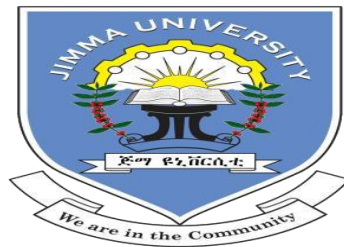# JIMMA UNIVERSITY INSTITUTE OF TECHNOLOGY DEPARTMENT OF COMPUTING PROGRAM: COMPUTER SCIENCE

REQUIRMENT SPECIFICATION, ANALYSIS AND SYSTEM DESIGN OF MOBILE ASSISTED MATERNAL HEALTH ADVISORY SYSTEM BY

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Submitted to: Department of Computing,NOS Chair

Submission Date: 04/02/2015

JIMMA UNIVERSITY

INSTITUTE OF TECHNOLOGY

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Project Viva – Voce held on ⸻⸻⸻⸻⸻

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Acknowledgment

As the beginning we would like to thank GOD for making us present and capable of doing this industrial project. Then we would like to thank our Advisors Mr.Kibret Zewdu and Dr. Deepak K. Sinha instructors of Jimma University computing department for their guidance in developing this project documentation.

We are also very grateful and extend our thanks to staff members of Jimma university department of computing department who have involved in performing this project by giving different advises to us.

Abstract

This project is a mobile assisted maternal health advisory system specially designed for mothers. The application will be installed on mobile phones. The application provides user friendly GUI in order to make it easy and efficient for the mothers to use the application. In this application, mothers can registered to the health center by using this application and reads necessary information for them from this application. The system also provides automatic drug taking time reminder for the mothers and also helps family planning workers to provide necessary information through this application.

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List of Abbreviation

MAMHAS	Mobile Assisted Maternal Healthy Advisory System
FP	Family Planning
IUD	Intrauterine
MH	Maternal healthy
MOH	Ministry of Health
FGAE	Family Guidance Association of Ethiopia
MDG	Millennium Development Goal
MCH	Maternal and Child Healthy
CRC	Class Responsibility Collaborator
UML	Unified Modeling Language.

CHAPTER ONE

INTRODUCTION

1.1. Background

Ethiopian Ministry of Health is established in 1984 and named as Ministry of Public Health. Since that, taking care of people health was the obligation of the organization and still does. To accomplish this, it was using different strategies. The major health problems of Ethiopia remain largely preventable communicable diseases and nutritional disorders. Following changes of Government in 1991, the Government produced the health policy which was the first of its kind in the country. The core elements of the health policy are democratization and decentralization of the health care system, development of the preventive, primitive and curative components of health care, assurance of accessibility of health care for all segments of the population and the promotion of private sector and NGOs participation in the health sector.

Ethiopia has 8 Millennium Development Goal (MDG) from which fourth and fifth is health issues. The goals will be achieved in 2015. The fourth goal is reducing child mortality and the fifth is improving maternal health. Six of the eight MDGs are already on track and strong efforts are being made to ensure that the remaining two are brought on track by the 2015 deadline.

Ethiopia has one of the highest rates of maternal mortality in Africa. Progress on reducing maternal mortality has stalled since 2005 when the country managed to reduce maternal mortality rate (MMR) to 676 per 100,000 births in 2010/11 from 871 in 2000/01. This means that with the MDG target of 267 per 100,000 births by 2015.

Modern FP services in Ethiopia were pioneered by the Family Guidance Association of Ethiopia (FGAE), which was established in 1966, with a fundamental philosophy that if the right health knowledge and skill is transferred, households can take responsibility for producing and maintaining their own health and their family.

FGAE"s first FP services were provided from a single-room clinic run by one nurse. FGAE"s programmatic activities and services gradually spread all over the country, with a

network of eight branches, 18 clinics, 26 youth centers, 740 community-based reproductive health (RH) service outlets, 242 outreach sites, six marketplace sites, and eight workplace sites. The ministry of health (MOH) also began to enhance the effort through provision of maternal and child health (MCH) and FP services in health facilities. Since 1980, the MOH further expanded its FP services through cyclic country support programs by the United Nations Population Fund (UNFPA) and other stakeholders.

There are around 17.26 million subscribers to phone in Ethiopia [2]. That makes mobile application preferable to reach this entire people with a little cost. The widespread adoption and use of mobile technologies is opening new and innovative ways to improve health and health care delivery in the world. Mobile applications can help people manage their own health and wellness, promote healthy living, and gain access to useful information when and where they need it.

Mobile health (mhealth) is not a solution to all of the problems confronting health systems in countries like Ethiopia, but it does hold the potential to greatly improve the efficiency of communication, reduce life threatening delays in the delivery of care and extend the reach of the health system to underserved community.

This project is intended to serve as the implementation of projects that The Federal Ministry of Health (FMOH) of Ethiopia has committed to reach MDGs 4 and 5 and has designated maternal Health as its highest priorities in the Health Sector Development Programmed IV for the period 2010-11 to 2015-16 will benefit communities throughout Ethiopia.

Mobile assisted maternal health advisory system is simply a mobile application that helps mothers or physician to get necessary information about maternal health and perform communication between mothers and physician or family planning workers. Typically, this application is exceedingly useful for a mothers or physician when they are far from each other and   busy.

1.2. Statement of the problem

More than 150 million women become pregnant in developing countries each year and an estimated 500,000 of them die from pregnancy-related causes [1]. Maternal health problems are also the causes for more than seven million pregnancies to result in stillbirths or infant deaths within the first week of life. Maternal death, of a woman in reproductive age, has a further impact by causing grave economic and social hardship for her family and community. Other than their health problems most women in the developing countries lack access to modern health care services and increase the magnitude of death from preventable problems.

The major determinants of maternal morbidity and mortality include pregnancy, the development of pregnancy-related complications, including complications from abortion and, the management of pregnancy, delivery, and the postpartum period. However, a lot of factors contribute to the low health status of women in the developing countries including Ethiopia. These factors include:

- ✓ Socio economic development of the country has serious Impact on morbidity and mortality.
- ✓ Access to health services:-Lack of access to modern health care services has great impact on increasing maternal death. Most pregnant women do not receive antenatal care; deliver without the assistance of trained health workers etc. Less than 10% of women in Ethiopia and many countries of Africa & Asia get Family planning services.
- ✓ Women"s reproductive and health behavior:- Reproductive and health behavior involves, for example, the age at which a woman becomes pregnant, whether the pregnancy is wanted, and what kind of health care the woman seeks

Due to the above factor:-

- ✓ Most pregnant women do not receive antenatal care.
- ✓ Maternal mortality and unnecessary pregnancy increased.
- ✓ Time and cost wastage to get health centers
- ✓ Women often lack access to relevant information, trained providers and supplies, and other essential services.

✓ Poorly timed unwanted pregnancies carry high risks of morbidity and mortality, as well as social and economic costs, particularly to the adolescent and many unwanted pregnancies end in unsafe abortion.

1.3 Purpose of the project

The purpose of this project is listed below:

✓ Help women care themselves by providing them necessary information

✓ Help Family Planning workers get necessary information over their mobile where ever the internet connection is available.

✓ Help women to talk/contact physicians from distance without physical contact.

✓ To remind them take their drug carefully in time.

✓ To reduce the cost of the health ministry which it costs to train more health care professionals

✓ To enable women chat with health centers physician with this application

1.4. Objectives

1.4.1 General objectives

The general objective of our project is to develop a mobile assisted maternal health advisory system to help mothers to get advices through this system to improve maternal health services.

1.4.2 Specific Objectives

The following are the specific objective of maternal health advisory system

✓ To conduct a study on mobile assisted maternal health advisory system

✓ Identify the users or stakeholders of mobile assisted maternal health advisory system

✓ Study throughout the existing system of mobile assisted maternal health advisory system

✓ Analyze the business function and functional workflow of the current system.

✓ Identify the problem of the existing system.

✓ Identify functional and non- functional requirements of the new system

 ✓ Design and develop the system based on the requirements identified

1.5. Scope and limitations

1.5.1 Scope

This project will help mothers and health care professionals by providing required information. It helps

Mothers

 ✓ Can get necessary information from the application installed on their mobile.
 ✓ Get detail advice and recommendation from physicians using chat, SMS, and call
 ✓ Can know about disease symptom, causes, prevention method and solution.
 ✓ Remember take a medicine and how to use it.
 ✓ Remember appointment with health centers
 ✓ Can register to the application to access the information

Family planning workers

Help the workers as they provide necessary information which help mothers about family planning without physical contact by upload information and chatting.

1.5.2 Limitations
 ✓ The system will not work unless network connection is available at the time
 ✓ The system will not work unless the user device has enough balance to access internet.
 ✓ The physician will not prescribe a medicine to mothers but they will make them aware about their problem and make them to visit close health station

1.6 Methodology and tools

1.6.1. Requirement gathering methods

For the collection of data we used observation, interview and literature view.

Observation: - We have observed the existing system. We observe Jimma university referral hospital how they assist maternal health.

Interview:-we used interview to get information about existing system for developing our project. We have conducted the interview with health care professionals and students who learned that professional in Jimma University.

Literature review:-we use this method to get addition information from different research applied on maternal health by using internet.

We are going to model the requirements that we gather using object oriented approach because object oriented technology is of broad means used to handle highly structured applications. Object oriented technology provides numerous advantages in applications by making them easy to use and maintain.

1.6.2 Tools

As described above in the requirement modeling it"s expected to use Object Oriented approach will be used for developing Mobile assisted maternal health advisory system**.** Object oriented technology is of broad means used to handle highly structured application systems. Object oriented technology provides numerous advantages in applications by making them easy to use and maintain, it is plat form independent, portable and reliable by itself.

We will use different software, hardware tools and programming language. Hardware tools such as computer (laptop), flash disk, and network cable. Software tool such as Eclipse, Argo, snipping Tools, Microsoft office word and PowerPoint and programming language such as HTML5, CSS3 and JavaScript are used.

1.6.2.1 Software Tools

- ✓ **Microsoft Office Word**:-We use Microsoft office word to type our project work.
- ✓ **Power Point**: -We use it to present our presentation in short and brief way.
- ✓ **MySQL**: - we use it for database connection.
- ✓ **Edraw max: -** we use this software to draw UML diagrams.

✓ **Snipping tool: -** we use snipping tool to capture picture from Argo software.

1.6.2.2 Hardware Tools

✓ **Computer**: - We use it to type on it and to install all software and programming language we require developing the system. All tasks are done on computer.

✓ **Network Cable: -** used to get the internet access by connecting internet line from internet hub to computer for further read and search information from internet.

✓ **Flash Disk**: - used to keep back up of our files.

1.7 Feasibility

Since Mobile assisted maternal health advisory system is very useful for the mothers in that it provides different information in their health, it is expected that this application system will also grow faster and more productively if mothers or physicians recognize the role of strategic financing from the system and interventions in to using it. This application simplifies their work by providing much functionality.

1.7.1 Economic feasibility

The development cost is one of the affecting factors of which results in inefficiency of the new system. On the current system users get the problem of cost in different situations. This means the proposed system should be economically feasible to reach its desired goal. In addition the developing materials are freely available the only thing the user requires is that mobile phone. As all the resources are already available, it give an indication of the system is economically possible for development

1.7.2 Technical feasibility

The technical issues that are involved in the system such as the normality and strength of the mothers mobile from the hardware part, the software should work properly in the proper inputs from its users from both user and the software point of view should be considered to determine the feasibility. There are also other services provided from the mobile for which we don"t need to

rebuild it again. Additionally, in simple terms long range portable mobile device required for the betterment of the application usage.

1.7.3 Time feasibility

Time feasibility is the most important and superior thing to be considered. The period of time considered as a resource under user control and sufficient to accomplish some work and it is an instance or single occasion for some work. This system is feasible by time since it reduces the time required to work through with physical contact.

1.7.4 Operational feasibility

The user should not misuse the system. To determine the operational feasibility of the system we should take into consideration the knowledge level of the users. Initially this system is proposed to be designed to who use mobile phone. The application is expected to be very flexible for its users. And this is also one of the factors that make it operationally feasible.

1.8 Organization of the project

Our system has five chapters. The first chapter of our project is introduction of our project. The second chapter deals with the functional and nonfunctional requirement of our system and we will show the functional requirement of our system using use case. The third chapter deals with the design. The fourth chapter deals with implementation of the project which is writing the code and at the end testing and evaluation of the project.

Time scheduling

In order to accomplish time effective and efficiently, we used the Gant charts to schedule times in all phases of project we do. Its major phases are listed below.
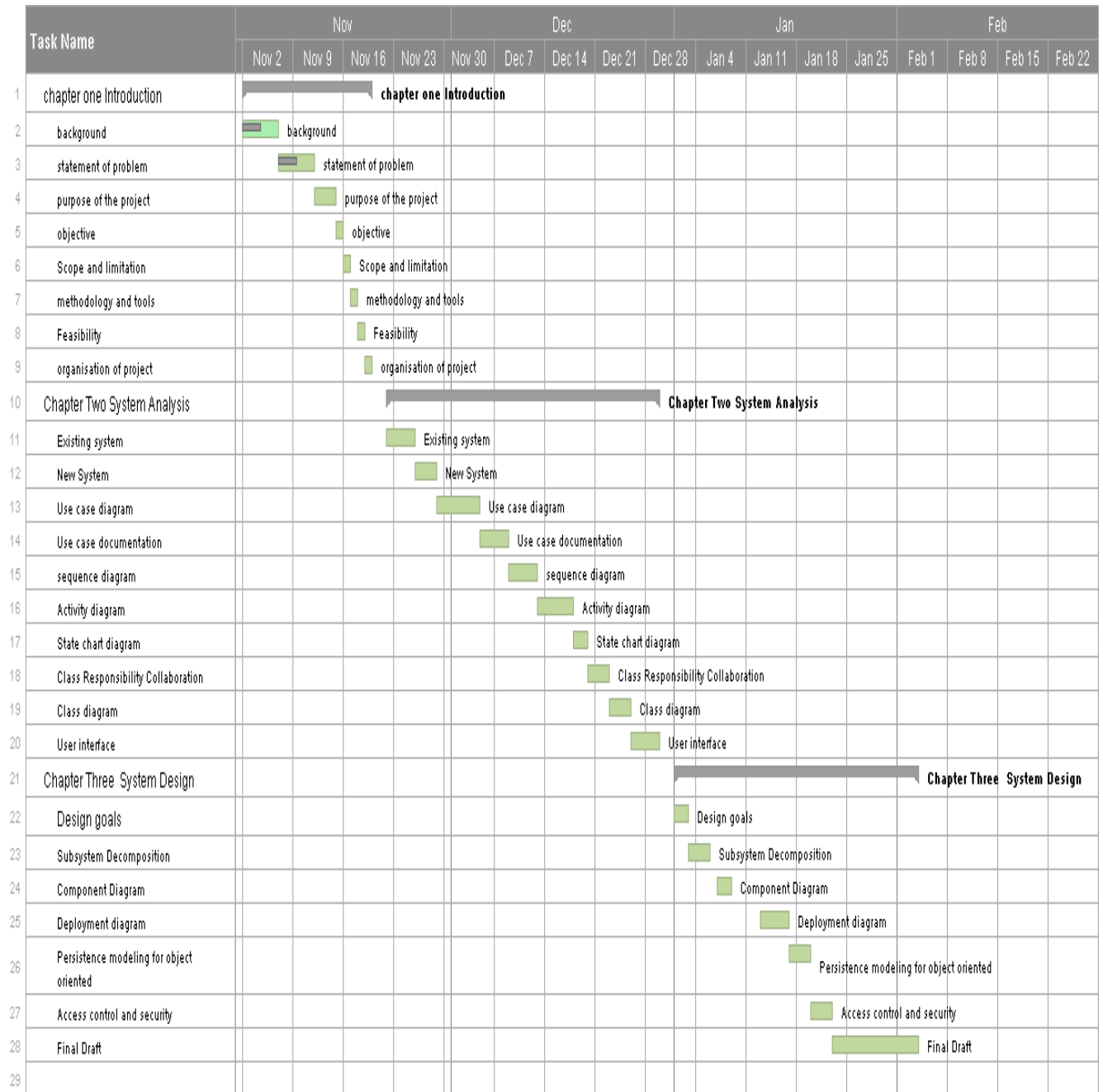
	Task Name	Nov				Dec					Jan				Feb			
		Nov 2	Nov 9	Nov 16	Nov 23	Nov 30	Dec 7	Dec 14	Dec 21	Dec 28	Jan 4	Jan 11	Jan 18	Jan 25	Feb 1	Feb 8	Feb 15	Feb 22
1	chapter one Introduction				chapter one Introduction													
2	background	background																
3	statement of problem		statement of problem															
4	purpose of the project		purpose of the project															
5	objective			objective														
6	Scope and limitation			Scope and limitation														
7	methodology and tools			methodology and tools														
8	Feasibility			Feasibility														
9	organisation of project			organisation of project														
10	Chapter Two System Analysis									Chapter Two System Analysis								
11	Existing system					Existing system												
12	New System					New System												
13	Use case diagram						Use case diagram											
14	Use case documentation						Use case documentation											
15	sequence diagram							sequence diagram										
16	Activity diagram							Activity diagram										
17	State chart diagram								State chart diagram									
18	Class Responsibility Collaboration								Class Responsibility Collaboration									
19	Class diagram									Class diagram								
20	User interface									User interface								
21	Chapter Three System Design												Chapter Three System Design					
22	Design goals										Design goals							
23	Subsystem Decomposition											Subsystem Decomposition						
24	Component Diagram											Component Diagram						
25	Deployment diagram												Deployment diagram					
26	Persistence modeling for object oriented													Persistence modeling for object oriented				
27	Access control and security												Access control and security					
28	Final Draft													Final Draft				
29																		

Fig 1.1 grant chart

CHAPTER TWO

SYSTEM ANALYSIS

2.1 Existing System

2.1.1 Existing System Description

Maternal health is the health of women during pregnancy, childbirth and the postpartum period. It encompasses the heath care dimensions of family planning, preconception, prenatal, and postnatal care in order to reduce maternal morbidity and mortality.

Preconception care can include education, health promotion, screening and other interventions among women of reproductive age to reduce risk factors that might affect future pregnancies. The goal of prenatal care is to detect any potential complications of pregnancy early, to prevent them if possible, and to direct the woman to appropriate specialist medical services as appropriate. Postnatal care issues include recovery from childbirth, concerns about newborn care, nutrition, breastfeeding, and family planning.

Family planning is defined as the ability of individuals and couples to anticipate and attain their desired number of children and the spacing and timing of their births. It is achieved through the use of contraceptive methods and the treatment of involuntary infertility.

Any reproductive-age person whether male or female, regardless of marital status is eligible for FP services, including information, education, and counseling.

Antenatal care is the care mothers receive from healthcare professionals during their pregnancy. The purpose of antenatal care is to monitor mother's health, baby's health and support mothers to make plans which are right for them.

Mother's first appointment with healthy professional is called a booking. During each antenatal visit, health professionals will check that mother's health. Mothers will be asked to supply a sample of urine at each visit.

An important part of antenatal care is getting information that will help mothers to make informed choices about your pregnancy.

Services offered at each level of the health system are Counseling, Provision of contraceptive methods, Screening for reproductive organ cancers, Prevention, screening, and management for STIs, including HIV and Prevention and management of infertility. Among the services registering the client, training the community, Counseling and Giving Reminder card are our project focus.

i. Registering clients

All clients seeking FP services need to have a client card. If they are new, after they get FP service they will have client card. If they have been using FP service change will be made on their card. The client card records their socio demographic and health history, the physical examination findings, and the client"s current FP method. The follow-up section of the card records the history and physical examination findings at the time of the visit. The client card will be stored in health post office.

The client card provides information on past and current use of an FP method and the client"s history of method switching (if any). It is an important tool for monitoring the quality of services, as it provides information on whether the client has been screened for his or her eligibility to use the method. It is useful for follow-up of clients. When the client cards are organized in a systematic way, it helps to track clients who discontinue methods.

ii .Training the community

FP services are delivered through the following service delivery modalities:

- ✓ Outreach services
- ✓ Social marketing

Outreach Service

An FP outreach program is when an FP team arranges on its own a service provision program at health posts or kebele in its catchment area. Such programs are regular and happen at fixed intervals (e.g., every month or quarterly).

Mobile Outreach: A mobile outreach program is when an FP team provides long-acting and permanent methods at the health post or health center level. The FP team is organized at the higher level. Such programs are not regular and are need-based.

One of the reasons for low utilization of long-acting and permanent FP methods is difficult geographic access or unavailability of the service at a nearby health service outlet. Hence, the outreach or mobile outreach program is meant to cover those households where the distance from nearest health center is a limiting factor. Outreach services should include counseling, and services integrated with other MCH activities, including the EPI.

Social marketing

Social marketing is a strategy that promotes, distributes, and sells contraceptives at affordable price through existing commercial channels. Social marketing promotes FP services through multimedia IEC. Social marketing is already being used for the promotion and sales of condoms, pills, and injectable. Other FP commodities (e.g., ECPs) can be distributed through social marketing, which complements the services that are rendered in the public, private, and NGO health institutions. Social marketing also involves pharmacies, drug stores, and rural drug vendors.

iii. Counseling steps for FP workers

Counseling steps in family planning based on The REDI frame work.

- ✓ R- Rapport building
- ✓ E-Exploration
- ✓ D-Decision making
- ✓ I-Implementation

A. Rapport building

- ✓ Greet client with respect
- ✓ Make introduction
- ✓ Identify category of the client i.e.
  - • New
  - • Satisfied return
  - • dissatisfied return
- ✓ assure confidentiality and privacy
- ✓ Explain the need to discuss sensitive and personal issues.

B. Exploration
  - ✓ Explore the client"s reason for the visit.

Determine the clients counseling needs and the focus   of the counseling session.

i.   For new clients
  - ✓ Explore clients past experience, current situation, and future RH related plans.
  - ✓ Explore clients reproductive history and goals
  - ✓ Explore issues related to sexuality
  - ✓ Explore clients history of STI/HIV
  - ✓ Explore STI risk and dual protection and help the client to perceive his or her risk for contracting and transmitting STI (sexual transmitted infections).

ii.   For returning clients
   Satisfied clients

  - ✓ Explore the patients/clients knowledge and satisfaction with the current method used
  - ✓ Confirm current method use
  - ✓ Ask the client about changes in his or her life such as:
    - • Plans about having children
    - • STI risk and status

Dissatisfied clients

  - ✓ Explore the reasons for the client"s dissatisfaction or the problem.
  - ✓ Causes of dissatisfaction and possible solutions, such as
    - ✓ Reassurance
    - ✓ Treatment of side effects
    - ✓ Switching methods as well as other options

C. Decision making
  - ✓ Identify the decisions the client needs to confirm or make
  - ✓ Explore relevant option for each decision.
  - ✓ Help the clients weigh the benefits, disadvantages and consequences of each option.
  - ✓ Does the clients any more children? Permanent vs. temporary methods.

D. Implementing the decision

    Assist the client:-

- ✓ In making a concrete and specific plan.
- ✓ Have the client develop skills to his or her chosen method.
- ✓ Identify barriers that the client might face in implementing her decision
- ✓ Develop strategies to overcome barriers.

Contraceptive methods

1. Natural

    Natural family planning are:-

- ✓ Fertility awareness method
- ✓ Calendar method
- ✓ Basal body temperature

    Non fertility awareness method

- ✓ Breast feeding
- ✓ Abstinence
- ✓ Sex without intercourse.

2. Barriers

- ✓ Condom
- ✓ Diaphragm
- ✓ Cervical cap

3. Spermicidal(chemicals)
4. Intrauterine device
5. Hormonal contraception"s
6. Emergency contraception"s
7. Sterilization

Steps of Antenatal care

Visit to provide	Services to be provided	Purposes of services
First visit or registration (when pregnancy is suspected)	o A personal medical health is taken. o Physical and abdominal examination. o Check blood pressure o Counsel on needs for 3 ANC visits, healthy diet ,need for rest o In endemic populations, treat for malaria, hookworm, iodine deficiency o First dose of tetanus toxoid	o To diagnose pregnancy and identify any complications during previous pregnancy o To detect and manage any co-existing complication i.e. TB, malaria, pre-eclapsia o To identify and manage hypertension o To establish a base line weight o To prevent anemia o To prevent tetanus in new born and mother
Second visit(between fourth and sixth month)	o Check blood pressure o Do physical examination o Second does of TT provides additional months of Iron and folic acid	o Detect and manage hypertension o To detect and manage pregnancy complication o Pre-eclapsia or severe anemia o To prevent anemia
Third visit at (eighth month of pregnancy)	o Check blood pressure o Do physical examination o Assist women and family in developing birth of preparedness	o Detect and manage hypertension o To detect and manage co-existing condition or complication o To be prepared for a safe and clean delivery and in the event of emergency
Fourth visit checkup at ninth month	o Check blood pressure o Do abdominal and physical examination o Counsel on breast feeding and birth spacing and limiting o Review BP/CR	o To detect and manage hypertension o To detect and manage any co-existing condition or complication o To prevent any delays in case of an emergency.

Table 2.1 antenatal care

iv. Giving Reminder card

FP workers give each woman the following information in writing on a reminder card, both for Implant and IUD (Intrauterine Device) then explain:

✓ The type of implant/IUD she has

✓ Date of insertion

✓ Month and year when implants/IUD will need to be removed or replaced

✓ Where to go if she has problems or questions with her implants

Fig 2.1 Implant reminder card

Fig 2.2 IUD reminder card

2.1.2 Existing system problem

Currently in our country there are a lot of problem in terms of maternal health such as the worker can tired and not give sufficient treatment to users. In current system the user can waste their money, energy and time to get advice from physician. They handle information of patient manually. Current system cannot give service unless the user contacts the physician or health station physically.

To create awareness about family planning among societies is difficult due to no enough family planning workers in our country.

2.2. New system

2.2.1 Non-functional Requirements and Constraints

Non-functional requirement is a requirement that specifies criteria that can be used to judge the operation of the system, rather than specific behaviors of the system which are specified under functional requirements of the system. The following are considered as the non-functional requirements for the project we are going to develop.

1. Security

Any information system must be secure to fulfill the three main components of system security which are confidentiality, integrity and availability, therefore to make the system that we are going to develop secure, we are going to employ authentication mechanism which is giving the user username and password so that no one apart from the authenticated user can get access to the system.

Since, this system is going to developed for mobile devices it considered to be physically secure because the only person who is going to use the device is the one who is the owner of that device.

2. Response time

The system should give the right response for the user as fast as possible, since the system we are developing is on mobile it will not be sophisticated to use and it will not take much time to handle responses.

3. Usability

After the proposed system is implemented it will be usable by mothers since it will be easy and friendly to use it is believed to be usable.

4. Error Handling

When a user interacts with the system errors may occur. To control this kind of inaccuracies system will generate different user friendly messages. To do this, most of the system execution buttons will be controlled according to the sequence which the user is expected to follow, or this can be done by generating different system responses to the input of the user.

5. User Interface

The system we are going to develop will have a user friendly graphical user interface (GUI) which allows users to interact with the system easily. The user is expected to have knowledge of using mobiles and also navigating through mobile interfaces.

6. **Portability**

The application should support different mobile platforms. It will support any mobile cell phone that has android operating system. It will be compatible with any screen size of the phone.

2.2.2 Functional Requirements

Functional requirement defines a function of a system or its component; drive the application architecture of a system.

Registration: - mothers registered by Admin or FP worker. Admin registers physician, Family planning workers and health stations.

Chatting: - help mothers to get detail advice and recommendation from physicians or family planning workers using chat form.

Upload information: - physician or FP workers upload information to the application which helps mothers.

Retrieve information: - mothers read information which uploaded by physician or FP workers

Update mothers information: - physician update mothers information depend service they get.

Set appointment: - the physician set the appointment he/she have with mothers to the application and the mother view appointment settled by physician and mothers depend on this appointment contact physicians.

2.2.3 Use case diagram

A Use Case diagram is a graphical representation of the high-level system scope. It includes use cases, which are pieces of functionality the system will provide, and actors, who are the users of the system.

Actors

With essential use case modeling an actor represents a role. An actor is a person, organization, or external system that plays a role in one or more interaction with the system. Actors are always external to the system being modeled; they are not the part of the system. The different actors in the system with their description are as follow. This system needs five actors. These are

- ✓ Admin:-responsible for managing users and registers new users.

✓ Physician: - physician is a health professional that responsible for give advice for mothers, upload information, and manage appointment by set, edit and view appointment which he/she have˝s with mothers

✓ Mothers: - mothers get service from the system by advisory chatting through the system, view information, view appointment.

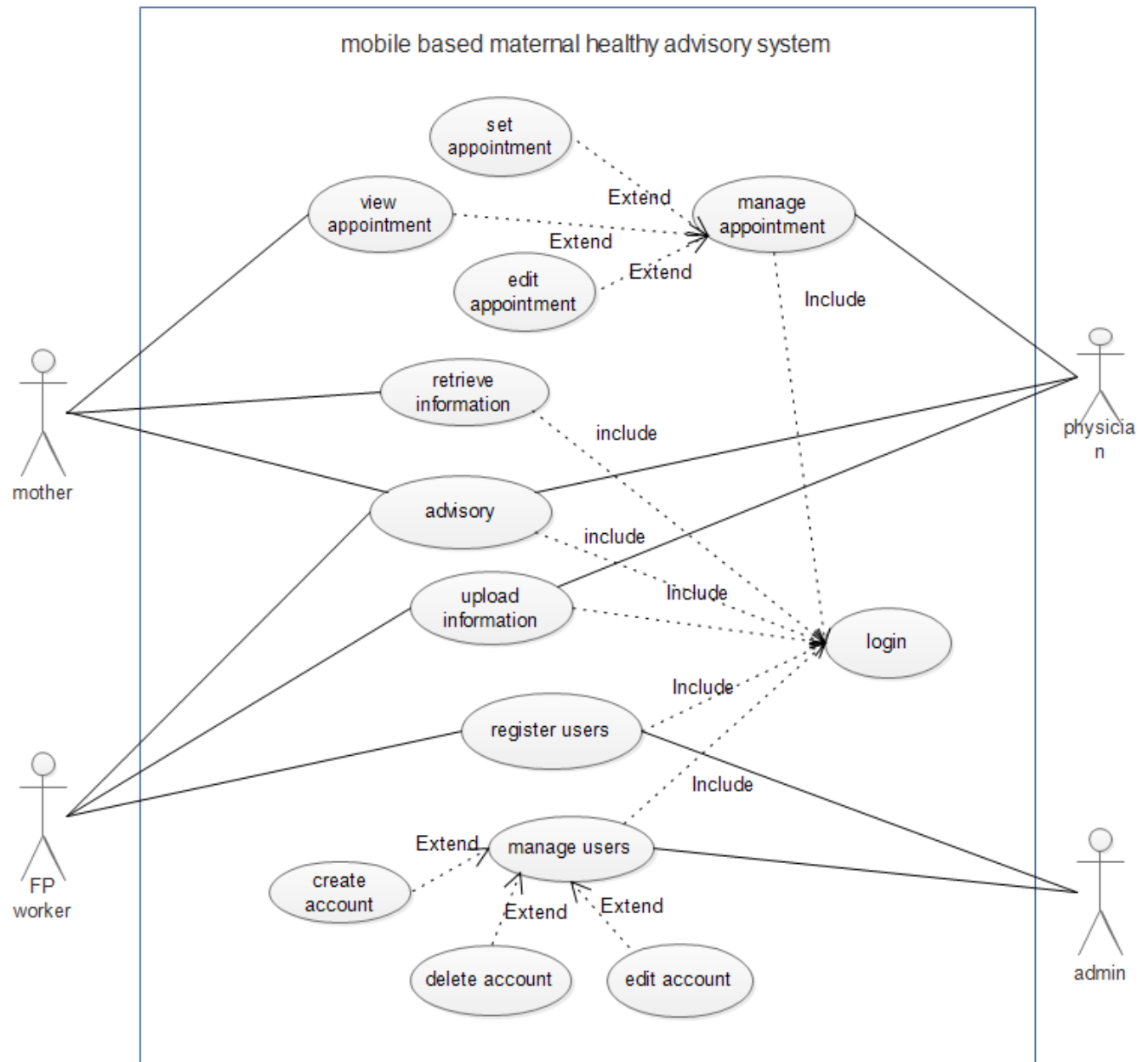✓ Fp worker: - responsible for give advice for mother, upload information and register new user (mother).

Figure 2.3 use case diagram

2.2.4 Use case documentation

Scenario name	Login
Description	The user is trying to get access to the system
Participating actor instances	Administrator, mothers, Family Planning worker, Physician, card officer

Pre-condition	1. Application must be on Android device 2. The user must be registered before
Flow of events	1. The user starts the application. 2. The system displays the login page 3. The user fills and submits the username and password. 4. The user select login button 5. The system checks the login information. 6. A 6.1 The system allows service

Alternative condition	6. B
	
	   6.1 The inserted information is not valid
	   6.2 The system let the user to try again/go back to previous page

Post condition	Successfully logged to the system

Table 2.2 Login scenario table

Scenario name	Register
Description	The user wants to register to the system
Participating actor instances	mothers, card officer
Pre-condition	1. Application must be on Android device

Flow of events	1. The user starts the application.
	2. The user select register button
	3. The user fill required information
	4. The user select register button
	5. The system checks if the account is valid
	6. A
	   6.1. The system save the account detail in the databases
	   6.2. The system allow the user to use service

Alternative condition	6. B
	   6.1. The account already exists in the database
	   6.2. The system let the user to try again/go back to previous page

Post condition	Successfully registered

Table 2.3 Register scenario table

Scenario name	Upload information
Description	The user wants to post information that will be retrieved by other users
Participating actor	FP workers, physician
Pre-condition	1. Application must be on Android device
Include	Login
Flow of events	1. The user starts the application 2. He/she must login 3. The user fill information in space provided 4. The user select save button 5. The system save the change made
Post condition	Successfully uploaded information to the system

Table 2.4 Upload information scenario table

Scenario name	Retrieve information
Description	The system enable users to view information posted
Participating actor	mothers, FP worker
Pre-condition	1. Application must be on Android device
Flow of events	1. The user initializes the system. 2. Select Browse information button 3. Visit information
Post condition	Successfully retrieved

Table 2.5 Retrieve information scenario table

Scenario name	chat
Description	Physician and/ FP worker will give advice and answer for users question
Participating actors	mothers, FP worker, physician
Pre-condition	1. mothers and physician/FP worker must be online at the same time
Include	Login

Flow of events	1.The user initializes the system
	2.The user login to the system
	1.A
	    1.1.Users(mothers, FP worker) will see online physicians
	    1.2.Users(mothers, FP worker) choose physician to chat with
	    1.3.Users(mothers, FP worker) can chat with selected physician

Alternative condition	2.B
	    2.1.Physician is not online
	    2.2.Users(mothers, FP worker) send message

Post condition	Users are chatting each other

Table 2.6 Advice scenario table

Scenario name	Create account
Description	The administrator create account for physicians, FP worker and card officer
Participating actor	administrator
Pre-condition	Application must be on android device
Include	Login
Flow of events	1. The administrator starts the server. 2. He/she login to the system 3. The administrator select „manage account" tab 4. He/she select create account button 5. Administrator fill required information 6. Administrator select save button 7. System check if account is valid 8. A 7.1.　System save the account in the database
Alternative condition	8. B 8.1.　The account already exists in the database 8.2.　The system let the administrator to try again/go back to previous page
Post condition	Successfully created

Table 2.7 Create account scenario table

Scenario name	Set appointment
Description	Physician set appointment with mother
Participating actor instances	physician
Pre-condition	The mothers with whom the physician will have an appointment should have been registered first.
Include	Login
Flow of events	1. System displays appointment setting window. 2. Enter date. 3. Enter time. 4. Enter mother''s name with whom he/she has appointment. 5. Press save button to save appointment
Alternative condition	5.B 5.1 The appointment is already exist 5.2 The system let the physician to try again/go back to previous page
Post condition	Successfully set

Table 2.8 create account scenario table

2.2.5 Sequence diagrams

A sequence diagram in a unified modeling language (UML) is a kind of interaction diagram that shows how processes operate with one another and in what order. It is a construct of a message sequence chart. A sequence diagram shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and sequence of messages exchanged between the objects needed to carry out the functionality of the scenario.
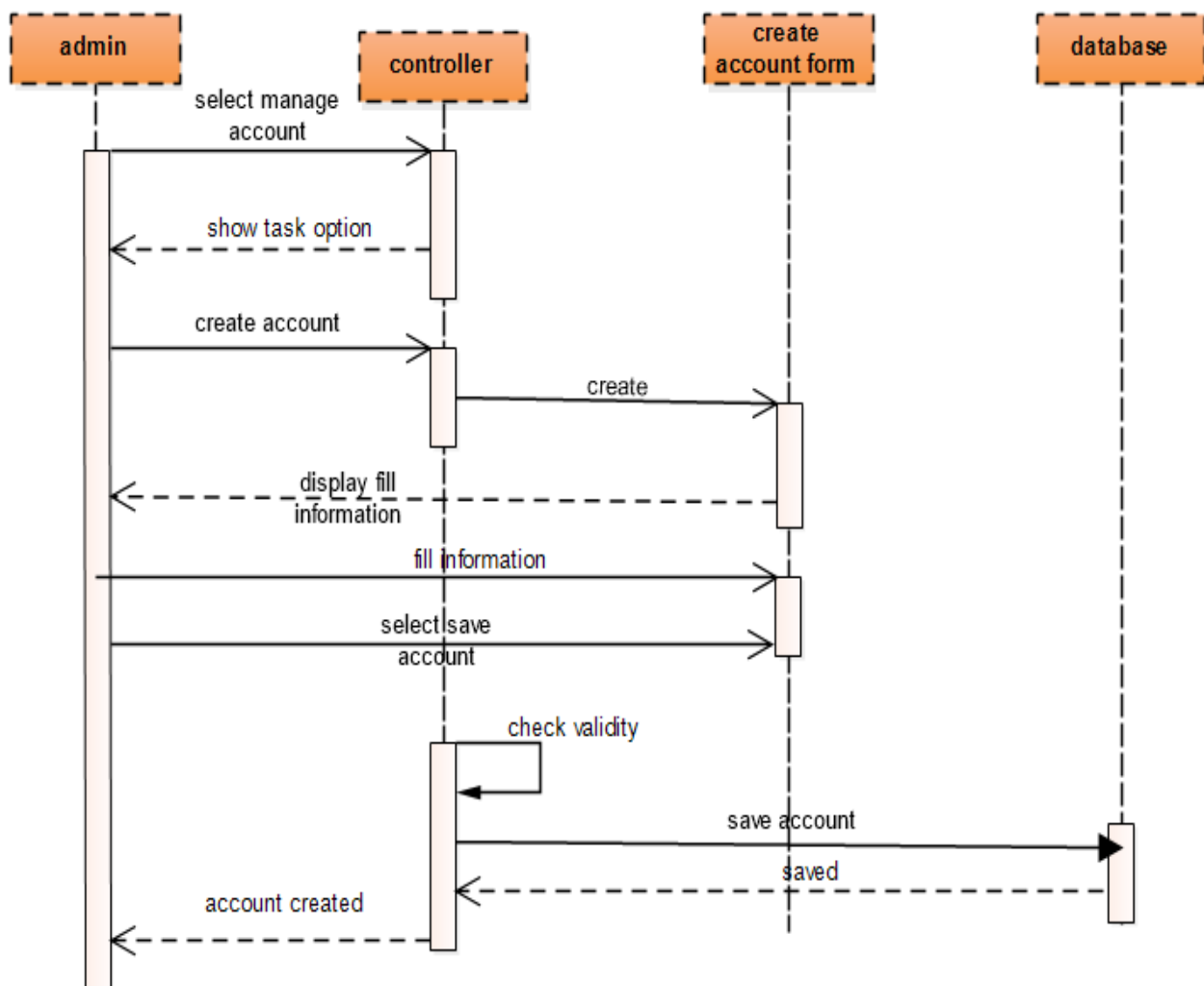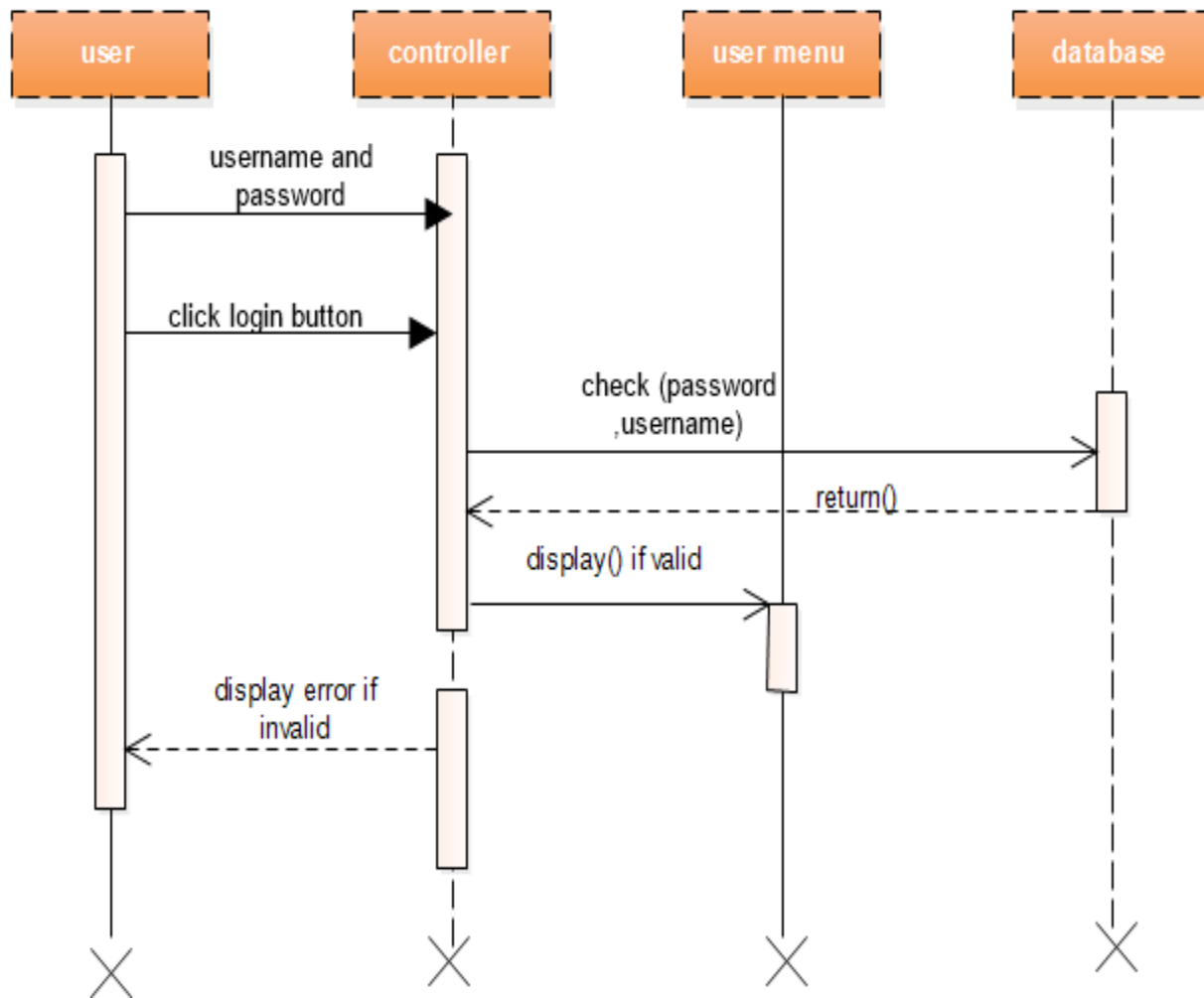

Figure 2.4 create account sequence diagram

Figure 2.5 login sequence diagram
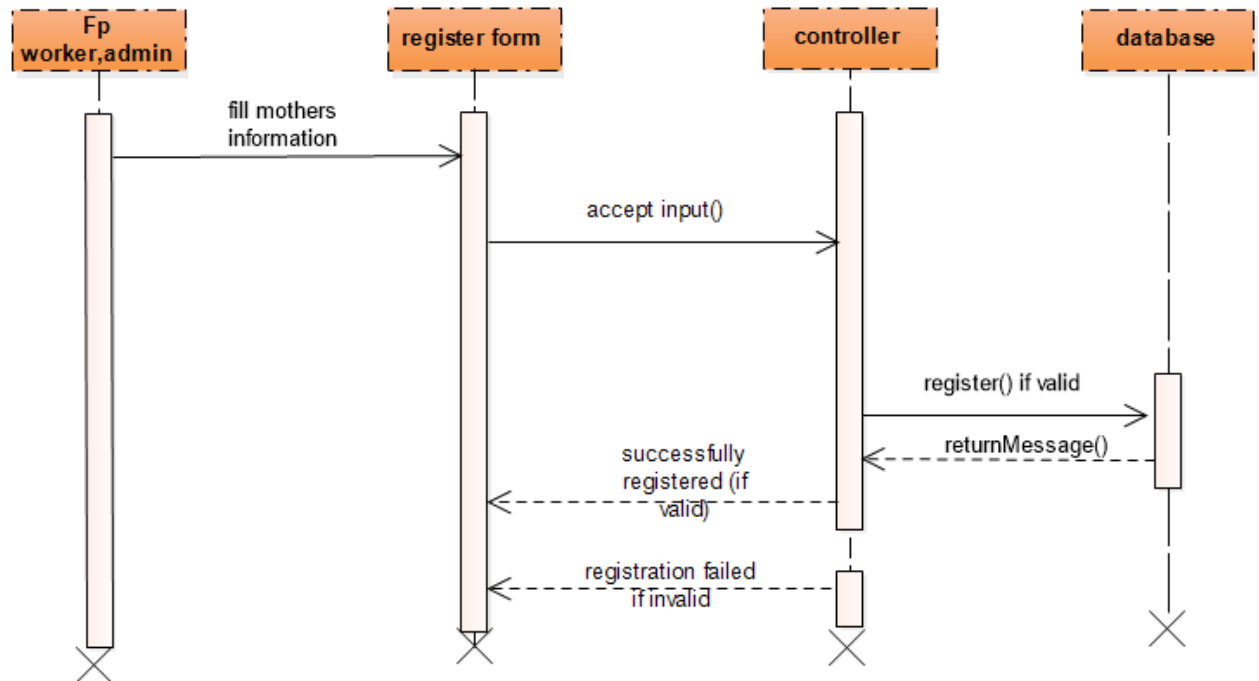
Figure 2.6 register sequence diagram
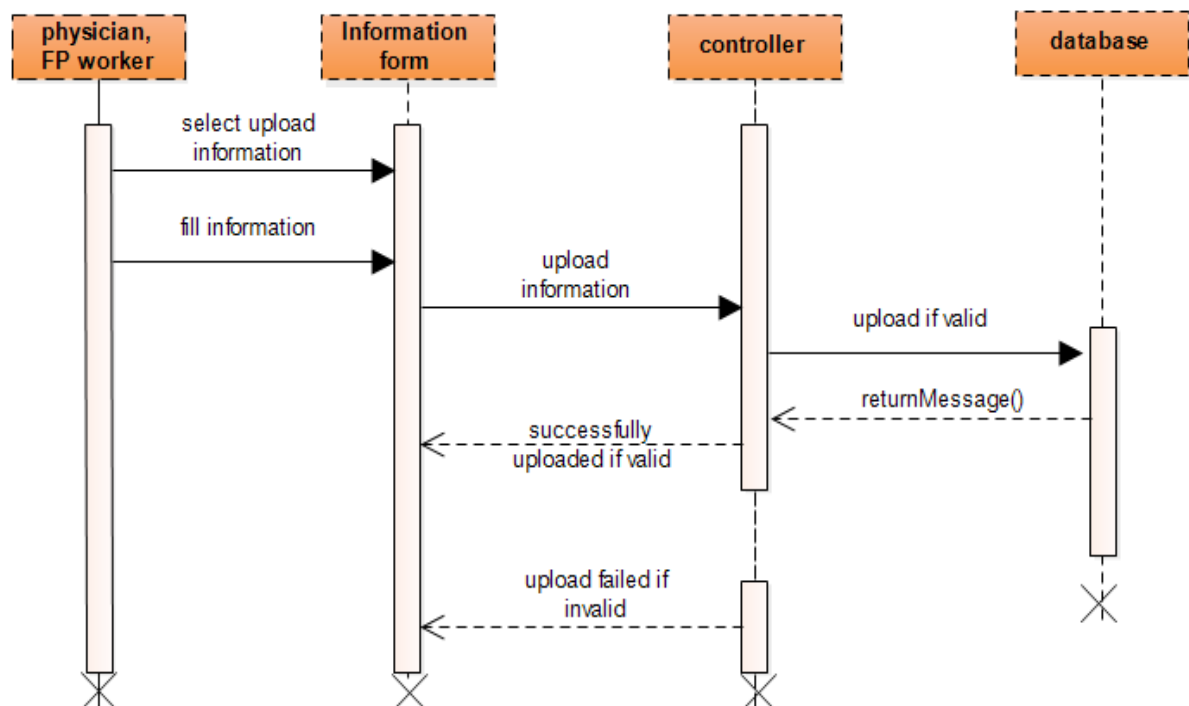
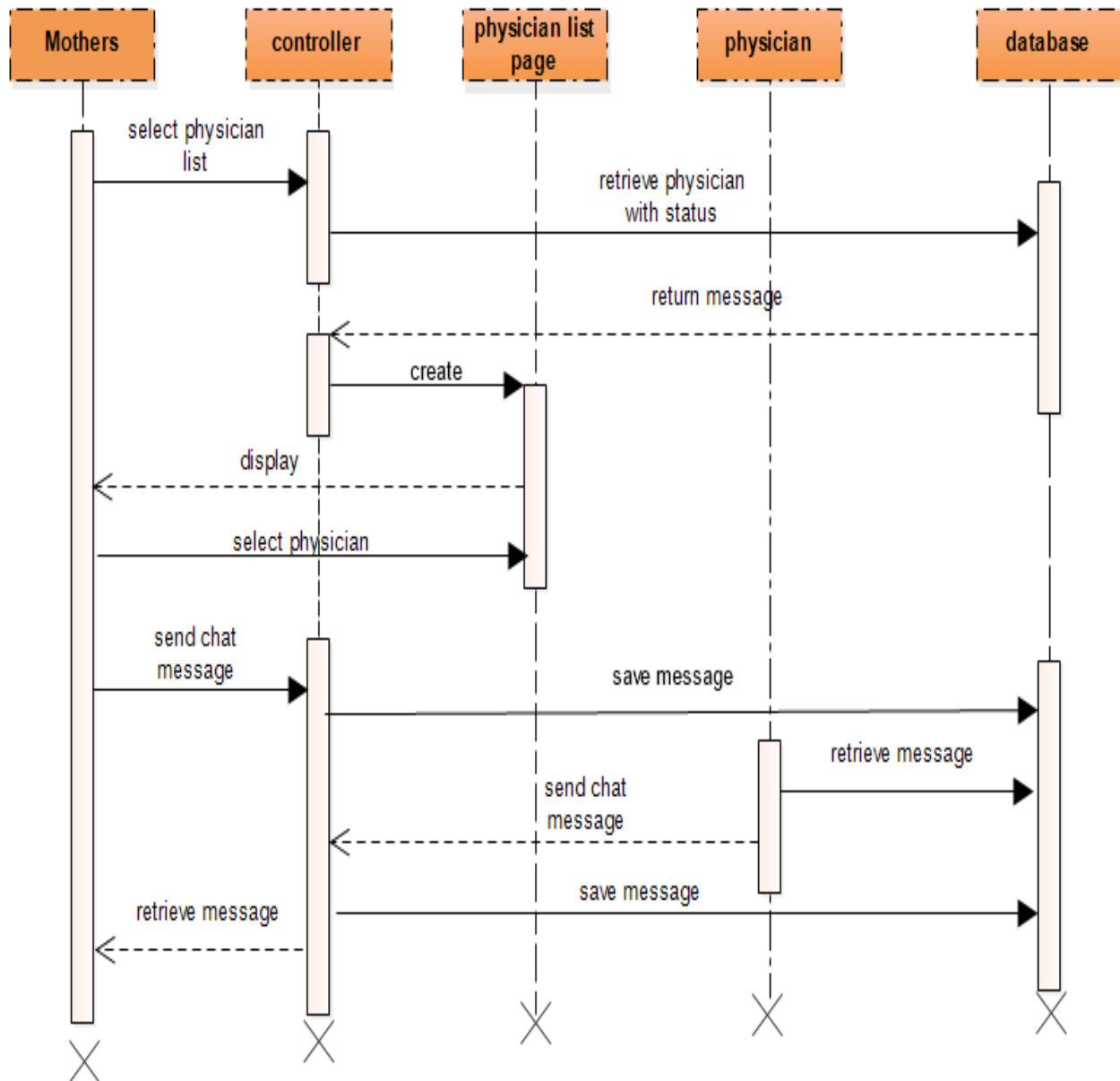Figure 2.7 upload information sequence diagram

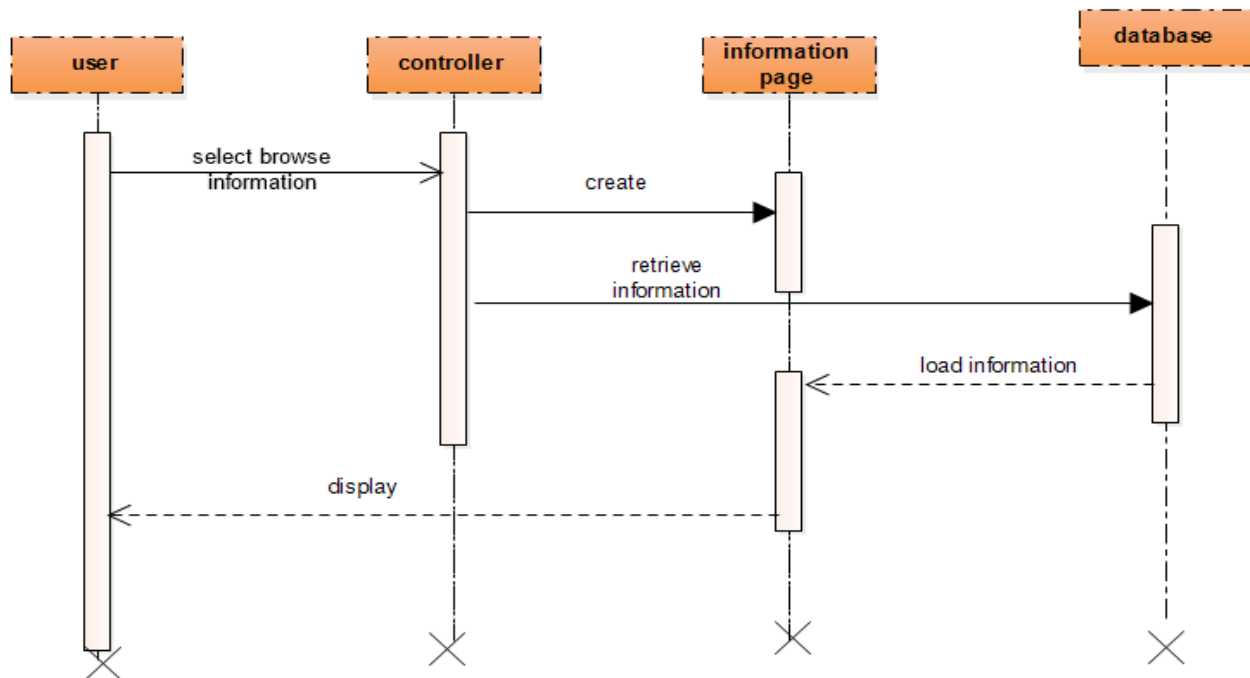Figure 2.8 chatting sequence diagrams

Figure 2.9   retrieve information sequence diagram
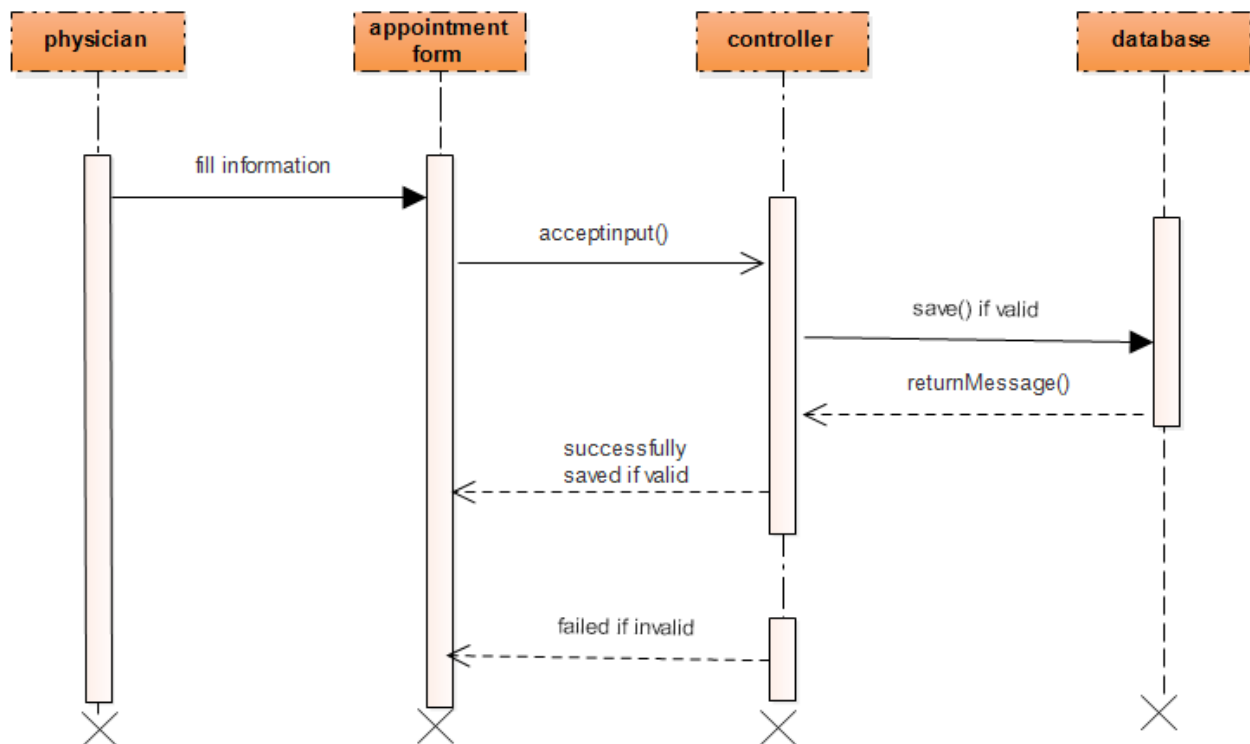

Figure 2.10 set appointment sequence diagram

2.2.6 Activity diagram

Activity diagrams are graphical representations of workflows of stepwise activities and actions with support for choice, iteration and concurrency. In the unified modeling language, activity diagrams can be used to describe the business and operational step-by-step workflows of components in a system. An activity diagram shows in overall flow of control. In its basic form an activity diagram is a simple and intuitive illustration of what happens in a workflow, what activities can be done in parallel, and whether there are alternative paths through the workflow.
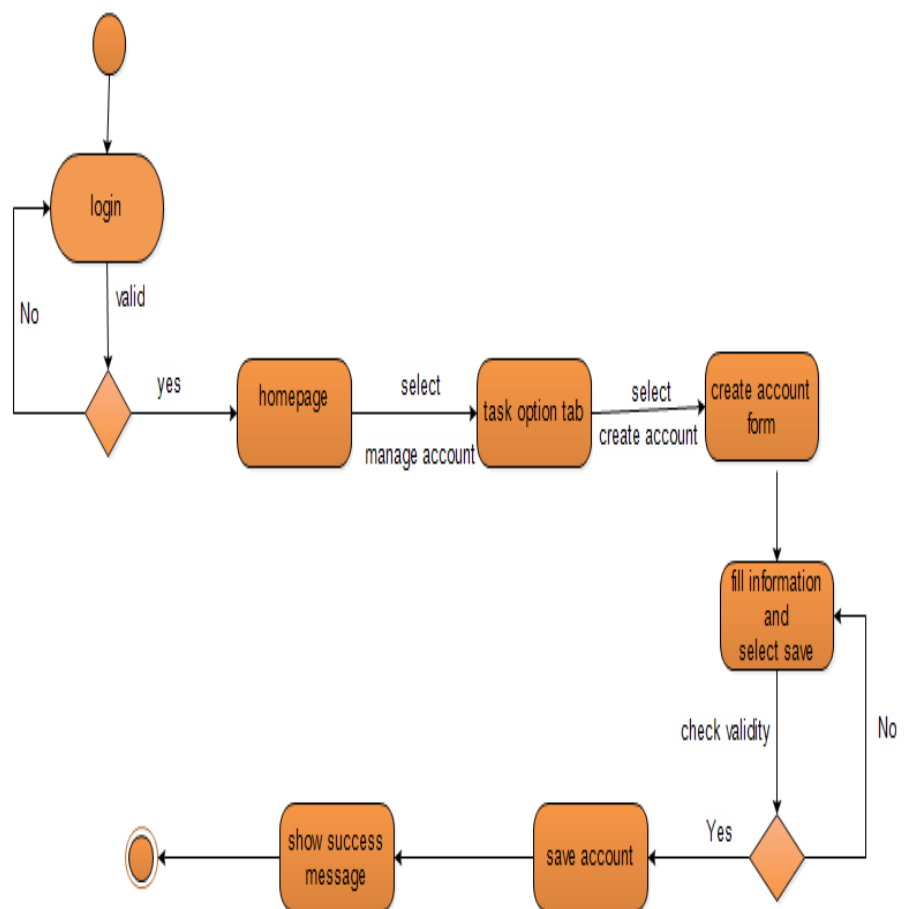
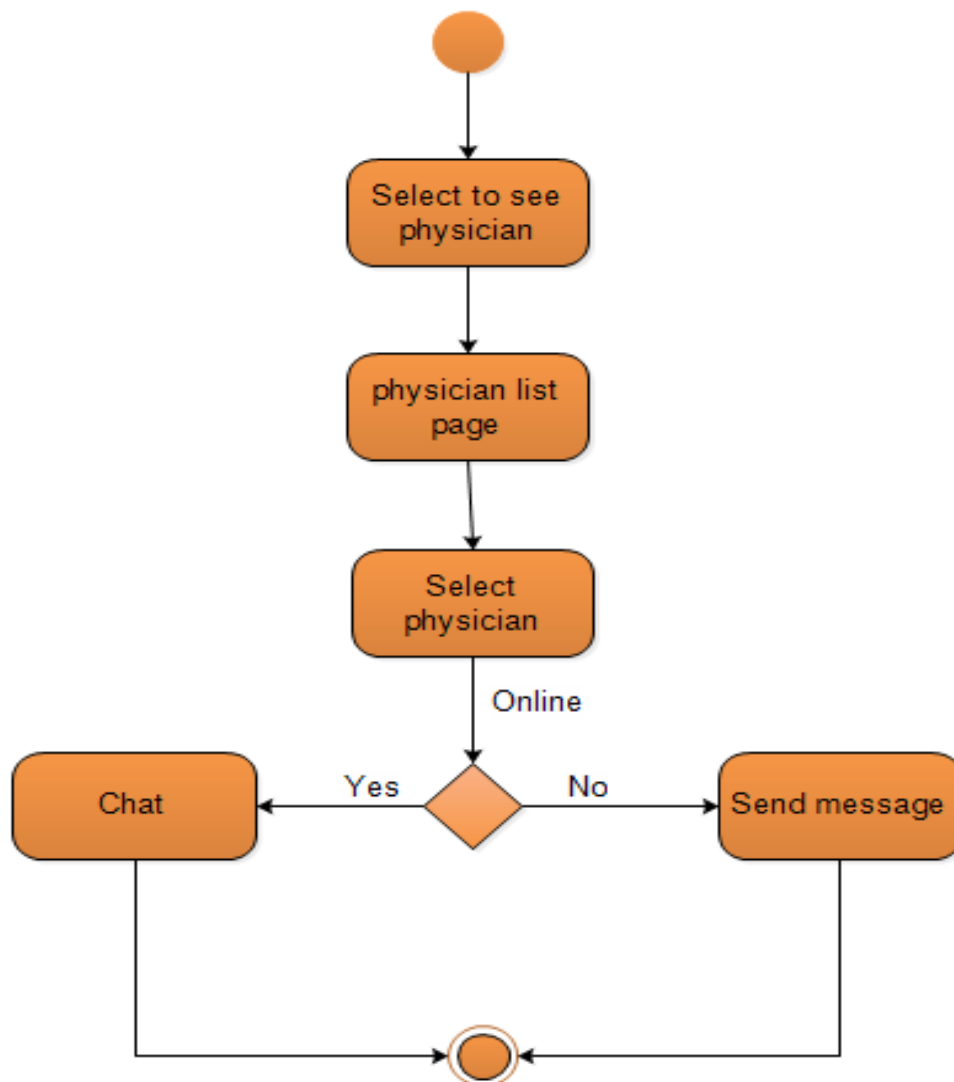Figure 2.11 activity diagram for create account

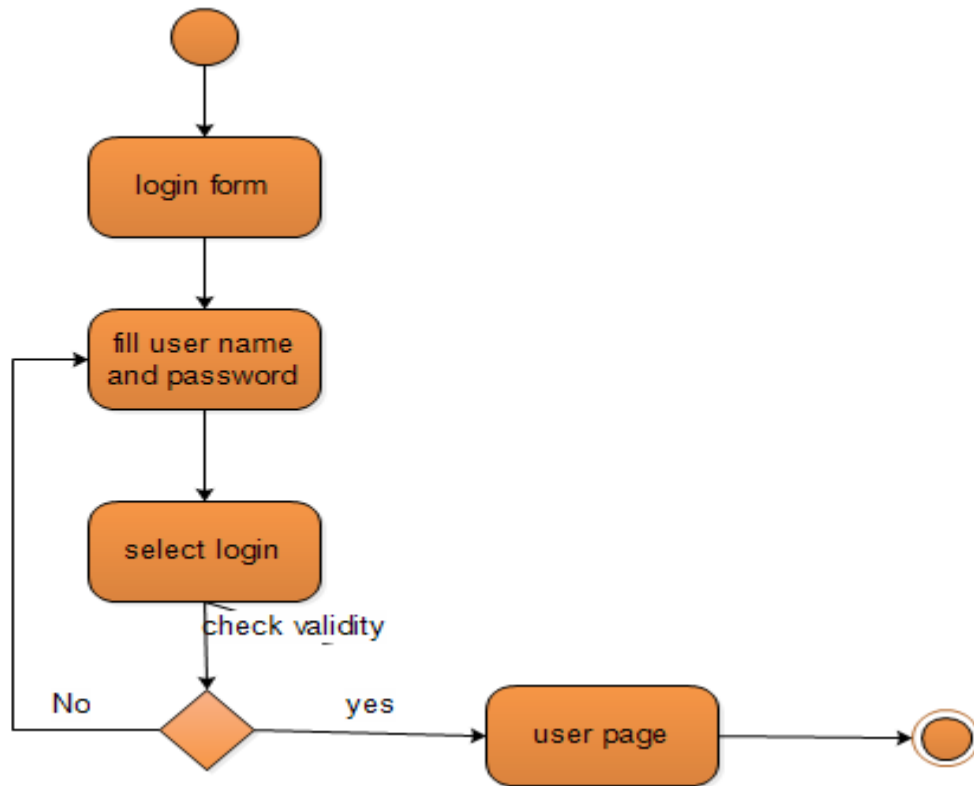Figure 2.12 activity diagrams for chatting

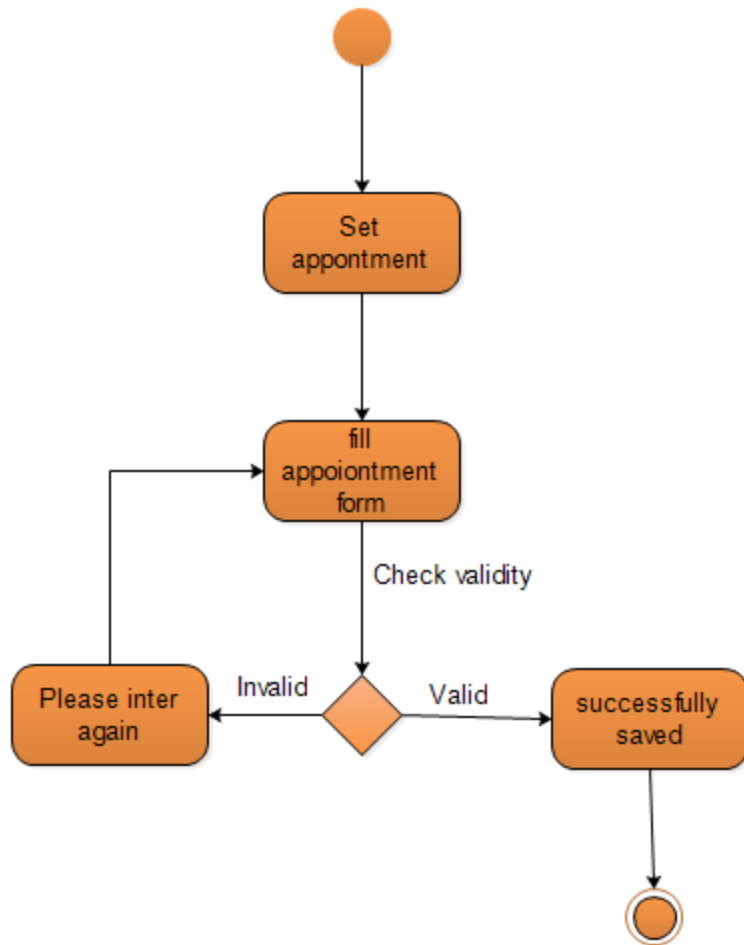Figure 2.13 activity diagrams for login
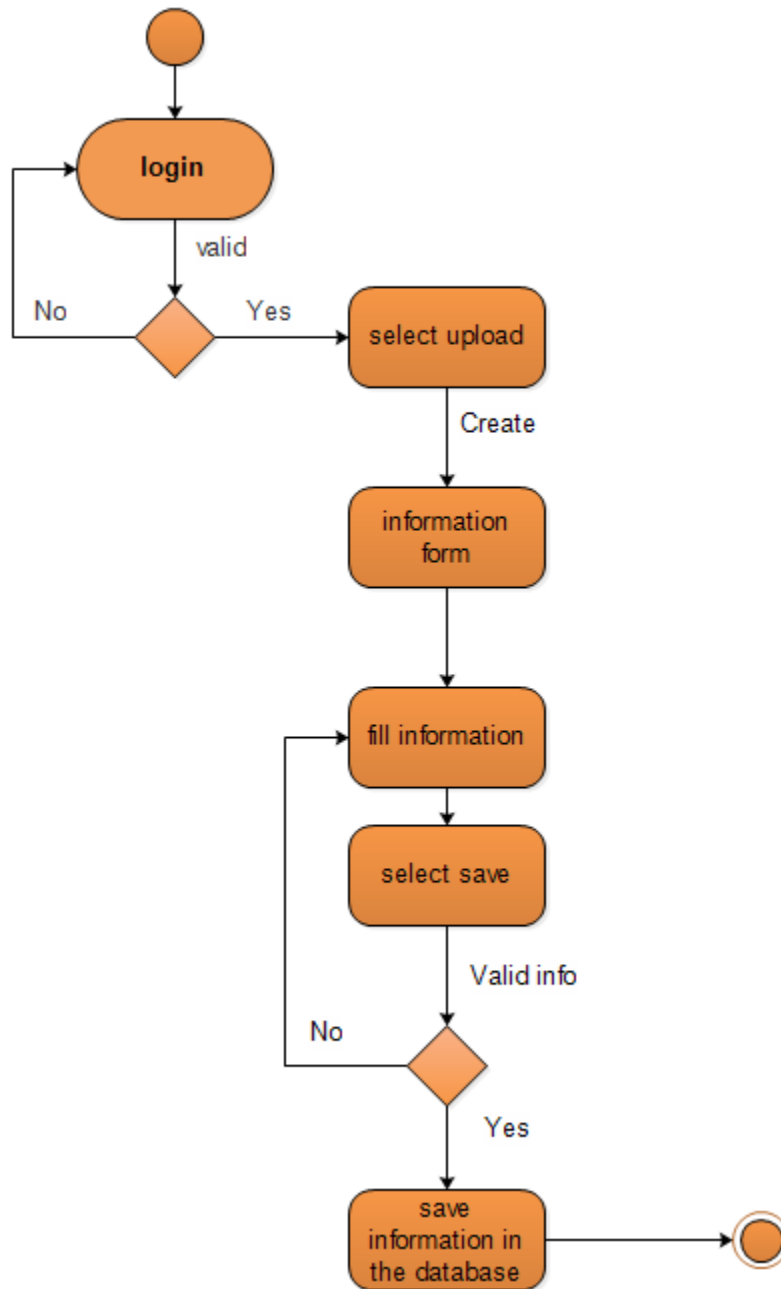
Figure 2.14 activity diagrams for set appointment

Figure 2.15 activity diagrams for upload information
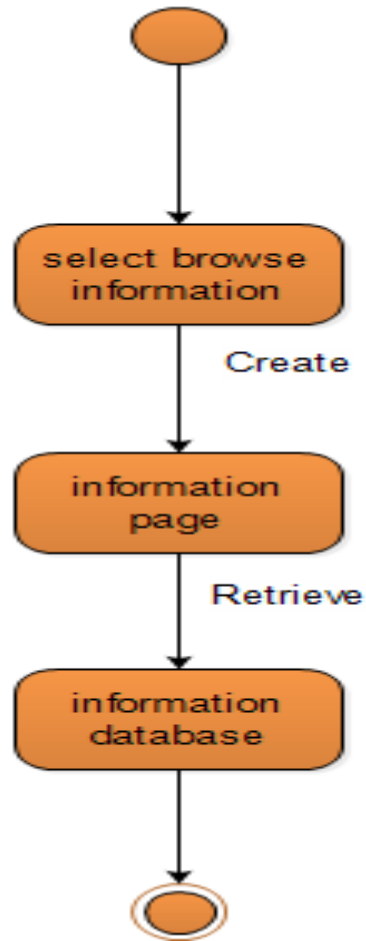
Figure 2.16 activity diagrams for Retrieve information
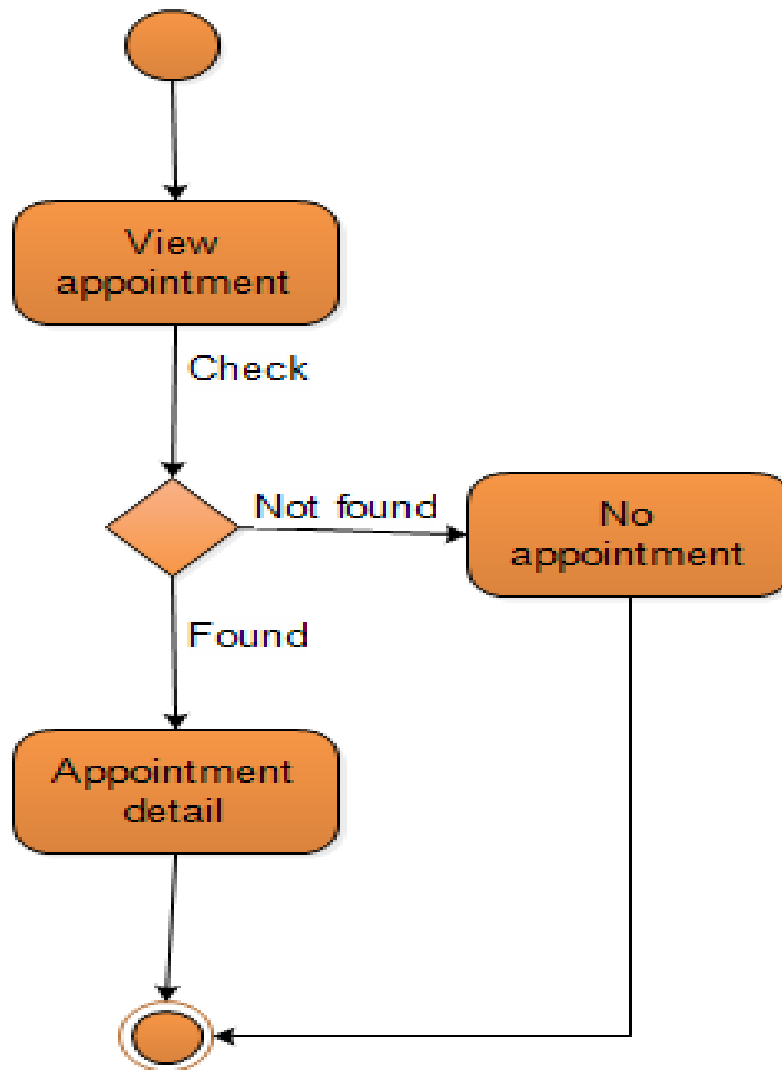
Figure 2.17 activity diagrams for view appointment

2.2.7 State chart diagram

State diagram or state chart diagram is a type of diagram used in computer science and related fields to describe the behavior of systems. State diagrams require that the system described is composed of states. Many forms of state diagrams exist which differ slightly and have different semantics. State diagrams are used to give an abstract description of the behavior of a system. This behavior is analyzed and represented in series of events that could occur in one or more possible states.

Fig 2.18 state chart diagram for login
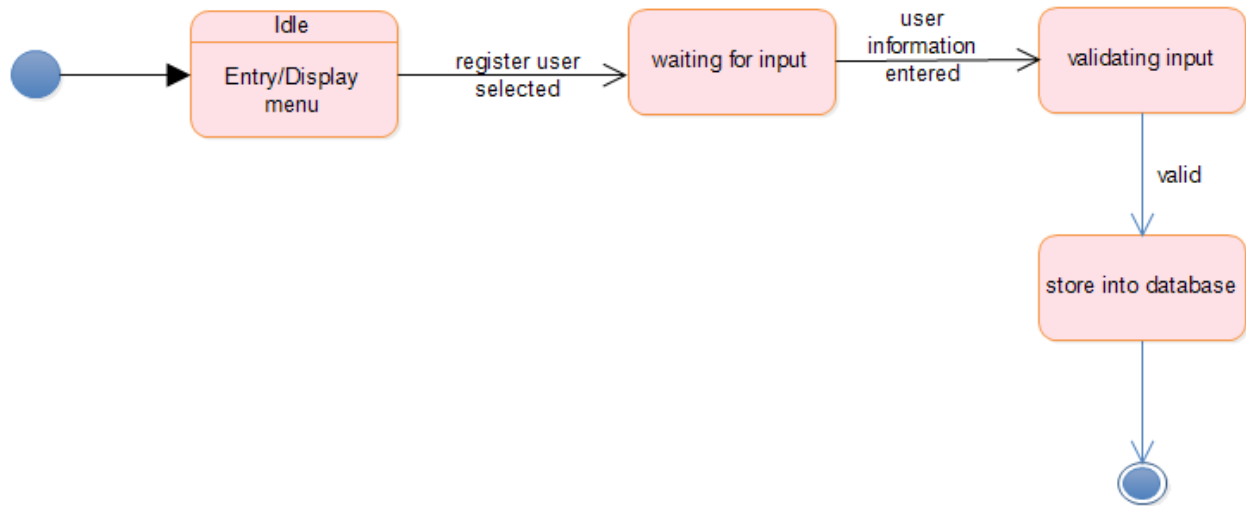
Fig 2.19 state chart diagram for registration
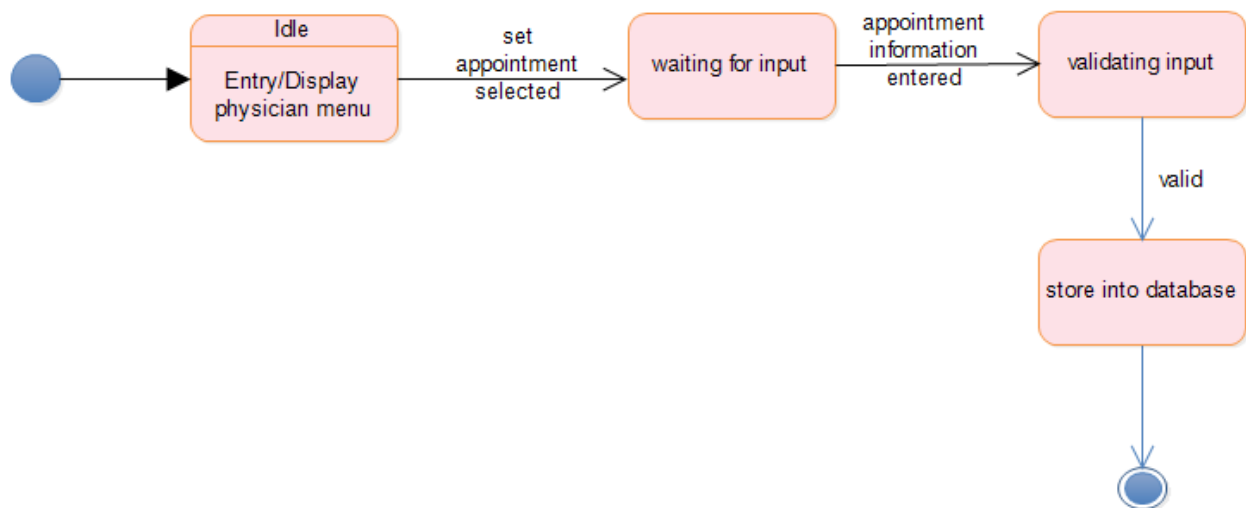
Fig 2.20 state chart diagram of set appointment
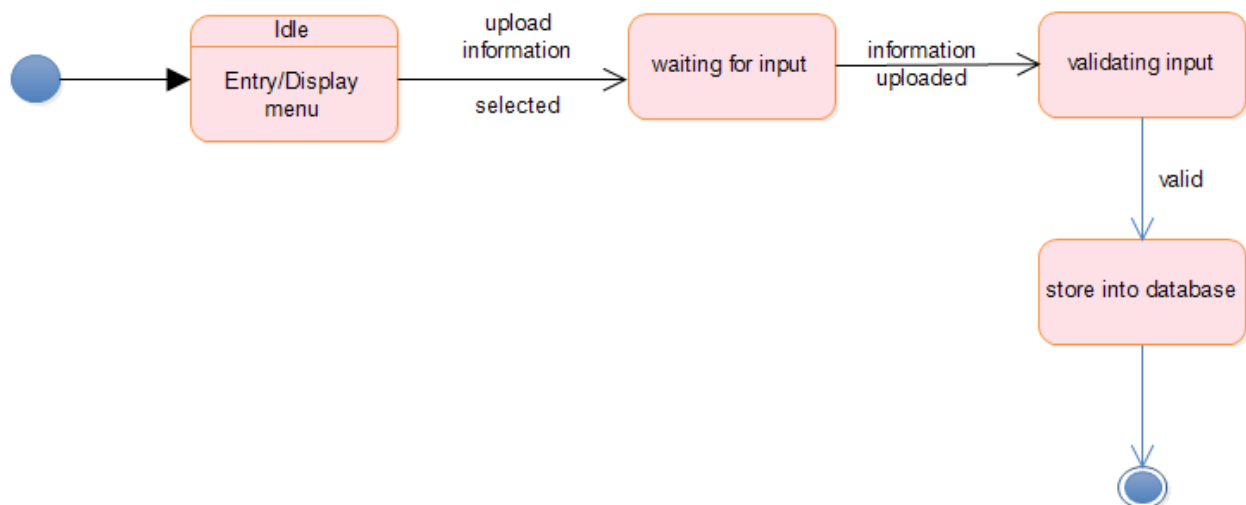
Figure 2.21 state chart of upload information

2.2.8 Class responsibility collaboration (CRC)

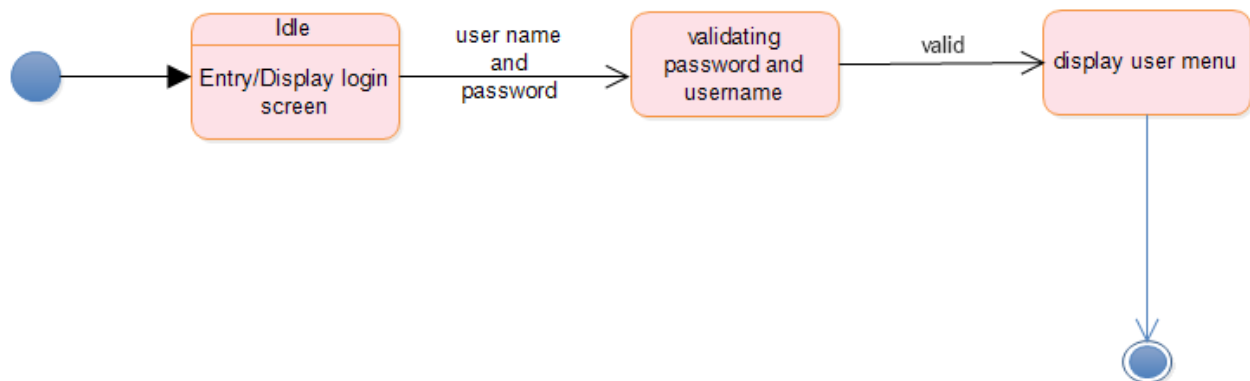A CRC model is a collection of standard index cards that have been divided into three sections. A class represents a collection of similar objects, a responsibility is something that a class knows or does, and a collaborator is another class that a class interacts with to fulfill its responsibilities. Collaboration diagrams represent interactions between objects as a series of sequenced messages. Collaboration diagrams describe both the static structure and the dynamic behavior of a system.

- ✓ **responsibility**: knowledge class maintains or service class provides

- ✓ **collaborator**: a class whose knowledge or services are needed to fulfill a responsibility

User	
Responsibility	**collaboration**
First name	Mother
Last name	Physician
Age	Family planning worker
Date of birth	Admin
Status	
Phone number	

Appointment	
Responsibility	**collaboration**
Appointment number mother name Time Date	Mother physician

authentication	
Responsibility	**collaboration**
Username Password	Mother Physician Fp worker Admin

Information	
Responsibility	**Collaboration**
Information type Name	Mother Physician Fp worker

Table 2.9 CRC table

2.2.9 Class diagram

A class diagram is an illustration of the relationships and code dependencies among classes in the Unified Modeling Language (UML). A class defines the attributes and operations in an object, which is a specific entity in a program or the unit of code representing that entity. Class diagrams are useful in all forms of object-oriented programming (OOP).
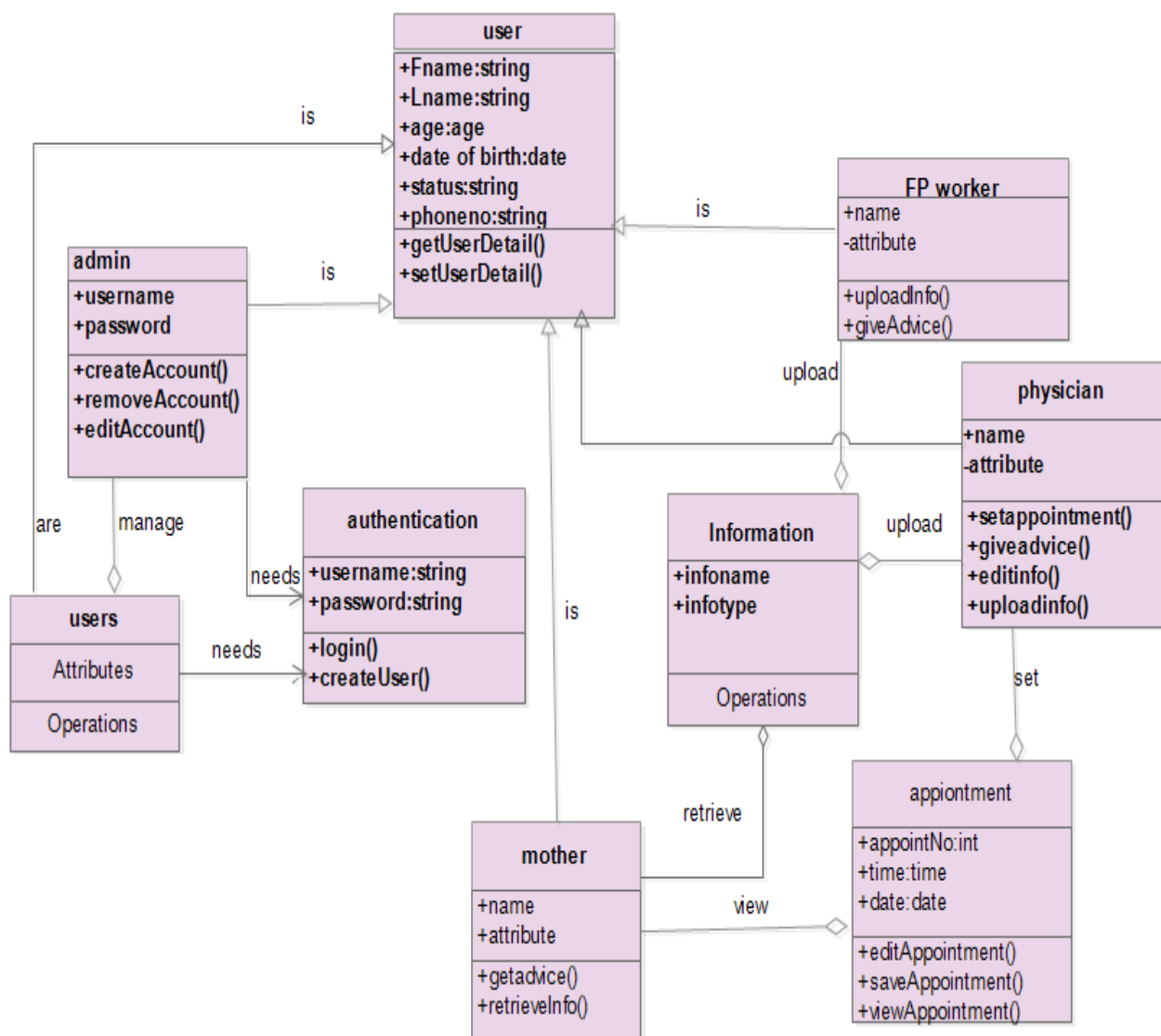
Figure 2.22 class diagram

2.2.10 User Interface Prototyping

Figure 2.23 login interface   figure 2.24 mother page

Figure 2.25 FP worker   Figure 2.26 physician page

Figure 2.27 set appointment form

Figure 2.28 advising form

CHAPTER THREE

SYSTEM DESIGN

3.1 Introduction

The analysis model describes the system completely from the actors" point of view and serves as the basis of communication between the client and the developers. The analysis model, however, does not contain information about the internal structure of the system, its hardware configuration, or, more generally, how the system should be realized. And System design is the transformation of the analysis model into a system design model.

In this chapter, we define the design goals of our project and decompose the system into smaller subsystems that it can be understandable. We also select strategies for building the system, such as the hardware/software platform on which the system will run, the persistent data management strategy, the global control flow, the access control policy, and the handling of boundary conditions. The result of this chapter is a model that includes a clear description of each of these strategies, subsystem decomposition, and a UML deployment diagram representing the hardware/software mapping of the system.

3.2 Design goals

The design goals represent the desired qualities the system should have and provide a consistent set of criteria that would be taken into consideration when making design decisions. The following are mentioned as the design goals of "mobile assisted maternal health advisory system".

Security: the system should be secure to maintain data confidentiality. The system should authenticate it"s users by prompting them to enter user name and password in order to get access to the system.

Extensibility: the system should allow any additional services easily if needed, in other words it should not be difficult to extend the system if additions are necessary.

Availability: the system should be available every time the user needs to access it.

Usability: the system should have user friendly user interface to allow the user to interact with the system easily.

Portability: the system should be able to run on any mobile that supports j2me mobile applications.

Performance: the main performance measure for a project is time, so the system should give fast responses for user requests.

3.3 Proposed Software Architecture

The architecture which will be used for the proposed system is a two tier architecture where the client or the user side is a mobile phone containing user interfaces like data entry interfaces, it is used to display information to the user. User directly interacts with the system through the interfaces on this layer.

The data layer or the database is responsible for storing all information needed for the system to function correctly. It is used to record or store information.
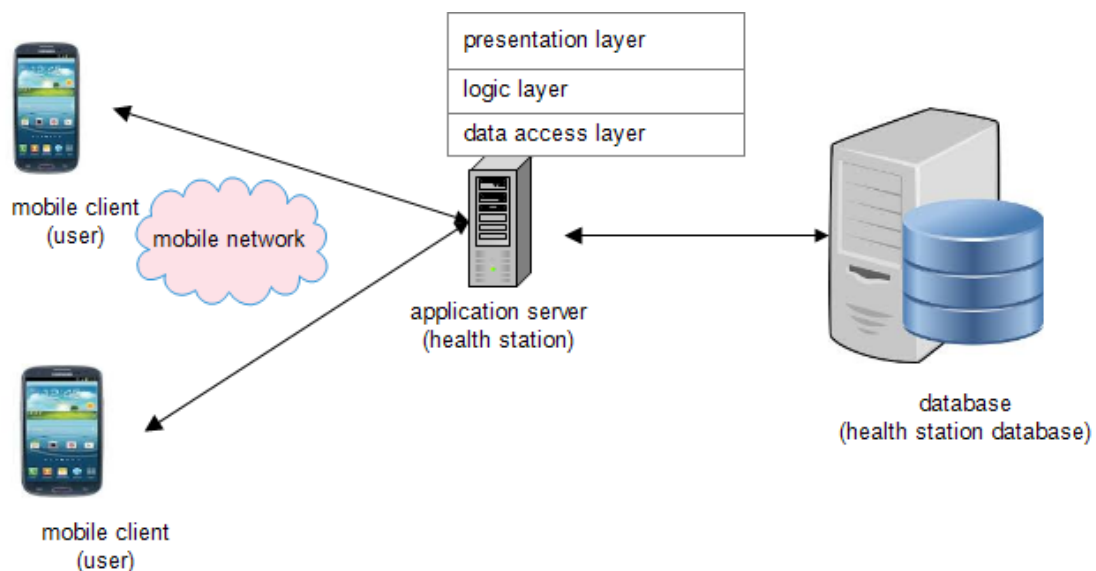
Figure 3.1 software architecture diagrams

3.3.1 Subsystem Decomposition

Subsystem decomposition will help reduce the complexity of the system. The subsystems can be considered as packages holding related classes or objects. The MAMHAS is decomposed into the following subsystems.

Mothers subsystem:- the   mothers subsystem responsible for view information, view appointment and get advice from physician or family planning workers in the form of chatting.

Admin subsystem: the administrator subsystem is responsible for managing accounts.

Physician subsystem:- the physician subsystem responsible for give advice for mothers, upload information and set appointment for mothers.

FP worker Subsystem: - the FP worker subsystem responsible for give advice about family planning for mother, upload information, view information, and register mothers.
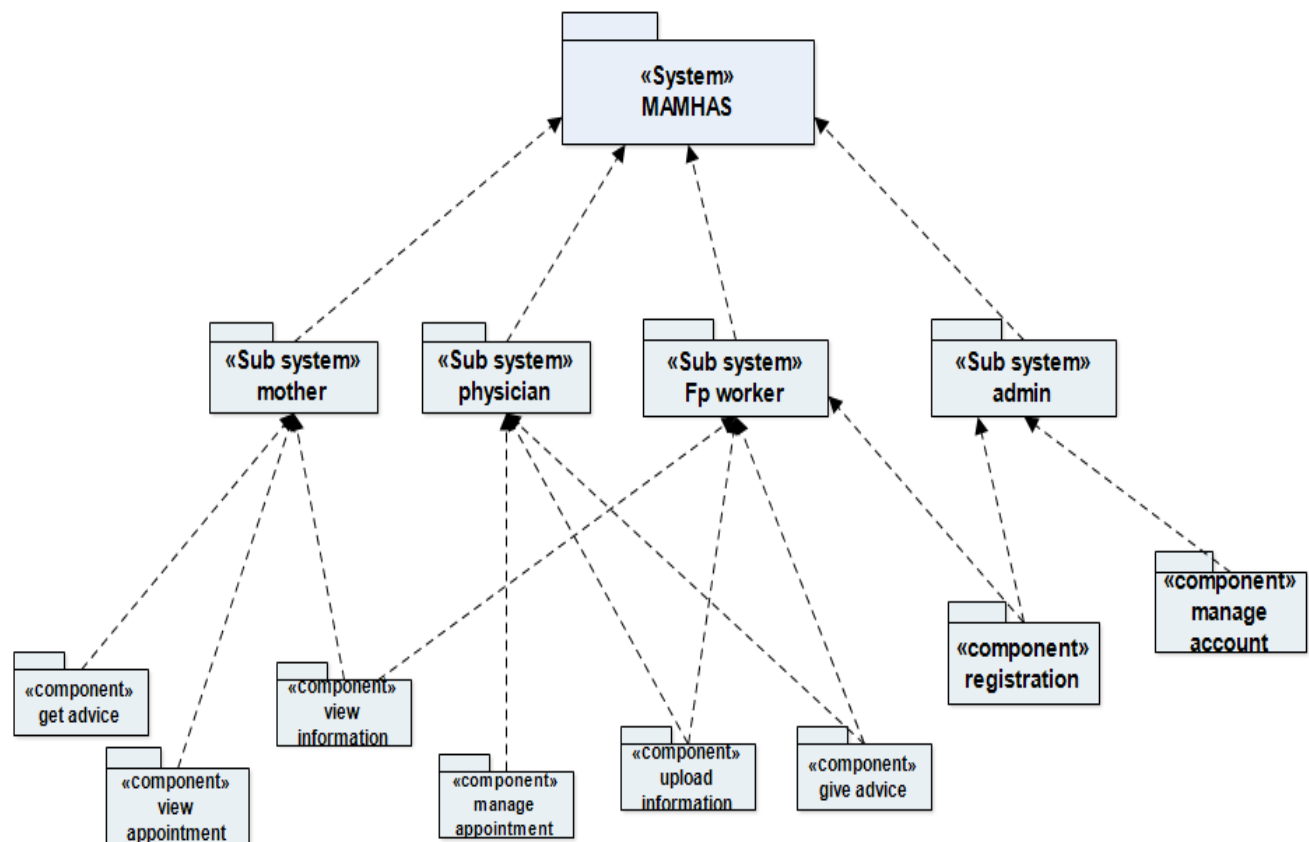
Figure 3.2 subsystem decomposition diagrams

3.3.2 Component diagram

In the unified modeling language, a component diagram depicts how components are wired together to form large components and or software systems. They are used to illustrate the structure of arbitrarily complex systems. The component diagram for MAMHAS is showed below.
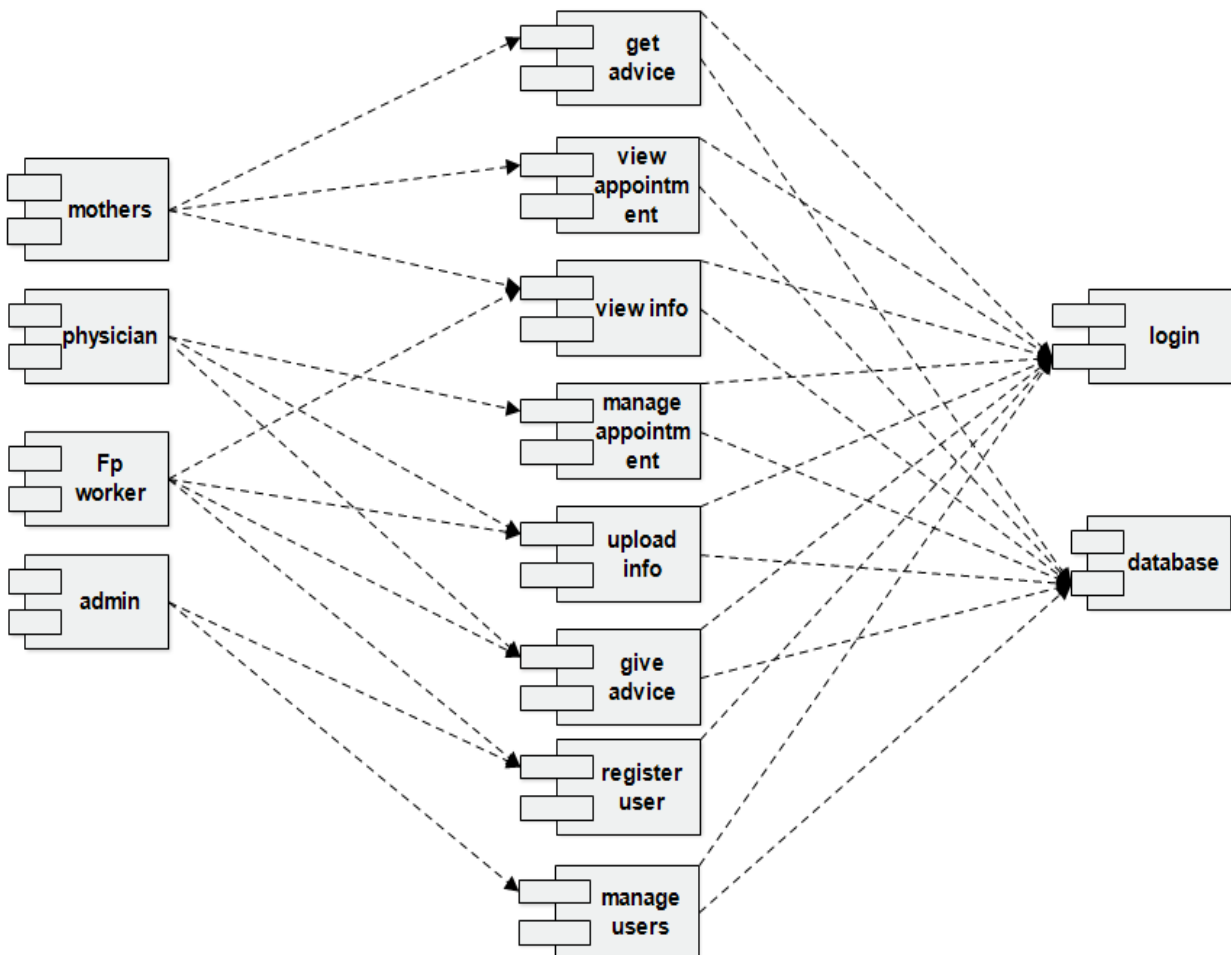
Figure 3.3 component diagram

3.3.3 Deployment diagram

A deployment diagram shows the hardware of your system and the software in that hardware. It maps a system‴s software components to the hardware that will execute them, also it models a system‴s logical elements, their physical location, and how they communicate. The following diagram is the new systems deployment diagram which shows the physical device phone with its software components.
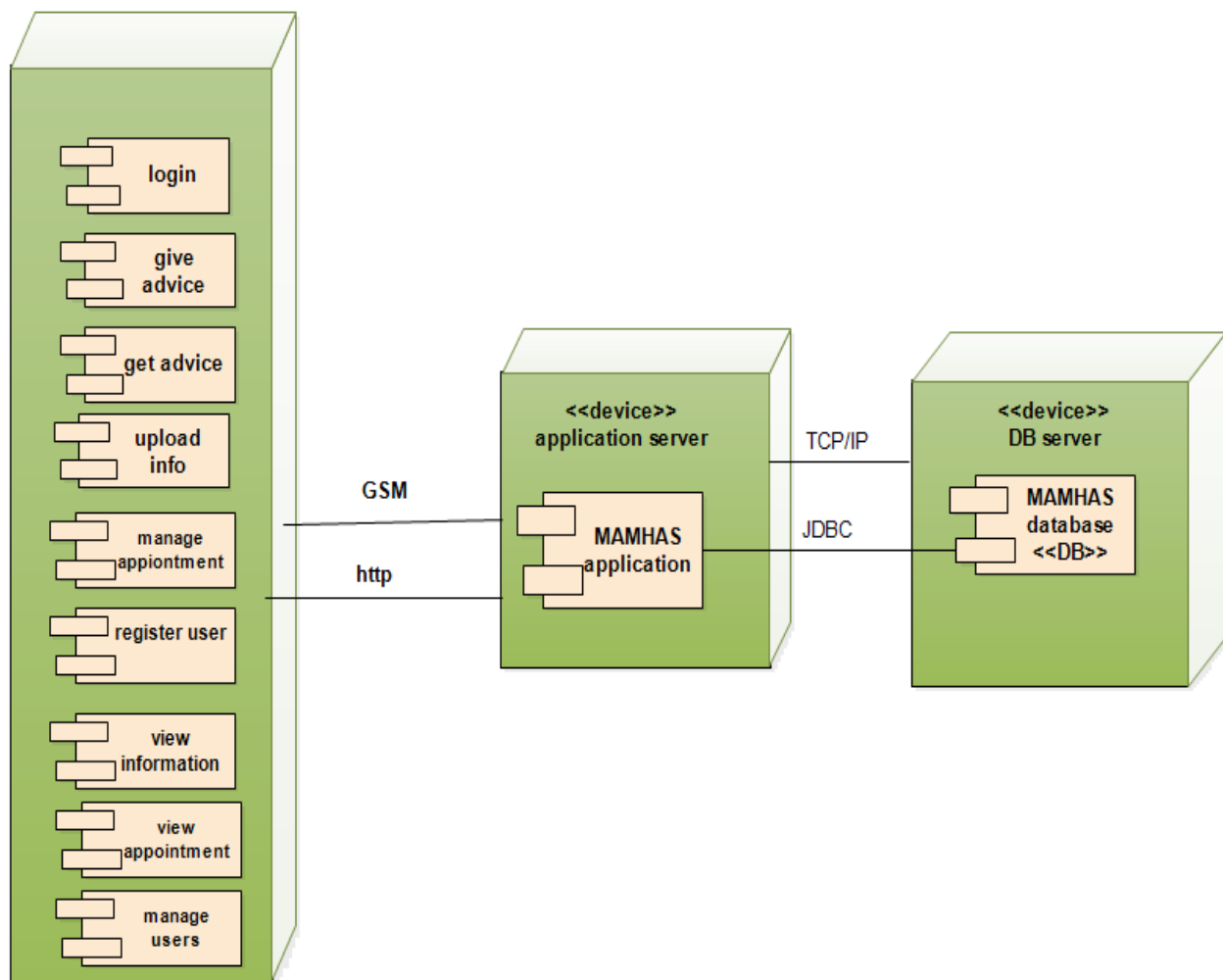
Figure 3.4 deployment diagram

3.3.4 Persistence modeling for object oriented database

Persistent objects are stored in a persistence mechanism. In this system, we use persistence modeling mechanism to store data of the new system"s application. This allows all the programs that operate on the mobile assisted maternal health advisory system data to do consistently. Moreover, storing data in a database enables the system to perform complex queries on a large data set.

3.3.4.1 Table mapping for persistence modeling

There are seven tables that will be implemented in the database, namely mother, physician, Fp worker, account, appointment, reminder, and information tables.

user
m_id: string
FName: string
LName: string
Gender: string
age: number
user photo image
marital_status: string
date: date
phone_no: string
description: string
email: string
user account_type: string
user account_name: string

<<user>> table
PK   m_id: varchar(20)
FName: varchar(20)
LName: varchar(20)
Gender: varchar(10)
age: number
user photo image
marital_status: string
date: date
phone_no: varchar(15)
description: varchar(max)
email:varchar(30)
FK user account_type: varchar(15)
user account_name: varchar(15)

information
info_name: string
info_type:string

<<information>> table
info_name: varchar(max)
info_type:varchar(50)

appointment_detail	<<appointment_detail>> table
Appointment no: number	PK Appointment no: integer(10)
mother name: string	mother name : varchar(30)
Date : date	Date : date
Time : time	Time :time(7)
mother id : string	FK mother id : varchar(10)

History	<<History>> table
hist-id: string m_id: String Ph_id/Ph_id:string date/time :date description:string	PK hist-id: string m_id: String Ph_id/Ph_id:string date/time :date description:string

Message	<<Message>> table
mmsg_id: number date/time:date sender:string reciever:string isfileattached:yes/no image: url vedio: url msgcontent	Pk msg_id: number date/time:date sender:string reciever:string isfileattached:yes/no image: url vedio: url msgcontent:string

Figure **3.5** Mapping objects into table

3.3.4.2 Relationship between tables

The following figure shows the relationship between the tables that are used to store data persistently in the system
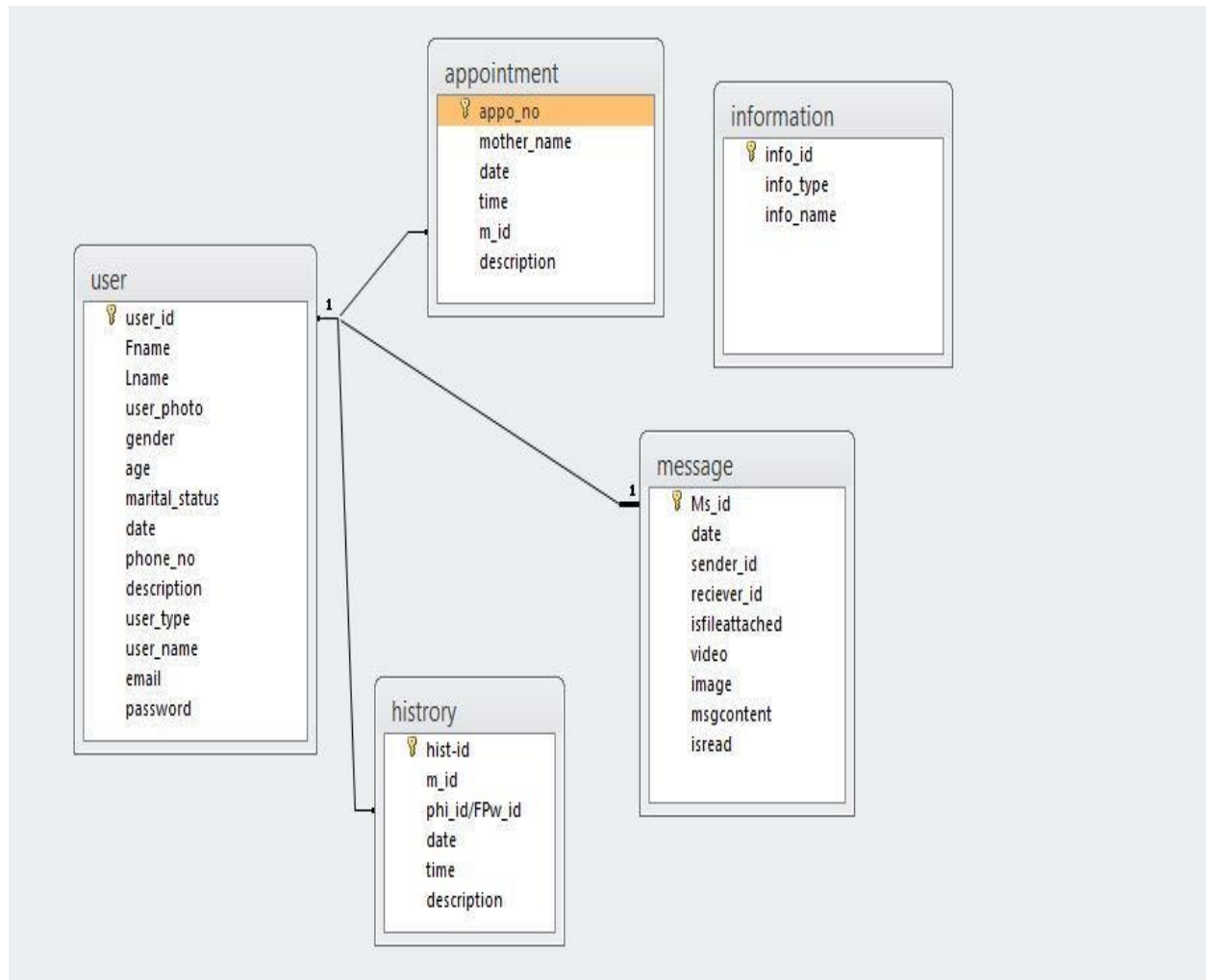
Figure 3.6 Relationships between tables.

3.3.5 Access control and security

The system we are developing will be deployed on mobile phones which are owned by a mother or physician, hence as long as the user is the actual user authenticated user can access whatever the functions provided by the system.

functionality	mother	physician	FP worker	administrator
Get advice	yes	no	no	no
View information	yes	no	yes	no
View appointment	yes	yes	no	no
Give advice	no	yes	yes	no
Upload information	no	yes	yes	no
Set appointment	no	yes	no	no
Manage accounts	no	no	no	yes
Register user	no	no	yes	yes

Table 3.1 Access control and security

CHAPTER FOUR

4 IMPLEMENTATION AND TESTING

Implementation is all about the processes involved in getting new software or hardware operating properly in its environment, including installation, configuration, running, testing, and making necessary changes. The importance of having this process set lies in the systematic analysis and way to carry out the tasks. Every activity aim to reach the objectives specified in the statement of work and the main goal is to achieve the final project with all the attributes demanded by the customer with a high level of quality.

4.1 Objectives of Implementation

The objectives of our software implementation activity are described as follows:

- Software implementation allows to prepare the team work for the activities and to have all the necessary tools to accomplish the work.

- Start using the website by using installed software like web browsers.

- Start guiding the users how to access all the services provided by the website.

- To identify issues that must be corrected by the software development team. The different types of tests are executed in different points of time.

- Identify key functionalities of the future system with the customer to avoid problems like forgotten key functionalities or requirements creep and exceptions.

- Software Component Identification is a key part of a software project. Failure to describe a design architecture that will incorporate all the requirements is a reason for disaster.

- The Product Delivery conducts ongoing activities, there should be no surprise, no delays to obtain acceptance of users.

4.2. Constraints on Implementation

The implementation part consists of certain constraints that are inputs for the implementation of the system to make it functional and operational. The following are some of the constraints of implementation in our mobile based application:-

Programming tools:- programming tools that are used during the implementation of the application(mobile assisted maternal health advisory system) are

Android Development Tools (adt):- mobile assisted maternal health advisory system is a mobile application so, this mobile application is developed using Android 4.4.2, which is one of the latest Android version and vertrigoServ which is used to implement the server side that is consisting of Apache (HTTP), MYSQL (SQL Database Management System). And also some of the android tools used during the development are listed below.

The Android SDK and Virtual Device Manager: Used to create and manage Android Virtual Devices (AVD) and SDK packages. The AVD hosts an emulator running a particular build of Android, letting us to specify the supported SDK version, screen resolution, amount of SD card storage available, and available hardware capabilities.

The Android Emulator: An implementation of the android virtual machine designed to run within a virtual device on our development computer. We use the emulator to test and debug our Android applications.

Genymotion: it is an Android emulator that comprises a complete set of sensors and features in order to interact with a virtual Android environment. With Genymotion, you can test your Android applications on a wide range of virtual devices for development, test and demonstration purposes. When it with AVD it is fast and effective to run the application that is developed on eclipse.

4.3. Testing by requirements

System testing involves testing and successful running of the developed system. The testing phase involves the testing of developed system using various kinds of data. An elaborate testing of data is prepared and the system is tested using the test data by inserting incorrect data. While testing, errors are noted and the corrections are made. The corrections are also noted for the future use. Testing can be stated as the process of validating and verifying that a computer program/application can:

- ✓ Meets the requirements that guided its design and development of our system,
- ✓ works as expected,
- ✓ Can be implemented with the same characteristics.
- ✓ And satisfy the need of the user.

Performance of the system has networked database. So, this can tell that the system can be used by different users. This allows many users can perform their actions simultaneously. This implies using the same database by different system.

Security Issue to protect mobile assisted maternal health advisory system data, to avoid loss of information and system misuse, the system shall provide restriction in using functionality and information access by its users. Security is implemented by requiring users to login before using the system. The login procedure is password protected

Error handling to continue working even if the user of the system inserts unsupported or incorrect data format by using exception handling mechanism . e.g user registration, if the admin enter character instead of number in phone number requests the system handle this error.

Test specification: login

Test case identifier	Login process
Test location	Login page
Feature to be tested	Checks whether the user is authorized user of the system or not
Feature to be criteria	The test passes: When user inserts correct username and password in the login page, the user page displayed If incorrect username and password inserted the system displays error message and allow to return password and username
data	Password and username information in the Login page.

Test case specification: user registration

Test case identifier	User registration
Test location	Registration page
Feature to be tested	Check whether registration is valid.
Feature to pass criteria	The test passes: When the admin or fp worker enters correct data the registration passed If incorrect data entered the system displays error message and allow returning registration data.
Data	User information

4. 4 Testing by Scope

- **Unit testing**

Each unit test is tested separately before integrating them into modules to test the interfaces between modules. While implementing the code all small components such as functions, conditional statements, loops and others were tested. For example while user registration, by providing the same username which already exists in the database the system displays the username is in use and recommends to use another username this assure lines of codes that are designed to verify the data entry is working well.

- **Integration testing**

Integration testing identifies problems that occur when units are combined. Class-Integration Testing has been made based on the relationships and the respective cardinalities that appear on the class diagram. After unit testing, our system is also tested whether every unit is integrated to every other unit. For example in case of set appointment if the physician enters mother id which is out of legitimate   process is rejected this shows the integration among classes is properly working.

- **System testing**

The system is functionally tested based on the use case model developed during the analysis phase, because they describe the exact behavior of how the users work with the application. The entire system is tested and approved, since it addresses all the user requirements such as accepts the data, process the data, stores the data, notify data entry errors and retrieve stored data. By doing so the system is working in line with the user's requirements.

4.5. Sample codes and Sample output screen

4.5.1 sample code

Sample code for login

```
package com.example.mother;
import java.util.ArrayList;
import java.util.List;
import org.apache.http.NameValuePair;
import org.apache.http.message.BasicNameValuePair;
import org.json.JSONArray;
import org.json.JSONException;
import org.json.JSONObject;
import android.annotation.SuppressLint;
import android.annotation.TargetApi;
import android.app.Activity;
import android.app.AlertDialog;
import android.app.ProgressDialog;
import android.content.DialogInterface;
import android.content.Intent;
import android.os.AsyncTask;
import android.os.Build;
import android.os.Bundle;
import android.os.StrictMode;
import android.text.Editable;
import android.text.TextWatcher;
import android.util.Log;
import android.view.Menu;
import android.view.View;
import android.view.View.OnClickListener;
import android.widget.Button;
import android.widget.EditText;
import android.widget.ImageButton;
import android.widget.Spinner;
import android.widget.TextView;
import android.widget.Toast;
public class NewLogin extends Activity {
private Button login;
String adm="admin";
String phy="physician";
String fpw="fp worker";
```

```
String moth="mother";
String usertype;
EditText us,ps;
EditText txtName;
EditText txtpass;
TextView checkerr,forgot;
String username,password;
 ImageButton bb;


private ProgressDialog pDialog;
Spinner sp;
// JSON parser class
JSONParser jsonParser = new JSONParser();
private static final String url ="http://192.168.56.1/mother/login.php";
private static final String TAG_USER = "user";
private static final String TAG_SUCCESS = "success";
private static final String TAG_MSG = "message";
@TargetApi(Build.VERSION_CODES.GINGERBREAD)
@SuppressLint("NewApi")
   @Override
   protected void onCreate(Bundle savedInstanceState) {
      super.onCreate(savedInstanceState);
      setContentView(R.layout.login);
      if(android.os.Build.VERSION.SDK_INT>9)
      {
          StrictMode.ThreadPolicy policy=new
StrictMode.ThreadPolicy.Builder().permitAll().build();
          StrictMode.setThreadPolicy(policy);
      }
      bb=(ImageButton)findViewById(R.id.gas);
      txtName= (EditText) findViewById(R.id.textUserName);
                txtpass= (EditText) findViewById(R.id.textPassword);
      forgot=(TextView)findViewById(R.id.forgot);
       System.out.println("message");
       password = txtpass.getText().toString();
                 username = txtName.getText().toString();
                 forgot.setOnClickListener(new OnClickListener() {
                               @Override
                       public void onClick(View arg0) {
                               // TODO Auto-generated method stub
                               Intent intent= new
Intent(NewLogin.this,createAccount.class);
```

```
                startActivity(intent);
                }
        });
    //checkFieldsForEmptyValues();
    bb.setOnClickListener(new OnClickListener() {
    @Override
    public void onClick(View arg0) {
     txtName= (EditText) findViewById(R.id.textUserName);
    txtpass= (EditText) findViewById(R.id.textPassword);
     password = txtpass.getText().toString();
     username = txtName.getText().toString();
     sp = ((Spinner) findViewById(R.id.spinner1));
    usertype= sp.getSelectedItem().toString();
    if(      username.trim().equals("")||password.trim().equals("")){
    NewLogin.this.runOnUiThread(new Runnable() {
 public void run() {
 AlertDialog.Builder builder = new AlertDialog.Builder(NewLogin.this);
builder.setTitle("error message");
 builder.setMessage("fill username or password correctly")
                        .setCancelable(false)
                        .setPositiveButton("OK", new
 DialogInterface.OnClickListener() {
                public void onClick(DialogInterface dialog, int id) {
                                 }
                            });
                            AlertDialog alert = builder.create();
                            alert.show();
                    }
                });
                }
                else{
                        new loginform().execute();


                }
            }
        });
    }

    class loginform extends AsyncTask<String, String, String> {
        @Override
            protected void onPreExecute() {
```

```
                    super.onPreExecute();
                    pDialog = new ProgressDialog(NewLogin.this);
                    pDialog.setMessage("Loading Login. Please wait...");
                    pDialog.setIndeterminate(false);
                    pDialog.setCancelable(true);
                    pDialog.show();
                }
    protected String doInBackground(String... params) {
                    // updating UI from Background Thread
    runOnUiThread(new Runnable() {
      public void run() {
                                        int success;
                                        String msg;
                                            try {
                                            // Building Parameters
                                            List<NameValuePair>      params      =      new
ArrayList<NameValuePair>();

                                            params.add(new
BasicNameValuePair("usertype", usertype));
                                            params.add(new
BasicNameValuePair("username", username));
                                            params.add(new
BasicNameValuePair("password", password));
                                            // getting account details by making HTTP
request
                                            // Note that account details url will use GET
request
                                            JSONObject              json              =
jsonParser.makeHttpRequest(url, "GET", params);
                                            // check your log for json response
                                            Log.d("login", json.toString());
                                            // json success tag
                                            success = json.getInt(TAG_SUCCESS);
                                            if (success == 1) {
                                                    // successfully received account details
                                                    JSONArray userObj = json

        .getJSONArray(TAG_USER); // JSON Array
                                            // get first account object from JSON Array
    JSONObject users = userObj.getJSONObject(0);
```

```
if(usertype.equals(adm)){
            Intent intent= new Intent(NewLogin.this,admin.class);
                    intent.putExtra("username", txtName.getText().toString());
                    intent.putExtra("usertype", usertype);
                            startActivity(intent);

                }else if(usertype.equals(phy)){
            Intent intent= new Intent(NewLogin.this,physician.class);
                    intent.putExtra("username", txtName.getText().toString());
                    startActivity(intent);

                                                        //finish();
                }else if(usertype.equals(fpw)){
            Intent intent= new Intent(NewLogin.this,fpworker.class);
            intent.putExtra("username", txtName.getText().toString());
                        intent.putExtra("usertype", usertype);
                                startActivity(intent);
                                            //finish();
                }else if(usertype.equals(moth)){
            Intent intent= new Intent(NewLogin.this,motherpage.class);
                    intent.putExtra("username", txtName.getText().toString());
                        startActivity(intent);
            //Intent inten= new Intent(NewLogin.this,checkappointment.class);
            //inten.putExtra("username", txtName.getText().toString());
                                            //      startActivity(intent);
                                //finish();
                                    }

            txtName.setText("");
          txtpass.setText("");
         }else if(success==0){

         msg = json.getString(TAG_MSG);
        final String mess=msg;
       NewLogin.this.runOnUiThread(new Runnable() {
                                    public void run() {
    AlertDialog.Builder builder = new AlertDialog.Builder(NewLogin.this);
      builder.setTitle("error message");
     builder.setMessage(mess)
     .setCancelable(false)
     .setPositiveButton("OK", new DialogInterface.OnClickListener() {
     public void onClick(DialogInterface dialog, int id) {
                                    }
```

```
                                                            });
    AlertDialog alert = builder.create();
      alert.show();
                                                   }
                                          });

                                }
                                } catch (JSONException e) {
                                        e.printStackTrace();
                                }
                        }
                });

                return null;
        }

        protected void onPostExecute(String file_url) {
                // dismiss the dialog once got all details
                pDialog.dismiss();
        }
    }

    @Override
    public boolean onCreateOptionsMenu(Menu menu) {
        // Inflate the menu; this adds items to the action bar if it is present.
        getMenuInflater().inflate(R.menu.main, menu);
        return true;
    }}
```
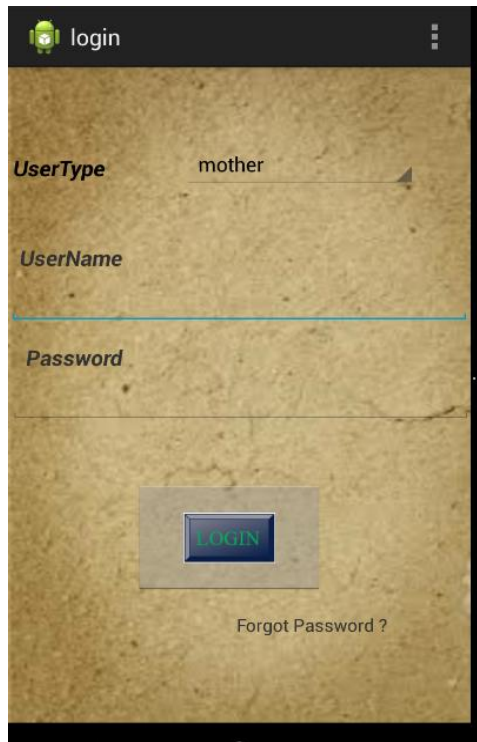
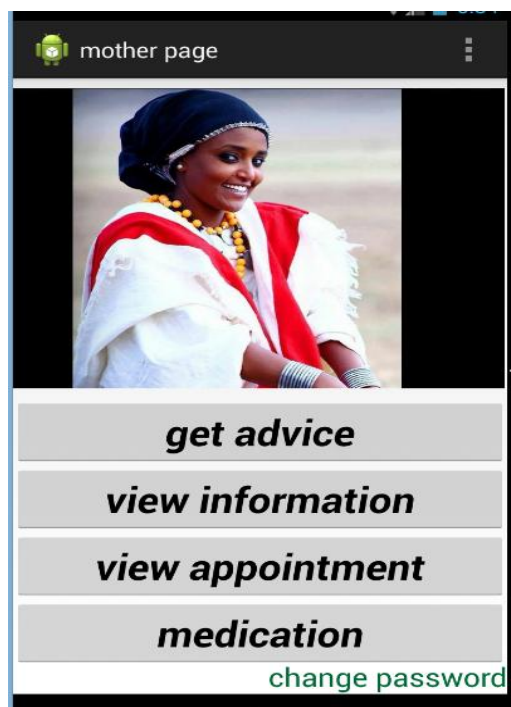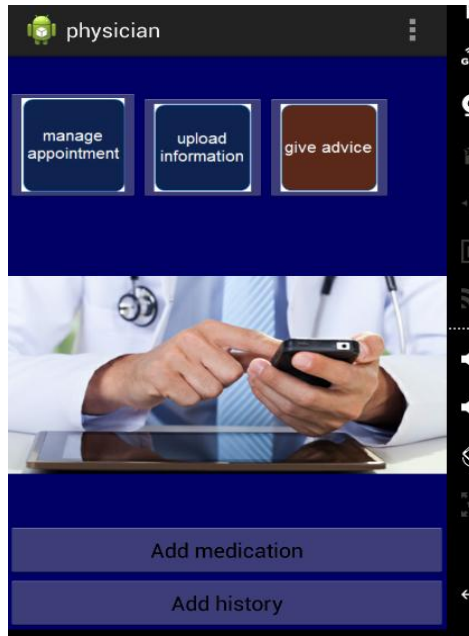**4.5.2. Sample output screen**

Fig 4.1 login page

Fig 4.2 mother page

Fig 4.3 physician page

Figure 4.4 Registration page

4.6. Installation

The process of moving from the current information system to the new one is called installation. For our system we use the following steps to install.

Step1: Connect Android device to PC via USB cable and turn on USB storage or get the apk by any means.

Step2: Copy .apk file to attached device's storage if it is connected with the computer.

Step3: Open File Manager app or the place where the apk is stored and click on the copied .apk file.

Step4: It will ask you whether to install this app or not. Click yes or OK to install.

References

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4. MOH: *National Reproductive Health Strategy 2006 - 2015*. Federal Democratic Republic of Ethiopia, Ministry of Health.: Addis Ababa, Ethiopia; 2006.