DEVELOPMENT OF EXPERT SYSTEM: COMPUTER-BASED HOME DOCTOR

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Abstract - The increase in diseases has not met with corresponding increase in healthcare experts and facilities. The need to provide an alternative and prompt healthcare expert advice to the worlds growing population becomes urgent. In the health sector, computers are already being used in various ways to provide solution to support services. This work is aimed at developing an expert system for diagnosing of diseases based on laboratory tests and ailment symptoms. This system employs artificial intelligence to analyze and make deduction based on expert knowledge. The deductions identifywith high degree of accuracy the particular disease the patient is likely to have. The complete system is known as COMPUTER-BASED HOME DOCTOR. C#.Net programming language was used through Object-Oriented Analysis and Design (OOAD). The system is user-friendly. The expert system works based on the information being fed into the system as an input. The system makes use of symptoms to diagnose a disease but if the number of diseases diagnosed is more than one, it recommends laboratory test for the user. The system generates laboratory ref code which the user must input when the lab test result is ready so that the system can recognize the test. After predicting the ailment type, the system prescribes drugs for the person. The result obtained from this work is a computer-based home doctor with high level of intelligence which can be used by the public at will to diagnose different kinds of ailments without visiting a hospital.

Keywords: Expert system, Diagnosis, Diseases, Symptoms, Laboratory tests, Laboratory results

1. INTRODUCTION

The user interface for the computer systems is evolving into an intelligent multi-modal interface[1]. It is now moving away from keyboard-driven instructions to more natural modes of interaction, using visual, audio and sensorial means. This is the first step in achieving a human-like communication between man and machine.The developments of Expert Systems (ESs) have drawn much attention of the research community in the last few decades. The idea of expert systems has also been widely accepted in clinical environment, starting from a simple database query to complex treatment recommendation[2]. Expert systems (ESs) solve problems that are normally solved by human "experts"[3]. An ES is a problem-solving package that mimics a human expert in a specialized area[3].

An Expert System is computer program that emulates the behavior of human expert to solve problems which are real world problems associated with a particular domain of knowledge[4][5]. An expert system is computer software that attempts to act like a human expert on a particular subject area[6]. It uses a knowledge base of human expertise for problem solving, or to clarify uncertainties where normally one or more human experts would need to be consulted[6].An Expert System which is sometimes called an Intelligent Knowledge Base System (IKBS) is essentially a computer system containing expertise in a particular area. The primary goal of an Expert System is to make expertise available to decision makers and technicians who read answers quickly.

Computer-based methods are increasingly used to improve the quality of medical services[7][8][9]. Artificial Intelligence (AI)[10]is the area of computer science focusing on creating machines that can engage on behaviors that humans consider intelligent[11].

When a disease is detected in its early stage, the treatment becomes easier and can easily be prevented. Identifying the treatment accurately depends on the method that is used in diagnosing the diseases[12]. Diagnosis is the process of fault-finding in a system (or determination of a disease state in a living system) based on interpretation of potentially noisy data[13].

Apart from human medicine, Expert System has a great prospect in medical agriculture. It has been applied in different areas like:

(i) Diagnosis of diseases in Rice Plant[14]

(ii) Diagnosis of Micro Nutrients Deficiencies in Crops[15]

(iii) Diagnosis of pests, diseases, disorders in Indian mango[16]

2.METHODOLOGY AND SYSTEM ANALYSIS

2.1 Design Methodology

Object-Oriented Analysis and Design (OOAD)[17][18][19][20] is the design methodology used in this work and the main programming language is C#.Net[21][22][23][24][25]. The object-oriented technique offers a seamless process that helps viewing the software architecture in terms of problem space elements. Object-oriented analysis and design (OOAD) is a software engineering approach that models a system as a group of interacting objects[26]. Each object represents some entity of interest in the system being modeled, and is characterized by its class, its state (data elements), and its behavior.

The expert system was divided into classes with each class handling a specific operation. The classes have attributes and methods that help them to achieve the goals in which they are set for. UML diagrams were used to represent the relationship between all the entities in the system. The implementation is basically on what the diagrams show.

2.2 Design Procedure and Analysis

Object-Oriented programming approach was used in place of other good approaches. Object-oriented programming is a method of implementation in which programs are organized as cooperative collections of objects, each of which represents an instance of some classes, and whose classes are all members of a hierarchy of classes united via inheritance relationships[27]. So many facts were extracted and information gathered before designing the system. The procedure for the design followed these steps:

- Gathering of information about diseases
- Building of knowledge
- Program Design
    i. The interface design
    ii. Building of classes
    iii. Database interaction

2.3UML diagrams of the System

In software design, UML diagram is always important. It helps in representing the project model in pictorial form so that the main idea can be conveyed and implemented.

The Unified Modeling Language (UML) is a general-purpose modeling language in the field of software engineering, which is designed to provide a standard way to visualize the design of a system[30].For nearly ten years, the Unified Modeling Language (UML) has been the industry standard for visualizing, specifying, constructing, and documenting the artifacts of a software-intensive system. As the de facto standard modeling language, the UML facilitates communication and reduces confusion among project stakeholders[31].

The Computer Home based doctor was represented in UML diagrams to give an insight of exactly what to develop. Diagrams like class diagrams and activity diagrams were used to describe the system.

2.3.1 Activity Diagram

Activity diagrams are graphical representations of workflows of stepwise activities and actions[32] with support for choice, iteration and concurrency. In the Unified Modeling Language, activity diagrams are intended to model both computational and organizational processes (i.e. workflows) [33]. Activity diagrams show the overall flow of control. Fig. 2.1 is the activity diagram of the computer based home doctor developed in this project. The circle denotes the terminals of the system (i.e. start and stop), the rounded rectangle denotes the action performed by the user of the system, the arrow shows the direction of flow of different actions, the thick horizontal line denotes junction where different activities converge or better still where different activities are initiated, and the rhombus denotes decision.

2.3.2 Class diagrams

In software engineering, a class diagram in the Unified Modeling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among objects [34]. The class diagram of the computer based home doctor is as shown in Fig. 2.2. The arrows in the class diagram show how a class inherits another class. The **CBHD** class is the super class and every other class inherits it and that is why the arrows are pointing from the other classes to the **CBHD** class.

2.4 Proposed System Features

The system has the following features:

1. A user selects symptoms
2. The system makes use of the symptoms to diagnose the disease
3. If more than one disease is diagnosed, the system then recommends lab tests to confirm the specific disease the user is suffering from. The system generates a **lab ref code** which the user must enter when the test result is out. The lab ref code enables the system to retrieve the recommended test from the database so that the user can just feed in the result.
4. The system allows the user to input age limit, enter drugs allergic to and specify pregnancy status.
5. The system prescribes drugs based on the input.

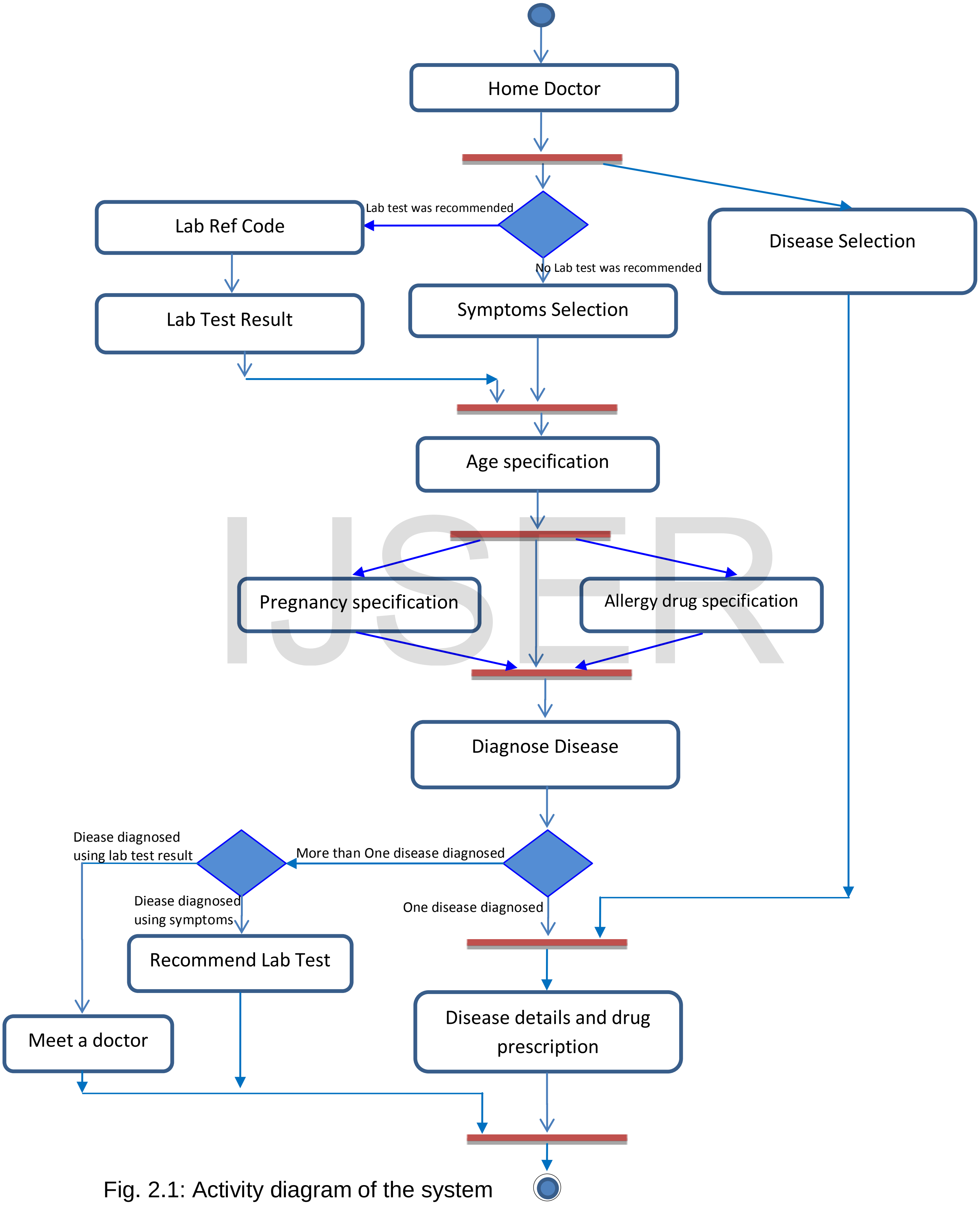


Fig. 2.1: Activity diagram of the system

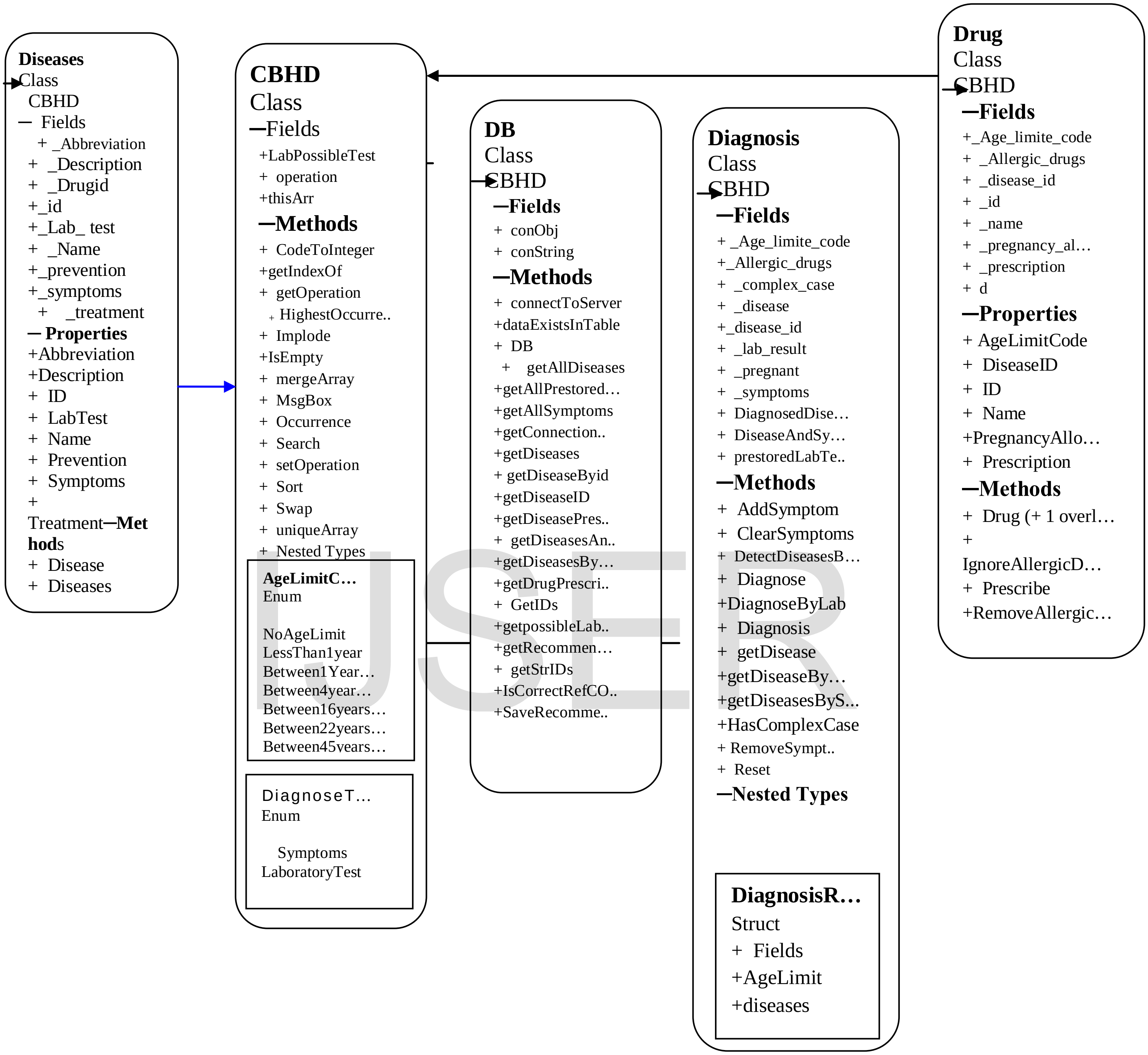


Fig. 2.2: Class diagram of the system.

3. SYSTEM DESIGN

3.1 Database Specification/Design

The effectiveness of the knowledge base of a system depends on how the database is structured. The purpose of the database specification is to guide the programmer on how to structure the database so that information can flow well be the application interface and the server. Good database design is a product of good database specification. The primary content of a database is table. A database contains primarily of table(s) which hold the information to be communicated or to be used to make decision based on user request. A database called **homedoctordb** was designed here to hold all the diseases obtained from hospitals and internet. The database has four tables namely:

(i) **Disease_lab_tests**: this table stores the possible laboratory tests for selected diseases. There are so many diseases gathered during the information gathering stage but twenty (20) of them were paid attention to because they have possible laboratory tests and results. This means that only twenty (20) diseases were stored in the database for simplicity.

(ii) **Diseases**: this table stores all the diseases available in the system. The table is well structured. It stores the name of the disease, symptoms, prevention and treatment.

(iii) **Drugs**: this table holds drugs for treating the diseases.

(iv) **laboratory_test_recommendation:** this table stores the recommended lab tests.

3.2. Design of System Modules

3.2.1 Main Interface Design

The main system design entails the architectural design. The architectural design of a system emphasizes on the design of the systems architecture which describes the structure, behavior, and more views of that system[37].Fig. 3.1 is the system architectural design.

There are three basic tiers in the architecture of the system design. They are:

1. **Presentation tier:** this is the user interface of the application. It was designed using Visual Studio.NET

2010. C# programming language was used to add brain to the interface.

2. **Middle tier:** this connects the presentation tier and the data tier together. The middle tier can sometimes be referred to as the business logic. It is the brain behind the application. It was implemented using C#.
3. **Data tier:** this is the part of the system that is responsible for storing data for the application. The information gathered about the diseases was stored in the database. Here Microsoft SQL Database file was used.

The flowchart in fig. 3.2 captures the order of operation of the system while diagnosing an ailment.

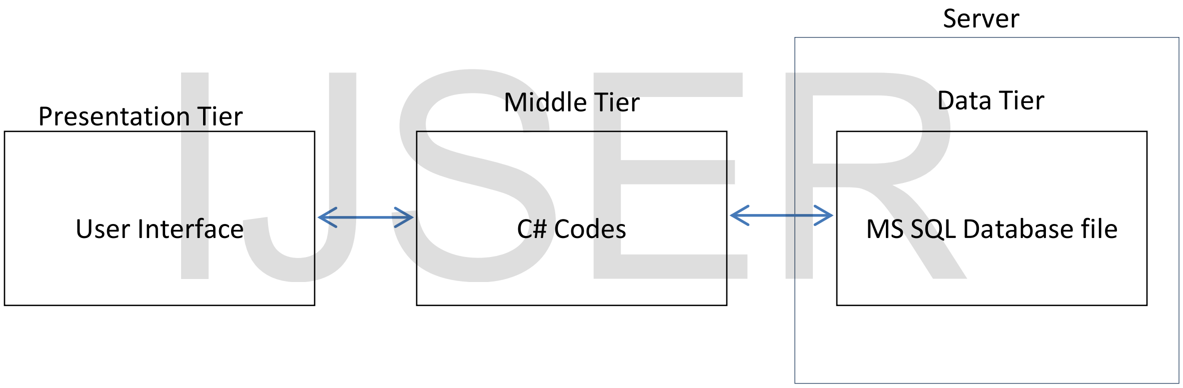


Fig. 3.1: System Architecture.

3.2.2 Input / Output Specification and Design

The input and output design of any system is important. The input design of this system is not a complex one in that the target users were assumed to be novice in handling computer. The interface of the system was designed primarily to be simple. Fig. 3.3 is the block diagram of the system. **LABORATORY TEST RESULT and AILMENT SYMPTOMS** blocks are inputs. These blocks capture information from the user. The symptoms and the laboratory test result can be entered by clicking. Alternatively, the user can equally enter the symptom via the keyboard.

The input/output submodules include:

a. **Diseases:** This contains all the diseases that were pre-stored in the database. When the application is launched, the system goes to the database table called **diseases** to retrieve all the diseases in it and display them on the application interface at the left hand side. The user can just select any of the diseases in order to view the details and treatment. Any disease selected through this means does not need other form of input specification such as age limit, drugs allergic to and pregnancy status. Here it is assumed that the users already know what he/she is suffering from. This is purely input block.

b. **Ailment Symptoms:** After the question box comes the ailment symptoms. This block can only be reached if the user had selected **No** option from the question dialog box. This interface contains all the symptoms of diseases stored in the database. The symptoms stored in the table are combined to form the symptoms list box items in the input design. Some diseases have some symptoms in common. In this kind of situation, the program does not repeat any symptom that was retrieved from a disease. The symptoms are combined in a unique way meaning no symptom is repeated.

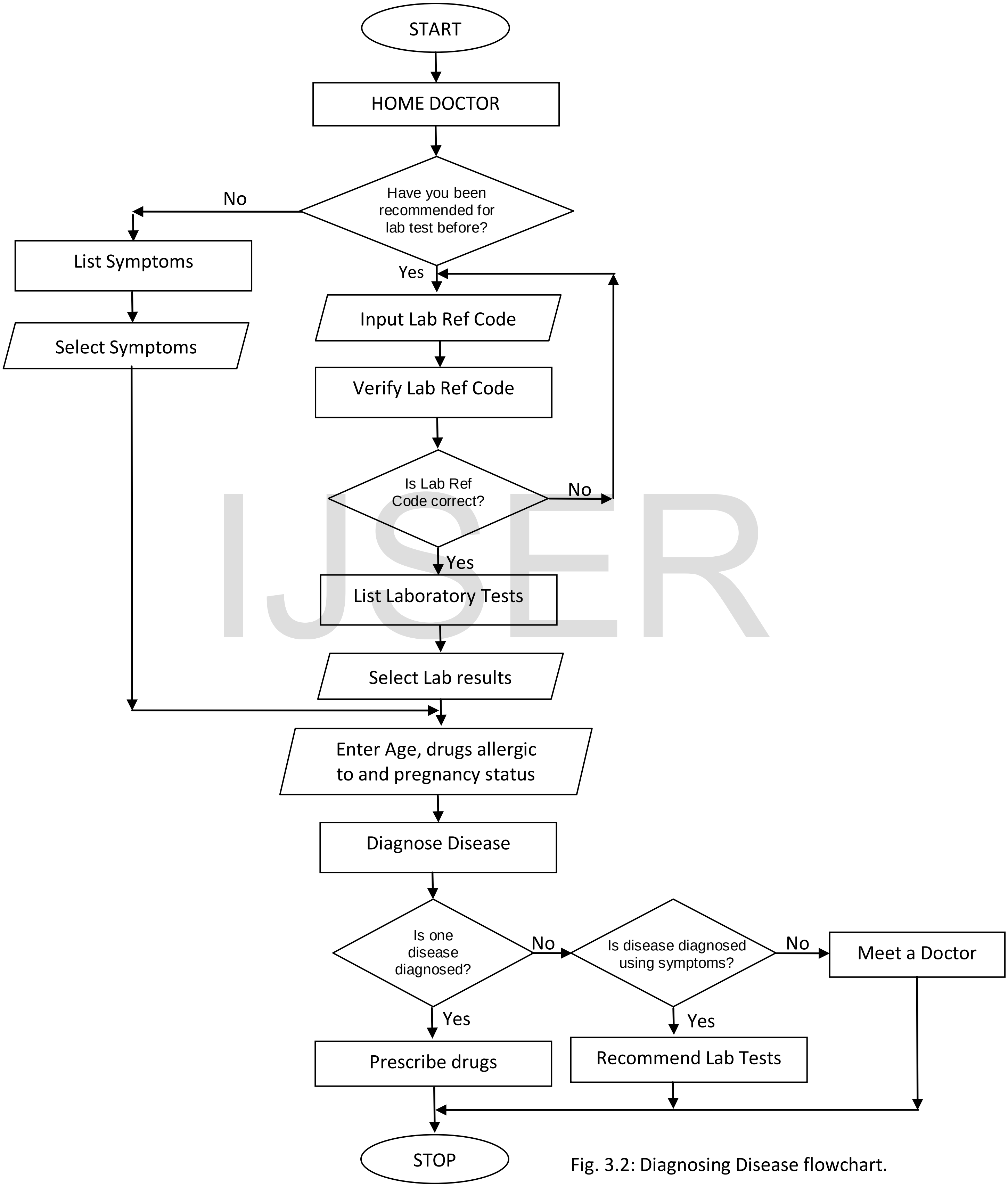


Fig. 3.2: Diagnosing Disease flowchart.

c. **Laboratory Test Result:** this particular block can only be reached also if the **Yes** option is selected and correct lab ref code entered in the question dialog box. The system verifies the lab ref code and displays exactly the recommended lab tests on this interface. In each laboratory test row, there are always list of possible results stored in drop down menu where the user can select the lab result for each of the tests. In a situation where the result obtained is not in the drop down menu, the user is expected to select **Result not present**.

d. **Input age, drugs allergic to and pregnancy:** when symptoms or lab tests results are entered, the next screen is this particular one. Here the user is expected to specify age limit, drugs allergic to and pregnancy status. This is called the final input stage of the system. This is purely input block.

e. **Lab Test Recommendation:** this block only displays if more than one ailment is diagnosed from the **ailment symptoms** block. When the user selects symptom(s), the system checks up the diseases with the selected symptom(s) in the database. If more than one disease has the symptom(s) in common, the diseases are picked and the system will not prescribe drugs for their treatments rather it will recommend laboratory tests drawn from all the diseases diagnosed just to be sure of the particular disease the user is suffering from. This particular interface displays the list of the recommended lab tests and the ref code.

f. **Drug prescription:** this is the final stage of the entire system. When the disease is diagnosed, the system displays the disease details and its drug prescription. This block is tied to two tables in the database namely: (i) diseases and (ii) drugs. This is purely output block.

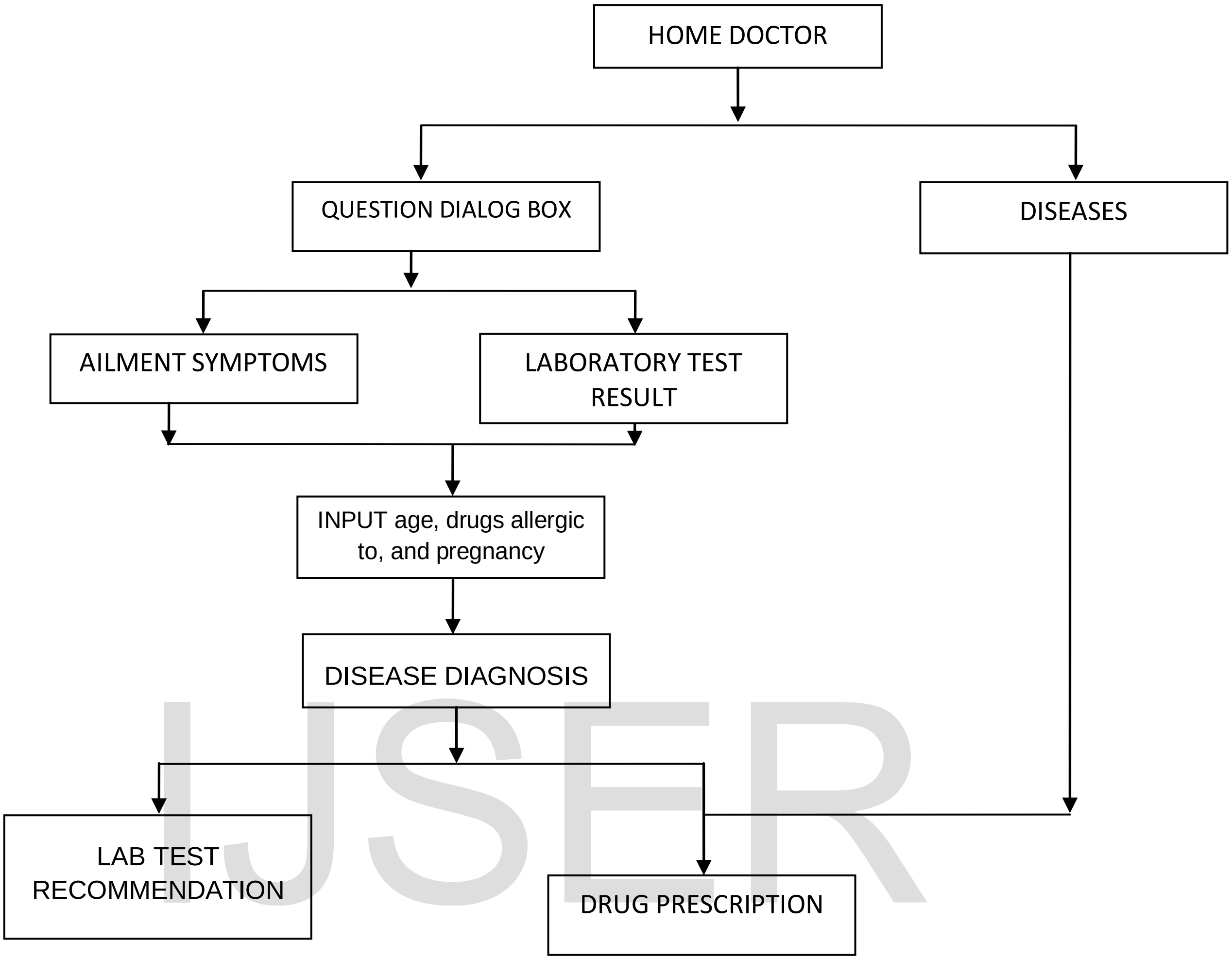


Fig. 3.3: System block diagram.

The system was designed in such a way that the user is always propmpted to do the follow:

i. Select Age range
ii. Enter drug(s) allergic to
iii. Tick Pregnant if user is a female and also pregnant

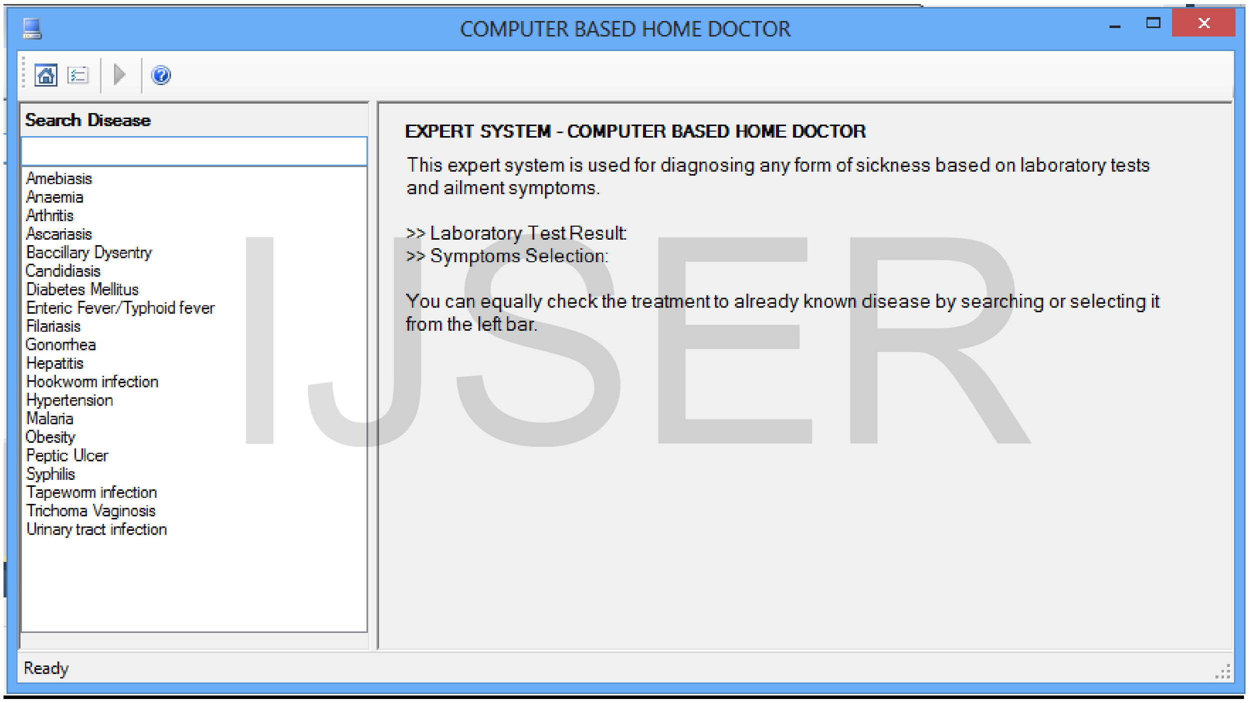
Whether the user is using symptoms or lab test to diagnose the disease, the system will always prompt the above inputs. The age range is mandatory but the remaining two are not.

Finally, if the user knows the particular ailment he/she is suffering from, the only thing he/she needs to do is select the disease from the list of the diseases. This is another form of input.

The output of the system is also a very simple one. The software displays the result of the disease being diagnosed and prescribes the drug for it in the last block (**DRUG PRESCRIPTION**) of the block diagram.

4. TESTING AND DISCUSSION OF RESULTS

The software was tested based on the main functions it performs and the results obtained were compared with physical results obtained from the hospital. The test was carried out using the two basic diagnosing methods namely: symptoms and Lab test. When the application was first loaded, the screen in fig. 4.1 appeared showing that the system is working and ready to take commands.



Amebiasis
Anaemia
Arthritis
Ascariasis
Baccillary Dysentry
Candidiasis
Diabetes Mellitus
Enteric Fever/Typhoid fever
Filariasis
Gonorrhea
Hepatitis
Hookworm infection
Hypertension
Malaria
Obesity
Peptic Ulcer
Syphilis
Tapeworm infection
Trichoma Vaginosis
Urinary tract infection

EXPERT SYSTEM - COMPUTER BASED HOME DOCTOR

This expert system is used for diagnosing any form of sickness based on laboratory tests and ailment symptoms.

>> Laboratory Test Result:
>> Symptoms Selection:

You can equally check the treatment to already known disease by searching or selecting it from the left bar.

Ready

Fig. 4.1: Computer Based Home Doctor Main Interface.

The application contains standard toolbar which holds command like Home(1st button), Diagnose Disease(2nd button), Help (3rd button) and Run (4th button). You can click any one to perform an activity.

4.1 Diagnosing Disease using Symptoms

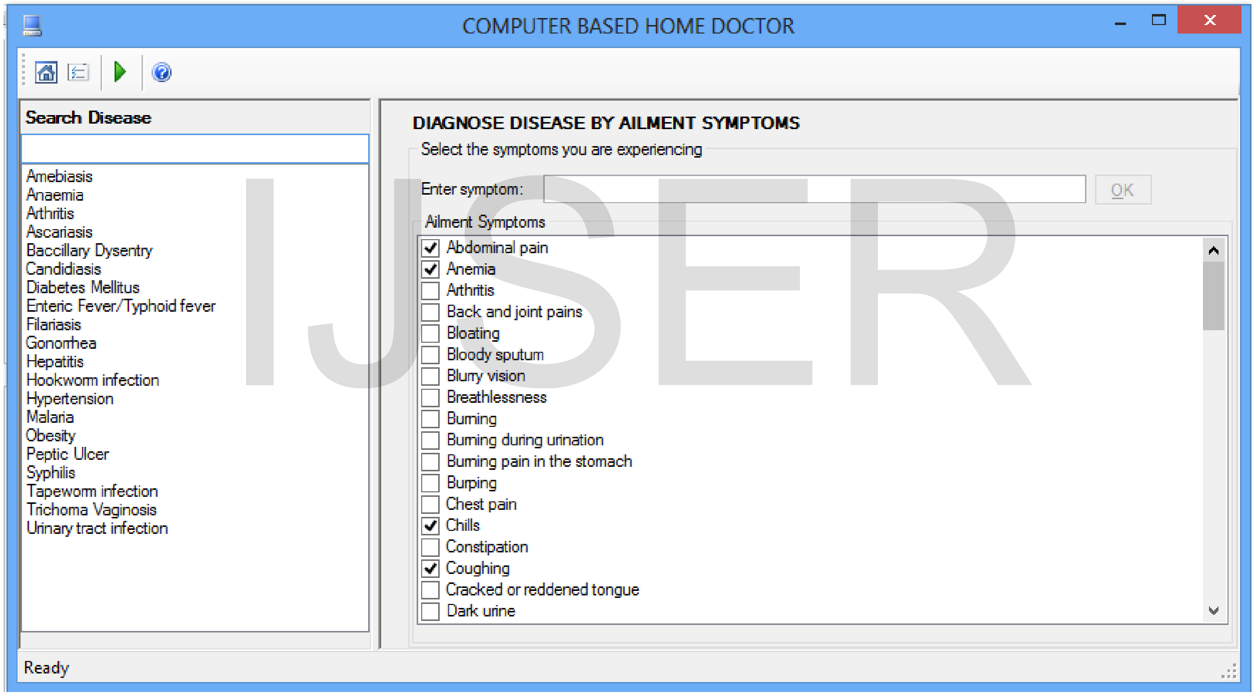
To diagnose disease using Symptoms, the 2nd button on the standard toolbar is clicked. Firstly, the lab info question dialog box is displayed asking “Was any

Laboratory Test recommended for you before?" There are two options on the window:

1. No, I want to do new diagnosis
2. Yes

Now to diagnose disease using symptoms, the first option is selected and the next button clicked.

After clicking the Next button, the list of symptoms in the database is displayed and the user can then select the symptoms he/she is experiencing. The symptoms are the combination of all the diseases symptoms pre-stored in the database. No symptom is repeated.


COMPUTER BASED HOME DOCTOR
Search Disease
DIAGNOSE DISEASE BY AILMENT SYMPTOMS
Select the symptoms you are experiencing
Enter symptom:
OK
Ailment Symptoms
Ready

Amebiasis
Anaemia
Arthritis
Ascariasis
Baccillary Dysentry
Candidiasis
Diabetes Mellitus
Enteric Fever/Typhoid fever
Filariasis
Gonorrhea
Hepatitis
Hookworm infection
Hypertension
Malaria
Obesity
Peptic Ulcer
Syphilis
Tapeworm infection
Trichoma Vaginosis
Urinary tract infection

☑ Abdominal pain
☑ Anemia
☐ Arthritis
☐ Back and joint pains
☐ Bloating
☐ Bloody sputum
☐ Blurry vision
☐ Breathlessness
☐ Burning
☐ Burning during urination
☐ Burning pain in the stomach
☐ Burping
☐ Chest pain
☑ Chills
☐ Constipation
☑ Coughing
☐ Cracked or reddened tongue
☐ Dark urine

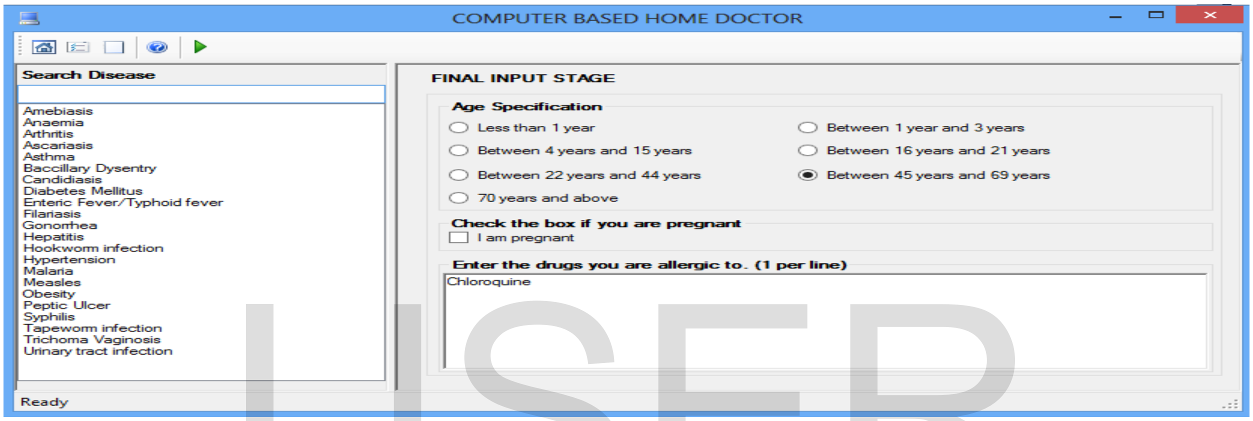
Fig. 4.2: Disease Diagnosis using symptoms interface.

To finish up the diagnosis of the disease, the final input stage of the system is displayed. This is where the user will select age range, enter drugs allergic to and also specify pregnancy status. The age limit specification is very important. In fact it is not optional. The user must specify it but the allergic drugs and pregnancy status are optional. The user can actually do away with them. In that case, the system will assume that the user is not pregnant and does not have any drug(s) that affect him/her.

The following symptoms were selected during the software testing:

- Fever, Chills, Headache, Sweats, Fatigue, Nausea and vomiting
- Loss of appetite, Diarrhoea, Abdominal pain, Coughing
- Anaemia, Muscle and joint pain

All the above symptoms are those of malaria.



Amebiasis
Anaemia
Arthritis
Ascariasis
Asthma
Baccillary Dysentry
Candidiasis
Diabetes Mellitus
Enteric Fever/Typhoid fever
Filariasis
Gonorrhea
Hepatitis
Hookworm infection
Hypertension
Malaria
Measles
Obesity
Peptic Ulcer
Syphilis
Tapeworm infection
Trichoma Vaginosis
Urinary tract infection

FINAL INPUT STAGE

Age Specification

○ Less than 1 year
○ Between 1 year and 3 years
○ Between 4 years and 15 years
○ Between 16 years and 21 years
○ Between 22 years and 44 years
● Between 45 years and 69 years
○ 70 years and above

Check the box if you are pregnant

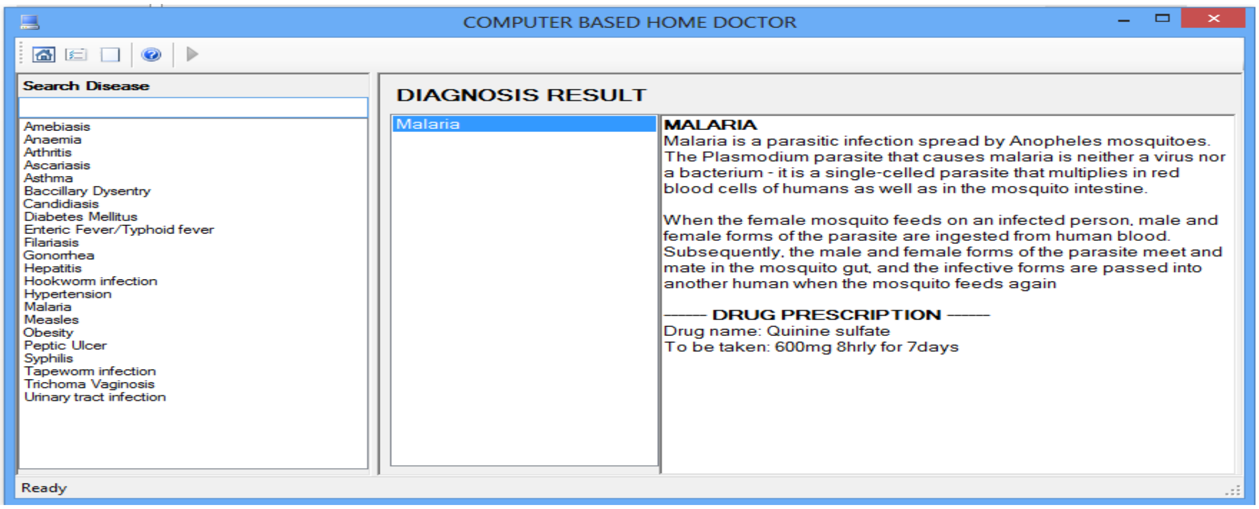
□ I am pregnant

Enter the drugs you are allergic to. (1 per line)

Chloroquine

Fig. 4.3: Age, pregnancy and drug allergic specification screenshot.

In the screenshot (fig. 4.3), Chloroquine was entered as drug allergic to therefore the system will never prescribe Chloroquine for the user.



Amebiasis
Anaemia
Arthritis
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Diabetes Mellitus
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Gonorrhea
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Hookworm infection
Hypertension
Malaria
Measles
Obesity
Peptic Ulcer
Syphilis
Tapeworm infection
Trichoma Vaginosis
Urinary tract infection

DIAGNOSIS RESULT

Malaria

MALARIA
Malaria is a parasitic infection spread by Anopheles mosquitoes. The Plasmodium parasite that causes malaria is neither a virus nor a bacterium - it is a single-celled parasite that multiplies in red blood cells of humans as well as in the mosquito intestine.

When the female mosquito feeds on an infected person, male and female forms of the parasite are ingested from human blood. Subsequently, the male and female forms of the parasite meet and mate in the mosquito gut, and the infective forms are passed into another human when the mosquito feeds again

------ DRUG PRESCRIPTION ------
Drug name: Quinine sulfate
To be taken: 600mg 8hrly for 7days

Fig.4.4: Disease Diagnosis screenshot showing Malaria as diagnosed disease.

Now, the system diagnosed Malaria and Prescribed Quinine Sulphate as the drug and to be taken 600mg 8hourly for 7 days.

The diagnosis in fig. 4.4 is just a case where just one disease is diagnosed. Now let us select Nausea and vomiting. Both of them are present in the diseases like Bacillary Dysentery, Malaria, Hepatitis and Peptic Ulcer. The system recommended the laboratory tests shown in fig. 4.5 to ascertain the particular disease among all of them.

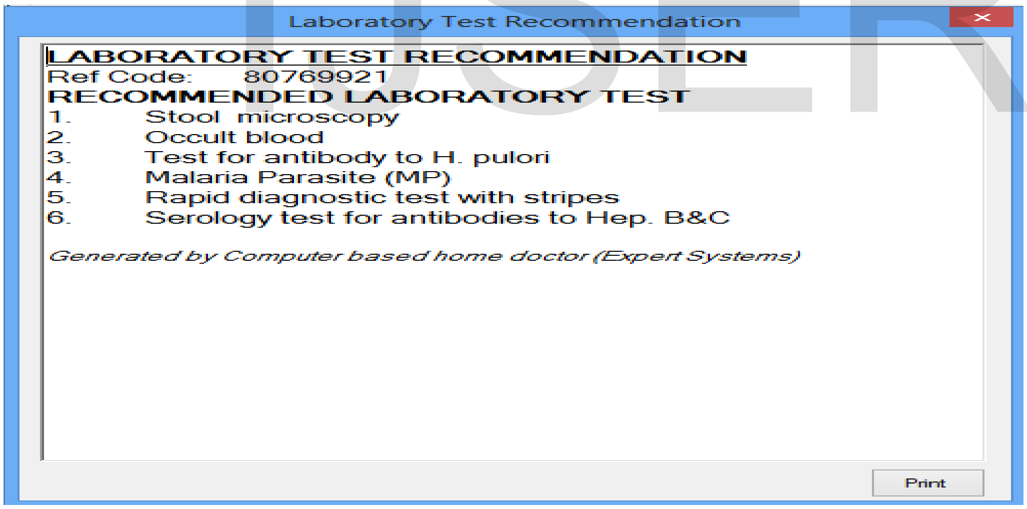
Going by the symptoms selected, the system would have diagnosed four different diseases but instead it recommended the laboratory tests with ref code **80769921**as shown in fig. 4.5. Let us look at the possible laboratory tests of the four diseases:

Bacillary Dysentery: this has *Stool microscopy* as the only test

Malaria: this has *Malaria Parasite (MP)* and *Rapid diagnostic test with stripes* as the lab tests

Hepatitis: this has only Serology test for *antibodies to Hep. B&C* as the lab test.

Peptic Ulcer: this has *Occult blood* and *Test for antibody to H. pylori* as the lab tests.



LABORATORY TEST RECOMMENDATION
Ref Code: 80769921
RECOMMENDED LABORATORY TEST
1. Stool microscopy
2. Occult blood
3. Test for antibody to H. pulori
4. Malaria Parasite (MP)
5. Rapid diagnostic test with stripes
6. Serology test for antibodies to Hep. B&C

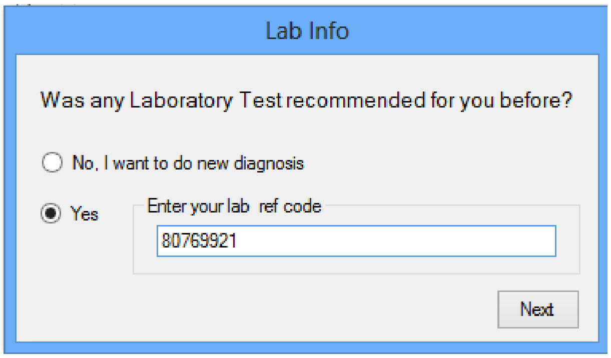
Generated by Computer based home doctor (Expert Systems)

Fig. 4.5: Laboratory test recommended

Now, looking at fig. 4.9, you will discover that all the four diseases have their individual possible laboratory tests listed. This shows that the program is working perfectly. The user is expected to print out or copy the laboratory test recommendation and head straight to any medical laboratory for proper examination.

4.1.2 Diagnosing Disease using Laboratory Test/Result

This feature is used if the system had recommended a lab test for the user and a ref code must have been generated in the process. To diagnose disease using Laboratory Test, the 2nd button on the standard toolbar is clicked as usual then **Yes**option is selected in the Lab Info question dialog box as shown in fig. 4.10. The user is expected to enter a correct ref code generated as at the time of the laboratory test recommendation then click the next button.



Lab Info

Was any Laboratory Test recommended for you before?

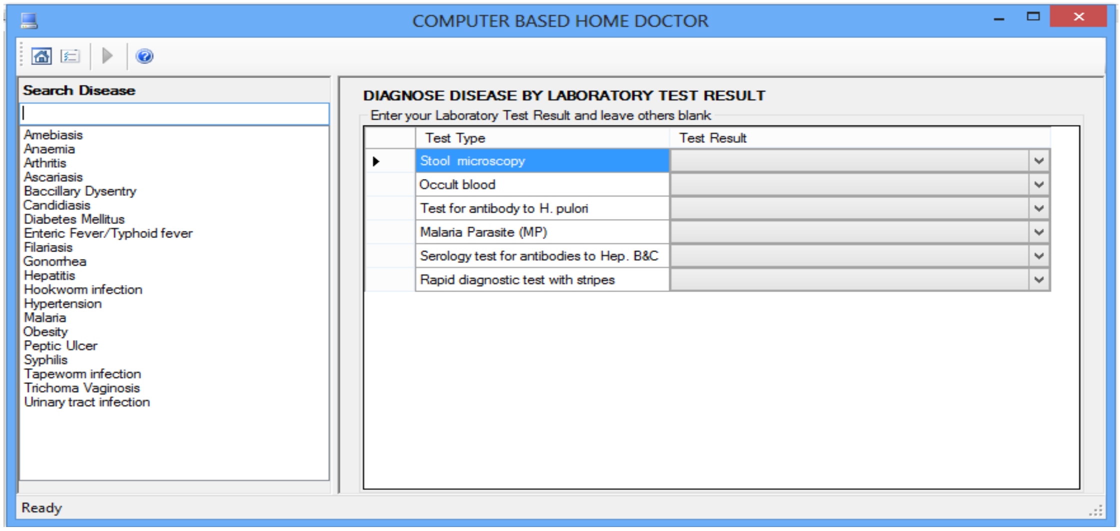
○ No, I want to do new diagnosis

● Yes

Enter your lab ref code: 80769921

Fig. 4.6: Lab Info Question dialog box

After entering a correct ref code, the system retrieves the recommended laboratory tests and displays them for the user to enter the results as shown in fig. 4.7.



Search Disease

Amebiasis
Anaemia
Arthritis
Ascariasis
Baccillary Dysentry
Candidiasis
Diabetes Mellitus
Enteric Fever/Typhoid fever
Filariasis
Gonorrhea
Hepatitis
Hookworm infection
Hypertension
Malaria
Obesity
Peptic Ulcer
Syphilis
Tapeworm infection
Trichoma Vaginosis
Urinary tract infection

DIAGNOSE DISEASE BY LABORATORY TEST RESULT

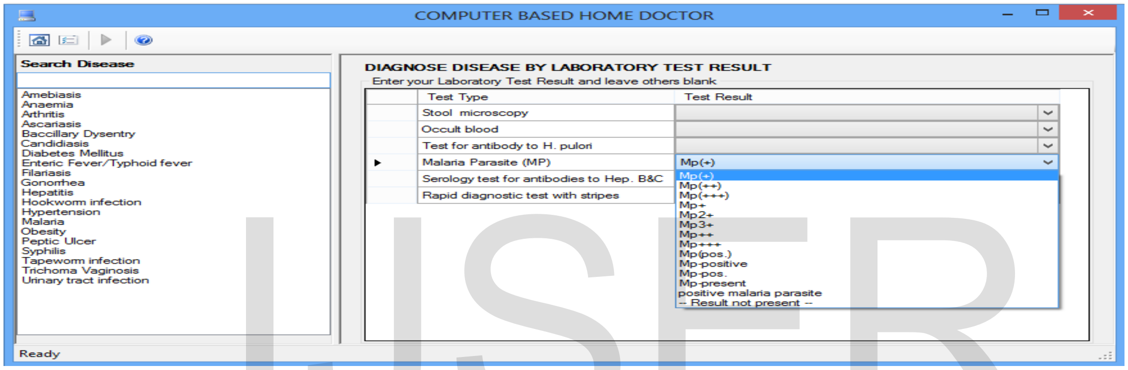
Enter your Laboratory Test Result and leave others blank

Test Type	Test Result
Stool microscopy	
Occult blood	
Test for antibody to H. pulori	
Malaria Parasite (MP)	
Serology test for antibodies to Hep. B&C	
Rapid diagnostic test with stripes	

Fig. 4.7: Disease Diagnosis using Laboratory Test.

The laboratory test input interface contains drop down menus where the user can click and select the pre-stored results that match the results obtained from the lab. Malaria has different ways of reporting the lab results and is contained in the drop down menu as shown in fig. 4.8. The user is expected to select one of the results or choose **Result not present**. That case the system will know that the user has been tested negative.

The screenshot in fig. 4.9 contains the assumed test result during the program testing. On the blood occult test result was filled as **Occult blood(++)** and others were filled as Result not present just for demonstration sake. The user can equally leave the result unfilled if the result is not found in the drop down menu.

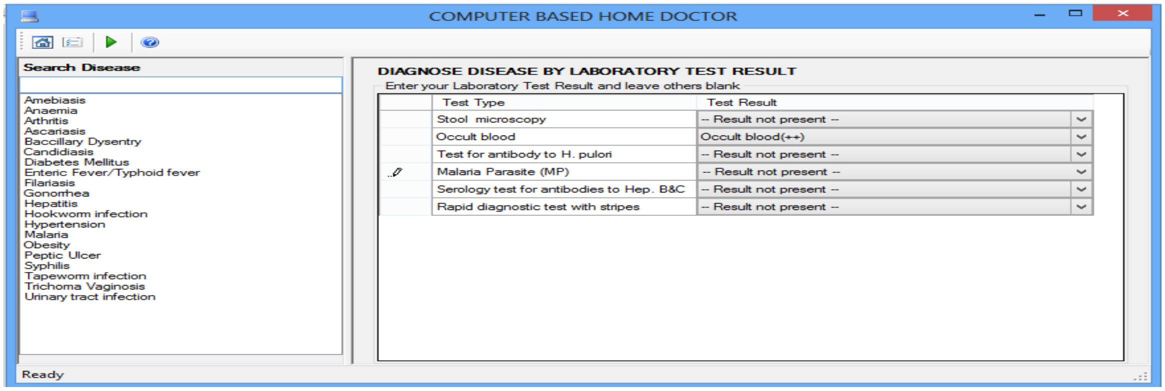


DIAGNOSE DISEASE BY LABORATORY TEST RESULT

Enter your Laboratory Test Result and leave others blank

	Test Type	Test Result
	Stool microscopy	
	Occult blood	
	Test for antibody to H. pulori	
▶	Malaria Parasite (MP)	Mp(+)
	Serology test for antibodies to Hep. B&C	
	Rapid diagnostic test with stripes	

Fig. 4.8: Disease Diagnosis using Laboratory Test



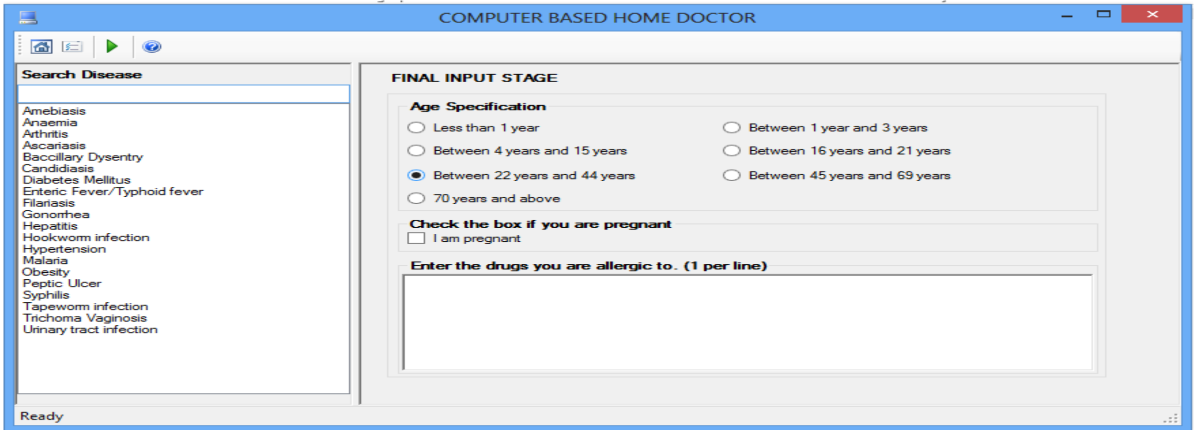
DIAGNOSE DISEASE BY LABORATORY TEST RESULT

Enter your Laboratory Test Result and leave others blank

Test Type	Test Result
Stool microscopy	-- Result not present --
Occult blood	Occult blood(++)
Test for antibody to H. pulori	-- Result not present --
Malaria Parasite (MP)	-- Result not present --
Serology test for antibodies to Hep. B&C	-- Result not present --
Rapid diagnostic test with stripes	-- Result not present --

Fig. 4.9: Laboratory Test input interface filled with lab results.

After entering the lab results, the Run button is clicked to move to the next stage. The screen in fig. 4.10 shows the next stage. It asks the user to specify age, enter drugs allergic to and specify pregnancy status.



Search Disease

Amebiasis
Anaemia
Arthritis
Ascariasis
Baccillary Dysentry
Candidiasis
Diabetes Mellitus
Enteric Fever/Typhoid fever
Filariasis
Gonorrhea
Hepatitis
Hookworm infection
Hypertension
Malaria
Obesity
Peptic Ulcer
Syphilis
Tapeworm infection
Trichoma Vaginosis
Urinary tract infection

FINAL INPUT STAGE

Age Specification

○ Less than 1 year
○ Between 1 year and 3 years
○ Between 4 years and 15 years
○ Between 16 years and 21 years
● Between 22 years and 44 years
○ Between 45 years and 69 years
○ 70 years and above

Check the box if you are pregnant

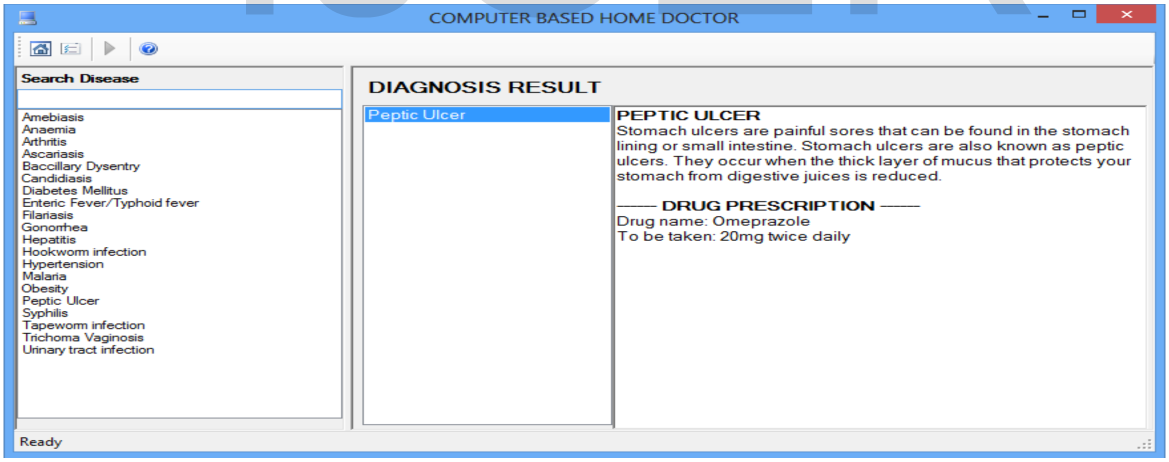
□ I am pregnant

Enter the drugs you are allergic to. (1 per line)

Ready

Fig. 4.10: Final input stage.

After this stage, the Run button is clicked again to do the final disease diagnosis. The interface that contains the disease details and the treatment is displayed as shown in fig. 4.11.



Search Disease

Amebiasis
Anaemia
Arthritis
Ascariasis
Baccillary Dysentry
Candidiasis
Diabetes Mellitus
Enteric Fever/Typhoid fever
Filariasis
Gonorrhea
Hepatitis
Hookworm infection
Hypertension
Malaria
Obesity
Peptic Ulcer
Syphilis
Tapeworm infection
Trichoma Vaginosis
Urinary tract infection

DIAGNOSIS RESULT

Peptic Ulcer

PEPTIC ULCER
Stomach ulcers are painful sores that can be found in the stomach lining or small intestine. Stomach ulcers are also known as peptic ulcers. They occur when the thick layer of mucus that protects your stomach from digestive juices is reduced.

------ DRUG PRESCRIPTION ------
Drug name: Omeprazole
To be taken: 20mg twice daily

Ready

Fig. 4.11: Disease diagnosis output screenshot

From the diagnosis result, Peptic Ulcer was diagnosed. The age limit selected is between 22years and 44years and the drug prescription for it is **Omeprazole** to be taking **20mg twice daily.**

5. CONCLUSION

The results of the tests reveal that the Home Doctor expert system is capable of diagnosing diseases using the symptoms supplied by any sick person who makes use of it. Also the flexibility of recommending relevant laboratory investigation increases the robustness of the expert Home Doctor to diagnose diseases with increased accuracy.The functionality of drug prescription based on the results of diagnosis is also a very dynamic feature incorporated in this expert system.

6. RECOMMENDATION

In the light of the systems accuracy, availability and accessibility we therefore recommend this Computer-based-home doctor software to persons living in areas where accesses to healthcare professionals are scare.

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