

Expert System for Diagnosis of Hepatitis B

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Abstract

This paper is a preview of the work so far concluded on Expert Systems implementation for the diagnosis of hepatitis B, which is one of the most common of all hepatitis ravaging mankind today. A user friendly application programme has been developed which can diagnose and prescribe solutions to the treatment of hepatitis B virus. The applications software has the capacity to monitor patients. The programme is limited to diagnosis and treatment of hepatitis B virus in Nigeria and the general terms in hepatitis B are considered under clinical study, general considerations, mechanisms regulation, virology, diagnosis and treatment.

Key Words: *Expert Systems, diagnosis, treatment, clinical study, patients*

1.0 Introduction

The use of computers has brought tremendous development to the world thereby making things a lot easier for people to handle. In recent times, only a few parts of the world are not making good use of computers to the full. It is only in these parts of the world that may not apply this software due to high cost of automation and low IT illiteracy level.

In the health sector two or more doctors cannot prescribe the same drug to a patient on a particular illness. Thus, the computer also at the end of the day will be making a routine decision for every patient. So far, there has been little success in achieving transfers of technology between medical computing research and the real application in medical science environment. In most cases new researches tend to be more interesting to the medical professionals compared to the implementation of an already existing system. This project will require the involvement of two professionals which are the medical doctors and the computer scientist. They can help in providing a software application package that the medical specialist will need using information the medical specialist provides.

Thus, the computer scientist is involved in tedious humanitarian services as well as

working under stringent conditions such as budget and many unappreciative clients. Despite all these draw backs, it presents an opportunity for hepatitis patient to get diagnosed and treated with the help of a computer.

In a paper presented by Shikhar, he proposed an architectural framework of an Expert System in the area of agriculture and describes the design and development of the Rule-based Expert System, using the Shell ESTA (Expert System for Text Animation). The designed system is intended for the diagnosis of common diseases occurring in the rice plant [2].

An Expert System is a computer program normally composed of a knowledge base, inference engine and user-interface [3]. The proposed expert system facilitates different components including decision support module with interactive user interfaces for diagnosis on the basis of response(s) of the user made against the queries related to particular disease symptoms. ESTA programming is based on logic programming approach. The system integrates a structured knowledge base that contains knowledge about symptoms and remedies of diseases in the rice plant appearing during their life span [1].

Ali (2010) had designed a Fuzzy Expert System for heart disease diagnosis. The designed system was based on the V.A. Medical Center, Long Beach and Cleveland Clinic Foundation data base. The system has 13 input fields and one output field. Input fields are chest pain type, blood pressure, cholesterol, fasting blood sugar, maximum heart rate, resting electrocardiography (ECG), exercise, old peak (ST depression induced by exercise relative to rest), thallium scan, sex and age. The output field refers to the presence of heart disease in the patient. It is integer valued from 0 (no presence) to 4 (distinguish presence (values 1, 2, 3, 4)). This system uses Mamdani inference method [4]. The results obtained from designed system are compared with the data in the database and observed results of designed system are correct in 94% of cases. The system was designed in Matlab software. The system can be viewed as an alternative for existing method.

The use of computer technology in the fields of medicine area diagnosis, treatment of illnesses and patient pursuit has highly increased [6]. Despite the fact that these fields, in which the computers are used, have very high complexity and uncertainty and the use of intelligent systems such as fuzzy logic, artificial neural network and genetic algorithm have been developed [5].

In the domain fields of heart disease risk, smoke, cholesterol, blood pressure, diabetes, sex and age are main risk factors that affect heart disease risk [4].

Detecting diseases at early stage can enable a patient to have early treatment which can lead to effective control. Identifying the treatment accurately depends on the method that is used in diagnosing the diseases [7]. A Diagnosis expert system (DExS) can help a great deal in identifying those diseases and describing methods of treatment to be carried out taking into account the user capability in order to deal and interact with expert system easily and clearly. Present expert system uses inference rules and plays an important role that will

provide certain methods of diagnosis for treatment [8].

Expert System can also be applied in Car failure detection. It is a complicated process and requires high level of expertise. Any attempt of developing an expert system dealing with car failure detection has to overcome various difficulties. The paper in the journal describes a proposed knowledge-based system for car failure detection [9].

A web-based expert system for wheat crop was also developed in Pakistan. Wheat is one of the major grain crops in Pakistan. It is cultivated in vast areas of Punjab followed by Sindh and ranked first as a cereal crop in the country [11]. Rule-based expert system covers two main classes of problems namely diseases and pests, normally encountered in wheat crop. The expert system is intended to help the farmers, researchers and students and provides an efficient and goal-oriented approach for solving common problems of wheat. The system gives results that are correct and consistent [10].

This paper is based on Hepatitis B, which is one of the most common of all hepatitis in Nigeria. Hepatitis B is irritation and swelling of the liver due to infection with the hepatitis B virus - HBV. Hepatitis B may be acute or chronic, the acute hepatitis B last less than six months, and it may lead to various infections that affect the liver. The chronic hepatitis B is at the risk of a lasting liver disease. It continues after and may persist beyond six months.

Most of the damages from hepatitis B virus occur because of the way the body responds to the infection, when the body's immune system detects the infection it sends out special cells to fight it off, however, these disease fighting cells can lead to liver inflammation. Hepatitis B is also known as Serum hepatitis.

It has been in existence for over a thousand years. T disease has been recorded to have had a large number of deaths in most developed countries. The liver being the second largest organ in the body plays an important role in regulating the composition

of various chemical cells in the body, this is the reason why special attention should be given to the liver. The computer which has already stored the relevant information needed by the physician and may be referred to as the stethoscope that assists the medical doctors do a very good job. Doctors can direct questions to the computer and receive answers on what they need to judge the diseases on the screen of the computer. This helps the doctor draw up an effective treatment chart thereby improving his efficiency on time, number of patients attended to and save more lives.

1.0.1 Types of Hepatitis B

There are three types of hepatitis B

- **Healthy chronic carrier of hepatitis B:** these carriers are not infectious to other people although they may slightly have a higher risk of cirrhosis and liver cancer. The virus becomes reactivated when the immune system becomes suppressed.
- **Chronic infectious hepatitis B:** here the person is highly infectious to people around, they have very inflamed and damaged liver even when the person has few or no symptoms.
- **Chronic mutant hepatitis B:** here the person has a mutant strain. A permanent alteration of HBV genetic make. They have the potential to be infectious to other and it is thought to be more resistant to treatment than the other types.

1.0.2 Mode of Transmission of HBV

Hepatitis B infection can be spread through having contact with the blood, semen, vaginal fluids and other body fluids of someone who already has hepatitis B infection.

Infection can be spread by these modes

- Blood transfusions
- Direct contact with blood in health care settings
- Sexual contact with an infected person.
- Tattoo and acupuncture with unclean needles or instruments.
- Sharing needles during drug use.

- Sharing personal items such as toothbrush, razors and nail clippers with the infected person.

- Pains on the right side of the abdomen.

It can also be passed from mother to child during child birth.

1.0.3 Symptoms of HBV

If the body is able to fight off the hepatitis B virus, any symptoms should go away over a period of weeks to 6 months. Many people with chronic hepatitis have few or no symptoms. They may not even look sick; as a result they may not know they are infectious. Some symptoms may not appear for up to 6 months after the infection. Early symptoms may include

- Appetite loss.
- Fatigue.
- Fever, low-grade.
- Muscle and joint aches.
- Nausea and vomiting.
- Yellowish skin, dark yellow urine due to jaundice.

1.0.4 Diagnosis and Test for HBV

The following test are done to identify and monitor liver damage from hepatitis B;

- Albumin level.
- Liver function test.
- Prothrombin time.

The following test are done to help diagnose and monitor people with hepatitis B,

- **Antibody to HBsAg (anti-HBs):** a positive result means the body has either had hepatitis B in the past or has received a hepatitis B vaccine.
- **Anti body to hepatitis B core antigen (anti-HBc):** a positive result means the body has recently been infected or in the past.
- **Hepatitis B surface antigen (HBsAg):** a positive result means that the body has an acute infection.
- **Hepatitis E surface antigen (HBe Ag):** a positive result means the body has hepatitis B infection and is more likely to

spread the infection to others through sexual contact or sharing needles.

Patients with chronic hepatitis will need ongoing blood test to monitor their status.

1.0.5 Treatment of HBV

Acute hepatitis needs no treatment other than careful monitoring of the liver and other body functions with blood test. Therefore the patient should get the following.

- Plenty of bed rest.
- Plenty of fluids to drink.
- Eating healthy foods.
- Treatment with alpha inferno and steroids given by injection. This stimulates the body's immune system and is administered for 16 weeks; it has no serious side effect.
- Treatment with lamuvudine, a drug taken orally for 52 weeks. Side effects are not serious.
- It is in rare cases that may need liver transplant due to liver failure.

Patients with chronic hepatitis b should avoid alcohol and should always check with the doctor before taking over the counter medication or herbal supplements. This even includes medication such as acetaminophen, aspirin and ibuprofen.

1.0 Objectives

The process of diagnosing and treating hepatitis B virus with this software is not easy but with mutual bridge between the doctors, patients and the computer will make

things faster and more efficient. Patients are to be under careful supervision for a long period of time.

The key objective here is to develop an application programme that is user friendly and can diagnose and treat hepatitis B virus both the control forms logically and functionally will be related within the system and is available to monitor patients and should be consistent.

2.0 Design Methodology:

The steps that has been adopted in the diagnosis and treatment of hepatitis B are as follows: analysis of current system, problem of the current system, analysis of the proposed system, system design, which are classified under Structured Systems Analysis and Design Methodology (SSADM).

The inference engine uses problem-solving knowledge or methods that interacts with the user and processes the result from the collection of rules and data in the knowledge base. An expert-system shell provides customizable inference engines and knowledge base that contains rules that are of the form "IF condition THEN action". The condition portion of the rule is usually a fact inputted by the user, the action portion of the rule can include actions that affect the outside world, activate another rule or add a new fact to the database. It has the capacity to acquire, store, retrieve, communicate, process and use knowledge for the purpose of solving problem. Figure 1 shows the Rule-based Expert System of the proposed system.

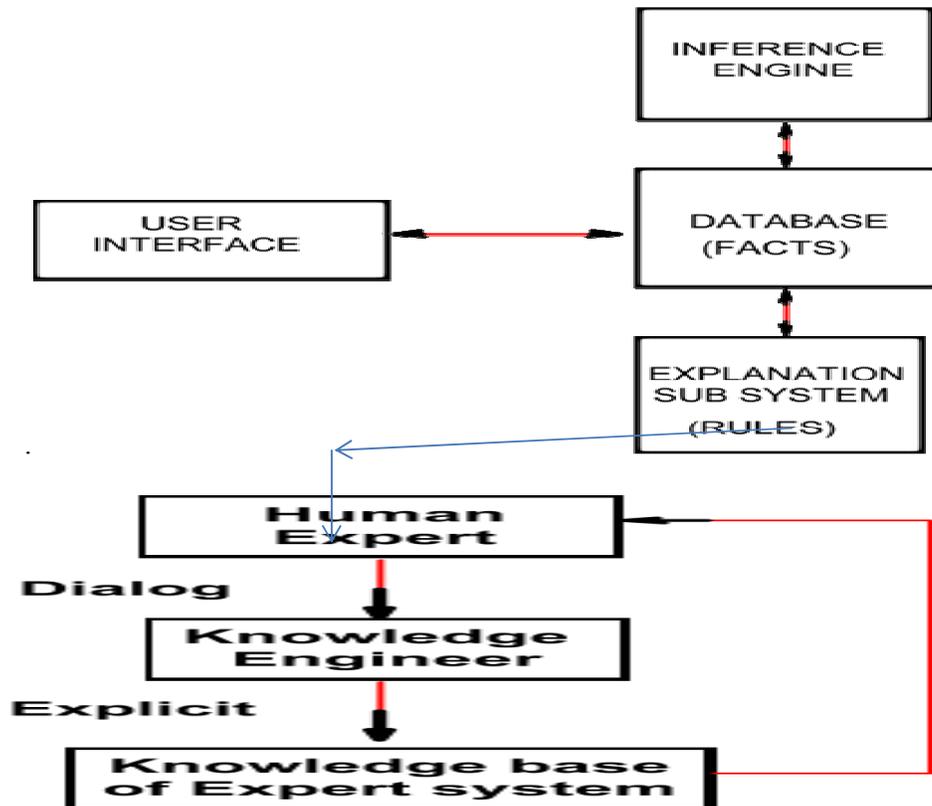


Figure 1: structure of the rule based expert system and developmental process

The methods to be taken are indicated in the following steps:

Step I

A feasibility study will be carried out to acquire knowledge about the activities of the physicians. This study also investigates the project and can either justify the development of the project or shows reasons why the project should not be continued.

Step II

Investigation and fact finding, which is a detailed study, will be conducted so as to identify the basic information requirements. It also involves contributions from the end users (asthmatics and experts) as well. They can easily pin-point the flaws in the old manual system and suggest improvements.

Step III

Analysis - this gives a full description of the old (manual) system and its objective. The manual system in this context refers to the traditional approach to diagnosis which

involves direct contact with the medical doctor or personnel as the case may be.

Step IV

Design is based on analysis carried out in the previous step and information gathered in previous steps. Interface will be created taken cognizance of the recommendations given in the previous stages. Coding comes in after the interface design; errors will be debugged and then the project can be implemented.

Step V

Training: in a situation where the project is to be adopted, there is a need to perform some training on the would-be users. The flowchart in figure (2) below, shows how the various subsystems or modules operate. The three (3) modules (subsystems) of the system are:

- i. Patient information
- ii. Diagnosis
- iii. Result and medication

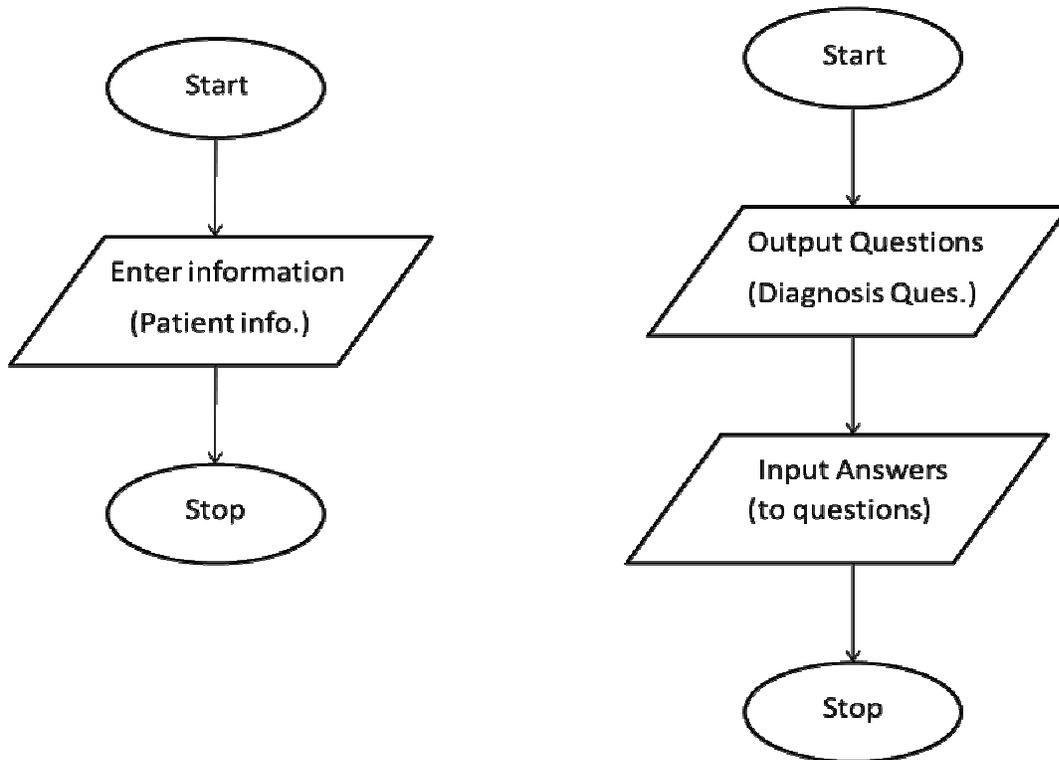


Figure 2 Patient information and diagnosis flowchart

Figure (3) indicates the system flow diagram, in which the database that will be used is MySQL because it is the world's most free and open source software (FOSS) database. MySQL is a relational database management system which was drawn from the need to quickly and efficiently deploy a data base application. Java is the programming Language adopted for coding the application. The data base:

- Stores users (patients) information

- Retrieves patient's information
- Updates records.

Single table will be designed to handle the various records of the patient that needed to be stored (such as gender, age, answers to the diagnostic questions, recommendation e.t.c) so as to enable the doctor retrieve the existing patient previous records. Also, the table will be properly decomposed so as to avoid repeating values.

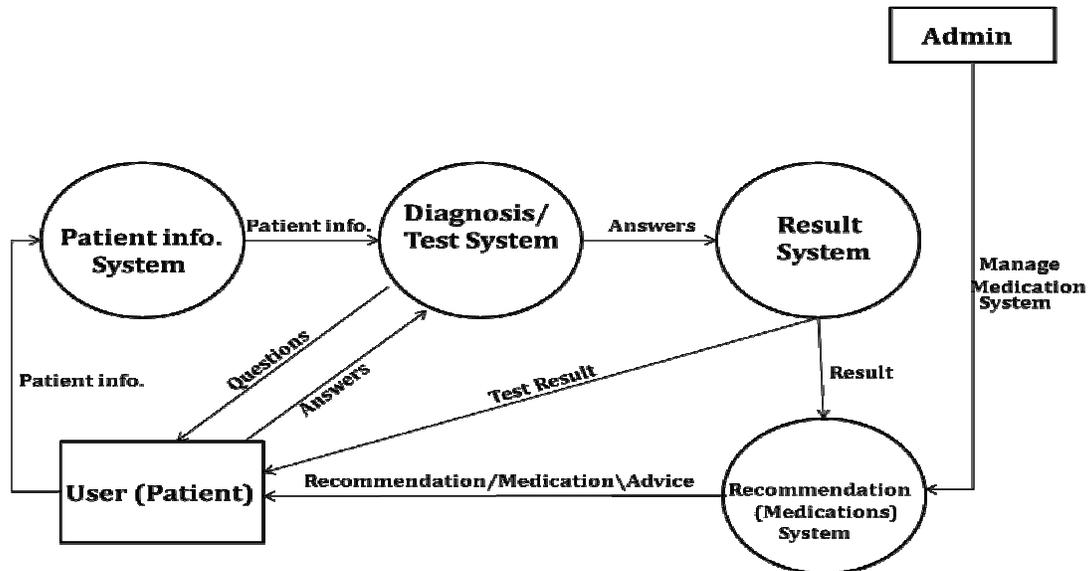


Figure 3: System Flow Diagram.

3.0 Results and Discussion.

The program has several windows (frames) each performing some certain tasks. In registering the patient, the first window is the patient information window which takes the information of the patient and performs some validity check on them. It is a separate class with only one constructor as:

```

public Frame1() {
    initComponents();
}

```

When the information provided by the patient is authenticated, it is sent to another window called the diagnostic test window. A separate class is also created for this task. The class has one constructor thus:

```

public Frame2() {
    initComponents();
}
public void setInformation(String name,
String state, String town, String age, String
gender, String marital, String regNo){
nameField.setText(name.toUpperCase());
noField.setText(regNo.toUpperCase());
stateField.setText(state.toUpperCase());

```

```

townField.setText(town.toUpperCase());
ageField.setText(age);
genderField.setText(gender.toUpperCase());
maritalField.setText(marital.toUpperCase());
;
}

```

Diagnosis test questions are asked as follows: and shown the interface in figure 5.

1. Do u have fever?
2. Do you have loss of appetite?
3. Do you have nausea and vomiting?
4. Do you have fatigue?
5. Do you have dark yellow urine?
6. Have you received any blood transfusion in the last 3-6 months?
7. Do you feel pains on the right hand side of your abdomen?
8. Does anyone in your house or family have or have been treated of hepatitis?
9. Have you nursed a patient with hepatitis recently?
10. Do you live in overcrowded environment?
11. Do you share formite (cloths) or any personal item like (toothbrush, razor e.t.c)?
12. Have you ever received injection

- using any unsterilized needle or tattoo with unsterilized instrument?
13. Have you had unprotected sex with someone you suspect to have hepatitis.?

And fields for providing answer to each of these questions are provided. When the user clicks the submit button, the answers are passed to another class called

Test to diagnose hepatitis thus:

1. HBs Ag test
2. HBe Ag test
3. Anti-Hbc test
4. LFT(liver function test)
5. Urinalysis
6. Abdominal scan

Also a separate class is created for this which has one constructor and no main method.

```
public ProgramLogic(){
}
```

The function of this class is to analyze the answers supplied by the user in order to determine whether the patient has hepatitis B or not.

If-else if – else statements are constructed in some amazing order to make correct decision. If test 1,2,3,5 are positive, patient should be placed on regular check up, treated and advised.

If any of test 4 and 6 are positive, patient should be placed on constant check up, treated with stronger medication, monitored and advised.

If test 6 is severely damaged, patient may need a liver transplant.

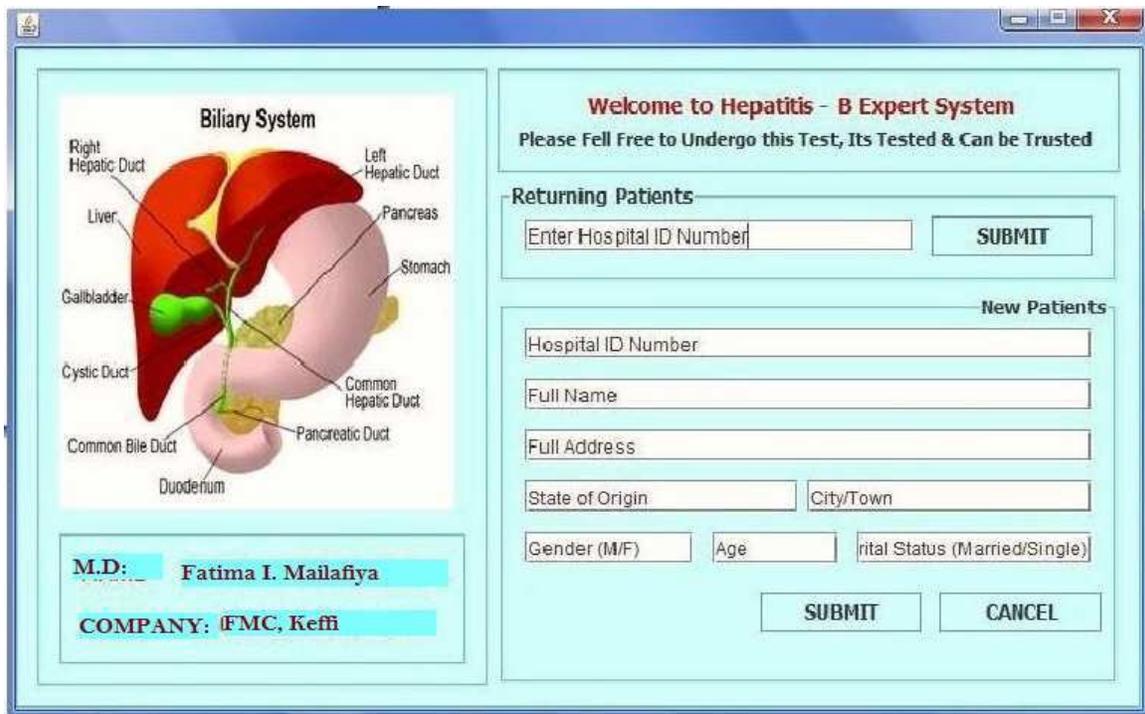


Figure 4 Information Interface.

A separate class is also created for this and it is also frame-based. It has only one constructor and several methods. There is a method that accepts the hepatitis B test result.

The frame has several panels. These include the panel containing the patient information (i.e. name, reg. No, age etc), the

panel containing the diagnostic question, responses of the patient, displaying the test result and the panel containing the appropriate recommendation, shown in figure (5), the other interfaces are shown later in this paper.

Patient Details

HOSPITAL ID NUMBER: ES/HBV/12345

FULL NAME: ABUBAKAR TANKO

ADDRESS: NO 10, HASSAN LAWAL AVENUE, GRA

STATE: NASARAWA GENDER: M

TOWN: KEFFI AGE: 32

MARITAL STATUS: MARRIED

Test Result

HEPATITIS-B CONFIRMED

Diagnosis Questions

DO YOU HAVE FEVER? YES YES

DO YOU HAVE APPETITE LOSS? YES YES

DO YOU HAVE NAUSEA AND VOMITING? YES YES

DO YOU HAVE FATIGUE? YES YES

DO YOU HAVE DARK YELLOW URINE? YES YES

HAVE YOU RECEIVED ANY BLOOD TRANSMISSION IN THE LAST 3 - 6 MONTHS? YES YES

DO YOU FEEL PAIN IN THE RIGHT HAND SIDE OF YOUR ABDOMEN? YES YES

DOES ANY ONE IN YOUR HOUSE (FAMILY) HAS/TREATED OF HEPATITIS? YES YES

HAVE YOU NURSED A PATIENT WITH HEPATITIS RECENTLY? YES YES

DO YOU LIVE IN AN OVERCROWDED ENVIRONMENT? YES YES

DO YOU SHARE FORMITE (CLOTHS) OR ANY PERSONAL ITEMS (RAZOR ETC)? YES YES

HAVE YOU EVER RECEIVED INJECTION/TREATED WITH AN UNSTERILIZED ITEM? YES YES

HAVE YOU HAD UNPROTECTED SEX WITH SUSPECTED HEPATITIS PERSON? YES YES

WHAT IS YOUR HBs Ag TEST RESULT? POSITIVE POSITIVE

WHAT IS YOUR HBe Ag TEST RESULT? POSITIVE POSITIVE

WHAT IS YOUR ANTI-HBc TEST RESULT? POSITIVE POSITIVE

WHAT IS YOUR LIVER FUJCTION TEST (LFT) RESULT? POSITIVE POSITIVE

WHAT IS YOUR URINALYSIS TEST RESULT? POSITIVE POSITIVE

WHAT IS YOUR ABDOMINAL ULTRA SCAN TEST RESULT? NORMAL NORMAL

SUBMIT CANCEL

Figure 5: Interface for the test questions

The method that receives the hepatitis B test result displays the result of the test on the result panel. The recommendations are based on the hepatitis B level as described in later in this paper..

These recommendations are read from an external text file so that it can be updated easily by updating the text file which resides in the user home directory.

Conclusion:

A feasibility study was carried out through interviews with medical experts so as to extract expertise about hepatitis B. Doctors were interviewed to gain insight into their expectation as they would be part of the end-users. After taking into consideration the facts gained from the interviews and the questioners the output of this investigation was analyzed and the design was made which was successfully implemented. This project explains and shows how possible expert systems for the diagnosis of hepatitis

B can be implemented. Below are some benefits:

- a. It makes diagnosis faster and less prone to errors
- b. The operation proved to be more consistent and accurate compared to the existing system

The project provides adequate solutions to the problems mentioned. It integrates expert systems into healthcare services via the creation of an expert system for hepatitis B diagnosis and management. If this project is fully implemented it will greatly aid the distribution of primary health care services around Nigeria, Africa and the globe.

The result of this project has shown that an expert system for diagnosis and management of hepatitis B would be of immense help to hepatitis, non-hepatitis, medical experts and all who are interested in gaining information about hepatitis B and its symptoms.

This system is not meant to replace doctors but to assist them in the quality service they render to humanity. The diagnostic capacity of a medical expert using

this System improves only slightly compared with his/her capacity without the aid of the system.

References

- [1] Rajkishore Prasad, Kumar Rajeev Ranjan, and A.K. Sinha, (2006) "AMRAPALIKA: An Expert system for the diagnosis of pests, diseases, disorders in Indian mango," *Knowl.-Based Syst.* 19(1): 9-21 (2006).
- [2] Shikhar Kr. Sarma, Kh. Robindro Singh, An Expert System for diagnosis of diseases in Rice Plant, *Department of Computer Science, Gauhati University Guwahati 781014: Assam, India*
- [3] Ganesan V., "Decision Support System "Crop-9-DSS" for Identified Crops", *Proceedings of World Academy of Science, Engineering and Technology Volume 12 March 2006 ISSN 1307-6884 PWASET Volume.*
- [4] Ali.Adeli (2010), A Fuzzy Expert System for Heart Disease Diagnosis, *Proceedings of International Multiconference of Engineers and Computer Scientists, 2010 Vol I, IMECS 2010, March 17-19, 2010, Hongkong.*
- [4] Mehdi.Neshat, A Fuzzy Expert System for Heart Disease Diagnosis, *Proceedings of International Multiconference of Engineers and Computer Scientists, 2010 Vol I, IMECS 2010, March 17-19, 2010, Hongkong.*
- [5] Ahmed Rafea, "Expert System Applications: Agriculture," *Central Laboratory for Agricultural Expert Systems, P.O.Box 100 Dokki Giza, Egypt.*
- [6] P.Santosh Kumar Patra, An Expert System for Diagnosis of Human diseases, 2010 *International Journal of Computer Applications (0975 – 8887) Volume 1 – No. 13.*
- [7] Russell, S. and P. Norvig, 2002. *Artificial Intelligence: A Modern Approach*, Prentice Hall, Second Edition.
- [8] Ahmad T. Al-Taani, An Expert System for Car Failure Diagnosis, *World Academy of Science, Engineering and Technology 12, 2005.*
- [9] Fahad Shahbaz Khan, Dr. Wheat: A Web-based Expert System for Diagnosis of Diseases and Pests in Pakistani Wheat, *Proceedings of the World Congress on Engineering 2008 Vol I , WCE 2008, July 2 - 4, 2008, London, U.K.*
- [10] Duan, Y., Edwards, J.S., and Xu, (2005) ***M.X. Web-based expert systems: Benefits and challenges.*** *Information & Management*, 42 (2005), 799-811.