IOSR Journal of Computer Engineering (IOSR-JCE)
e-ISSN: 2278-0661,p-ISSN: 2278-8727, Volume 26, Issue 4, Ser. 3 (July. – August. 2024), PP 43-66
www.iosrjournals.org

A Web-Based Expert System For The Diagnosis And Treatment Of Bacterial Diseases: A Case Study Of Tetanus, Syphilis And Tuberculosis

Yunisa Sunday, Yahaya Yusuf Nurudeen, Abdulkadir Nafisat,
Ekundayo Kayode Onimisi, Ahmed KharimahBimbola,
Habib Itopa Mohammed, Audu Abdulrahim Ahmed
Department Of Computer Science, Confluence University Of Science And Technology, P.M.B. 1040, Osara,Kogi State, Nigeria And department Of Computer Science, Kabba College Of Agriculture, Ahmadu Bello University, Zaria, Kaduna State, Nigeria

Abstract
This web-based expert system for the diagnosis and treatment of bacteria diseases will help to provide a prescription and management of syphilis, tuberculosis and tetanus which are classes of bacterial diseases that are difficult to diagnose and the appropriate drugs for its cure are scarce. This will be achieved by storing human expert domain on bacteria treatment like syphilis, tuberculosis and tetanus which can be used by non-medical doctor for quick treatment of these chronic diseases with the aid of expert level knowledge on the diagnosis of these diseases so that such knowledge could be accessed and available to people who are not expert in that field of infectious diseases. This web-based expert system will be accurate with high processing features to analysis these infectious diseases such as tetanus, syphilis and tuberculosis by isolating and identifying pathogenic bacteria or symptoms that cause the disease and its treatment for quick reference in the absence of human medical expert. This will help to reduce the cost of treating syphilis, tuberculosis and tetanus diseases and also decentralize access to medical care by provision of knowledge base accessible to every end user. The research was Object Oriented Analysis and Design base.

Keywords: *Expert System, Diagnosis and Treatment, Tetanus, Syphilis, Tuberculosis, Bacteria Infectious Diseases.*

Date of Submission: 01-08-2024 Date of Acceptance: 10-08-2024

I. Introduction

According to Kattan M. W. (2001) states that, medical expert systems are designed to improve patient care by optimizing medical decision making. Kattan M. W. (2001) further illustrate the features of a medical systems which is used to recommend an input-based data use for differentiating decision support system for medical diagnosis. Auora and Marta (2021), discuss medical expert systems that are necessary tools which can assist physicians and patients in the diagnosis and treatment of diseases. Auora and Marta (2021), also buttress the synergy of information technology and clinical knowledge which intends to improve healthcare services and reliability. **Adekoya** *et al., **(2008)***proposed a Medical Expert Solution (MES) system that diagnoses symptoms related to some tropical diseases, suggests the likely ailment, and advances possible treatment based on the MES diagnosis. The MES uses a knowledge base which comprises of two knowledge structures, namely symptoms and diseases. According to **Adekoya** *et al., **(2008)***emphasized that MES system has a user-friendly interface that makes it easy for user to supply or obtain information to/from the expert system during run-time. The various symptoms of tropical diseases are stored in the diagnostic center and the patient selects signs and symptoms from a drop-down list. These data are then used by the expert system to perform the diagnosis. **Adekoya** *et al., **(2008)***vividly discuss the MES inference engine uses a forward chaining mechanism to search the knowledge base for symptom of disease and its associated therapy which matches the query "supplied by the patient. Mochammad*et al., **(2022)*** discuss several bacteria diseases that are caused by unhealthy food, one of which is Salmonella bacteria. Diseases from the Samonella bacteria can attack the digestive tract which includes the stomach, small intestine, and large intestine orcolon. Some species of salmonella can cause infection through food. This includes Salmonella Typhi and Salmonella Shigella. Based on the problems above, Mochammad*et al.,**(2022)***buttress their points further by analyzing the effect of these diseases to the majority of people living in a tropical region as majority of this individual do not know the symptoms of this bacterialdisease and how to diagnose it with a high certainty value. With the aim of making an expert system

application through each android phone by means of a diagnosis through the signs and symptoms hereby chose to use the forward chaining method for easy diagnosis. Bacteria disease is one of the greatest health issues affecting people in the society today and expert systems can be used virtually in all spheres of life. The idea behind this researched work is to develop a web-based expert systems to provide support in common clinical problems like diagnosis of bacteria disease like tetanus, syphilis and tuberculosis, to identify its causes and specific prescriptions. This web-based medical knowledge could be useful in areas where there is a shortage of health expert.

The diagnosis and treatment of this bacteria infectious diseases like tuberculosis, tetanus and syphilis involves several levels of uncertainty and imprecision. The task of disease diagnosis and management is complex because of the numerous variables involved. Sometimes, the individual affected by these infections may not actually described how the feel, also, the medical expert may not easily prescribe the appropriate drugs for these bacterial diseases and the malfunctioning of the laboratory equipment may contribute to faulty medical results these may led to untimely death of these patients suffering from bacteria diseases like tetanus, syphilis and tuberculosis.

The harmful effects of bacterial organisms to the human body cannot be underestimated. In the same vein, tuberculosis, tetanus and syphilis are the commonest causes of mortality in Nigeria, the treatment is costly and the experts are very few. Therefore, the development of a web-based expert system on medical diagnosis and treatment for these bacterial infectious diseases and prescribing treatment for its cure such as syphilis, tuberculosis and tetanus which was developed for bacteria isolation, identification, and treatment is a great milestone that needed to be encouraged for daily use and for research advancement.

Statement of Problem

A web-based medical expert system for the diagnosis and treatment of bacterial infectious diseases like tetanus syphilis, and tuberculosis are few and often scarce. The laboratory analysis for isolating and identifying these bacterial diseases may be difficult. The bacteria diseases diagnosed in our conventional hospitals and medical facilities are costly and sometimes inaccessible. Therefore, this web-based expert system for the diagnosis and treatment of these infections will capture medical expertise in some dangerous infectious diseases such as tuberculosis, tetanus, and syphilis and make it available to others to perform a medical treatment in absent of a medical practitioner. The problems are summarized below;

i. The time involved to diagnose these bacterial diseases like tetanus, syphilis and tuberculosis
ii. The cost of treating these bacteria diseases like tetanus, syphilis and tuberculosis
iii. The high rate of death which occurred as a result of not having an expert to treat these bacterial diseases due to brain drain
iv. Inaccurate laboratory test result on bacterial organisms due to scarce of qualified laboratory technicians and equipment in our medical centers.

Objectives

The main objective of this study is to develop a web-based expert system for the diagnosis and treatment of bacterial infectious diseases like tuberculosis, syphilis and tetanus.

Some specific objectives include the following;

i. To identify relevant symptoms and information on bacterial infections and with the results obtained at this stage, produce possible diagnoses and suggest treatments.
ii. To create a medical record for patient's health history.
iii. To design a web-based expert system for diagnosis and treatment of bacterial infectious diseases like tuberculosis, tetanus and syphilis.
iv. To implement a web-based expert system for diagnosis and treatment of bacterial infectious diseases like tuberculosis, tetanus and syphilis.

Scope of the Study

This study was done to deliver a web-based expert system that will be able to diagnose bacterial Infectious diseases like tuberculosis, tetanus and syphilis and prescribe the appropriate drugs for its cure. This was done by developing a rule based expert systems that can identify pathogenic organisms that cause the diseases and instantly prescribed treatment for its cure. This study mainly targets a peculiar class of diseases cause by bacterial infections such as; tuberculosis, tetanus and syphilis.

Significance of the Study

This research will preserve high level knowledge on the diagnosis and treatment of infectious diseases like tuberculosis, tetanus and syphilis and also provide this knowledge to people who might be non-experts themselves. The following benefits can be derived from this research work which includes;

i. To provide an accurate diagnosis and treatment of these organisms which are tetanus, syphilis and tuberculosis in absent of a medical expert.
ii. To improve performance standards and to provide quality results in our medical centers.
iii. It provides diagnostic simplicity, cost reduction and enforcement of medical diagnostic standards in patient care and file management.
iv. The system will be beneficial for training students and researches on infectious diseases like tuberculosis, tetanus and syphilis.

Theoretical Background

The major technologies used in this project are HTML (Hypertext Makeup Language), JavaScript and MYSQL Database Management System. Each of the HTML documents is a sequence of elements. An element consists of a start tag, content and a closing tag in that order. The following is an example of an HTML element in the web document to present the home page of the site:

<h class="welcomeHeader">Welcome to medical expert solution</h1>.

<h1> is start tag. </h1> is the corresponding end tag. "Welcome to medical expert solution "is the content of the element. Forms are used to collect data about diseases. A form is a collection of data fields for collecting data input, from a user entity and a submit button sends the collected data to a servlet for proper processing of the data. The form element has an "ACTION" attribute which supplies the address, better known as universal resource locator (url), of this action document.

The following are fragments of HTML forms used in this application.

```
<formmethod="post" action='Patient'sRegistrationController' name="frmRegister" id="frmRegister">
…
First name: <inputtype="text"name="firstname"/>
Last name: <inputtype="text"name="lastname"/>
Sex: <selectname="sex">
<optionvalue="Male"selected="selected">Male</option>
<optionvalue="Female">Female</option>
</select>
…
<input name="reset" type="reset" value="Cancel" />
<input name="submit" type = "submit" value="Register" />
</form>
```

The registration form below is produced by the above code fragment.

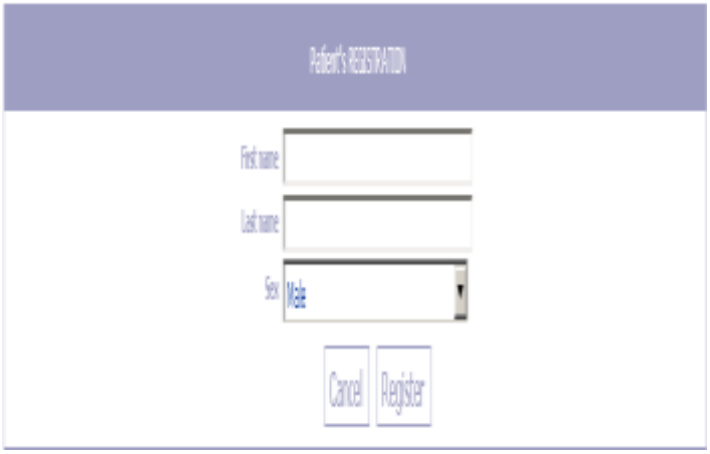

Figure 2.1 Registration form

The HTML code above when implemented by the web browser displays the user's registration form in Figure 2.1 on the screen. Data received by the action document, "RegistrationController" from the form is displayed by the registration form code into corresponding fields in a record that is then stored in the application's relational database.

```
<formmethod="post"action='userLoginController'name="frmLogin"onSubmit="javascript:checkFields(this);">
Username:<inputtype="text"name="username"/></td>
Password:<inputtype="password"name="password"/>
<inputname="submit"type="submit"value="LOG IN"/>      ...
</form>
```

The result of the code snippet above is a login form that is shown in figure 2.2.

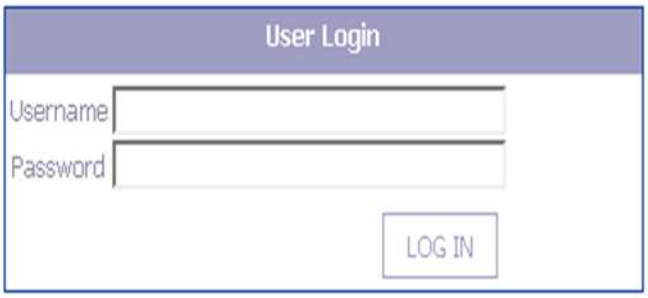

Figure 2.2: Login form

The login form is a sample form that a user will use to log into the system. A click on "LOG IN" button will trigger a call to a JavaScript function which performs client side form validation before the form is submitted to an action document specified as a "*LoginController*". The action document will be used to handle user authentication and thereafter redirects the user to the appropriate page.

The following is a JavaScript code used to validate user login form.

```
<script type="text/javascript" language="javascript">
function checkFields(form)
{
if (form.username.value==""){
alert("You must enter your username.");
}
…
}
</script>
```

The alert dialog box below is produced by the above JavaScript code fragment when a user clicks on the "LOG IN" button without specifying his username in the username textfied.

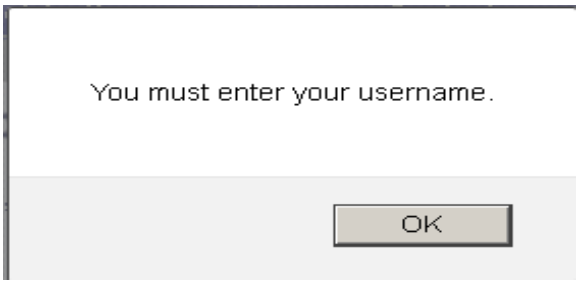

Figure 2.3: alert dialog box.

The above JavaScript code checks login form data fields to find out if they are not empty before sending the data to LoginController.java servlet for user authentication.

MySQL Database Management System: Java codes and MySQL queries was used in my application to insert, update, retrieve and delete data from the database.

II. Literature Review

Bakpo and Udanor (2011), defines an Expert system as a computer program that store information from human domain experts. This information is stored in a special database referred to as a knowledge base. Knowledge bases are used to solve problems in diverse application domains such as space science, medical sciences, geology and robotics. Bakpo and Udanor (2011), further discuss artificial intelligence as a design of intelligence in an artificial device. That is, the science of making machine or computer do things that will require intelligence if done by human being.

Ovidiu.S.Noran. (2003) acknowledged that, computer-based methods are increasingly used to improve the quality of medical services. Mostly the remote areas for the treatment of bacterial infections, the population are deprived of the facilities/ experts to diagnose/treat disease. So, it is the need of the day to store the expertise of specialists in computers through expert system technology. People may consult the specialist doctor if it is necessary or serious. Ovidiu.S.Noran. (2003) further stated that a Rule based expert system includes both conventional techniques, such as database management systems (DBMSs), and artificial intelligence (AI) techniques, such as knowledge-based systems (KBSs) or expert systems (ESs). In this researched work, an intelligent based medical system for diagnosis of bacteria diseases and treatment such as syphilis, tetanus and tuberculosis that will use inference-based mechanism will be presented.

Shu-Hsien Liao (2005) attempts to overcome limitations inherent in conventional computer-aided diagnosis by creating programs that simulate expert human reasoning. Shu-Hsien Liao (2005) also stated that several attempts that was made to develop computer programs that can serve as consultants which can improved the representations of clinical knowledge and sophisticated problem-solving strategies have advanced the field of artificial intelligence in medicine. To overcome this problem of lack of access highlighted by Shu-Hsien Liao (2005), the proposed web-based expert system will provide a web-based medical diagnosis platform which will assist user who has little contact with computer system. Peter szolovits,. *et al.,* (1988) discuss several attempts to overcome limitations inherent in conventional computer-aided diagnosis, investigators have created programs that simulate expert human reasoning. Hopes that such a strategy would lead to clinically useful programs have not been fulfilled, but many of the problems impeding creation of effective artificial intelligence programs have been solved. Strategies have been developed to limit the number of hypotheses that a program must consider and to incorporate pathophysiologic reasoning. Peter szolovits,. *et al.,* (1988) point out innovation that permits a program to analyze cases in which one disorder influences the presentation of another. Prototypes embodying such reasoning can explain their conclusions in medical terms that can be reviewed by the user. Despite these advances, further major research and developmental efforts will be necessary before expert performance by the computer becomes a reality.

Angeli .C. (2010) critically analyze medical science field as an enormous field that includes a large number of expertise, knowledge and information. Medical Diagnosis System can be used to provide the prescription for general health diseases like Malaria, Typhoid and Plague. According to Angeli. C. (2010) to get good medical treatment is a right of every country citizen. Due to the insufficient availability of experts in a medical domain, it is a big challenge for the country to provide good medical services to their country populace. Angeli .C. (2010) also looks at the major advantage of Adoptive Medical Diagnosis System using Expert System which gives the prescription as the doctor ordered to the patient, the system can be used anytime and anywhere which always work as a human expert. Its aim is to create an interactive web page that helps to provide primary health care facility without human interference. Its problems of limited human resources and the equipment is in low supply which affects large coverage. To overcome this, the proposed system which is a web-based system will solve the problem of low coverage and accessibility of the system and its operation is easy since it is a user-friendly application,

Dipanwita *et al.,* (2011)discuss the benefits of detecting diseases at early stage which enable one to overcome complication and treat them appropriate. In addition, Dipanwita *et al.,* (2011)state that, identifying the treatment of these bacteria diseases accurately depends on the method that is used in diagnosing the diseases. A medical expert system diagnosis can help a great deal in identifying diseases and prescribing 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.

Gufran Ahmad Ansari (2013) defines expert system (ES) as the branch of applied artificial intelligence (AI), and were developed by the AI community in the mid-1960s. according to Gufran Ahmad Ansari (2013), he further discusses the basic idea behind ES is simply that expertise mostly in medical science, which is the vast body of task-specific knowledge, is transferred from a human to a computer.

Santosh *et al.,* (2010) emphasize that; expert system has emerged as a branch of Artificial Intelligence. The intellectual roots of expert systems can be found in the ambitions of Artificial Intelligence to develop "thinking computers". According to Santosh *et al.,* (2010), states that, in 1980's, expert systems emerged from the laboratories and developed commercial applications due to the powerful new software for expert systems development as well as the new possibilities of hardware. An intelligent computer program that uses knowledge and inference procedures to solve problems that is difficult enough to require significant human expertise for their solution".

The major medical expert systems that were used for various diseases diagnoses, their features, strengths and weaknesses are illustrated below;

MYCIN Expert System Applications

Cecilia and Fabio (2011) give details on MYCIN expert system as one of the earliest rules based intelligent system developed in LISP for purposes of diagnosis of infectious diseases and suggesting corresponding chemotherapy. According to Cecilia and Fabio (2011) explain how to do a diagnosis properly if it involves culturing the specimens for the isolation and identification of the bacterial infections. Unfortunately, this takes 48hours and if doctors were to wait for that time some patients could die. As a result of this weakness, a system called MYCIN was developed up with quick guesses about the likely problems from the available data and use guesses to treat patients as they wait for the expert's system report.

Features of MYCIN Expert system

The major features of a MYCIN expert system include the following;

- Employs inexact reasoning
- Remembers prior session
- Accommodates the users
- Has spell checker and provides alternative recommendations

Strengths of MYCIN Expert System

- Corporate knowledge always retained from users
- Knowledge can be incomplete--the expertise can be expanded as needed.
- Conventional programs must be completed before they can be used.
- MYCIN expert systems can act as consultant, instructor, or partner/colleague.

Weaknesses of MYCIN Expert System

- Domain is often be restricted or narrow.
- Determination of expertise reliability and completeness is very difficult.
- MYCIN Expert Systems are expensive
- Time constraint in MYCIN expert system hindered quick diagnosis.

Therefore, due to cost and time constraint associated with the MYCIN expert system, the proposed web-based expert system for the diagnosis and treatment of tetanus, syphilis and tuberculosis will address time consuming and cost implication that are already featured in MYCIN expert system.

Felmot Expert System

Lenka and Tomas (2011) discuss the development of a diagnostic expert system called FELMOT for identification of vestibular organ diseases caused by some bacterial organisms. The first version of a knowledge base containing available knowledge on the human vestibular system. Lenka and Tomas (2011), vividly discuss all the syndromes diagnosed by the system (till now) are the following ones: Menier disease, neuritis vestibularis (inflammation of the vestibular nerve), brainstem ischemia, vestibular. The FELMOT system can be used not only as a diagnostic tool but also as an educational aid. For this purpose, it is advantageous that it is equipped with an extended explanation mechanism that enables the user to explain which symptoms support or reject the final diagnosis.

Features of FELMOT Diagnostic System

The major features of a FELMOT system include the following;

- It has Domain independence;
- It has machine independent;
- Possesses diagnostic character;

Strengths of FELMOT Diagnostic System

- FELMOT system has the ability to handle multiple diagnostic experiments.
- It has different techniques aimed at creating knowledge capturing structure behind a simple inference net which enable the system to combine more inference engines operating on different principles in parallel.
- It possesses certain knowledge which may help in specialized libraries for diagnostic system and training.

Weaknesses of FELMOT Diagnostic System

- FELMOT system is of the simple first-generation expert system and it is not sophisticated enough to solve a computer task in a wider diagnostic problem area.
- Its knowledge representation is based on the inference network only which leads to cumbersome behavior of the system when the volume of relevant knowledge exceeds a certain threshold.

Therefore, due to FELMOT inability to properly isolate the pathogenic organism because of its limitation in exploiting the deep knowledge and the cumbersome behavior of the system to handle high volume of data, the developed web-based expert system for diagnosis and treatment of tetanus, syphilis and tuberculosis will improve this limitation by designing a system that can handle large volume of data and will be able to isolate organisms and also prescribed treatment for its cure which FELMOT System could not address.

We –Based Diagnostic System (ISABEL)

Mahesh *et al.*, (2009) describe a web-based system called ISABEL technology used for the diagnosis of cardiac patients in rural areas with a centralized server and expert cardiologists which constitute the framework. According to Mahesh *et al.*, (2009), Personal details, clinical information and ECG acquired from a patient at the rural center are sent to a centralized server and the server stores the diagnosed results and forwards the same to the respective rural center. The physician at the rural center can view the diagnosed results and recommendations from the expert and effect treatment.

Features We –Based Diagnostic System (ISABEL)

- Isabel diagnostic advice system is derived from searching unformatted medical textual content (statistical natural language processing). This power approved permits users to search by concept matching as well as word matching and is significantly different from previous diagnostic expert system.
- The clinical feature input into Isabel system has unstructured free text language, in order to facilitate ease of usage by clinician in a busy environment.
- Validation of the Isabel has been conducted both by independent researchers as well as system developer and other academic collaborators.

Strengths We –Based Diagnostic System (ISABEL)

- Isabel has the ability to provide suggestive drugs for clinicians by diagnosingthe ailment based on the information given according to the specific body system.
- It minimizes time taken to diagnose critical diseases like heart failure.
- Isabel is not only making the right diagnosis but helps in answering clinical questionregarding the specific ailment under diagnosis.

Weaknesses We –Based Diagnostic System (ISABEL)

- Sometimes, different diagnosis is demanded by the system which includes clinical features, result of the test and investigation before it reaches the final conclusion which invariably leads to extra cost.
- Proper isolation of pathogenic organisms cannot be handled by Isabel diagnostic system.
- There is always high cost of maintenance and error prone system due to its long interactive platform before reaching final recommendation.

Therefore, this expert system for the diagnosis and treatment of bacterial infectious diseases such as syphilis, tetanus and tuberculosis designed will properly isolate all the diseases symptoms in a very short time. The system was designed in a very simple way that can enable even the less educated individual to have access with minimal error.

CASNET Diagnostic System

Edward and Shortliffe, (1986) discuss CASNET as an ophthalmology advisor designed to assess disease states and recommend management for patients with glaucoma which based its advice on interpretations of accumulated experience in patient data banks. According to Edward and Shortliffe, (1986), states that the physicians formulate tentative hypotheses rapidly after obtaining the first few pieces of information about a patient and then let those hypotheses (typically a differential diagnosis) guide further data collection and problem solving, that led to a growing interest in Al systems that might function as expert consultants.

Features of CASNET Diagnostic System

- CASTNET was the first medical expert system based upon causal precepts designed to assist in the diagnosis of glaucoma.
- CASTNET knowledge is represented in the system as a network of pathophysiologic state.
- The most interesting feature of CASTNET is the hierarchical organization of its knowledge base. At the lowest level are the patient signs and symptoms and test. The middle layer consists of pathophysiologic state and the highest knowledge level is composed of disease categories such as open angle glaucoma, secondary glaucoma and so on.

Strengths CASNET Diagnostic System

- The CASNET system gives detailed structuring of findings so that data on a patient can be acquired in a focused and rapid manner by the specification of appropriate question types (multiple choice, alternative choice etc) which help to reduce the asking of irrelevant questions.
- The maintenance of several different weights of confirmation that depend on the types of relations underling particular inference i.e causal vs evidential. So that conflicts and contradictions can be more easily detected, and the coherence of a particular set of hypotheses assessed.
- It can present alternative expertise derived from different consultants.

Weaknesses CASNET Diagnostic System

- Lack of knowledge concerning the actual mechanism for the diagnosis of a number of diseases remains a major impediment to the creation of causal systems i.e. the pathophysiology of rheumatologic disorders is much less well defined than those in cardiology.
- The general domain of CASNET system cannot be completely built using the reasoning model, however, the causal knowledge is not encoded implicitly in its knowledge base.
- Another designed weakness in CASTNET is the level of knowledge detail. ThoughCASTNET can use deep knowledge of their domain which sometimes may not understand what they are manipulating from the beginning due to lack of detailed knowledge of the designed network of causally linked node.

Internist/ Caduceus System

Agbo-Aja *et al.,* (2014) state that Internist/ Caduceus expert system was developed which incorporate information of about 350 diagnose of about 500 symptoms and signs of different ailment including bacterial organisms. Agbo-Aja *et al.,* (2014) further illustrate that knowledge base of the system is represented in the form of taxonomic (hierarchical form of semantic network) structure of illness. The list of disease and laboratory data is presented in the system and disease that would account for the manifestation is diagnosed.

Features

Randolph *et al.,* (1982) enumerate the features, strengths and weakness of internist as follows:

- INTERNIST can choose between several different strategies for carrying out differential diagnose.
- The system can investigate subjects which verify, eliminate or discriminate its hypotheses depending upon the number under consideration.
- INTERNIST system interprets clinical information in internal medicine; it has been developed to the point where it can assist with the diagnoses of about 600 diseases in internal medicines.

Strengths

- Internist is an experimental computer program capable of making multiple and complete diagnoses in internal medicine. It differs from most other programs for computer-assisted diagnosis in the generality of its approach and the size and diversity of its knowledge base.
- INTERNIST has considerable educational value. The disease profiles, the list of diseases in which a given clinical manifestation occurs, and the interconnections among diseases (LINKS) provide a quick and ready means of acquiring at least orienting clinical information. Such has proved useful not only to medical students and residents but to clinical practitioners as well.

Weaknesses

- The evaluation of internist demonstrated that the present form of the program is not sufficiently reliable for clinical applications. Specific deficiencies that must be overcome include the program's inability to reason an automatic or temporal diagnostic result, its inability to construct differential diagnoses spanning multiple areas, its occasional attribution of findings improper causes, and its inability to explain its "thinking".
- Another weakness resulted from deficiencies in the design or implementation (or both) of the computer program. Included in this category were failure to incorporate temporal reasoning capabilities; problems resulting from use of the scoring algorithm; the inability to take a broad overview in attacking a complex problem;

Bacterial Isolation and Identification of Pathogenic Organisms

Paul Singleton, (1999) vividly described Pathogenic bacteria are micro-organisms that can successfully invade, establish, and cause infections in an appropriate host unique niche. The isolation and identification of such pathogens is based on their morphology, physiology, staining, biochemical and genetic characteristics. Bacteria need varying growth media for their isolation and show colonial characteristics as they grow.

The Bacteria Infectious Diseases

Paul Singleton, (1999) describes bacteria diseases as those diseases caused by some bacteria organisms. Although, these organisms are generally larger than viruses when viewed with the aid of a microscopic machines. Some of these diseases are syphilis, tuberculosis and tetanus etc. These diseases can be transferred from one person to another through body sexual contacts.

In summary, David and Jennifer (2003) emphasized that syphilis is an infection caused by the bacteria called *Treponema pallidum*. Syphilis is a sexually-transmitted infectious disease. The bacteria that cause it spread through broken skin or mucous membranes. The symptoms of syphilis depend on the stage of the disease. Many people do not have symptoms. In general, painless sores and swollen lymph nodes are possible symptoms of primary syphilis. Those with secondary syphilis may also have fever, fatigue, rash, aches and pains, and loss of appetite, among other symptoms.

David and Jennifer (2003) discuss Tetanus as an infection of the nervous system with the potentially deadly bacteria called Clostridium tetani (C. tetani). Tetanus often begins with mild spasms in the jaw muscles (lockjaw). The spasms can also affect your chest, neck, back, and abdominal muscles. Back muscle spasms often cause arching, called opisthotonos. Sometimes the spasms affect muscles that help with breathing, which can lead to breathing problems. Prolonged muscular action causes sudden, powerful, and painful contractions of muscle groups. This is called tetany. These episodes can cause fractures and muscle tears. Other symptoms include: Drooling, Excessive sweating, Fever, Hand or foot spasms, Irritability, Swallowing difficulty and Uncontrolled urination or defecation.

David and Jennifer (2003) illustrate Tuberculosis (TB) as a disease caused by germs that are spread from person to person through the air. TB usually affects the lungs, but it can also affect other parts of the body, such as the brain, the kidneys, or the spine. A person with TB can die if they do not get treatment. The general symptoms of TB disease include feelings of sickness or weakness, weight loss, fever, and night sweats. The symptoms of TB disease of the lungs also include coughing, chest pain, and the coughing up of blood.

System Analysis and Design Methodology

Critical look at the existing system for the diagnosis and treatment of bacterial infectious diseases with a view to identifying its structure, functionalities, drawback and designing a new system that addresses the lapses of the existing system. System analysis is the phenomenon that deals with the thorough examination of an organization system to determine its extent and limitation in order to provide an improved solution to the system. The methodology employed in the development of the proposed system is the Object-oriented Analysis and Design Methodology (OOAD) which is a model-driven technique that integrates data and processes into constructs called objects. The methodology compels programmers to reason in terms of objects, rather than procedures when planning for codes.

Analysis of the existing System

The diagnosis of bacterial infectious diseases in most hospitals/clinics is being done manually. When a patient comes to the clinic for the first time, they would need to follow some procedures, i.e. they have to buy hospital's card, register, and go to the triage. Then their case notes are prepared and sent to the consultant physician. All these processes are carried out while on the queue in the waiting area, except in an emergency, it takes time as all the processes are done manually. It is time consuming and causes fatigue in workers which can lead to loss of vital information; also there can be data inaccuracy. Oftentimes, a stool culture test may be required to actually detect the exact bacterial organism that causes the infection but took 48hrs before the test result will be obtained which led to patient death in case of a serious emergency. In the forms, the full bio-data of the patient are captured. In case of death their next of kin can be contacted for appropriate decision to be taken. This information is also verified to ascertain its correctness.

The input of the current system is a note from the medical doctor referring the patient to laboratory test.
The note usually contains the following:

- The name of the hospital.
- The Doctor's name.
- The doctor's signature.
- The name of the Laboratory referred to.
- The nature of test to be carried out.

The figure 3.1 below is a sample doctor's medical examination form.

Patient Medical Information	
Surname:	Other Name:
Date Of Birth:	Gender:
Marital Status:	Ocupation:
Name Of The Hospital:	
Doctor`S Name:	
Prescription:	
Laboratory Result:	
Doctor`S Signature:	

Figure 3.1: Sample medical examination form

The output of the existing system is usually a laboratory report on the specified medical test. It is always signed by a qualified lab scientist. The information contained in the report includes the following:

- The name of the Laboratory.
- The name of the patient.
- The nature of test carried out.
- Observations made during test.

Summary Of Test Result.

NAME: AGE:

ADDRESS: PHONE NO: DATE:
TEST REQUEST :

HB…… N 14 – 16g/100/C SEROLOGY
ANTIGEN

PCV …….. 35 -50% OR 0.501/C WIDAL TEST H O
MP …….. SAL TYPHI
SAL PARATYPHI
“ “
PLATELET COUNT ……140 – 400X109/C “ “
GENOTYPE …… . COMMENT
ESR ……..M(3-50 F(4-7/H) HBS AG……
STOOL MICRO VDRI …….
BLOOD CHEMISTRY XYZ ……
-BLOOD SUGAR PSA ……..
-FASTING ……..(<6.4MMO/L OR) PREGNANCY……
-RANDOM ……. (115MG%

RENAL FUNCTION TEST
UREA …… (3.0/8.0MM0.1/1) LIVER FUNCTION TEST
(18.48MG/100ML)
CREAATINE …… (60.130UM01/1 TOTAL BILLIRGBIN……(3-
21UM01/J)
IN FEMALE IS LOWER 1.3MG/10MML 0.2-
SODIUM ……. MM01(133-045) AL. PHOS ……(.20-
90U/1AD)
CHLORIDE ……..MM01(95-110) UP TO 350 U/I CH
POTASSIUM ……..MM01(3.3-5.1)
BIOCARBONATE ……MM01(18-30) AST……. UP TO 42 U/1
SGOT
URINEANALYSIS
BLOOD ……. ALANINE
BILLIRUBIN…… SGOT …… UP TO 18U/C

PROTEIN…….	SKIN	SNIP
…….		
NITITE……..	SICKLING	TEST
……		
KETONE……		
ASCORBIC……		
GLUCOSE……	BLOOD GROUP TEST	
PH…….	A B AB O	
LAB. TECHNICIAN'S SIGNATURE:		

Figure 3.2: sample of lab report.

The information flow diagram of figure 3.3 shows how information flows from one point to another in an existing Hospital Medical Diagnosis model. The diagram below is the information flow diagram of the old system:

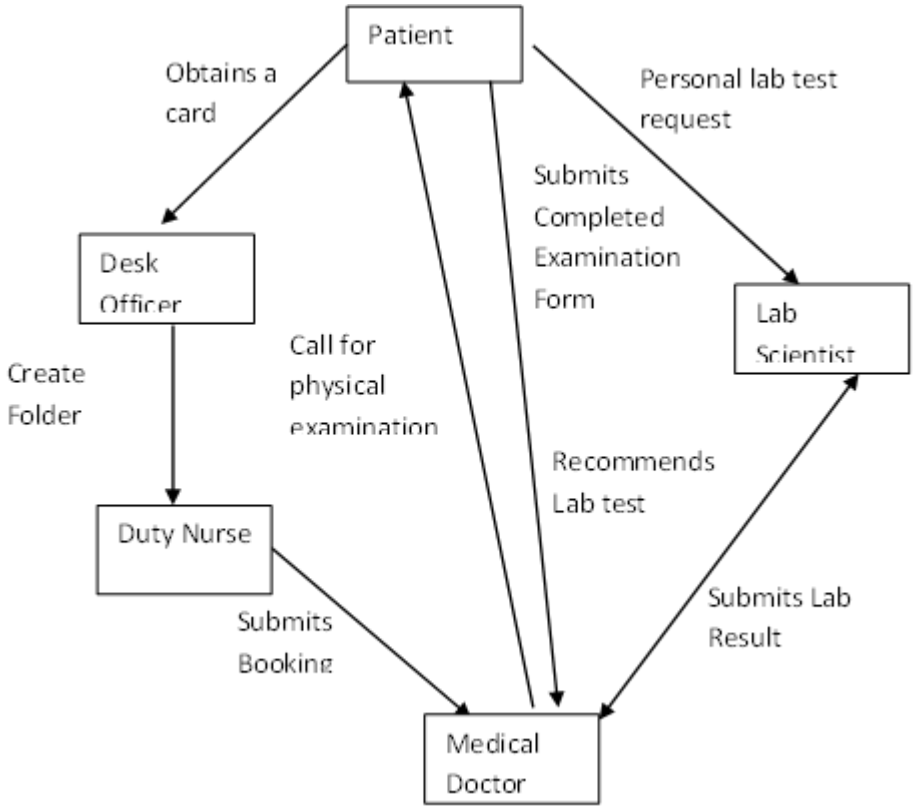

Figure 3.3: information flow diagram

Problems Inherent in the Existing System

The following represents some of the problems of the current system.

- Lack of proper storage system
- Delay in the provision of laboratory result
- Possibility of human error in administering treatment to patients
- Frequent destruction of medical files and records due to fire outbreak, termites and flood disaster.
- The death/absent of the human expert causes a serious disruption in the delivery of health services

Justification of the Proposed System

In view of the problems inherent in the existing system, it is important to seek for an improvement. The improvement calls for automation of the diagnosis system. The new system will be equipped with the following:

- Proper backup of the knowledge of the human expert.
- Elimination of possible human error, since several experts are involved in the design of such system.

- Distance and accessibility is not a problem.
- The system does not die; always there to render services.
- Medical history can always be stored and retrieved with ease.
- The automated system will reduce the amount of time spent as automation of these two entities i.e, patient registration and disease diagnosis would go a long way to reduce time spent by the patient in the hospital.
- Cost of managing the data and providing manpower would be drastically reduced.
- The cost of training new staffers for the manual system would be reduced.

Analysis of the Proposed System / Results

Systems are created to solve problems. System is a collection of components that works together to realize some objectives of the system. The proposed System comprises of two main sections, the first section is the user interface which is meant for information display and user interaction with the system while the second section (expert system) comprises of the inference engine and the knowledge base where the diagnostic center is situated. The processing mode is highly interactive and the processing algorithm which was used to achieve the required task is outlined below:

- When the system is started, the Welcome screen or Home page is displayed with the following links "Register, Login, patient, Help, etc". Selecting Login allows the patient to Login into the system. If the username and password of the patient have been authorized, there is a form that would be displayed in which the user can either click the "medical" or the "help" menu strip bar. If "medical" was chosen then the patients can then have access to the diagnosis page to select and deselect his/her symptoms, get the medication and health tips for his/ her ailment. If the patient's username and password of the patient have not been authorized this means the username or password is invalid, then the patient needs to click on the new user link label to register a new username and password.
- The user can either click on the "Register" if that is the patient's first time of using the system or enter his/her username and password to go to patients' module.
- If the patient clicked the Register, the patient needs to enter his/her details so that it can then be stored into the database. If the patient has entered the username and password, the patient's username and password can either be authorized or unauthorized.
- The patient can also get his/her details after having been diagnosed by the health management system.
- When the user finishes using the system, the user exits the system by clicking the logout link.

System Requirement Specification

Unified modeling language (UML) is the design tool used in this research work. the Objects-Oriented Analysis (OOA) in the proposed system looks at the problem domain, with the aim of producing a conceptual model of the information that exists in the area being analyzed such like the use case diagram of the system and class diagram which are the UML tools used in this work.

Use Case Diagram of the System

The result of object-oriented analysis is a description of what the system is functionally required to do, in the form of a conceptual model that will typically be presented as a set of use cases. A use case is a function to be performed by the system from the user's perspective. The figure below is the use case boundary diagram of the system.

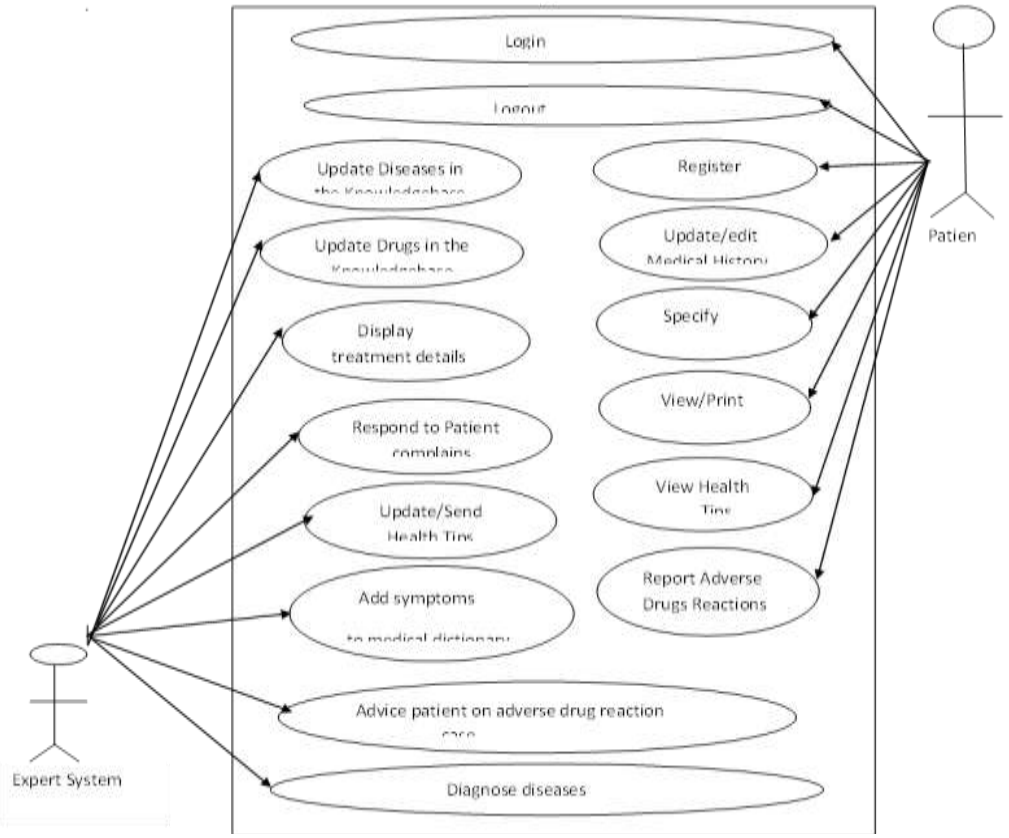

Figure 3.4: use case boundary diagram of the system

Description: In the above Boundary Diagram, the large rectangle is the system boundary. Everything inside the rectangle is part of the system under development. Outside the rectangle are the actors in the system.

Actors are entities that provide the stimuli for the system. Usually, they are human users, or other systems. Inside the boundary rectangle are the use cases. These are the ovals with names inside. The lines connect the actors to the use cases that they stimulate.

Class Diagram of the System

UML class diagrams in figure 3.5 allow us to denote the static structures of the system and relationship between classes. A class is depicted on the class diagram as a rectangle with three horizontal sections. The upper section shows the class name (such as Symptom, Disease, Patient, etc), the middle section contains the class attributes, and the lower section contains the class functions or methods or operations.

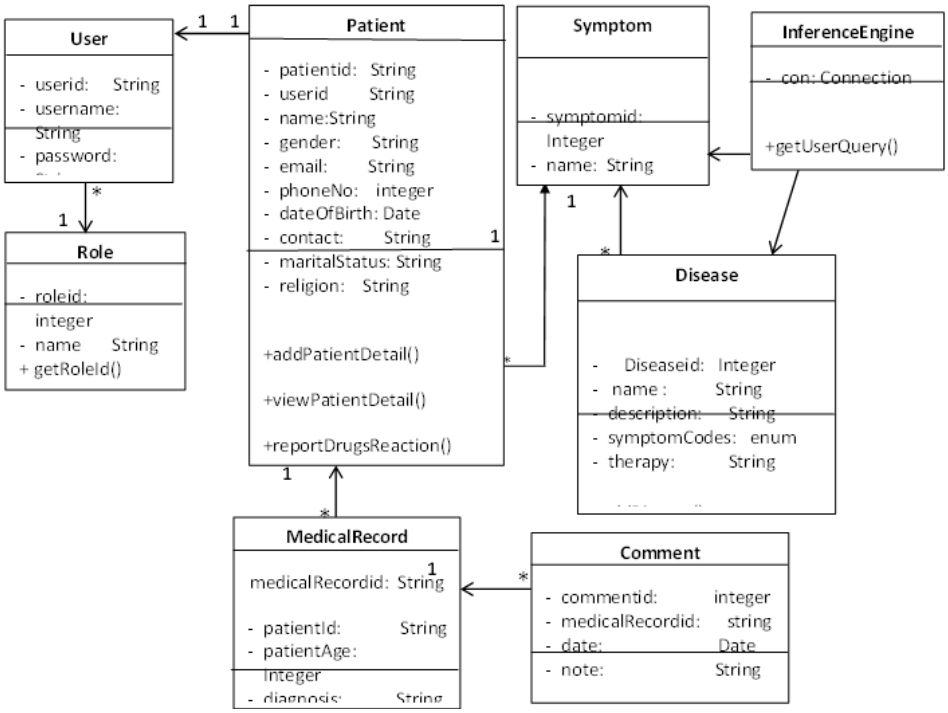

Figure 3.5: class diagram of the system

Sequence Diagram of the System

UML Sequence Diagrams model the time sequencing of messages within the system and show how objects interact with messages. It is used to show or describe the detail implementation of system behavior shown in the use case diagram.

Figure 3.6, 3.7 and 3.8 are the sequence diagram of some of the behavior shown in the use case boundary diagram.

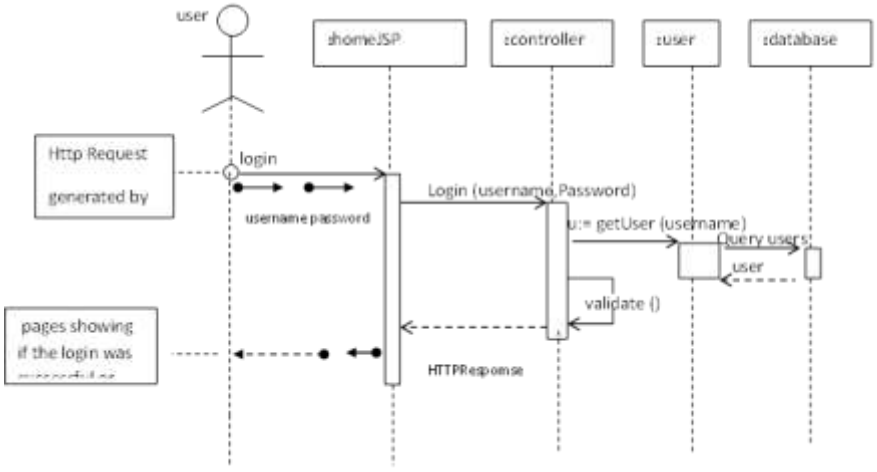

Figure 3.7: register sequence diagram of the system

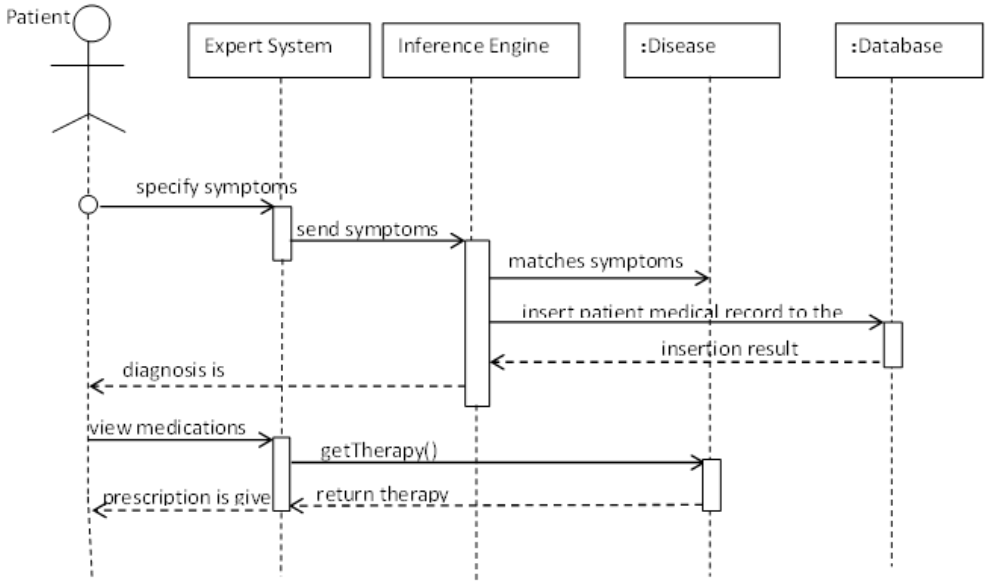

Figure 3.8: Symptom Sequence Diagram Of The System

Design of the Proposed System

The design of the proposed system transforms the conceptual model produced in analysis to take account of the constraints imposed by the chosen architecture and any non- functional technological or environmental-constraints, such as transaction throughput, response time, run-time platform, development environment, or programming language.

The concepts in the analysis model are mapped onto implementation classes and interfaces. The result is a model of the solution domain; this gives a detailed description of how the system is to be built.

Database/ Knowledge Base Design

The Bacterial Infection Diagnosis expert system knowledge base used MySQL relational database management system to create the following tables namely;

1. Role table
2. User table
3. Symptom table
4. Disease table
5. Patient table
6. Medical Record table
7. Comment table

The structures of some of the proposed system tables are given in tables 1, 2…….5.

Table 1: role

Field	Data Type	Size	NULL	Description	Action	Extra
role_id	Integer	11	No	Unique role identification number	Primary key	Auto_increment
Name	Varchar	15	No	Role name	Index	

Table 2: user

Field	Data Type	Size	NULL	Description	Action	Extra
user_id	string	10	No	Unique user identification number	Primary key (PK	Auto_increment
role_id	integer	11	No	Role identification number	Foreign key (FK)	
first_name	Varchar	20	No	User first name		
last_name	Varchar	20	No	User surname		
Username	Varchar	20	No	User login identification number	Unique	

Password	**Varchar**	**18**	**No**	**User password**	**Index**	

Table 3: symptom

Field	Data Type	Size	NULL	Description	Action	Extra
symptom_id	**Integer**	**11**	**No**	**Unique symptom identification number**	**Primary key**	**Auto_increment**
Name	**Varchar**	**25**	**No**	**Symptom name**	**Index**	

Table 4: disease

Field	Data Type	Size	NULL	Description	Action	Extra
disease_id	**Integer**	**11**	**No**	**Unique disease identification number**	**Primary key**	**Auto_increment**
symptom_codes	**Enum**	**-**	**No**	**Disease symptoms codes**		
Name	**Varchar**	**15**	**No**	**Disease name**	**Index**	
Description	**Varchar**	**25**	**Yes**	**Disease description**		
Therapy	**Text**	**-**	**No**	**Disease treatments**		

Table 5: patient

Field	Data Type	Size	NULL	Description	Action	Extra
patient_id	**String**	**20**	**No**	**Unique patient identification number**	**Primary key**	**Auto_increment**
user_id	**String**	**20**	**No**	**User id**	**FK**	**Index**
Name	**Varchar**	**15**	**No**	**Patient name**		
Gender	**Varchar**	**6**	**No**	**Patient gender**		
Email	**Varchar**	**36**	**No**	**Patient email address**		
phone_no	**Varchar**	**11**	**No**	**Patient phone numbers**		
date_of_birth	**Date**	**-**	**No**	**Patient date of birth**		
Contact	**Varchar**	**20**	**No**	**Patient contact address**		
marital_status	**Varchar**	**8**	**No**	**Patient marital status**		
Religion	**Varchar**	**20**	**No**	**Patient religion**		

Expert system Features for Medical Diagnosis

The expert system features for bacterial infectious diseases describes the fundamental knowledge of building the system and the basic operation of the entire system starting from the patient's contact to where the medical expert supply information needed for the disease diagnosis. Here, the patient interacts through user interface to diagnose his/her ailments, the user interface then contacts the inference engine for query processing and retrieving of information from the knowledge base or the working memory.Using a medical expert system as an example, the following features characterize an expert system implementation for the bacterial infectious diseases:

- An organized knowledge base, often in the form of a database (e.g. a set of illness and their symptoms).
- A user interface, able to support diagnostic or similar discussion with the users (i.e. to enable patient pose medical problems or to check an initial diagnosis).
- A facility to hold details of the states of the current consultation (e.g. the patient in consulting the expert system may have to go through a lengthy questions and answer sessions and the system has to keep track of the state of the questions).
- An inference engine i.e., software which uses the knowledge base and the current status of the consultation to either formulate further questions for the user or draw conclusions about what actions to be recommended to the users (e.g. a mechanism for producing a sequence of question for the patient to answer so that the expert system can arrive at a diagnosis).

- A knowledge acquisition system, i.e. a facility to update the knowledge base. It is via the knowledge acquisition system that the human expert is able to enter knowledge to the expert system (e.g. suitable system for entering the relevant facts about various diseases).the system makes an assessment of the problem and recommendan action to be taken as shown in figure 3.9 below;

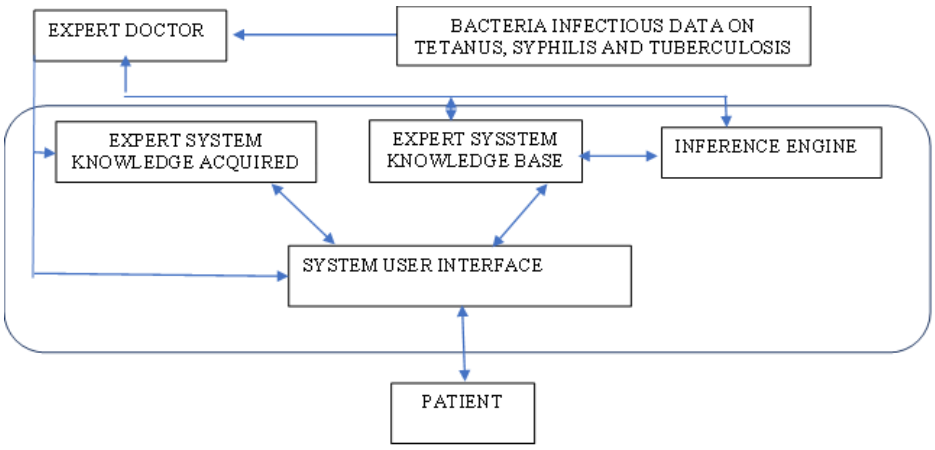

Figure: 3.9: Expert System Features for Medical Diagnosis

Input Design

This Bacterial Infection Diagnosis expert system will have a user interface that receives user input and displays desired output. The user interface consists of different web pages. The login page (Figure 3:10) of the application will have different links that a user can navigate through and accepts user's username and password. The patient registration page would have textboxes to fetch the patient's first name, middle name, last name gender, email, phone number, date of birth, contact, marital status, religion, password and action buttons to submit patient's details for process, While the symptoms page would have links to navigate a patient to other pages of the system and other necessary inputs such as checkboxes that enable users tick their symptoms and activate processing as depicted in Figure 3.13.

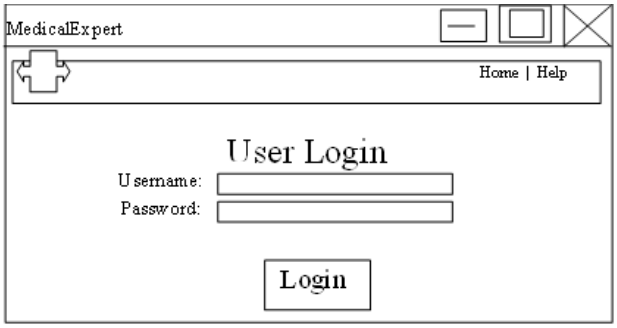

Figure 3.11: login form

Figure 3.12: register form

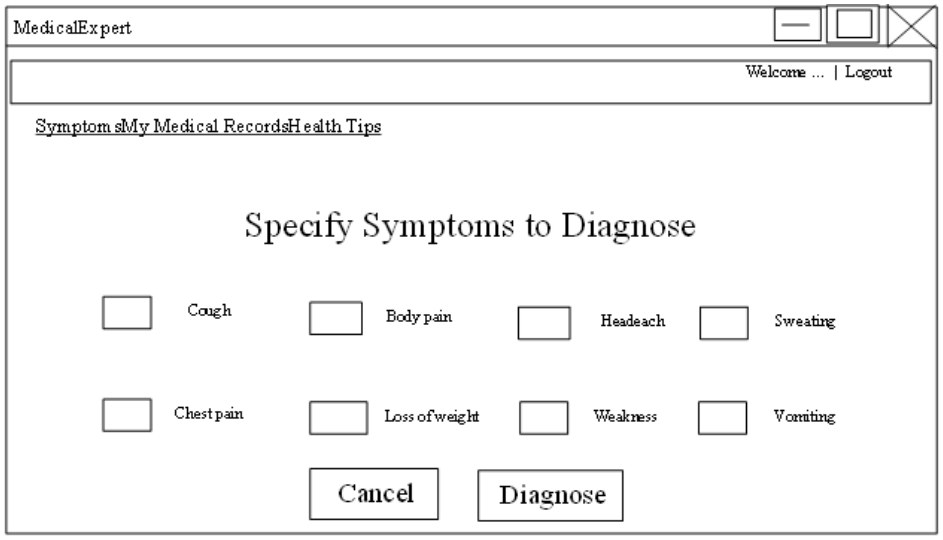

Figure 3.13: symptom form

Output Design

This Bacterial Infection Diagnosis expert system will also use the user interface to display desired output to users. HTML and Java Server Pages (JSPs) document will display output to the user as depicted in Figure 3.14. Most of the outputs from the system include health tips, patient's medical h histories, diagnosis result, and drug prescriptions.

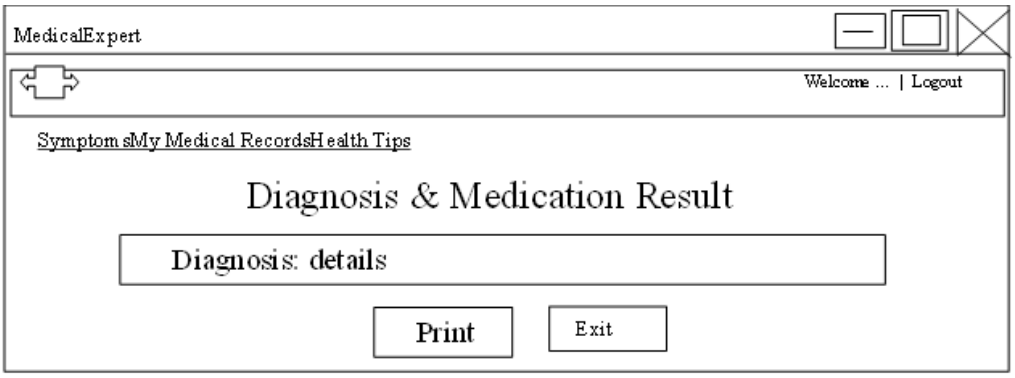

Figure 3.14: diagnosis/medication result

Algorithm Design

The Bacterial Infection Diagnosis expert system inference engine uses a forward chaining mechanism to search the knowledge base for symptom of disease and its associated therapy which matches the query supplied by the patient.

Algorithmic rules in the TB–Diagnosis Expert System (TB-DES)

Where TB is suspected. The presence of cough with bloody sputum and swollen lymph is probably an indication of Mycobacterium infection, which is captured in the following algorithmic rules.

If <symptom is cough AND
(NOT symptom is headache)
AND (symptom is bloody sputum)
AND symptom is swollen lymph/neck/joint>
then <Notify (Patient), "Tuberculosis is very likely, Therapy() = "seek medical help, use co-trimoxazole, lower the fever with cool and wet cloths, and take nutritious food and plenty of liquid"">.

Where TB is not suspected. When cough is not observed and sputum occurrence is none or minimal, and where it occurs, it is not bloody, and then TB is not likely. This is depicted in the following algorithmic rules.

If <symptom is cough AND
(NOT Symptom is bloody sputum)
AND (NOT symptom is swollen lymph/neck/joint>

then <Notify (Patient), "Tuberculosis is not likely but ordinary cough">.

System Implementation

The system is a complete easy menu driven application, such that the user is required to select option of choice from the webpage to display desired information. The purpose of system implementation can be summarized as follows: making the new system available to a prepared set of users (deployment) and positioning on-going support and maintenance of the system within the performing organization (the transition). At a final level, deploying the system consists of executing all steps necessary to educate the users on the use of the new system, placing the newly developed system into production, confirming that all data required at the start of operations is available, accurate, and also validate the business functions that interact with the system are functioning effectively. However, the previous chapter has provided a better understanding of systems analysis and its requirements as well as the design of the system. In this chapter we will explain the details of the system's implementation, focusing on the development architecture and processes, testing, and program documentation.

Choice of Development Environment

The coding of the entire program was done in Eclipse Integrated Development Environment (IDE). Eclipse is an open source community whose projects are focused on providing an extensible development platform and application frameworks for building software. Eclipse provides extensible tools and frameworks that span the software development lifecycle, including support for modeling, language development environments for Java, C/C++ and others, testing and performance, business intelligence, rich client applications and embedded development. An eclipse platform is a generic integrated development environment (IDE) foundation without a specific programming language. The platform contains IDE functionality and is built with components creating applications by using component subsets. Developers create, share and edit generic projects and files in the platform, while participating within a multiple team development environment repository.

Programming Language Employed

The programming language used for this research work is java programming language. Java has become one of the most important languages for Web and Internet applications. In the development of this system, Java has also generated significant interest in the business community, where it has proved to have tremendous commercial potential. In addition to being a useful tool for helping businesses to promote their products and services over the Internet, Java is also a good language for distributing software and providing services to employees and clients on private corporate networks or intranets. Because of its original intended role as a language for programming microprocessors embedded in consumer appliances, Java has been designed with a number of interesting features:

- **Java is object oriented.** Object-oriented languages divide programs into separate modules, called objects, which encapsulate the program's data and operations. Thus, object-oriented programming (OOP) and object-oriented design (OOD) refer to a particular way of organizing programs, one which is rapidly emerging as the preferred approach for building complex software systems. Java was designed from scratch as an object-oriented language.
- **Java is robust.** Meaning that errors in Java programs don't cause system crashes as often as errors in other programming languages. Certain features of the language enable many potential errors to be detected before a program is run.
- **Java is platform independent.** A platform, in this context, is just a particular kind of computer system, such as a Macintosh or Windows system. Java's trademark is "Write once, run anywhere." This means that a Java program can be run without changing on different kinds of computers. This is not true for other high-level programming languages. This portability which is the ability to run on virtually any platform is one reason that Java is well suited for WWW applications.
- **Java is a distributed language.** This means that its programs can be designed to run on computer networks. In addition to the language itself, Java comes with an extensive collection of code libraries software that has been designed to be used directly for specific types of applications that make it very easy to build software systems for the Internet and the WWW. This is one of the reasons why Java is well suited for supporting applications on corporate networks.
- **Java is a secure language**. Java contains features that protect against un-trusted code that might introduce a virus or corrupt your system in some way. For example, once they are downloaded into your browser, Web-based Java programs are prevented from reading and writing information from and to your desktop computer.

Implementation Architecture

The architecture of the proposed system is shown in figure 4.0.

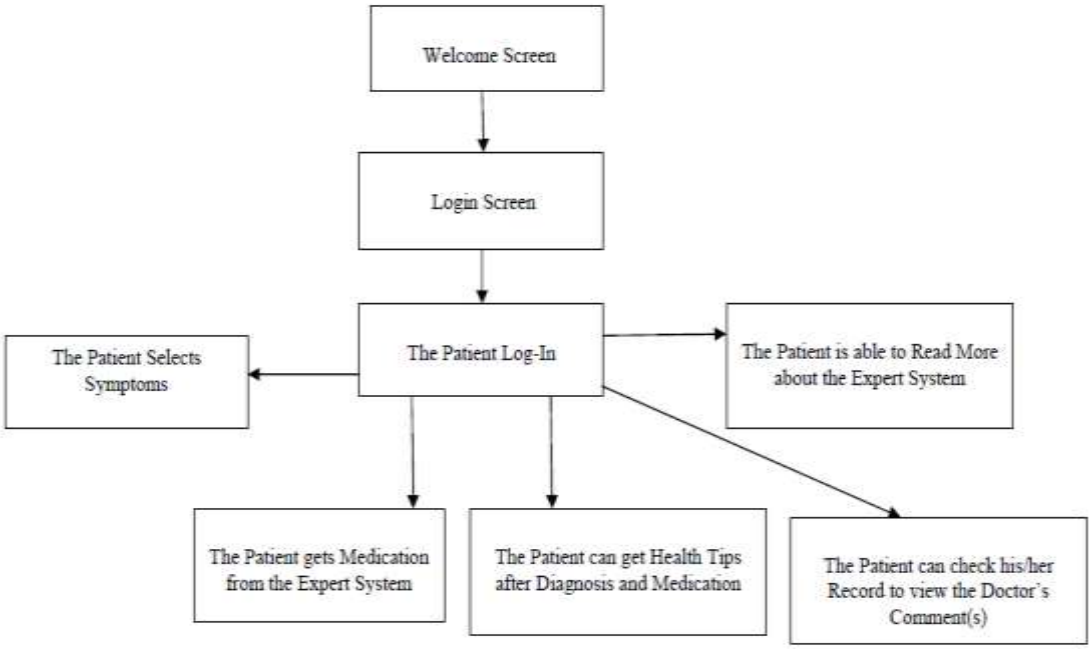

Figure 4.1: The architecture of the system

Software Testing

In testing, we check both verification (the software complies with the requirements) and validation (the software has been written correctly and effectively). The software is also tested against its analysis specifications.

There are different types of tests adopted at different stages. They include;

i. Unit Testing – Testing each class or unit of the software interface.
ii. Integration Testing – Testing done during the combination of various class and various modules for compatibility check.
iii. Module/Sub-System Testing – Testing done on a module before integration.
iv. System Testing –Testing after the combination of the various modules or subsystems to produce the required software.
v. Acceptance Testing - In this stage, I chose to invite people who work in the medical field in Kogi State General hospital to do the acceptance testing.

Two different software testing techniques were adopted as a systematic testing approach and they are:

i. White Box Testing – This technique focuses on the program control structure which involves close examination of procedure detail. Program statements, internal data structure, loop, logical paths and logical statements are tested. White box testing helps us to test the quality of the construction of the software.
ii. Black Box Testing – This technique tests the quality of the performance of the software and is conducted at the software interface. It tests the functionality of the system.

The aim of the two test techniques conducted was to ensure that the software has the following attributes: Completeness, Correctness, Reliability and Possibility of maintenance. In the course of the software implementation, testing is done several times to ensure that the software meets the users' requirements at each point. Testing is not done with the main software but on a duplicate of the software called the 'Test software' so as to have where to fall back on incase of any crash during testing.

Screen Shots of the Input and Output of the Application

The screen shots of the input and output of the application are given below:

Home

The home main menu serves as the guest page to the software. It is also used by the registered users to log into the application.

Figure 4.2 screen shot of home page

Registration

The registration page is used by patients to register to the system.

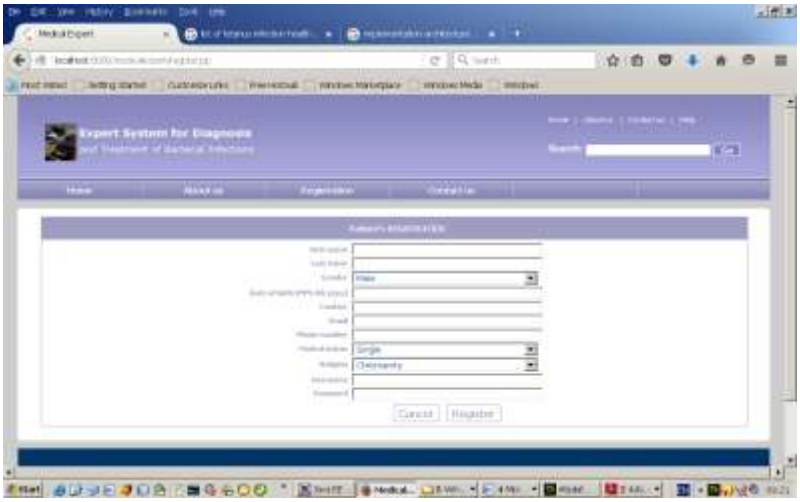

Figure 4.3 screen shot of registration page

Add Symptom

The add symptom page is used by the administrator to add disease symptoms to the system.

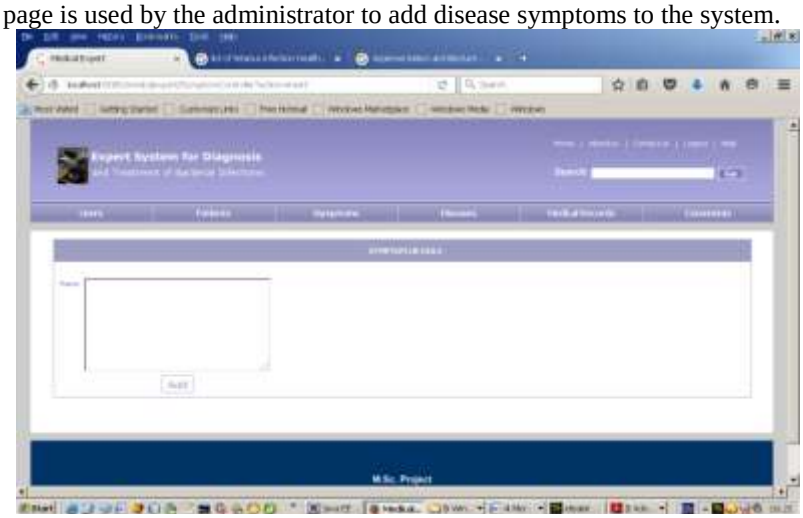

Figure 4.4 screen shot of add symptom page

Symptom List
The symptom list page shows the added disease symptoms in the system.

Figure 4.5 screen shot of symptom list page

Add Disease
The add disease page is used by the administrator to add diseases to the system.

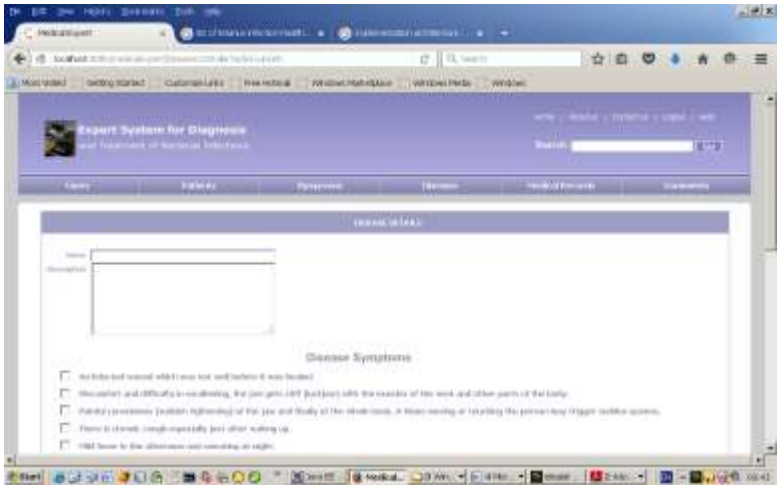

Figure 4.5 screen shot of add disease page

Disease List
The disease list page shows the added diseases in the system.

Figure 4.7 screen shot of disease list page

Patient Details
The patient details page shows the details of a registered patient in the system.

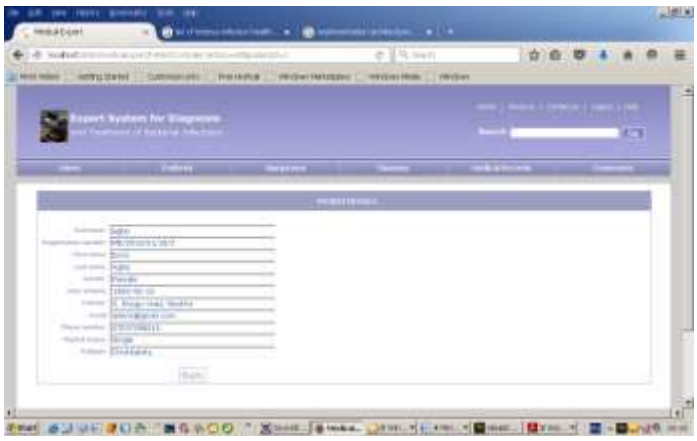

Figure 4.8 screen shot of patient details page

Symptoms Selection Page
This shows the list of symptoms in the system which a patient is required to select for diagnosis.

Figure 4.9 screen shot of symptoms selection page

Diagnosis Result
This page shows the result of the diagnosis.

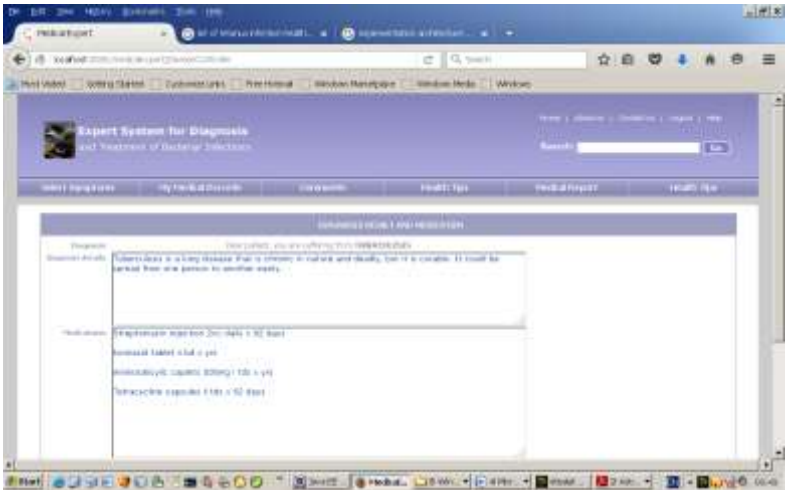

Figure 4.10 screen shot of diagnosis result page

Documentation

Program documentation consists mainly of the statement of the functions of the functional units of the entire system. It is important to provide the program documentation or source code for the following reasons.

- To ensure continuity of software development and improvement even if there is a change in the original designers of the system.
- To ensure that the system maintenance process is convenient and effective.
- To enable programmers keep track of the last point of the development of the system
- To allow for future amendment at a later stage in system development.

System Requirements

This handles what is required in terms of technology, economy, personnel and equipment in order to be able to implement the software.

Hardware Requirements

The hardware requirements for the project which is designed to run on an application/web server and web browsers are as follows:

a. Processor – Intel Pentium IV processor (or higher) or its equivalent.
b. Memory – 512MB of Random Access Memory (RAM) or higher.
c. 20GB hard disk drive or higher.
d. A Network Interface Card (NIC) or Wireless Local Area Network (WLAN) for network connectivity.
e. 15 inches monitor for display.
f. Keyboard and mouse for input and pointing.
g. 52 CD-ROM drives.

Software Requirements

The software requirements for the developed software include:

a. Windows operating system or any other java compatible operating system.
b. Java development kit (JDK) version 1.6 or higher.
c. Apache Tomcat web server version 7.0.26 or higher
d. MySQL server version 5.1 database or higher.
e. Microsoft internet explorer version 4.0 (or higher) or any other web browsers.
f. Reliable access to the internet

User Manual

This aspect is concerned with how to use the software. The software is user friendly and interactive; this makes it easy for people who do not know how to use computer efficiently.

To use the software the users, have to do the following:

1) Boot a PC
2) When the PC starts up, run the apache Tomcat web server by going through (drive):/ apache-tomcat-7.0.26/bin/startup.Batch.
3) Open the internet explorer or Mozilla firefox and type http://localhost/medicalexpert -on the address bar and press enter key.
4) When the Home page displays, the user will be prompted to specify his/her username and password for authentication after registering to the system (In case of patient).

When the user logs in successfully to the user's module, he/she is required to use the system's dashboard to go to any page he/she wants to work on or logs out.

III. Summary And Conclusion

Summary

This web-based research clearly shows the importance of expert systems as problem solver that man finds difficult to handle. This conventional medical practitioner takes a long time to achieved a reliable result and oftentimes, these results may be gotten too late which may leads to fatal damages. Also, the knowledge expert may be lost because of retirement age. these knowledge experts are scarce, many times busy, and expensive to employ especially in the less developed world. Since expert systems are fast and accurate at reaching a solution, this developed web-based expert system will be useful in helping patient make better decision. knowledge expert for the diagnosis and treatment of bacterial diseases like tuberculosis, tetanus and syphilis are scarce, such that identification of relevant symptoms may often fail. Hence, this web-based expert

system has captured human expertise for these dangerous infections and makes it available to others especially patients to perform an expert work in absent of a human medical expert.

Contribution to Knowledge

Expert system for medical diagnosis is not a new development since some expert systems like MYCIN, FELMOT, INTERNIST and CASTNET has been developed to meet some of the needs of our medical sector in area of disease diagnosis. However, they are some weaknesses in the existing expert system which need to be improved such as time constraint in MYCIN where a stool culture test analysis is require before it reaches the final diagnosis. This may lead to death of patient. Also, ISABEL's weakness is the request of the system for different diagnosis which includes clinical features, result of the test from laboratory and other investigation before reaching the final conclusion which invariably leads to extra cost. Therefore, this web-based expert system for the diagnosis and treatment of bacterial infections like tuberculosis, tetanus and syphilis will improved on these weaknesses by incorporating all the prevailing symptoms and various diagnostic features for bacterial diagnosis for quick identification of those symptoms without extra cost or time constraints as featured in MYCIN, ISABEL and others. This helps the patients and other medical personnel to reach quick diagnosis and effect appropriate treatment.

Recommendations

- Government and academic institutions should encourage students and lecturers to do more researches on expert system by subsidizing cost involve in embarking on such training, this will enable us compete with other countries that have use expert system to advance their economics.
- Expert system for bacterial infections should be used by every patient suffering from infectious diseases like syphilis, tuberculosis and tetanus because of its diagnostic simplicity and cost reduction aimed at improving their health standard due to the prevailing economic hardship in our society today.
- This medical expert system for the diagnosis and treatment of bacterial diseases like syphilis, tuberculosis and tetanus for bacterial isolation and identification of prevailing symptoms and drugs administration is a milestone that needed to be recommended for medical and microbiological students for research purposes on bacterial organisms and its control.

Conclusion

At the end of this work, we have been able to analyze, design and implement a web-based expert system on bacterial infections which will be of high benefit to patient suffering from infections such as syphilis, tuberculosis and tetanus.

The knowledge domain is sourced through extensive consultations with the knowledge expert in the medical field. Other relevant information was sourced from online and some related literatures which have been reviewed. These consultations helped in formulating the production rules which can compare favorably with other expert system earlier developed for the diagnosis of bacteria diseases like MYCIN, FELMOT and ISABEL.

Suggestion for further studies

In the course of this web-based expert system development, only tuberculosis, tetanus and syphilis was designed and implemented. Future work on expert system for bacterial infectious diseases should be upgraded to include other bacterial diseases like cancer, leprosy and other non-bacterial pathogens like fungal and viral infections. Since the field of microbiology is an ever-growing field especially in this era of genetic engineering where new microorganisms are discovered.

REFERENCES:

Kattan M. W. (2001): Expert system in Medicine, International Encyclopedia of the social and behavioral Science

Auora Saibene and Marta Giltri (2021): Expert System: Definitions, Advantages and Issues in Medical Application. Expert System with Application

Adekoya A F, Akinwale A T and Oke O E (2008):A Medical Expert System For Managing Tropical Diseases | College Of Natural Sciences Proceedings (Funaab.Edu.Ng)

Bakpo F.S. and Udanor C. N. (2011): Artificial Intelligence with Prolog Programming. J.T.C Publishers, 12 Edinburgh Road, Enugu State, Nigeria. ISBN:-978-35036-6-9, (pg 7-16 and 138-194)

Ovidiu.S.Noran. (2003): Evolution of an Expert System.

Available electronically:http://www.cit.gu.edu.au/noran(pg. 1-15)

Shu-Hsien Liao (2005): Expert system methodologies and applications—a decade review from 1995 to 2004Department of Management Sciences and Decision Making, Tamkang University, No. 151, Yingjuan Rd, Danshuei Jen, Taipei 251, Taiwan, ROC www.elsevier.com/locate/eswa pg (94 - 95).

PETER SZOLOVITS,. RAMESH S. PATIL, ,and WILLIAM B. SCHWARTZ, M.D.(1988)Artificial Intelligence in Medical Diagnosis. Artificial Intelligence in Medical Diagnosis | Annals of Internal Medicine (acpjournals.org)

Angeli .C. (2010): Diagnostic Expert Systems: From Expert's Knowledge to Real-Time Systems Department of Mathematics and Computer Science, Technological Education Institute of Piraeus, Konstantinoupoleos 38, N. Smirni, GR-171 21 Athens, Greece, Vol. 1, (pg. 51-52)

Dipanwita , Sagar & Nirmala (2011): Disease diagnosis system
International Journal of Computer Science & Informatics, Volume-I, Issue-II, 2011
Available online at www.interscience.in,(pg. 48).

Gufran Ahmad Ansari (2013): An Adoptive Medical Diagnosis System Using Expert System with Applications.
Journal of Emerging Trends in Computing and Information Sciences
Vol. 4, No. 3 ISSN 2079-8407
http://www.cisjournal.org. pg(303 – 305).

Santosh, Prava and Mandal (2010): An Expert System for diagnosis of Human Disease. (pg. 71) International journal of computer applications (0975-8887) Volume 1 – No. 13
Centers for Disease Control and Prevention 1600 Clifton Rd. Atlanta, GA 30333, USA.

Cecilia Schatz and Fabio Kurt (2011): Intelligent and Expert Systems in Medicine – A Review.
Avenida Sete de Setembro, 3165, Curitiba-PR - CEP 80.230-910
E-mail: ceciliavallejos@yahoo.com, fabioks@utfpr.edu.br. Pg. (3).

Lenka Lhotska and Tomas Vleck (2011): Medical Applications of Enhanced Rule-Base Expert System. The Gerstner Lab, Czech Technical University in Prague, Technicka 2, 16627 Prague 6, Czech Republic. E-mail: lhotska@feld.cvut.cz (pg. 10-11)

.Mahesh, Kandaswamy, and Venkatesan (2009): International Journal of Recent Trends in Computer Engineering, Vol 2, No. 3, (pg. 3)

Edward .H. Shortliffe, MD, PhD, (1986): Medical expert systems-Knowledge tools for physicians, In Medical informatics: Medical Computer Science Group, Knowledge Systems Laboratory, Departments of Medicine and Computer Science, Stanford University School of Medicine, Stanford, California. CA 94305-5479. (pg. 830-832)

Agbo-Ajala, Adeyemi& Makinde (2014): A Prototype Expert System For Human Diseases Diagnosis
Computing, Information Systems, Development Informatics & Allied Research Journal Vol. 5 No. 4. – www.cisdijournal.net. Pg. (1-30).

Randolph Miller, Harry and Jack Myers, (1982): INTERNIST-!,An Experimental computer - Based Diagnostic Consultant for General internal Medicine
Used with permission of the *New England Journal of Medicine.* From vol. 307,(pp. 190-204)

Paul Singleton, (1999): Bacteria In Biology, Biotechnology and Medicine. John Wiley & Sons Ltd, Chichester, Baffin Lane, West Sussex Po19 IUD, England. ISBN: 0-47197468-4. (pg. 1-3)

David Brown and Jennifer Frank, (2003): Syphilis Diseases Control Center DeWitt Army Community Hospital, Fort Belvoir, Virginia. Syphilis Disease Retrieved January2003, from www.niaid.nih.gov/factsheets/stdsyph.htm. (pg. 1-30)