Libyan International Medical University

College of Health Information Technology

Department of Health Informatics

Project **Title:**

Patient fail system

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Dedicate

اهدي هذا العمل إلي روح (أبي) الطاهرة رحمه الله الذي لطالمه تمني أن يراني في هذه المرحلة
و إلى من بها أكبر وعليها أعتمد (أمي) التي ساندتني حتى وصلت إلي هذه المرحلة وإلي
خالي(المهندس عون السنفاز) وخالتي وإخوتي و أحبتي وزملائي.

Thanks and appreciation:

Thank everyone who helped to complete this search and gave me a helping for who provided me with the necessary for the completion of this research information and singled out MS(Elham Bakir.)

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Introduction

Health information technology (HIT) : is information technology applied to health and health care. It supports health information management across computerized systems and the secure exchange of health information between consumers, providers, payers, and quality monitors. Based on an often-cited 2008 report on a small series of studies conducted at four sites that provide ambulatory care–three U.S. medical centers and one in the Netherlands– the use of Electronic Health Records (EHRs) was viewed as the most promising tool for improving the overall quality, safety and efficiency of the health delivery system, broad and consistent utilization of HIT will:

- Improve health care quality or effectiveness.
- Increase health care productivity or efficiency.
- Prevent medical errors and increase health care accuracy and procedural correctness.
- Reduce health care costs.
- Increase administrative efficiencies and healthcare work processes.
- Decrease paperwork and unproductive or idle work time.
- Extend real-time communications of health informatics among health care professionals; and Expand access to affordable care.

We don't doubt that health informatics is very common   and helpful which the services are much better and tasks are more easier ,in this project I will do the patients files system which helps the center to save time and cost and lack of contradiction patient data.

The book will be divided on several chapters as follows:

Chapter I: feasibility study of the system:

I'm going through this chapter to talk about diabetes , its causes and the name of the project and the objectives of this project and defines the initial study of the system and to talk about the center and scenarios work since entering the center and even get out of it for more information can be found on this chapter.

Chapter II Analysis:

This chapter will define the analysis process, the system will be analyzed using the methodology vehicle (Unified Modeling Language UML) and more information can be found on this chapter.

Chapter III: description system requirements:

This chapter will describe the process of transforming the current system to the proposed automated system will also be the definition of user requirements and described the inputs and outputs of the system and more information can be found on this chapter.

Chapter IV: Design :

This stage is the stage parallel to the stage of writing software and designing the system it depends on special programs and devices and shifting theories proposed objectives into programs to be executed materially.

Chapter V: **implementation** and Testing:

This stage is the stage that follows the design directly and where the application of the system, and here we can enter real data and the final delivery of the system after making sure there are no defects in the system ;there is some tests that doing to do to ensure the accuracy of the system works, and will be mentioned some of the proposals, and for more information you can read this chapter.

Chapter1

Feasibility Study

1.1 Preface:

At this stage we know the current system and its borders and old work plan in the center and we get the data for the system .

1.2 About the Center:

2   The Center was established in 1969 at the hands of Dr. Othman Alcadekke Stadium and was a room at the Hospital of the Republic and was the first clinic for follow-up of diabetes in the Middle East and North Africa and then moved to a clinic, Mr. Hussein. In the year 1977 to the present It is in the same Headquarters and provides services to more than 70,000 on the AC and the center is almost the only place in the eastern region of Libya .It provides services to the Center for follow-up clinics for diabetes, divided into three days for women and three days for men.

3   With clinics castrating him place such as :

4   - Diabetic foot .

5   -Eye Clinic.

6   -Dental clinic.

7   - Clinic dermatologist .

8   - Clinic pregnant women with diabetes

1.3 Problem Definition:

At the center all the transactions manually , which takes a lot of time, effort and cost , as well as loss of data .In this project will be to solve this problem and create a flexible system easy and less effort and cost to complete the patient and doctors data recording and booking appointments for patient**.**

1.4 The old system problems:

Manual system is facing many difficulties in the patient follow-up and data recording process, which in turn hinder the process of registration and follow-up and disrupting the process of running the system with no guarantee the accuracy of this data and the mention of these problems **are Follows**:

1. occurrence of confusion at work.

2. the lack of coordination in the manual system, where the large number of securities caused the loss of documents.

3. lack of responsibility concerning the data used in the current system.

4. Slow work, boredom and loss of time and a delay in the work, and this may adversely affect the work.

5. wasted in storage spaces causing a contradiction in the data.

6 .difficulty reporting that contribute to making the right decision.

7 .lack of credibility of the data (may be wrong data for the patient record).

1.5 The old scenario

The patient comes to the center without a prior reservation

And every time he visited the center the patient diagnosis a different doctor , not the same doctor who diagnosis the previous time

1.6 Objectives of the new system

Develop a system that works to reduce the above-mentioned problems and contribute to raise the efficiency of administrative work by providing the following:

1. The reduction of paperwork and files.

2. Provide a high storage capacity for data and maintain them from damage.

3. Reduce errors in receiving .

4. Work speed in the follow-up of patients .

5. Eliminate the problem of contradictory data.

6 Ensuring the protection of information.

7 Eliminating manual burden.

8 - Access to any information

Chapter 2
Analysis

2.1 preface:

Encompasses those tasks that go into determining the needs or conditions to meet for a new or altered product, taking account of the possibly conflicting requirements of the various stakeholders, such as beneficiaries or users.

2.2 The methods used in data collection:

1. Personal interviews with the center employed .

2. Actual practice to work at the center.

2.3 Method Used in this project :

The method used in this project is Structured Systems Analysis and Design Method (SSADM) for the project Which is originally released as methodology, is a systems approach to the analysis and design of information systems. SSADM was produced for the Central Computer and Telecommunications Agency, a Uk government office concerned with the use of technology in government, from 1980 onwards.

2.4 Description system using UML (Unified Modeling Language) :

Is the language of graphical modeling gives us a formula to describe the key elements of the systems software , which is supported language to encode programming operations offering a symbolic way simplified to express different software business models and facilitates whereby the stakeholders of analysts and designers follow up phases of development of the system is the language of the new methods for analysis and the design and implementation of programs oriented programming using visual style and uses geometric forms and charts give a complete picture of the system to be designed to make it easy to visualize a complete system and facilitates maintenance.

UML consists of several forms of drawing schemes and confine ourselves using some of these forms in this project are as follows :
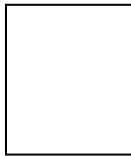
2 .4.1 Use case diagram :

It describes the interaction between the system and other external systems and Actor

And the steps involved to draw this scheme can be summarized as follows:

1. drawing system boundaries
2. develop use cases on the drawing
3. Do define actors .
4. Add links between the actors and use cases and together.

- By following the above steps correct and accurate manner we can easily access to use cases ; The use cases are the description of the behavior of the system are of interest through the stages of analysis , development and helps in understanding the requirements.

The following table illustrates some of the symbols and forms used in the use cases :

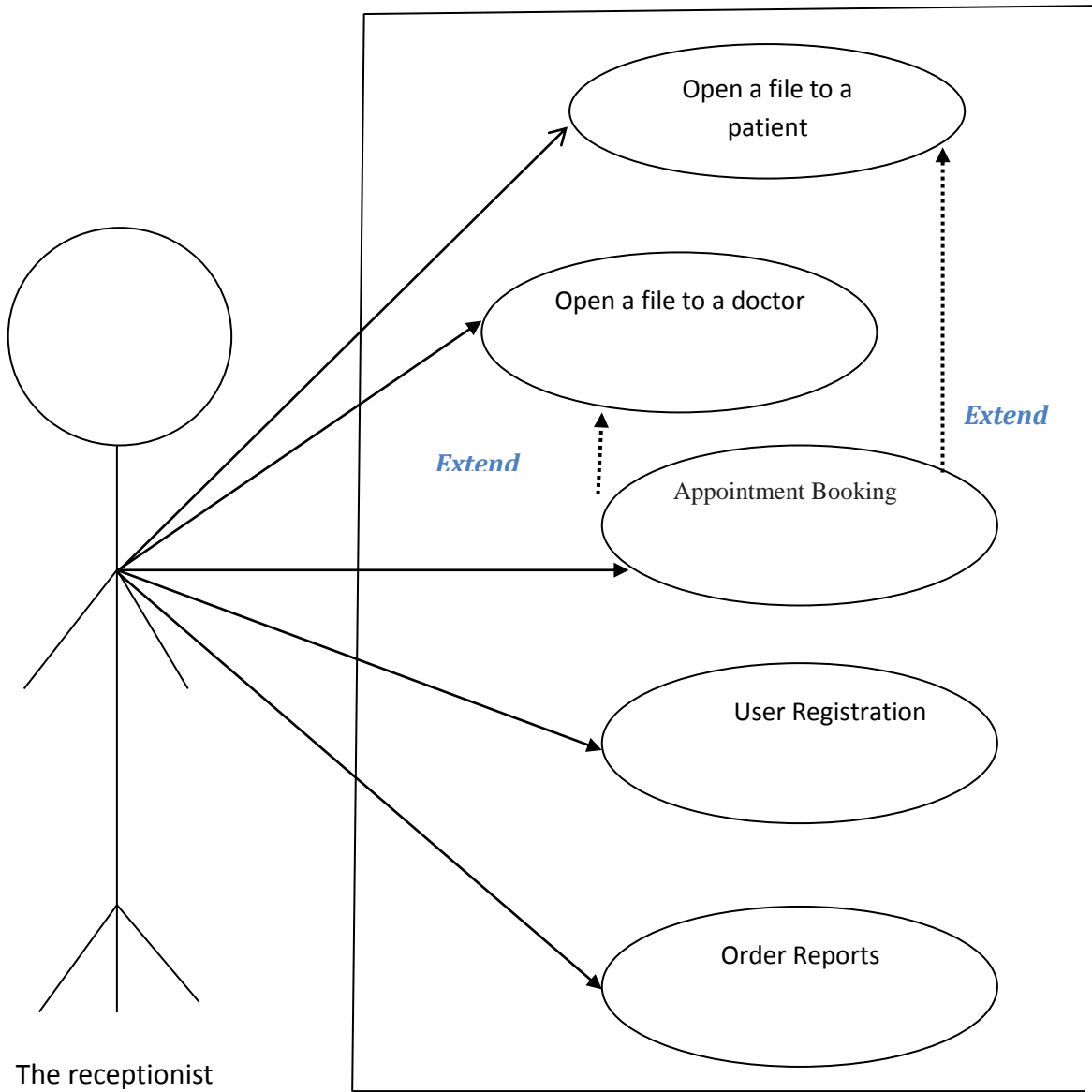| The meaning of the symbol	Symbol
System boundary	
ACTOR	
Represents the basic operations in the system	
Is the link between the use cases	

Table(1)

shows the symbols used in the use case diagram

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The system (current) scenario:

The receptionist who will use the system .When the patient want to book an appointment; the receptionist will open the system and enter the user name and password then press the "LOGIN" in the event that the password and name matches will go to the main menu ; else message will be show that the error number or name . Then the receptionist open the reservation screen , in case that the patient is not already registered ;will be recorded data first ," To add a new patient pressed add new patients then enter the patient data in the event that patient number is conflicting with another patient; message box will be show content that another patient have the same number " to booking an appointment select the patient 's name, doctor's name , the time and date of booking , in case that the time and date of booking contradictions with the doctor who was booking with ; will be show a message that the time is reserved and choose another time and date.
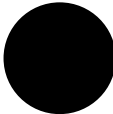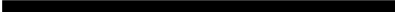
The following figure shows the case of use The proposed system

Open a file to a patient

Open a file to a doctor

Extend

Appointment Booking

Extend

User Registration

Order Reports

The receptionist

Figure(1)

shows the use case for The proposed system

2.4.2 Primary Scenarios & Activity Diagrams

Symbol	The meaning of the symbol
●	Start
→	data flow
▭	Input and output
◆	Achieving condition
⬤	End
▬	Synchronization Bar

Table(2)

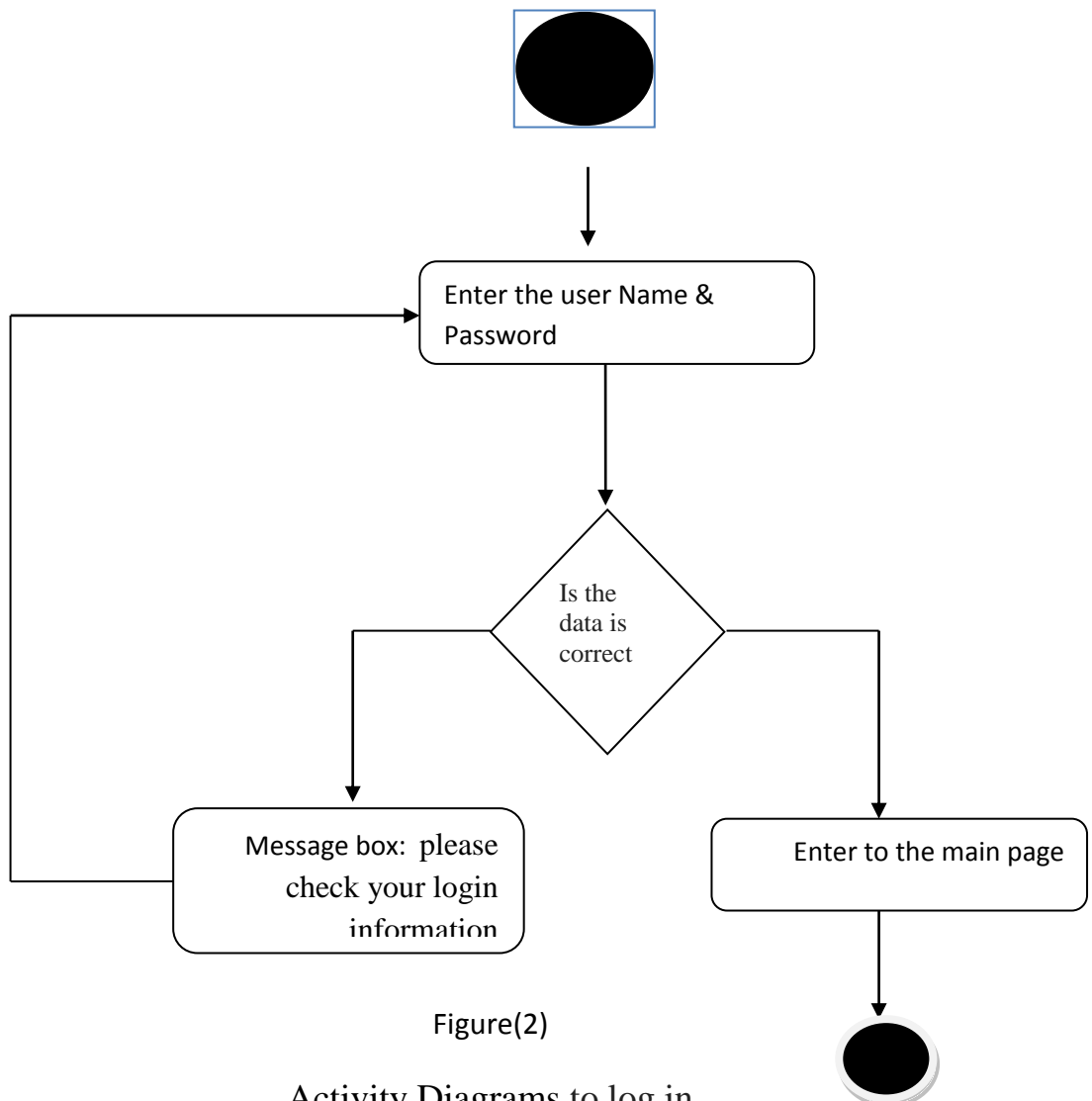shows the symbols used in the Activity Diagrams

Activity name: login to the system

The beginning of the activity: the user wants to login to system

The user access to the system.

1. Enter the user name and password.

2.The system checks the data entered

2. If data is correct the user login to the system else msg box will show: please check your login information
   The end of the activity: login to the system successfully

Figure(2)

Activity Diagrams to log in
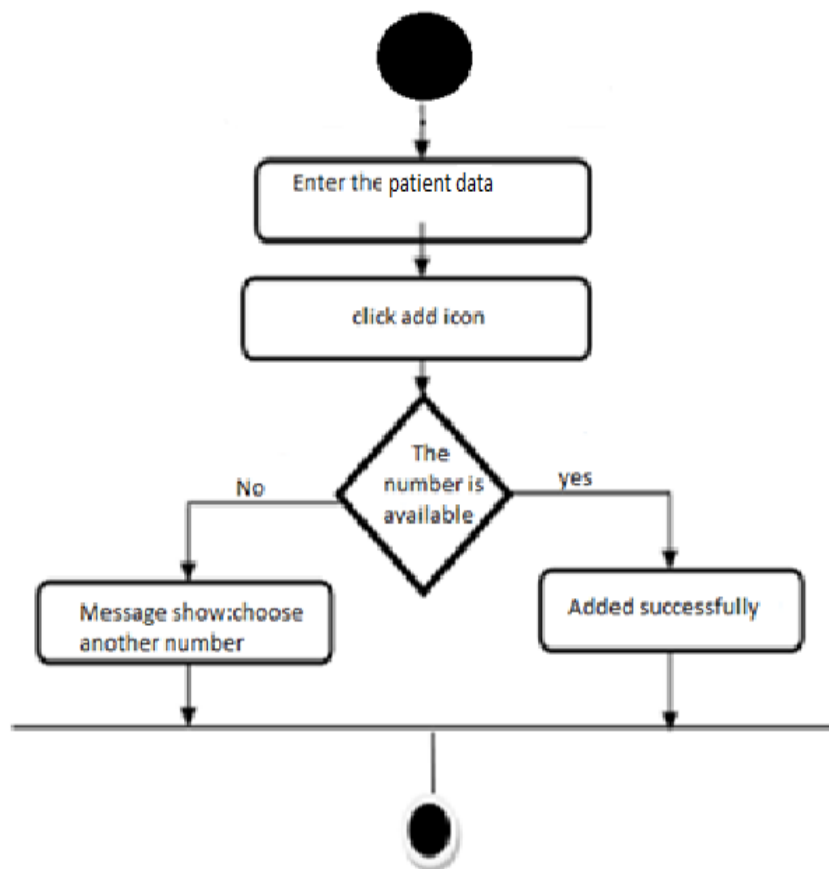
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Activity name: Add new patient :

Activity Name: Add new patient

The beginning of the activity: the user wants to add patient data

The user access to the system.

1. enter patient data.
2. The user enters the patient number and all personal data.
3. presses the Add icon.
4. The system checks the data entered:
5. In the case the number is available ; data will saved else message box show choose another number.

The end of the activity: add patient successfully

Figure(3)

Activity Diagrams to add patient
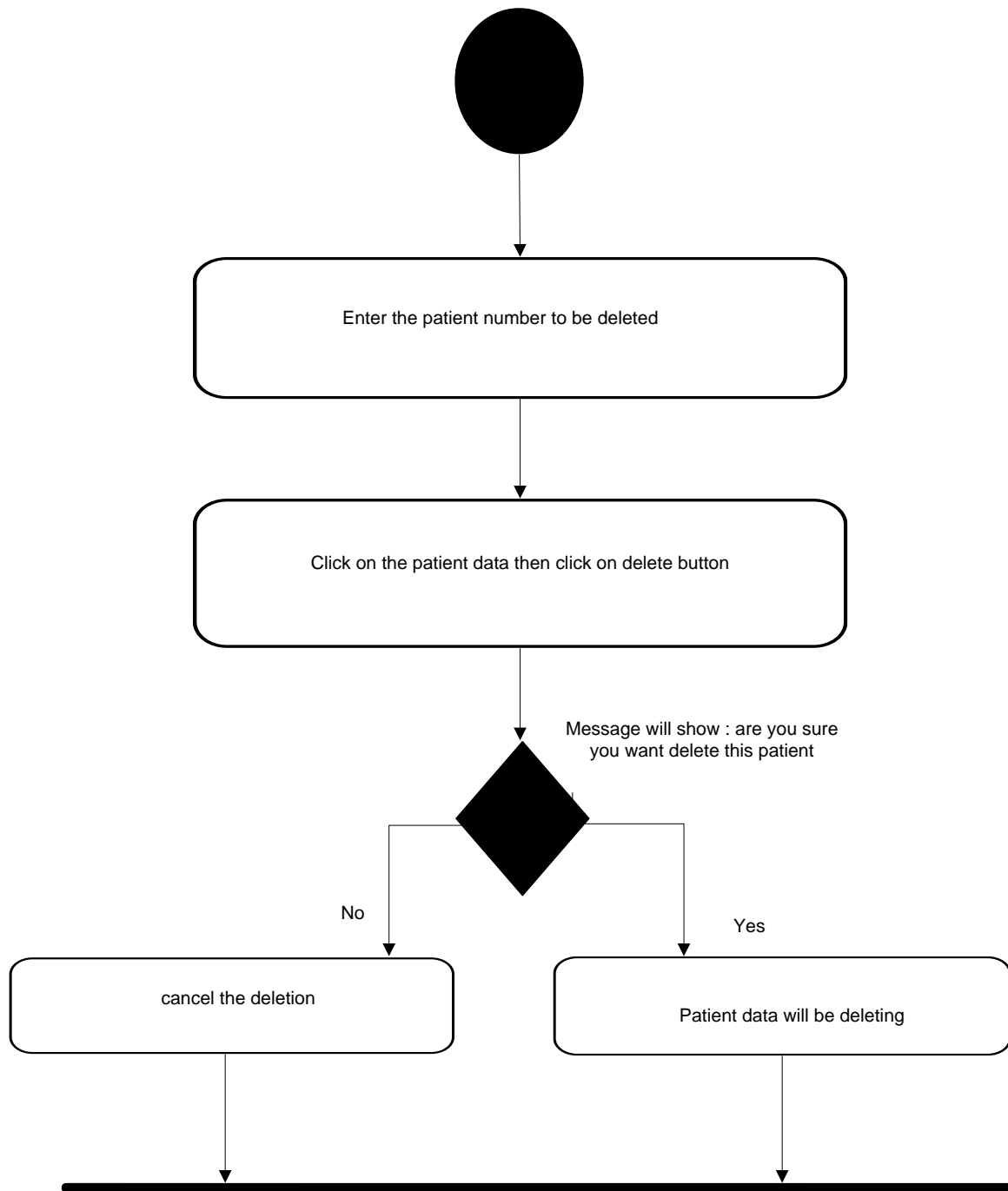
22

Activity name: Delete patient

The beginning of the activity: the user wants to delete the patient data

1. access to the system.

2. Open the patient screen .

3. Enters the number of the patient.

4. Presses the delete button.

Message box : Are you sure you want delete this patient ?:

In the case of the user's choice to OK the patient data will be deleted else data don't delete

The end of the activity: deleted successfully

Enter the patient number to be deleted

Click on the patient data then click on delete button

Message will show : are you sure
you want delete this patient

No

Yes

cancel the deletion

Patient data will be deleting

Figure(4)

show Activity Diagrams to delete patient
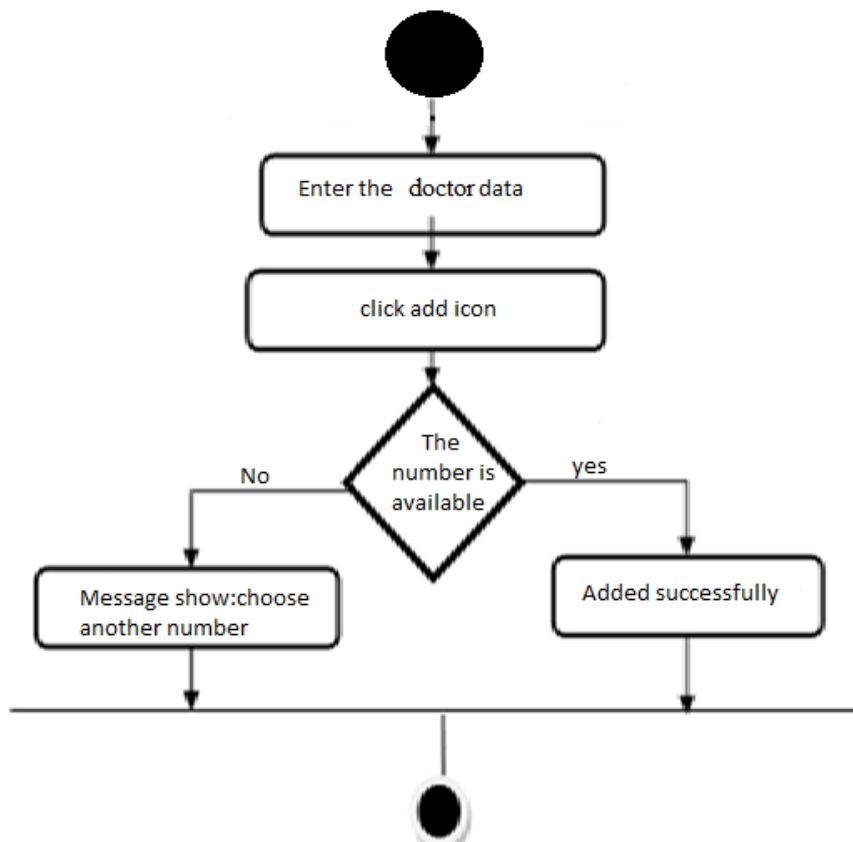
Activity name: Add new doctor :

Activity Name: Add new doctor

The beginning of the activity: the user wants to add doctor data

The user access to the system.

1. enter doctor data.
2. The user enters the doctor number and all personal data.
3. presses the Add icon.
4. The system checks the data entered:
5. In the case the number is available ; data will saved else message box show choose another number.

The end of the activity: add doctor successfully

Figure(5)

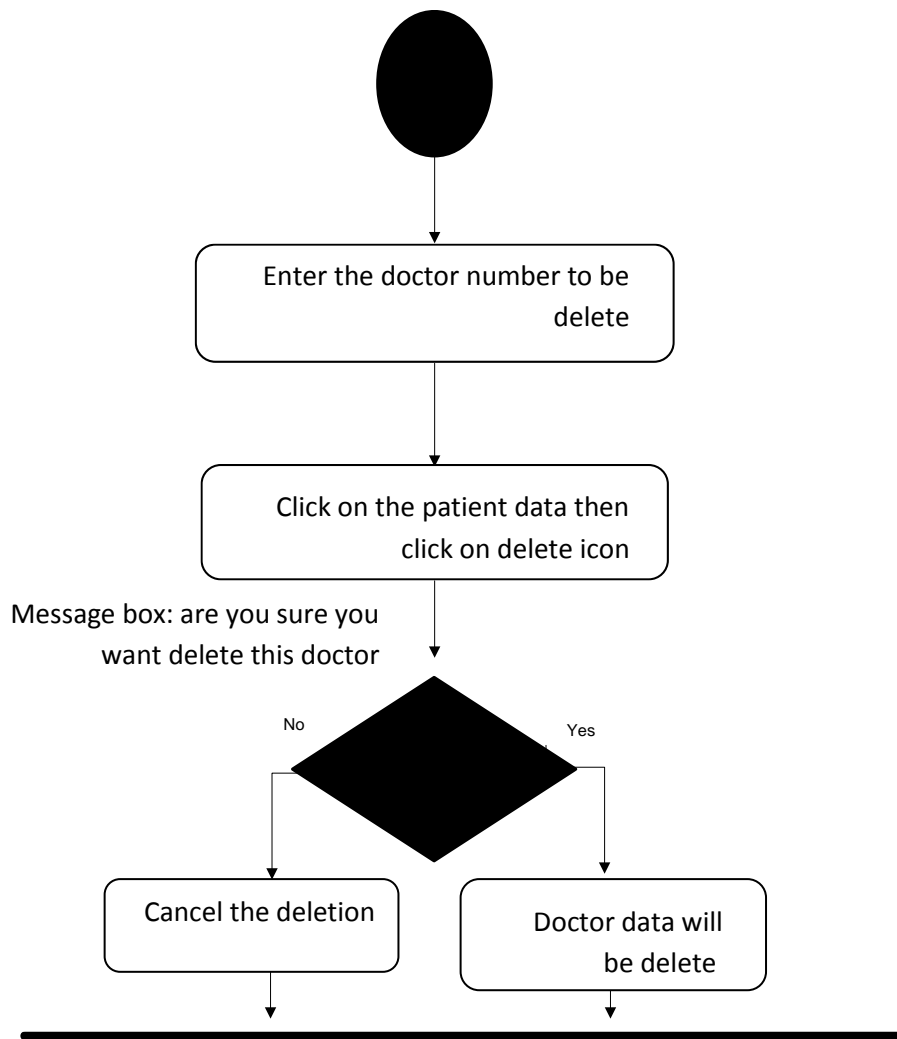show Activity Diagrams to add doctor

Activity name: Delete doctor :

The beginning of the activity: the user wants to delete the doctor data

   access to the system.

   1. Open the patient screen .

   2. Enters the number of the patient.

   3. Presses the delete button.

   4. Message box : Are you sure you want delete this patient ?:

 In the case of the user's choice to OK the patient data will be deleted else data don't delete

 The end of the activity: deleted successfully

Enter the doctor number to be delete

Click on the patient data then click on delete icon

Message box: are you sure you want delete this doctor

No

Yes

Cancel the deletion

Doctor data will be delete

Figure(6)

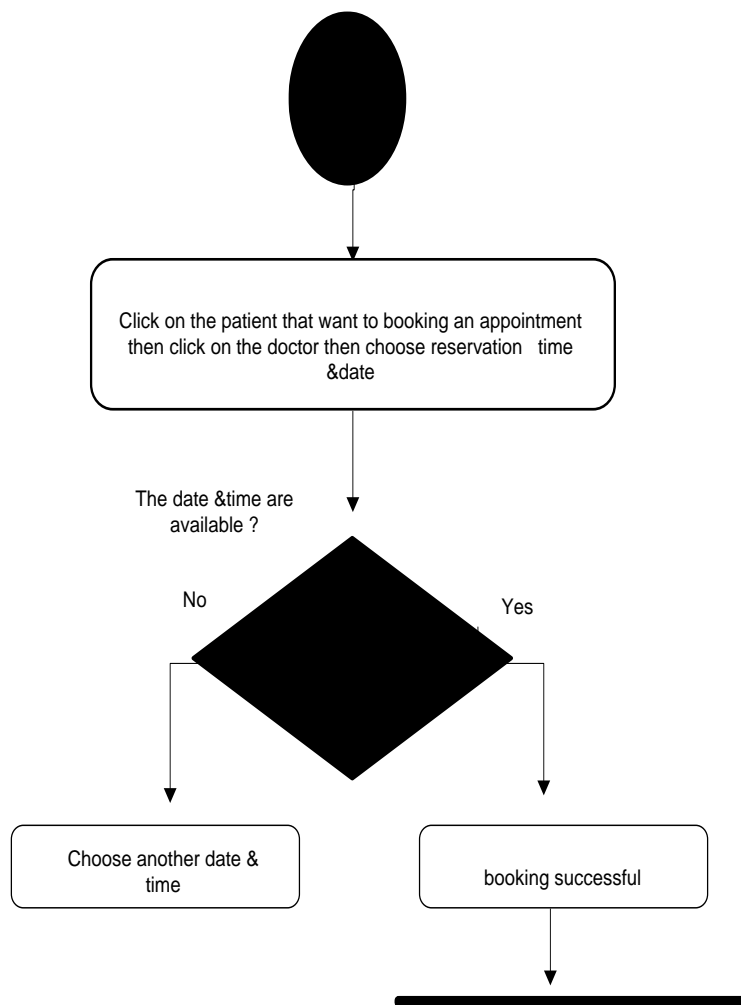show Activity Diagrams to   delete doctor

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Activity name: Reservation

The beginning of the activity: booking an appointment

access to the system.

1. Open the reservation screen .

2. Click on the patient that want to booking an appointment then click on the doctor then choose reservation   time &date

3. The date &time are available ?
- In the case yes booking successful

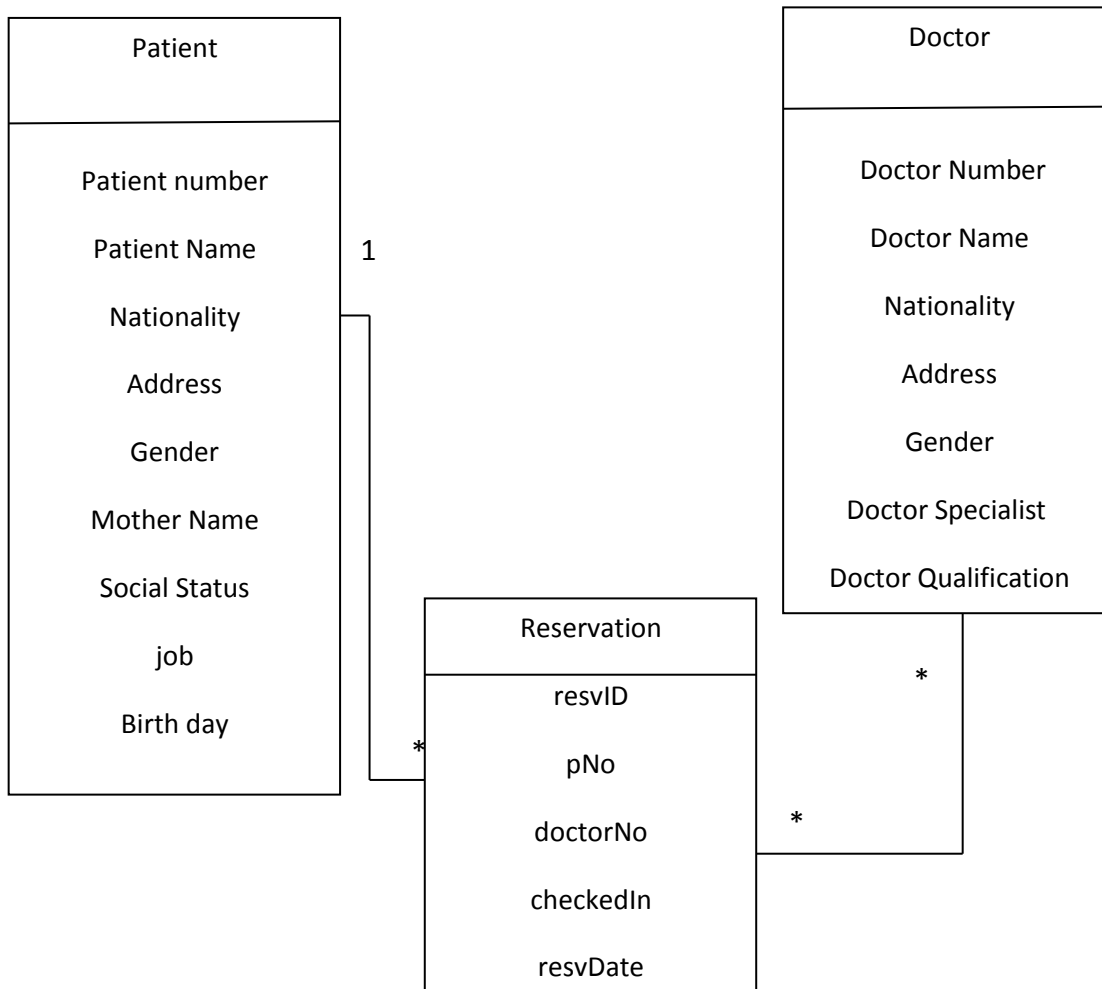- Else the user must choose another date &time

The end of the activity: deleted successfully

Click on the patient that want to booking an appointment
then click on the doctor then choose reservation   time
&date

The date &time are
available ?

No

Yes

Choose another date &
time

booking successful

Figure(7)

Activity Diagrams to book an appointment

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2.4 Class diagram :

Patient
Patient number
Patient Name
Nationality
Address
Gender
Mother Name
Social Status
job
Birth day

Doctor
Doctor Number
Doctor Name
Nationality
Address
Gender
Doctor Specialist
Doctor Qualification

Reservation
resvID
pNo
doctorNo
checkedIn
resvDate

1

*

*

*

Figure(8)

Class diagram

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Chapter 3

Requirement specification

3.1 Preface

Described the system requirements and a comprehensive description of the intended purpose and the system that is under development.

- **Advantage:**

It explains the tasks carried out by the system and how its performance and reduce the time and effort required by developers to achieve the goals of existing and reduce costs.

3.2 PURPOSE OF THE REQUIREMENTS DOCUMENNT:

This document has been written to document the system requirements specification of Benghazi reception center for the treatment of patients with diabetes and The aim of this work programming manual system to an electronic system.

3.3 Project Scope

The proposed system helps to accomplish the functions described in the process use cases, and documentation of each case, and also to produce reports and queries.

3.4 System Function

The system provides the user with many functions which :

1. Register and save patient data.
2. Register and save doctor data.
3. register and save user data.
4. Booking appointments for patients.
5. Print reports.

3.5 System constraints

It has been put restrictions on how to access the system only authorized can enter to the system.

3.6 System Requirements :

The system needs to perform its functions the following :

1. The device's memory should be at least 2GB.

 2. speed device at least MHz2000CPU .

3. windows 7 operating system or any update latest version of windows.

4.Printer.

5. visual basic 2013 application.

3.7 Description input system : -

It is intended to clarify the system the center of inputs in order to obtain The required output , and it has been classified data that will be entered in the system
The following tables:

Patient Table

	Column Name	Data Type	Allow Nulls
🔑▶	pNo	bigint	☐
	pName	nvarchar(50)	☐
	nationality	nvarchar(15)	☑
	address	nvarchar(50)	☑
	motherName	nvarchar(50)	☑
	socialStatus	nvarchar(10)	☑
	job	nvarchar(20)	☑
	gender	nvarchar(10)	☐
	bday	datetime	☐

Table(3)

Patient Table

Doctors Table

Column Name	Data Type	Allow Nulls
🔑 doctorNo	bigint	☐
dName	nvarchar(50)	☐
nationality	nvarchar(15)	☐
address	nvarchar(50)	☐
gender	nvarchar(15)	☐
docSp	nvarchar(30)	☐
docQ	nvarchar(30)	☐

Table(4)

Doctors Table

Users Table

Column Name	Data Type	Allow Nulls
🔑 Id	int	☐
userName	nvarchar(30)	☐
password	nvarchar(30)	☐
userAccess	bit	☐

Table(5)

Users Table

Reservation Table

Column Name	Data Type	Allow Nulls
🔑 resvID	bigint	☐
pNo	bigint	☐
doctorNo	bigint	☐
checkedIn	bit	☑
resvDate	datetime	☑
▶		☐

Table(6)

Reservation Table

3.8 Description system outputs: -

At this stage it is to identify all the output into the system ;Ex: report

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3.9 Functional Requirements

This part described how to go from the input to the output.

1. **Add new patient :**

Input: Patient (name**,** number,date of birth ,etc)
Processing: System must be certain that the data entered in the case is that they are correct Date and to make sure that patient number who has been entered are available or not then save the data.
Output: Take out an alert message, in the case that the input wrong or the number is not available.

2. **Add new doctor :**

Input: doctor (name**,** number, ,etc)
Processing: System must be certain that the data entered in the case is that they are correct Date and to make sure that doctor number who has been entered are available or not then save the data.
Output: Take out an alert message, in the case that the input wrong or no data entry is determined.

3.Add new users :

Input: user (name**,** number, ,password)
Processing: : System must be certain that the data entered in the case is that they are correct Date and to make sure that user number who has been entered are available or not then save the data.
Output: Take out an alert message, in the case that the input wrong or the number is not available.

4.Book an appointment:

Input: choose the patient name,doctor name, Time and date of booking

Processing: The system checks if the time and date is available or not.

Output: Take out an alert message, in the case the time and date is not available else will book an appointment.

3.10 Non-functional requirements:

 The system must be able to serve more than one users.
• system Must be a quick response to commands.
• Negotiable system maintenance and development.

Chapter 4
Design

4.1 Preface:

The goal of this stage is to produce a detailed design of the data that will be used as a base for database design files, programs, and also will be described and a description of logically to be utilized in the completion of the physical description of the program.

4.2 Dynamic design of the system

It is the actual composition of the operations of the system by**(UML)** schemes derived:
1. Sequence Diagram.
2. Cooperation Diagram.
3. Component Diagram.
4. Distribution Diagram.
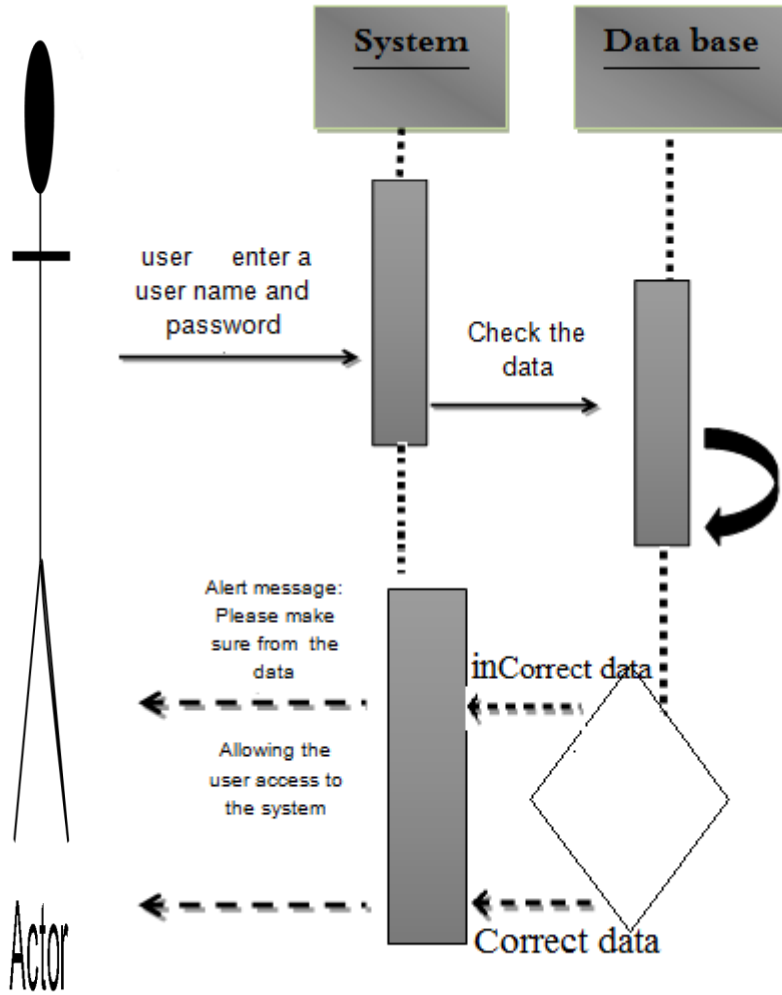
4.2.1 Sequence Diagram:

The interaction between the system and the user and between parts of the system and shows the messages that are sent and received between these parts and shows the user , and this plan addresses the dynamic behavior of the system as well as the time in the exchange of requests and messages.

The following table illustrates some of the symbols and forms used in Sequence Diagram:

Symbol	
Object	**Common classification sneak in time to receive and send messages**
…………………. **Life line**	**It refers to the life cycle of the object through the chronology to perform the operation**
	Select the object , which sends and receives messages
Message 1 ⟶ **Return** **Message 2** ⟵··············	**It shows messages and data from one object to another movement**

Table(7)

symbols used in the Sequence Diagram

1. Sequence Diagram to Entry system:

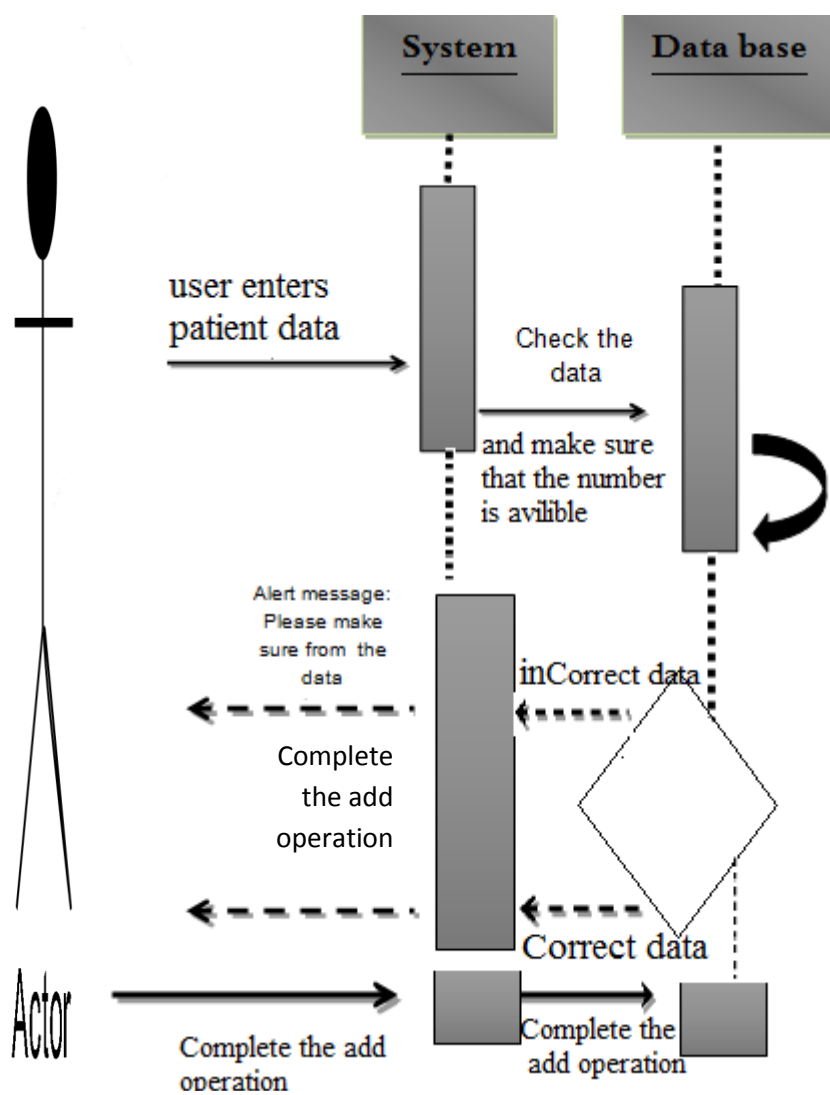

Figure(9)

Sequence Diagram to Entry system

Cooperation Daigram to Entry system:

1.user enters a name and password

| User | | system |

4. allowing the user access to the system

6.alert message please make sure from tge data

3 . Data are correct

5.Incorrect data

2. check the data

| Data base |
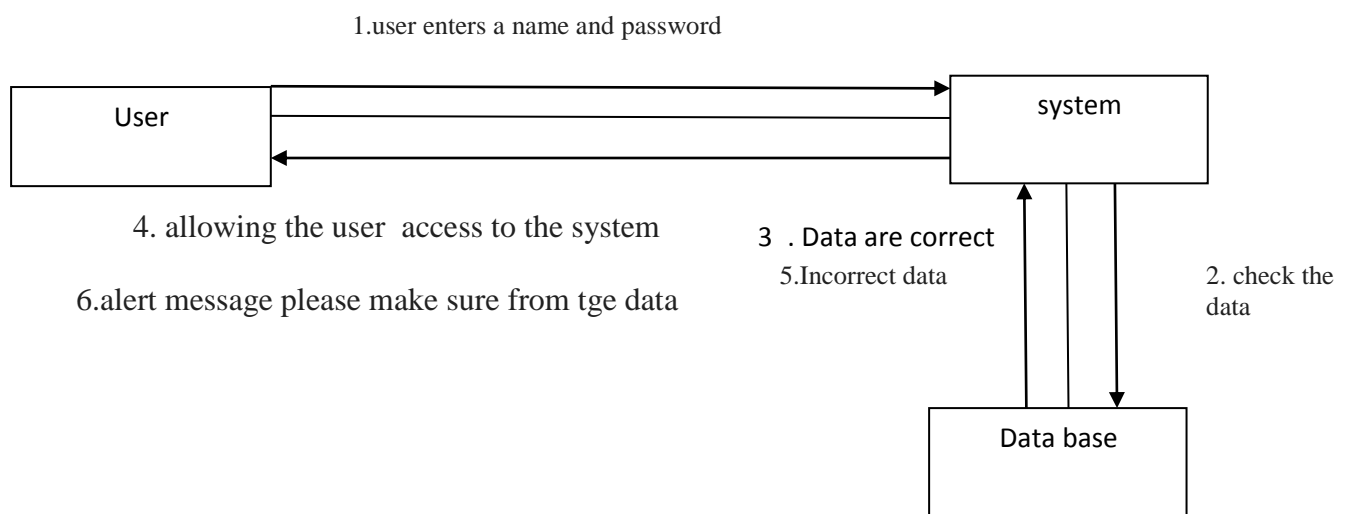
Figure(10)

Cooperation Daigram to Entry system

2. Sequence Diagram to add nwe Patient:

System

Data base

user enters
patient data

Check the
data

and make sure
that the number
is avilible

Alert message:
Please make
sure from the
data

inCorrect data

Complete
the add
operation

Correct data

Actor

Complete the add
operation

Complete the
add operation

Figure(11)

Sequence Diagram to add nwe Patient

Cooperation Daigram to add nwe Patient:

| User | 1. user enter   patient data → | System |

4. complete the add
6 alert
message:please
make sure from
the data

3. correct data
5. incorrect data

2.Check the
data and make
sure that the
number is
avilible.

| Data base |
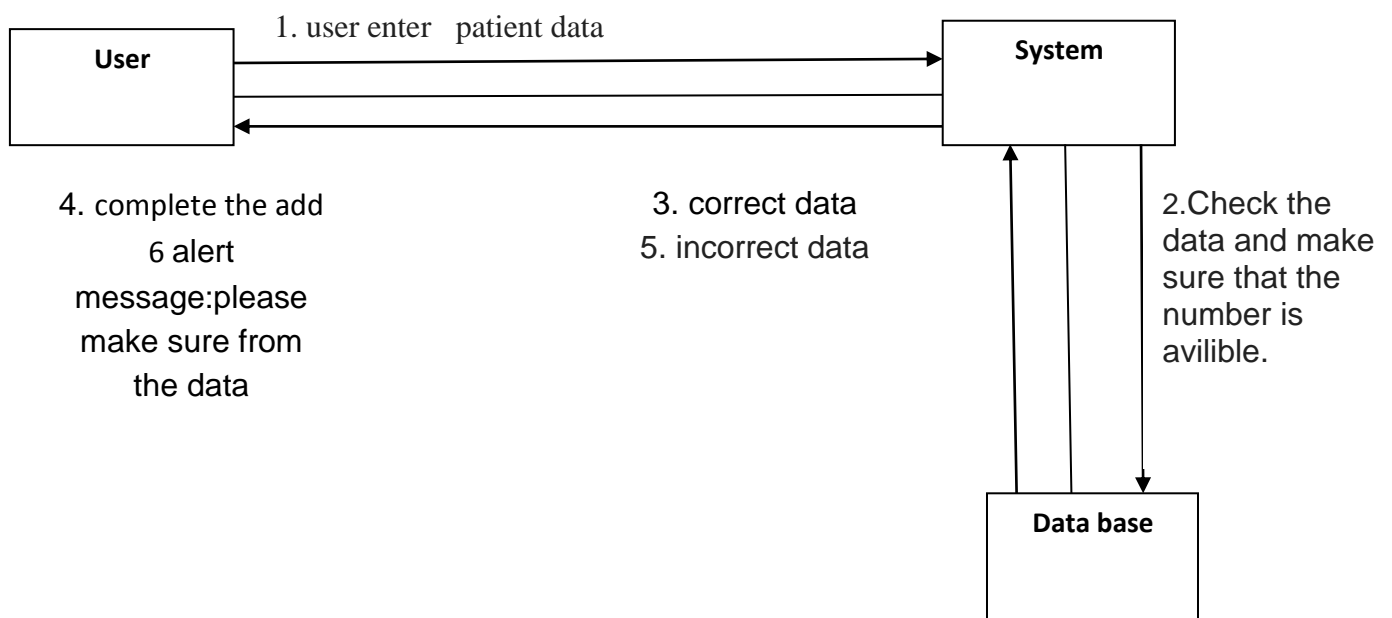
Figure(12)

Cooperation Daigram to add nwe Patient

3. Sequence Diagram to Add new doctor:
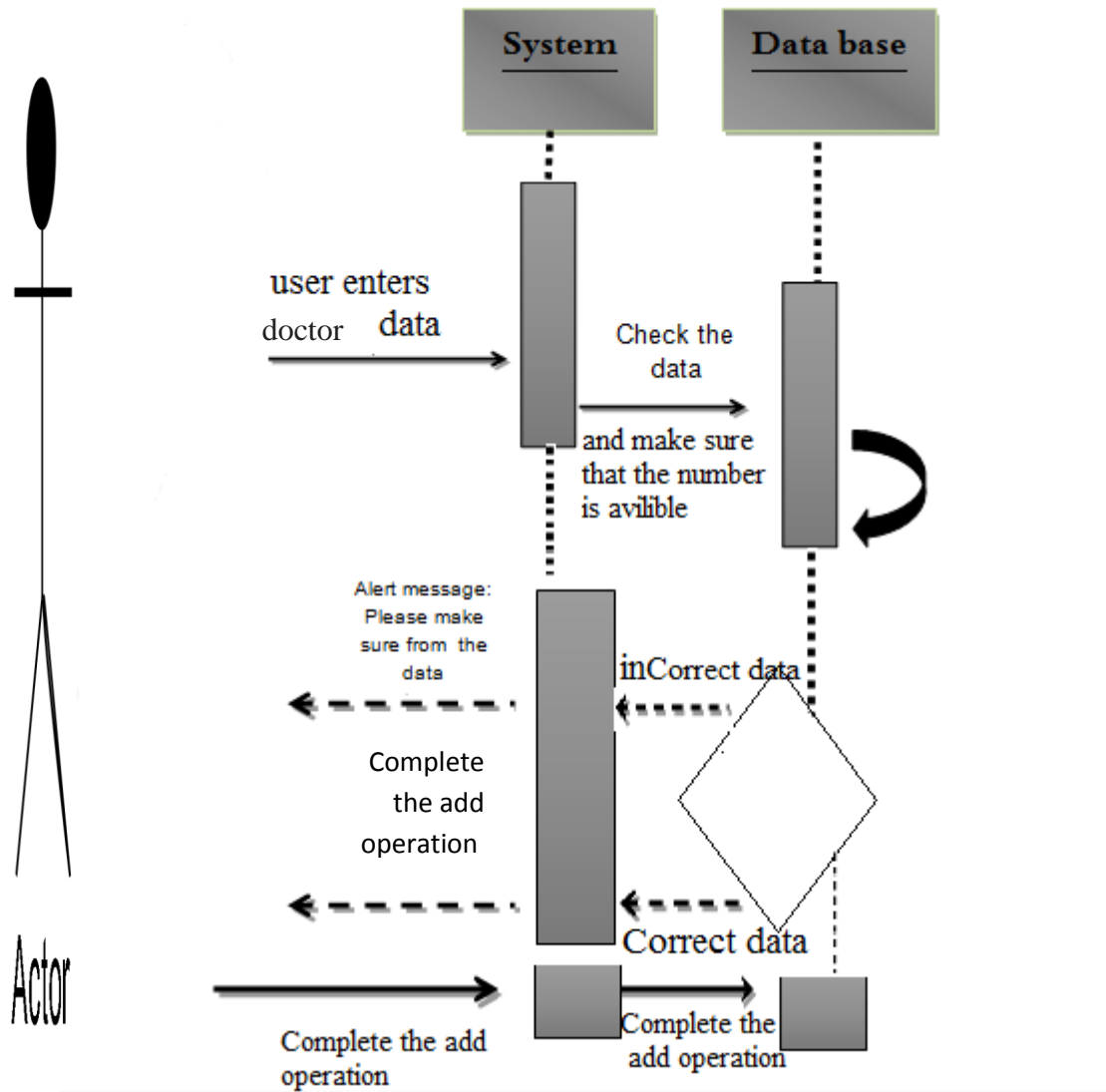
Figure(13)

Sequence Diagram to Add new doctor

Cooperation Daigram to Add new doctor:

1. user enter   doctor data

User		System

4. alert
message:please
make sure from
the data
6 complete the add

2.Check the data and make
sure that the number is
avilible.
 3. correct data
5. incorrect data

Data base
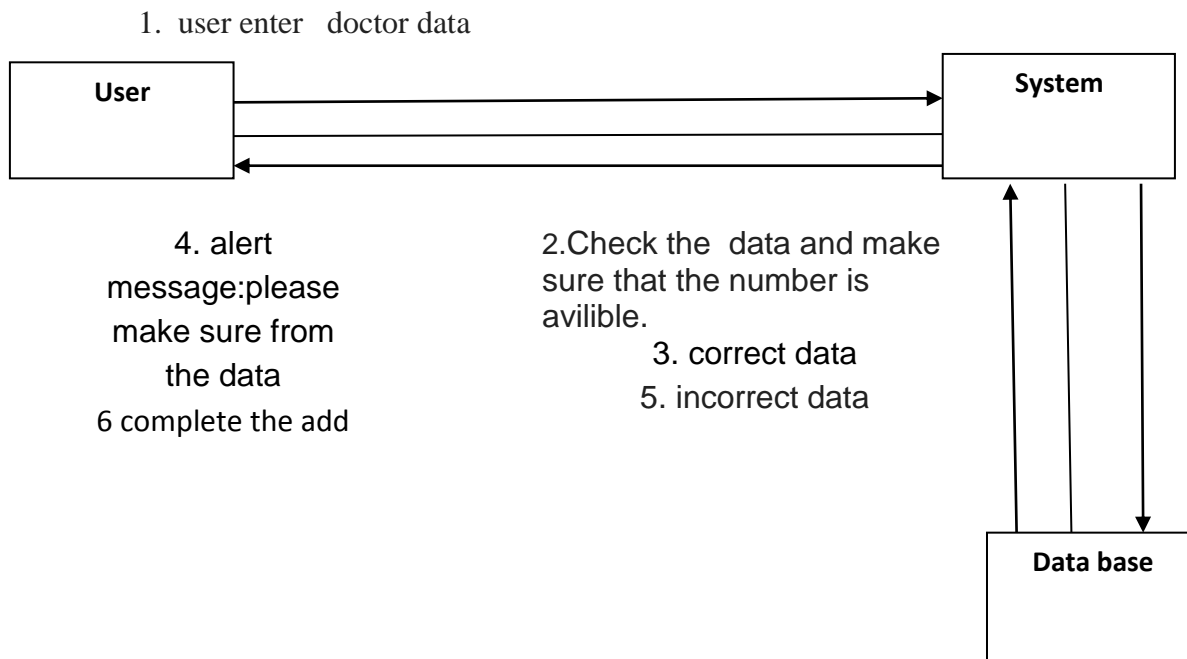
Figure(14)

Cooperation Daigram to Add new doctor

4. Sequence Diagram to Reservation :

User enter the reservation data (patient name, doctor name,date&time)

Check the data and make sure the date& time are avilible

inCorrect data

Alert message: Please make sure from the data

Complete the reservation

Correct data

Complete the reservation operation

Complete the reservation operation
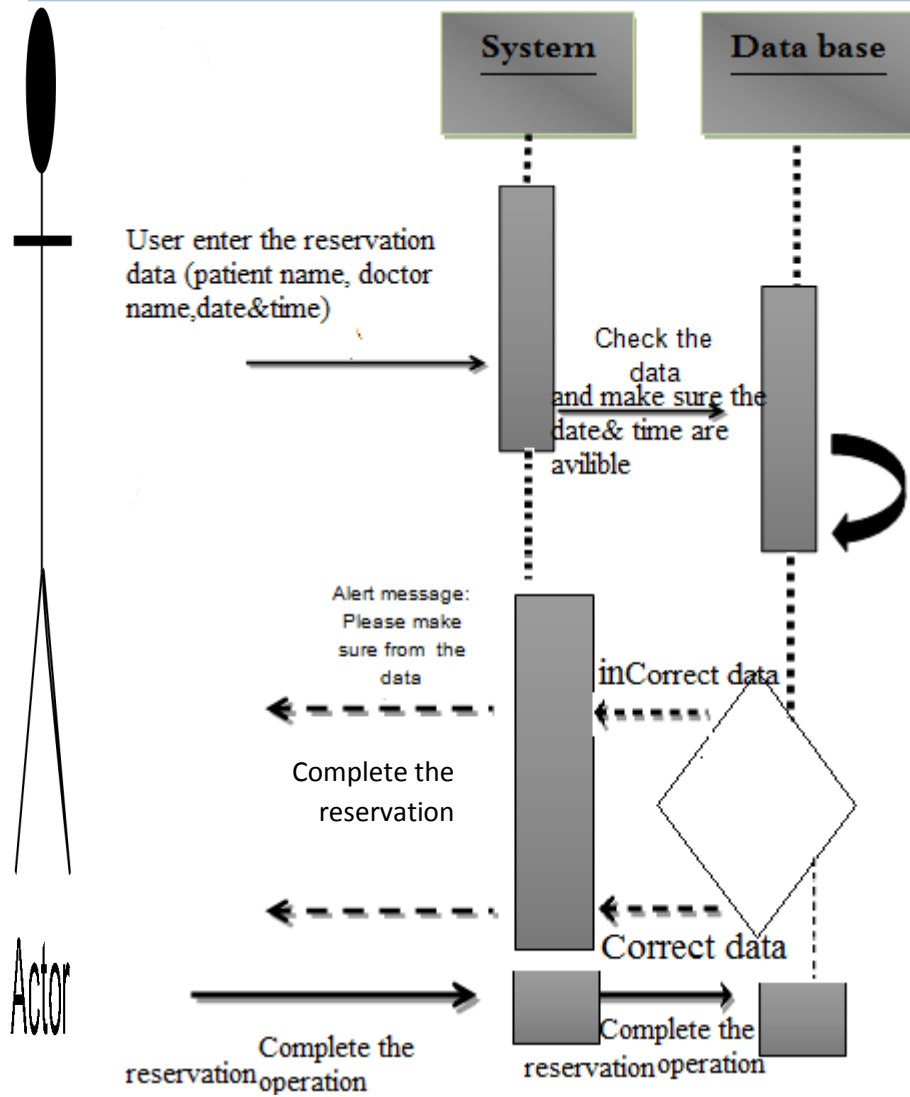
Figure(15)

Sequence Diagram to Reservation

Cooperation Daigram to Reservation:

User enter the reservation data (patient name, doctor name,date&time)

1. user enter the reservation data(patient name,doctor name,date&time)

```
┌──────────┐   1. user enter the reservation data   ┌──────────┐
│   User   │ ────────────────────────────────────▶  │  System  │
│          │ ◀────────────────────────────────────  │          │
└──────────┘                                         └──────────┘
```

| User | System | Data base |

4. alert message:please make sure from the data

5 complete the reservation

3. incorrect data
5.correct data

2.Check the data and make sure the date &time are available

Data base
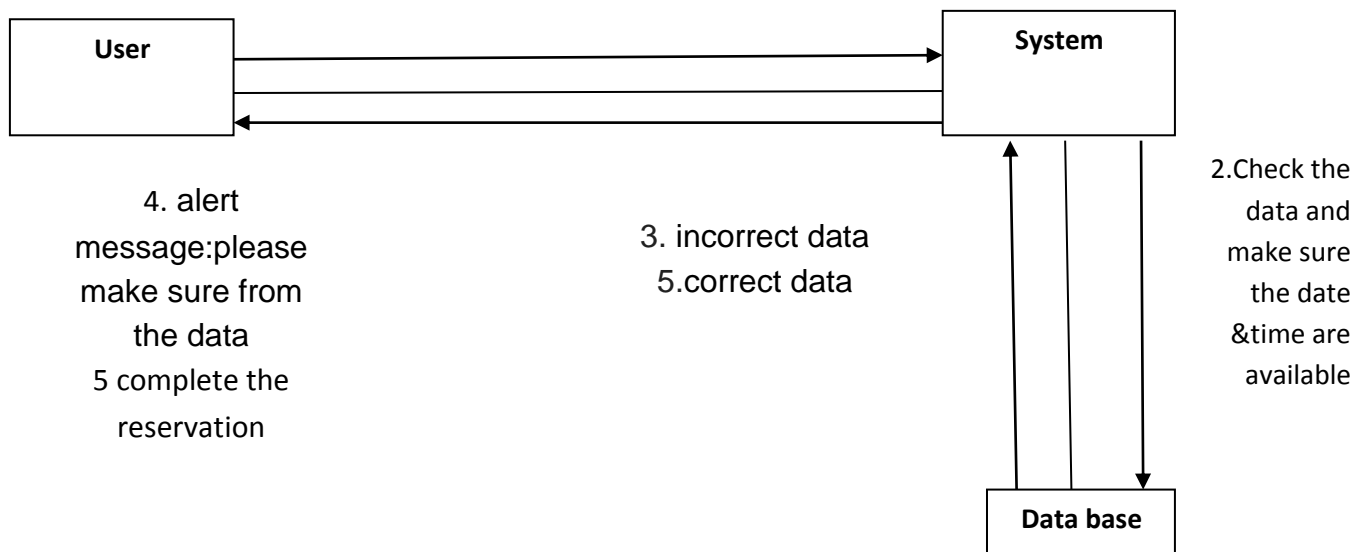
Figure(16)

Cooperation Daigram to Reservation

4.2.2 Component diagram:

This scheme represents the actual components of the system in terms of screens and processes and the relations between the parts and components of the system , where the components A rectangular component contains the name and functions

Main form

doctor.vb

patient.vb

main page.vb

resravation.vb

resravation.vb

reports.vb

Doctors

Add

Modify

Delete

Reservation

Add

Modify

Delete

patient

Add

Modify

Delete

Data base

Database.mdfl
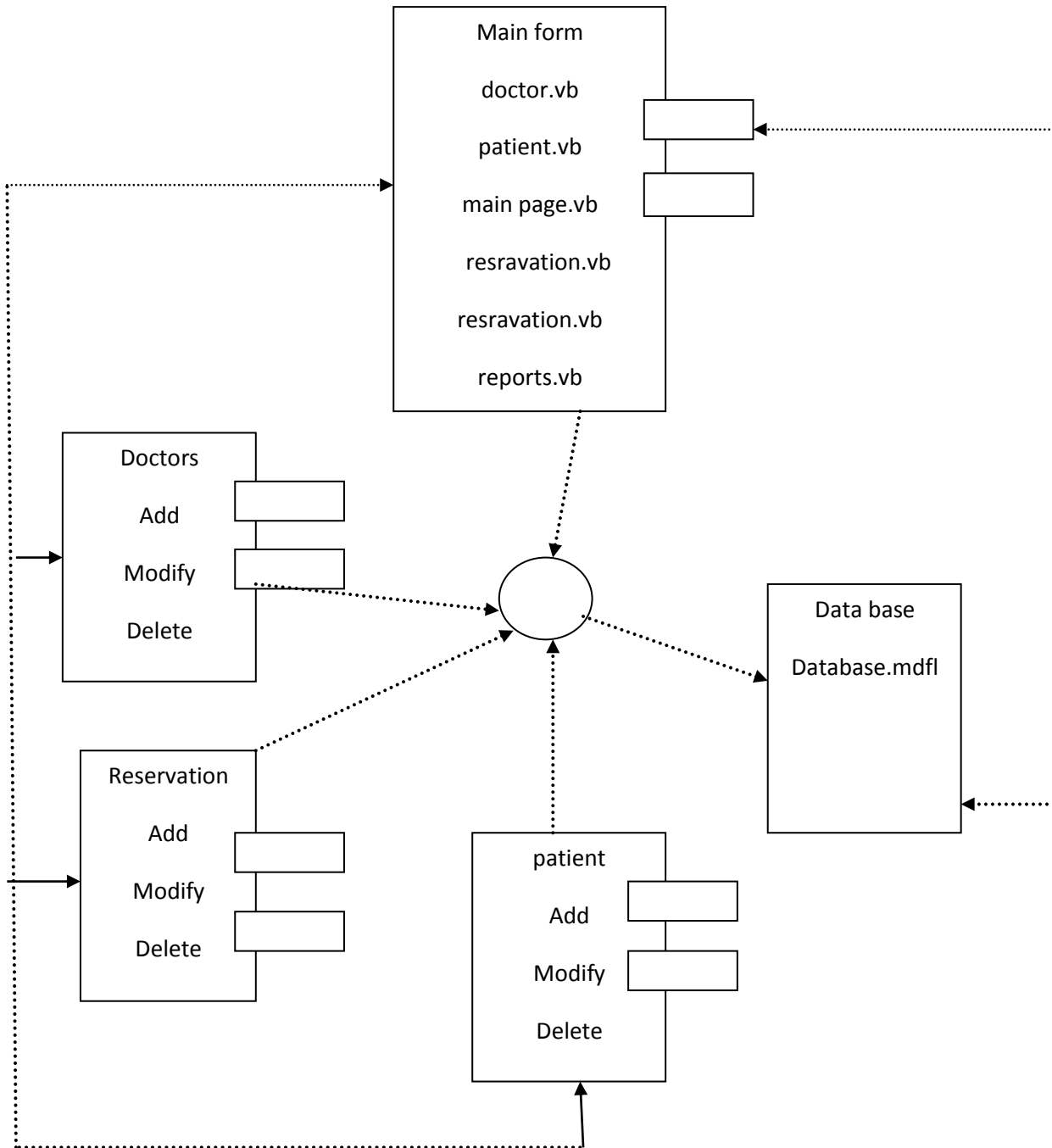
Figure(17)

Component diagram

4.2.3 Deployment Diagram:
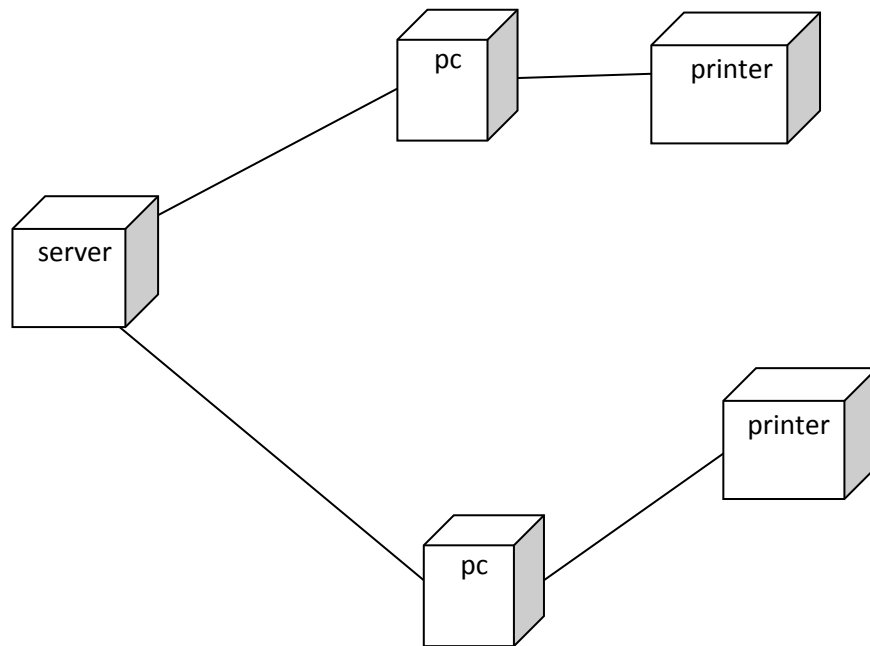
Figure(18)

Deployment Diagram

4.2.4 Physical design:

At this stage, the logical design to transform the design depends on the software which is known as the physical design Data .

Files used in the system :

: The patient's file data [personal data] : This file containing the personal data of the patient:

Field name	Field Type	Field size	Field Description	Notes
Patient_name	Nvarchar	(40)	-	-
+patient_number	bigint	-	-	Primary key
Nationality	nvarchar(15)	-	-	-
Address	nvarchar(50)	-	-	-
Mother Name	nvarchar(50)	-	-	-
Social Status	nvarchar(10)	-	-	-
Job	nvarchar(20)	-	-	-
Gender	nvarchar(10)	-	-	-
Bday	datetime	-	Date of Birth	-

Patient Data

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2: File Data doctor [personal data] : This file Contains doctor's personal data.

Field name	Field Type	Field size	Field Description	Notes
doctorNo	bigint	-	Doctor number	Primary key
Name	nvarchar	50	Doctor name	-
nationality	nvarchar	15		
address	nvarchar	50		
Gender	nvarchar	50		
DocSp	nvarchar	30	Doctor specialization	-
DocQ	nvarchar	30	Doctor qualification	-

Doctor Data

3. User Table:

Field name	Field Type	Field size	Field Description	Notes
userName	nvarchar	30	-	-
password	Int	-	-	-
User number	int	-	-	Primary key

User Data

4. Reservation Table

Field name	Field Type	Field size	Field Description	Notes
Resv _id	bigint	-		Primary key
PNo	bigint	-	Patient name	
Doctor no	bigint	-	Doctor number	
checkedIn	bit	-		
resvDate	Datetime	-	Reservation date	

Reservation Data

4.3 Graphical User Interface (GUI):

Login screen of the system

It contains the user number and passwords

Login screen of the system

*

Main screen

This screen contains the main menu of the system as following form:
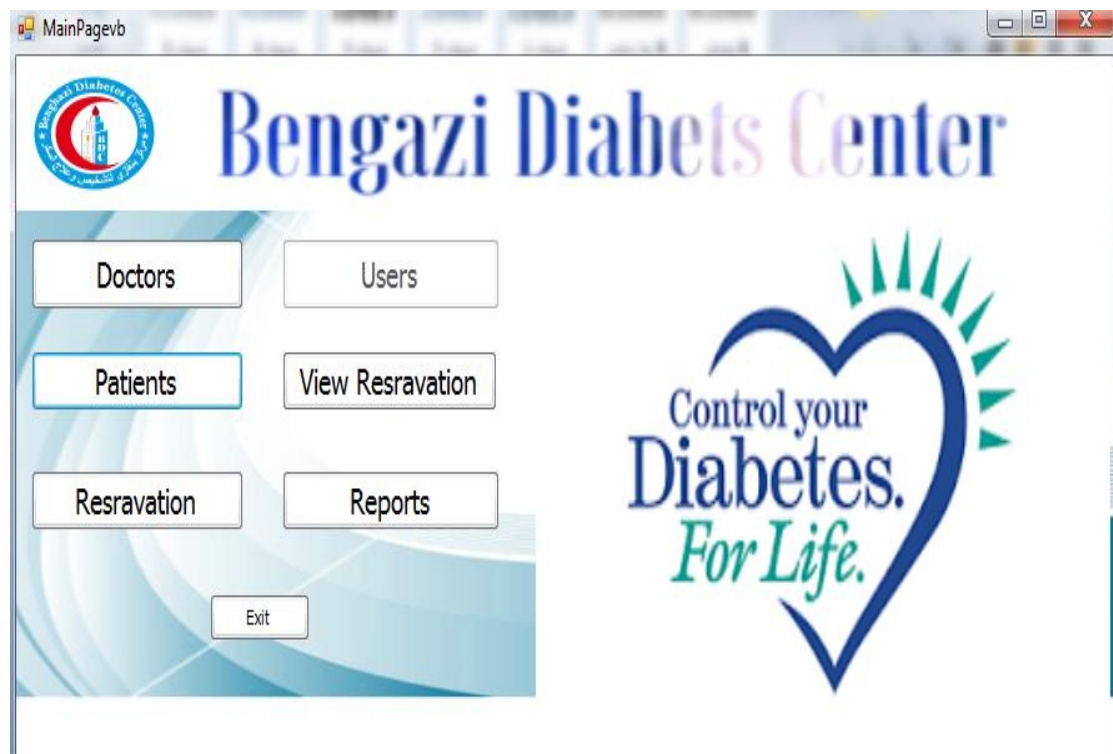
Main screen of the system

Patient screen

This screen contains the personal data of the patient as following form:

Patient screen of the system

Doctor screen

This screen contains the personal data of the doctor as following form

Doctor screen of the system

Booked screen

special screen to book appointments as following form:

Booked screen of the system

Reporting Screen

And these screen to view reports for patients and doctors
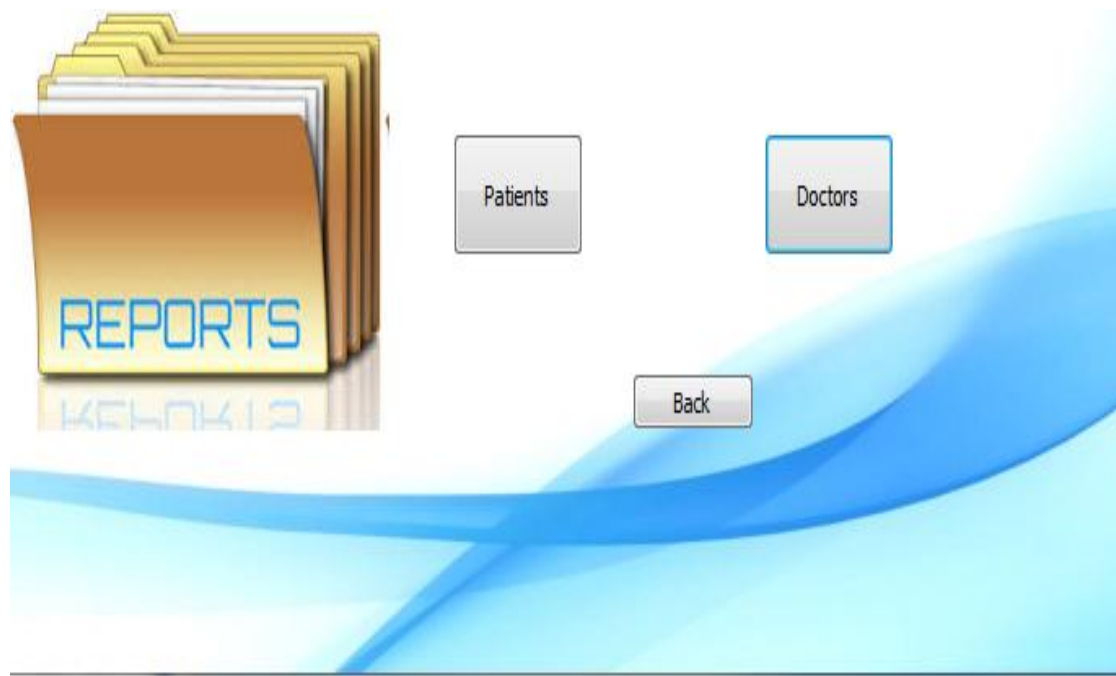
Report screen of the system

View reservation screen

This screen display for all bookings

Reservation screen of the system

Chapter 5

Implementation and Testing

- The system is applied under the operating system (Windows Vista Business) Using the language of Visual Basic 2013

5.1 Programming language used

Visual language is considered an extension of the language BASIC operating system under (visual basic) was released in 1964 , where he was the purpose of which is the work of a powerful and easy to use application languages at once
Even issued a Microsoft visual basic language company to run under the operating system where the window turned BASIC language to the working language of the relevant interfaces environment Graphical applications for BASIC language

The advantages of using Visual BASIC :

1. Great ability to use multimedia

2. phrases , drawings, engravings easily used.

3. Library strong to carry the texts

4. replace the activated memory use dynamic and static arrays problems.

5. Dealing with the database in a simple form .

6. immediate error detection .

7. When the application is complete you can convert the program the perspective of an executable file .

8. supports serial files and handle random and fixed .

5.2 Testing:

The goal of this process is to review the logical and natural processes for the new system to make sure it is functioning as planned , which put her and to make sure to store data properly and to detect and correct errors

5.2.1 Types of tests:

1. Dynamic Black Box.
2. Dynamic White Box.
3. Static Black Box.
4. Static White Box.

I use one type of tests and is :

* **Dynamic Black Box**

Which is testing the system work more functional in terms of the implementation of the Occupation of whether or not (success or failure) without the knowledge of any code that you cannot see the details , but rather what matters is output
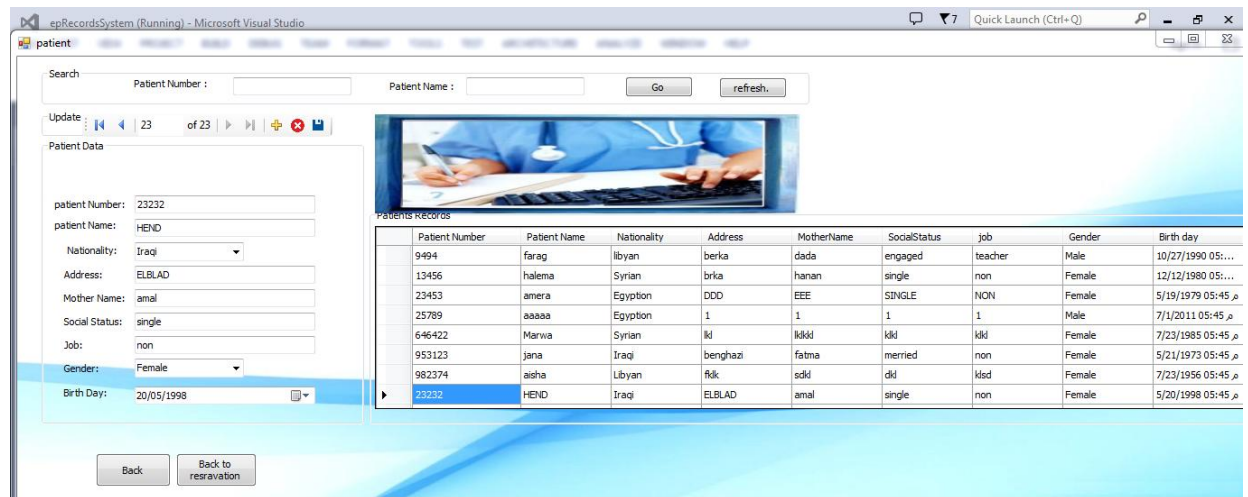

Black-Box Testing
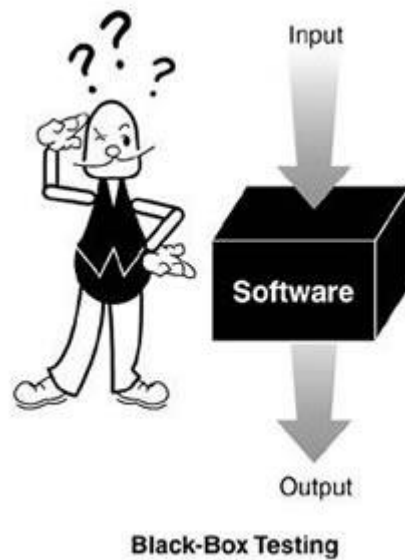
5.2.2 TEST CASE:

failed LOGIN CASE

TEST CASE NUMBER	1
PURPOSE	Login to the system
Steps	Enter the user name /user id /password Click on login button
Pre-requisites	The user is already registered
Expected result	Enter to the system
Actual results (pass/fail)	TRUE ☐ Fails ☑ √
Notes	Non

Add new patient successfully

TEST CASE NUMBER	2
PURPOSE	ADD a new patient
Steps	Open the patient form and write the patient data then click on save.
Pre-requisites	Enter to the system
Expected result	Add a new patient
Actual results (pass/fail)	TRUE √ Fails ☐
Notes	Non

Delete a patient

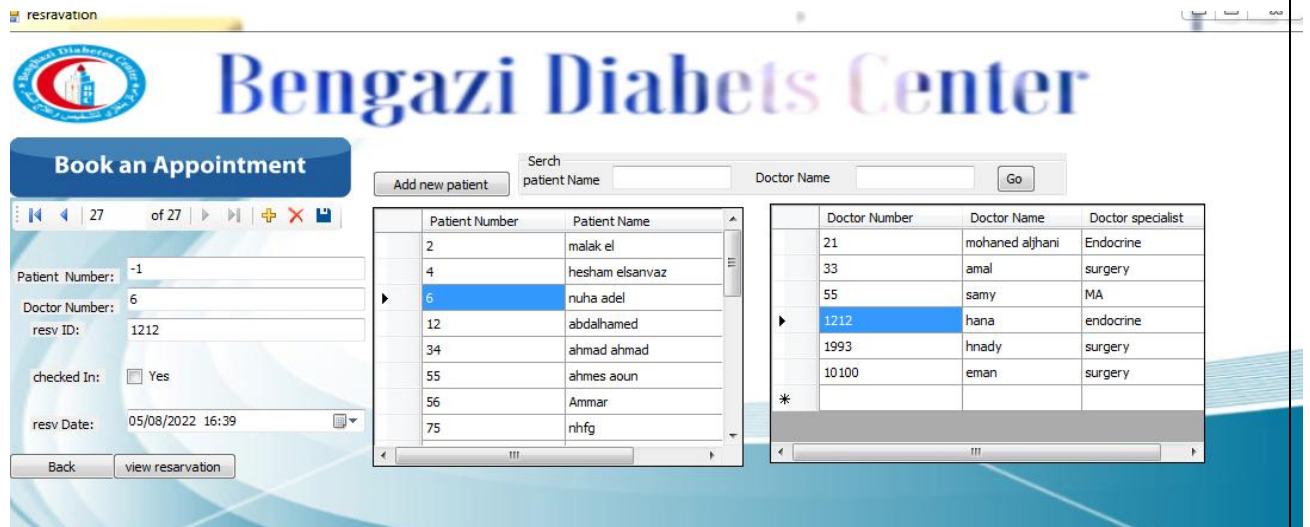| TEST CASE NUMBER	3
PURPOSE	Delete patient
Steps	Open the patient form and click on the patient that want to delete then click on delete bottom.
Pre-requisites	Enter to the system
Expected result	Delete patient
Actual results (pass/fail)	TRUE √ Fails
Notes	Non

Add Doctor

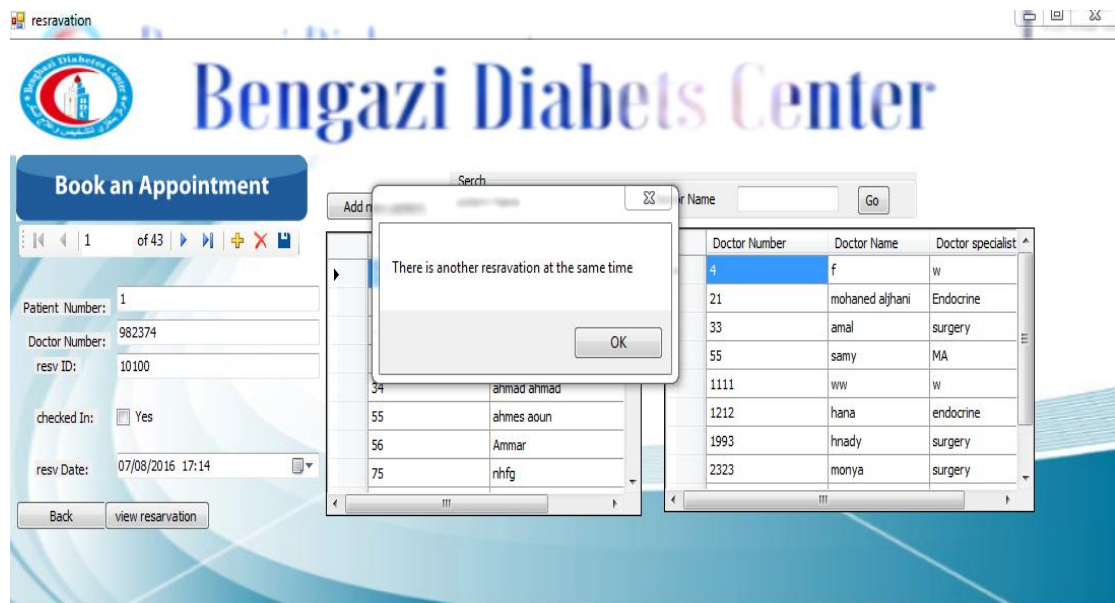| TEST CASE NUMBER	4
PURPOSE	Add Doctor
Steps	Open the Doctor form and write the Doctor data then click on save.
Pre-requisites	Enter to the system
Expected result	Add New Doctor
Actual results (pass/fail)	TRUE ☑ Fails ☐
Notes	Non

Delete Doctor:
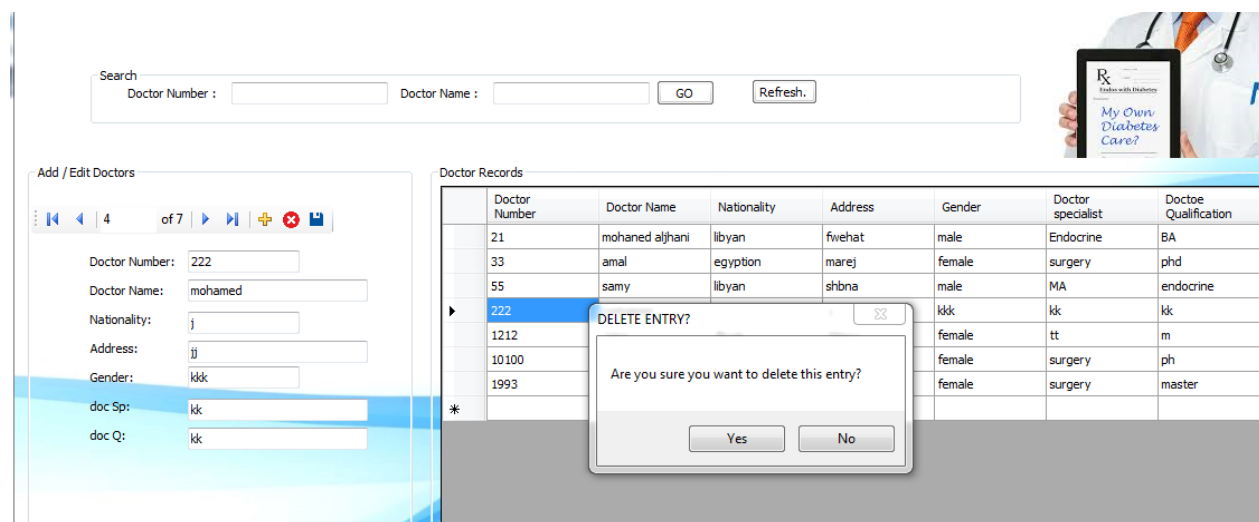
TEST CASE NUMBER	5
PURPOSE	Delete Doctor
Steps	Open the patient form and click on the patient that want to delete then click on delete bottom.
Pre-requisites	Enter to the system
Expected result	Delete Doctor
Actual results (pass/fail)	TRUE [ ] Fails [√]
Notes	Non

BOOK an appointment:

TEST CASE NUMBER	6
PURPOSE	Booking an appointment
Steps	Open the Reservation form and Click on the patient to be booked him an appointment and then chose the right doctor and then chose the time and date of booking then click on save bottom .
Pre-requisites	Enter to the system
Expected result	Booking an appointment
Actual results (pass/fail)	√ Fail
Notes	Non

Booking an Appointment but there is another preview Booking in same date and time

TEST CASE NUMBER	7
PURPOSE	Booking an appointment
Steps	Open the Reservation form and Click on the patient to be booked him an appointment and then chose the right doctor and then chose the time and date of booking then click on save bottom . then will view a message box so you can't save the booking
Pre-requisites	Enter to the system
Expected result	-
Actual results (pass/fail)	TRUE ☐ Fails √
Notes	Non

References

- **Graduated previous project**
- **Actual practice to work at the center**

https://www.youtube.com/channel/UCjmZcOZ0Q9rQ6IA7zyB-79w

/http://stackoverflow.com

https://en.wikipedia.org/wiki/Black-box_testing