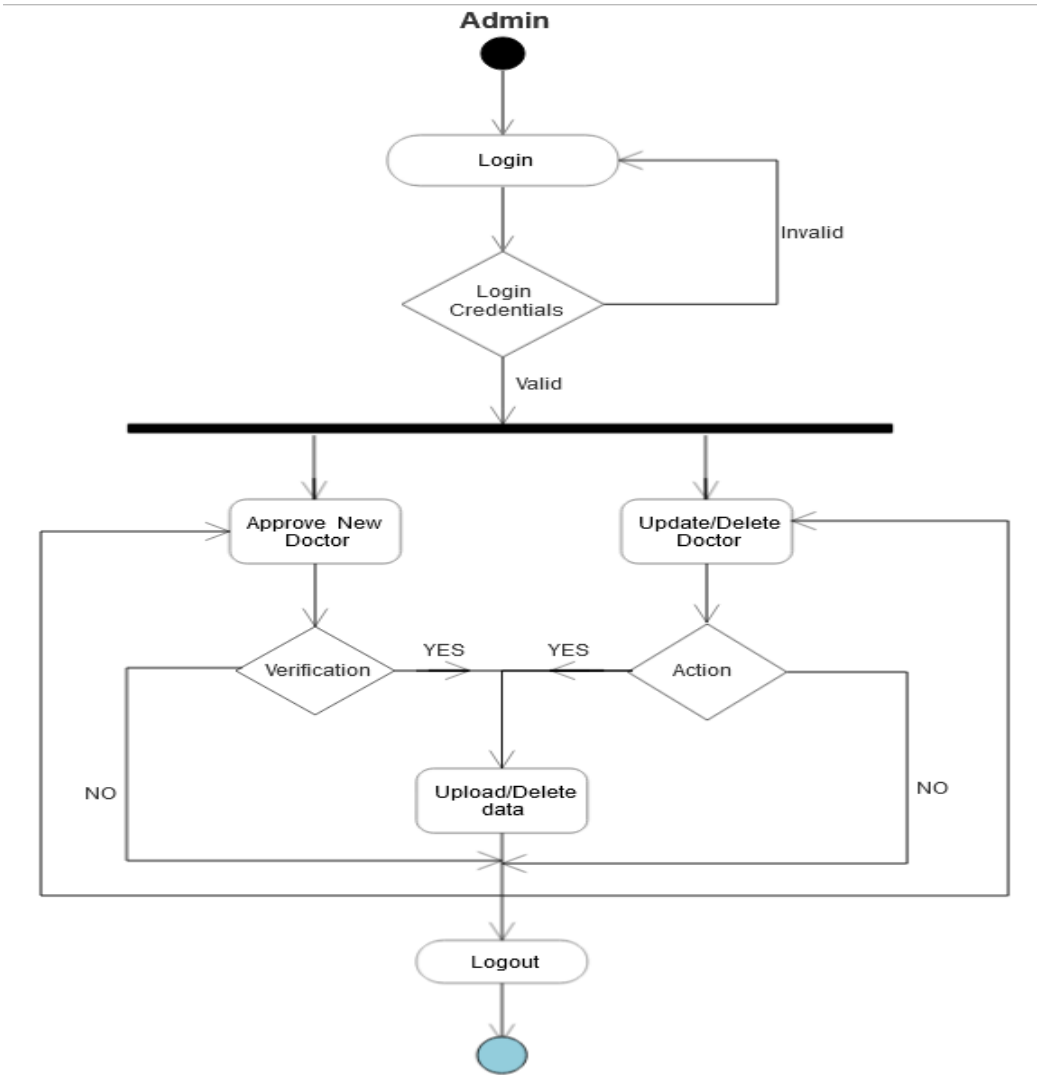


Figure 5.4 Activity Diagram of Admin

Activity diagram includes all types of rows like sequential, concurrent or branched with decisions. It is nothing but preview of system execution or how system will execute once project will complete.

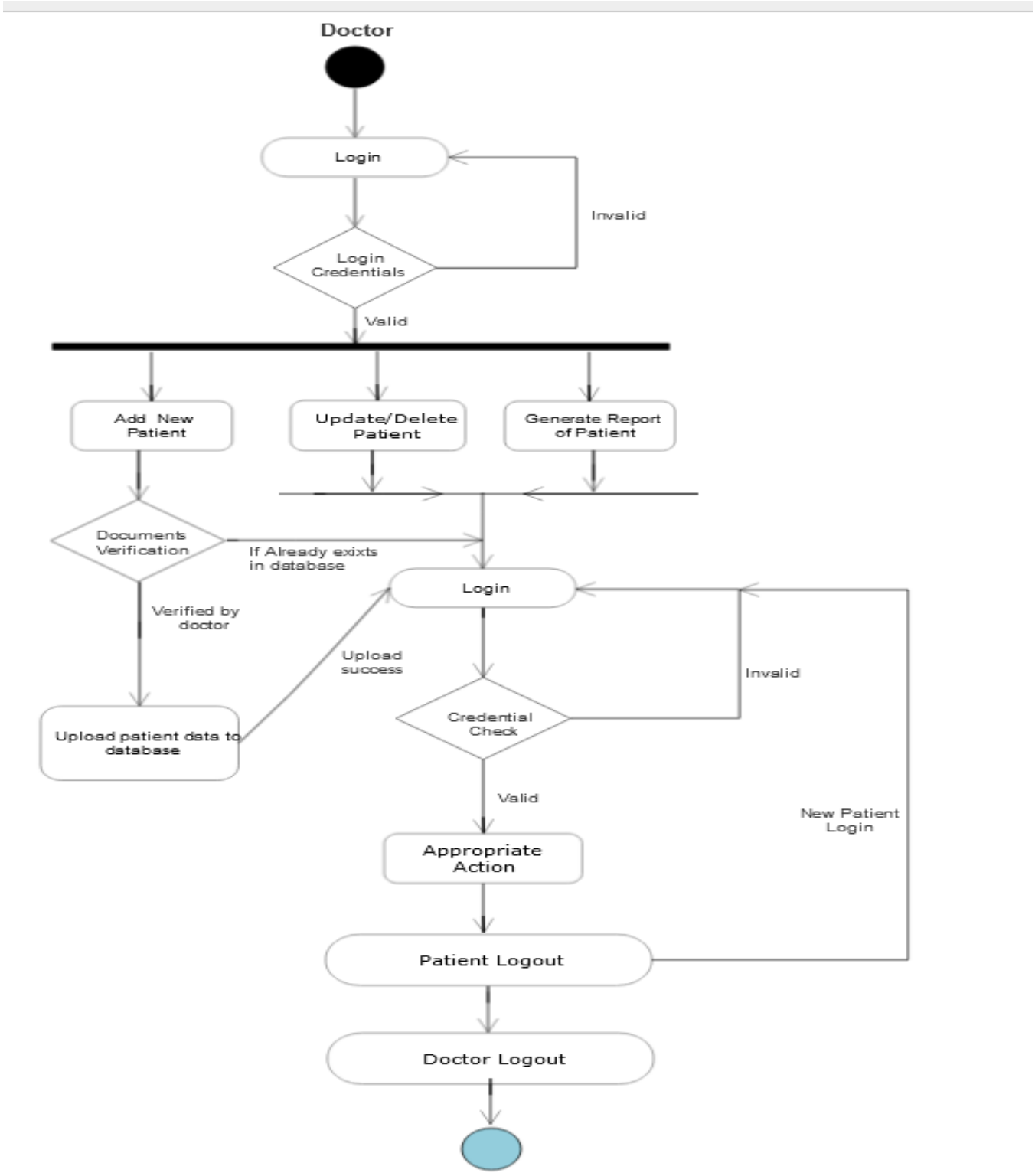


Figure 5.4 Activity Diagram of Doctor

## 5.5 Sequence Diagrams:

- A sequence diagram is an interaction diagram. From the name it is clear that the diagram deals with some sequences, which are the sequence of messages owing from one object to another.

- Interaction among the components of a system is very important from implementation and execution perspective. So Sequence diagram is used to visualize the sequence of calls in a system to perform a specific functionality.

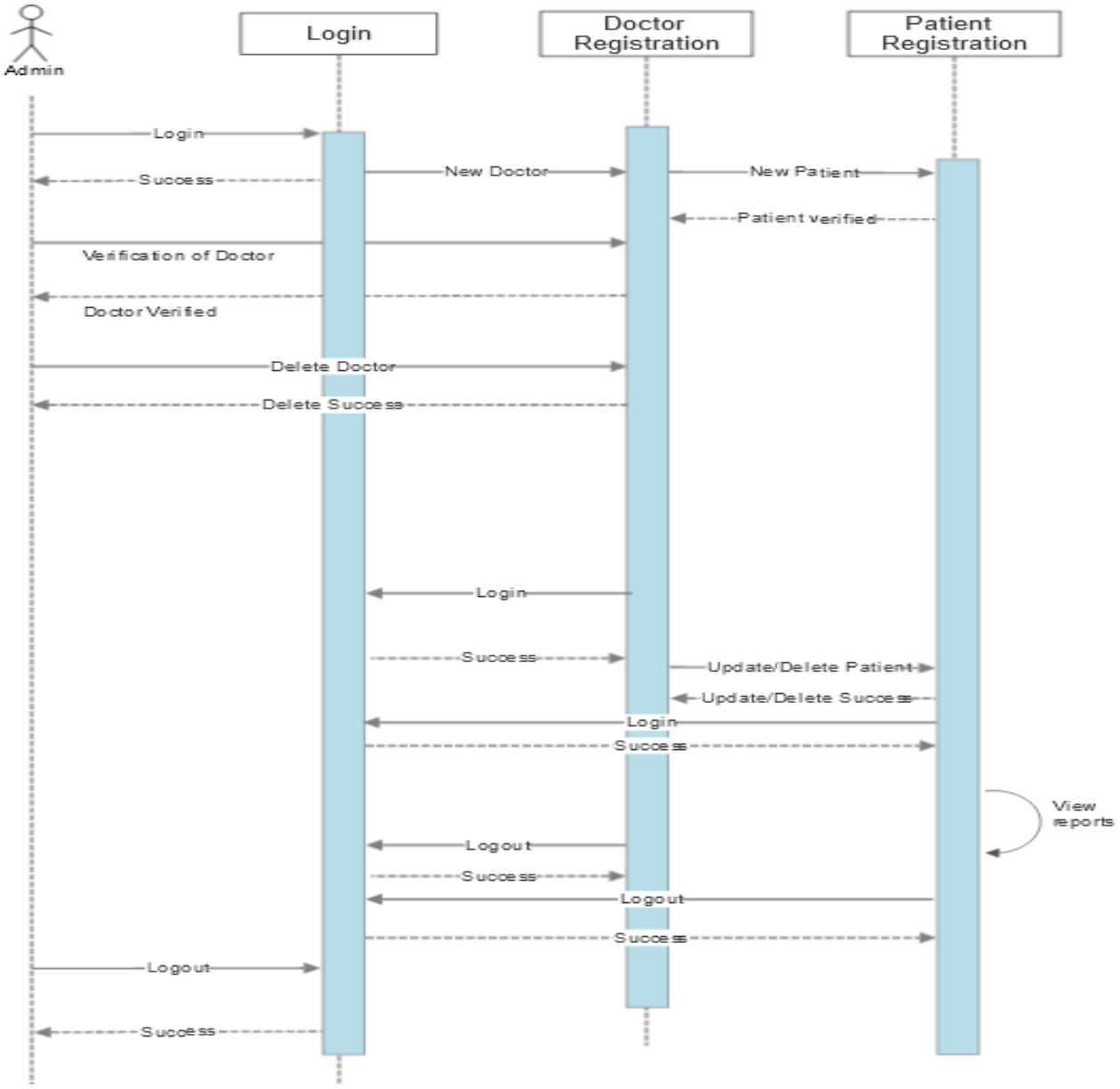


Figure 5.5 System Sequence Diagram

In above System Sequence Diagram messages, written with horizontal arrows with the Message name written above them, display interaction. Here important characteristic of a sequence diagram is that time passes from top to bottom : the interaction starts near the top of the diagram and ends at the bottom (i.e. Lower equals Later).

## 5.6 Class Diagrams:

- Class diagrams are the most common diagrams used in UML. Class diagram consists of classes, interfaces, associations and collaboration.
- It basically represent the object oriented view of a system which is static in nature. It represents the object orientation of a system. So it is generally used for development purpose. This is the most widely used diagram at the time of system construction.

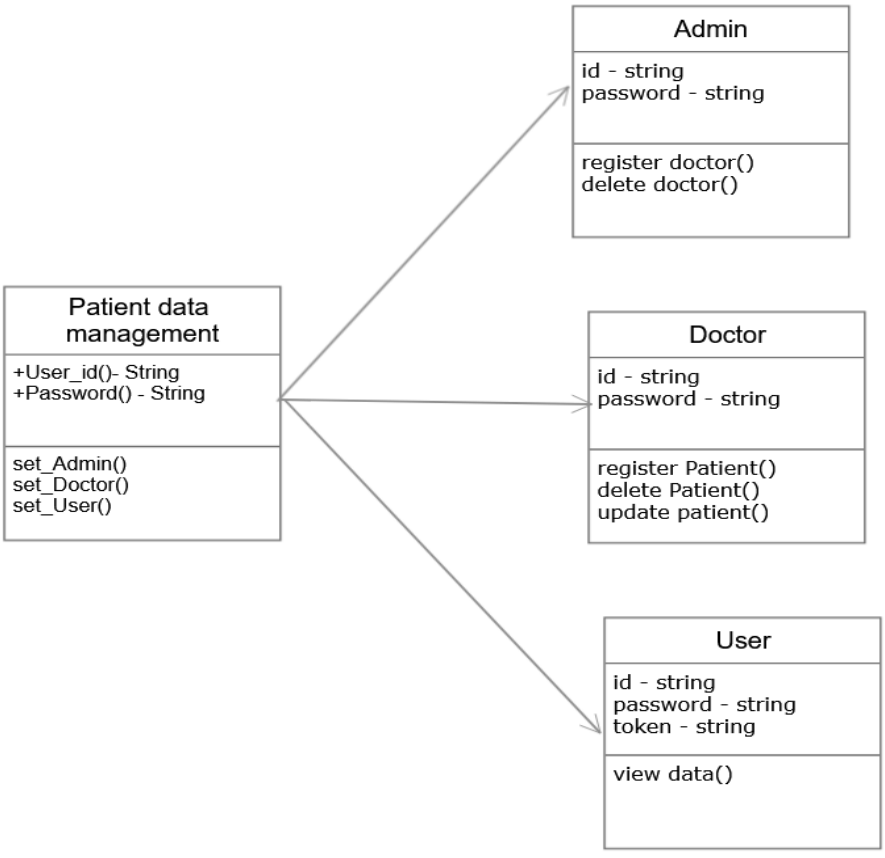


Figure 5.6 Class Diagram

# Chapter 6

# System Requirements

## Hardware Requirements

- Intel core i3 or greater
- 2Gb RAM or greater
- 60 GB Hard Disk

## Software Requirements

- Windows 10 OS/Any Server.
- Mongo DB latest version
- XAMPP, Robo 3T

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