ISSN NO. 2320-5407

Journal homepage: http://www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

RESEARCH ARTICLE

A RULE BASED EXPERT SYSTEM FOR DIAGNOSIS OF FEVER

***Sunday Tunmibi[1], Oriyomi Adeniji[1] Ayooluwa Aregbesola[2] and Ayodeji Dasylva[3]**

1. School of Computer Science, Mathematics and Information Technology, Houdegbe North American University, Republic of Benin.

2. Centre for Learning Resources, Landmark University, Omu-Aran, Kwara State, Nigeria.

3. HR Department, Keystone Bank Limited, Victoria Island, Lagos State, Nigeria.

Manuscript Info

Manuscript History:

Received: 11 August 2013
Final Accepted: 21 August 2013
Published Online: September 2013

Key words:
Expert system,
Fever, Sick patients,
Medical fields, Nigeria.

Abstract

This paper deals with the design and development of a rule based expert system for diagnosis of fever, a common health disorder among Africans. This system interacts with users with plain English language based on some arranged rules. These rules, which are a typical collection of if/then rules, are extracted from experts in the medical fields in Nigeria. Using these rules, a knowledge base was designed for the expert system. Some programming codes were also written in VB.Net for making deduction of new facts from rules in the knowledge base. It is believed that this design can help to reduce the congestion we often see in our hospitals by providing solution for sick patients, irrespective of their locations.

Copy Right, IJAR, 2013,. All rights reserved.

Introduction

An expert system is a computer program designed to solve problems in a domain in which there is human expertise. The knowledge built into the system is usually obtained from experts in the field. Based on this knowledge, an expert system can replicate the thinking process of the human experts and make logical deductions accordingly. This paper focuses on the design and development of a rule based expert system for the diagnosis of fever.

The two most common form of fever in Nigeria are malaria and typhoid. According to Malaria site (internet), malaria causes significant morbidity and mortality worldwide. In developing nations, scarce resources lead to inadequate diagnostic procedures. Malaria can result in anemia (a decreased number of red blood cells). The remains of the destroyed red blood cells clump together and cause blockages in the blood vessels. This can result in brain damage or kidney damage, which is potentially fatal. A particularly serious, potentially life threatening, form of malaria parasite is called *Plasmodium falciparum*. Similarly, a bacterium called Salmonella typhi (S. typhi) is responsible for typhoid. S. typhi may be spread by consuming contaminated water, beverages and food, after which the bacteria enter the intestines and then the bloodstream, where they may spread to other body parts. Initial typhoid symptoms include malaise, headache, diarrhea (or constipation), sore throat, fever as high as 1040F, as well as a rash. Diagnosis is carried out on the blood, bone marrow or stool cultures and with the Widal test. In epidemics and less wealthy countries, after excluding malaria, dysentery or pneumonia, a therapeutic trial time with chloramphenicol is generally undertaken while awaiting the results of Widal test and cultures of the blood and stool (Ryan and Ray, 2004). Apart from malaria and typhoid fever, the rule based expert system designed in this paper is developed to diagnose other types of fever such as pel-ebstein fever, leptospirosis fever, scarlet fever, dengue fever, rheumatic fever, hay fever and lassa fever.

There are many reasons for building an expert system to solve health related problems. Human experts may not always be available or may even be absent from a location. Also, by pooling knowledge of many experts, an expert system may be better than one human expert in its overall performance. An expert system does not get tired and are expected to be more consistent. It can also be used for training and passing on the knowledge derived from the human experts.

Literature Review

An expert system simply replicates the heuristic knowledge of human experts. According to

Hatzilygeroudis, Vassilakos and Tsakalidis (1994), Heuristic knowledge represents experience accumulated through years and concerns the way an expert uses the above knowledge to make diagnoses. A diagnosis basically consists in relating patient data with corresponding diseases. In order for the computer to be able to retrieve and use heuristic knowledge, expert systems are organized in three distinct levels. These are the knowledge base, the working memory and the inference engine. The knowledge base contains the domain knowledge of the system. It is typically represented as a collection of if/then rules. During the execution of an expert system, new facts are derived. These facts, together with the information entered by the user are stored in the working memory. The inference engine is the part of the expert system that performs the deduction of new facts from previously derived facts and rules in the knowledge base. The user interface is usually through the use of natural language. Typical expert system architecture is shown below.

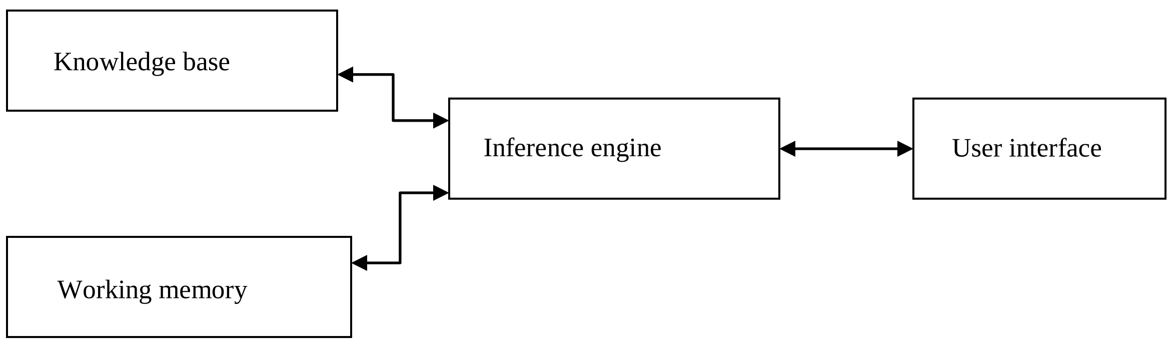

Figure 1: Expert system architecture

According to Cuena, Fernandez, Lopez de Mantaras and Verdejo (1985), research into the use of artificial intelligence in medicine (AIM) started in the end of the 1960's and produced a number of experimental systems. These include:

DENDRAL (Stanford University, 1967) deduces the chemical molecular structure of an organic structure from its formula, spectrographical data and magnetic-nuclear resonances.

INTERNIST (Pittsburgh University, 1974) was a rule-based expert system for the diagnosis of complex problems in general internal medicine. This system covered 80% of the knowledge of internal medicine, but was criticized for the shallowness of their knowledge.

MYCIN (Stanford University, 1976) was a rule-based expert system to diagnose and recommend treatment for certain blood infections (antimicrobial selection for patients with bacteremia or meningitis).

CASNET (Rutgers University, 1960) was an expert system for the diagnosis and treatment of glaucoma.

EXPERT (Rutgers University, 1979) was an extension generalized of the CASNET formalism which was used in creating consultation systems in rheumatology and endocrinology.

ONCOCIN (Stanford University, 1981) was a rule-based medical expert system for oncology protocol management. It was designed to assist physicians in treating cancer patients receiving chemotherapy.

At present, many new expert systems have been designed in the medical field to take care of health related issues.

Fever (also known as pyrexia) is a frequent medical symptom that describes an increase in internal body temperature to levels that are above normal. According to Sarah (2005), fever patterns can be categorized into prolonged fever, fever of unknown origin, recurrent fever and periodic fever. Prolonged fever is a single illness in which duration of fever exceeds that expected for the clinical diagnosis or a single illness in which fever was an initial major symptom and subsequently is low grade or only a perceived problem. Fever of unknown origin is a single illness of at least 3 weeks' duration in which fever greater than $38.3^{o}C$ is present on most days, and diagnosis is uncertain after 1 week of intense evaluation. Recurrent fever is a single illness in which fever and other signs and symptoms wane and wax (sometimes in relationship to discontinuation of antimicrobial therapy) or multiple illnesses occurring at irregular intervals, involving different organ systems in which fever is one, variable component. Periodic fever has to do with Recurring episodes of illness for which fever is the cardinal feature, and other associated symptoms are similar and predictable, and duration is days to weeks, with intervening intervals of weeks to months of complete well-being. Episodes can have either ‘‘clockwork’’ or irregular periodicity.

Malaria fever and typhoid fever are the two most common types of fever in Nigeria. Plasmodium, which causes malaria, is a group of one-celled, animal parasites that lives on the red cells in the blood of many birds, reptiles and mammals. There are four human malaria species - P. Falciparum, P. Ovale, P. Vivax and P. Malariae. P. Falciparum is by far the most dangerous. Unfortunately it is also the most common in Africa! Certain Anopheles mosquitoes transmit malaria. The parasite has to undergo a crucial development process in the mosquito, and this cannot happen in any other mosquito. Malaria kills roughly 850, 000 people each year, most of whom are children under 5, and 90% of whom live in Africa, south of the Sahara. Each year there are probably more than 300 million cases of malaria. Malaria is responsible for one out of every 4 childhood deaths in Africa. Women are four times more likely to get sick and twice as likely to die from malaria if they are pregnant (Medical research council, 2001).

According to WHO (2003), Typhoid fever is caused by *Salmonella typhi*, a Gram-negative bacterium. The clinical presentation of typhoid fever varies from a mild illness with low-grade fever, malaise, and slight dry cough to a severe clinical picture with abdominal discomfort and multiple complications. Many factors influence the severity and overall clinical outcome of the infection. They include the duration of illness before the initiation of appropriate therapy, the choice of antimicrobial treatment, age, the previous exposure or vaccination history, the virulence of the bacterial strain, the quantity of inoculums ingested, host factors (e.g. HLA type, AIDS or other immunosuppression) and whether the individual was taking other medications such as H2 blockers or antacids to diminish gastric acid. Acute typhoid fever is characterized by prolonged fever, disturbances of bowel function (constipation in adults, diarrhoea in children), headache, malaise and anorexia. Bronchitic cough is common in the early stage of the illness. During the period of fever, up to 25% of patients show exanthem (rose spots), on the chest, abdomen and back. Apart from malaria fever and typhoid fever, other types of fever include scarlet fever, dengue fever, rheumatic fever, hay fever, lassa fever, pel-ebstein fever and leptospirosis fever.

Overview of the Designed rule based expert system

A rule based expert system called e-Diagnosis was designed to run under WINDOWS environment with VB.Net programming language. This programming language is preferred due to its object oriented nature and its interactive capabilities with the users. Data were collected from different medical experts in order to build the new system, and special attention was given to understudy how a doctor attends to and diagnose patients. This new system is designed to visualize and simulate how patient diagnosis can be done with the use of computer. The new system is very easy to use and user friendly. Patients and medical practitioner that are already familiar with WINDOWS and WINDOWS based PACKAGES like MS EXCEL, MS WORD, PageMaker etc would be able to use this system with less stress. Labels, messages, boxes, dialogue boxes make the system even easier to use. The system also prompts and alerts the user if important data are omitted, as well as to save before exiting the application. The package worked on the simple logic of entering data, verifying data, validating data, editing, updating and computing. The program when run or compiled will display the welcome form which introduces the user to the application. The following are the procedures necessary for the diagnosis of a sick patient:

LOGIN FORM: This serves as an introductory screen to the application where user is expected to supply username and password for authentication.

REGISTRATION FORM: This allows user to enter information about the patient’s bio-data with reference to patient identity.

DIAGNOSIS PAGE: This allows user to enter information about the patient’s illness i.e. the symptoms, diagnose the symptoms, prescribed drugs and print the report.

REPORTS PAGE: This displays the results of the diagnosis and also prescribes the necessary drugs.

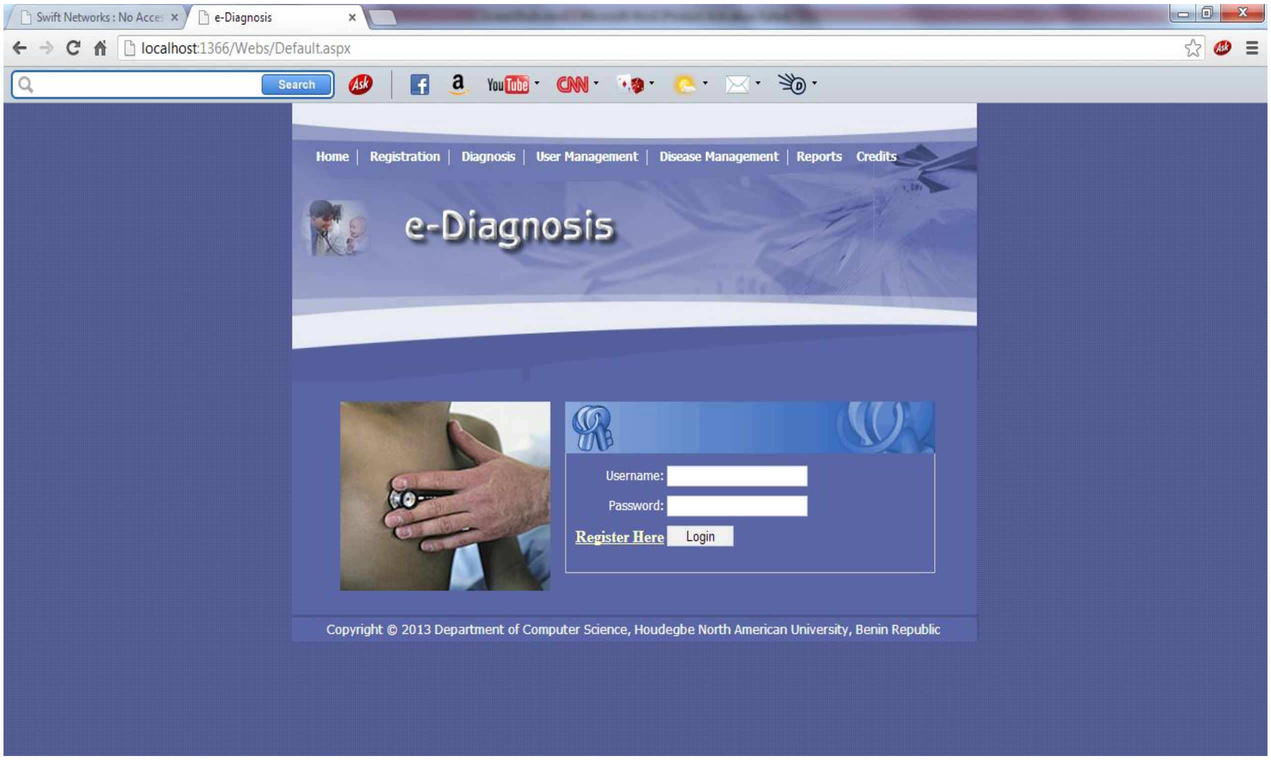

Figure 2: Snapshot of login page

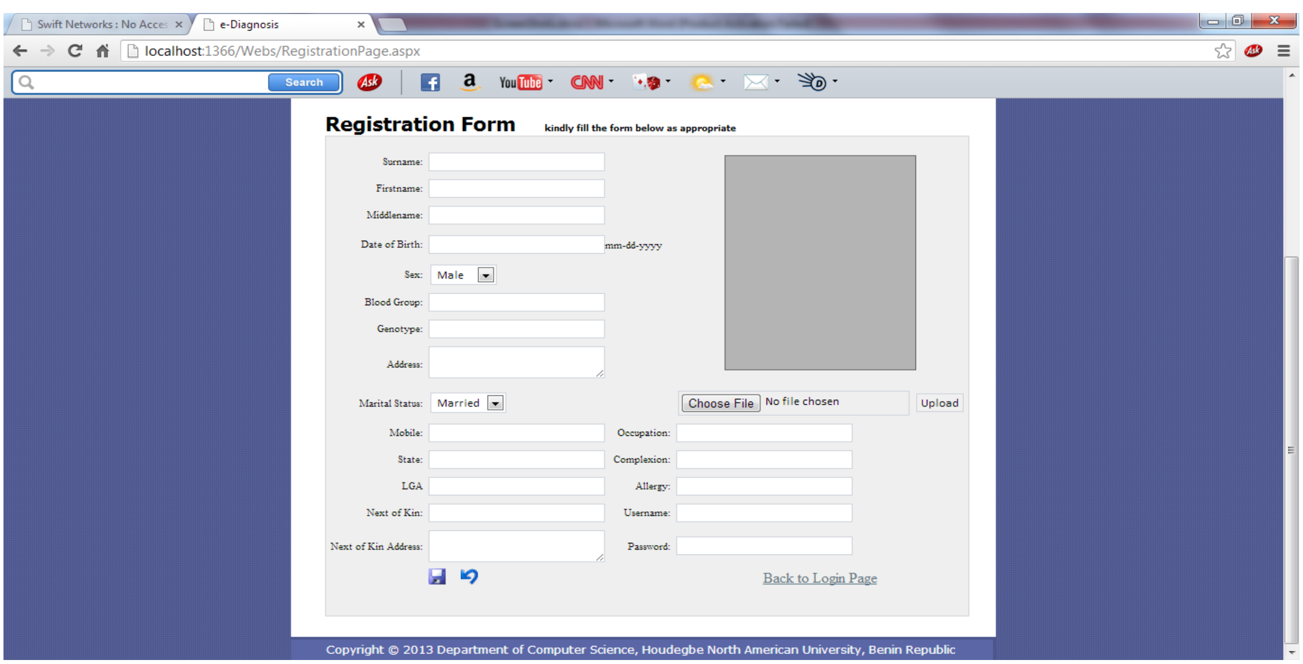

Figure 3: Snapshot of registration page

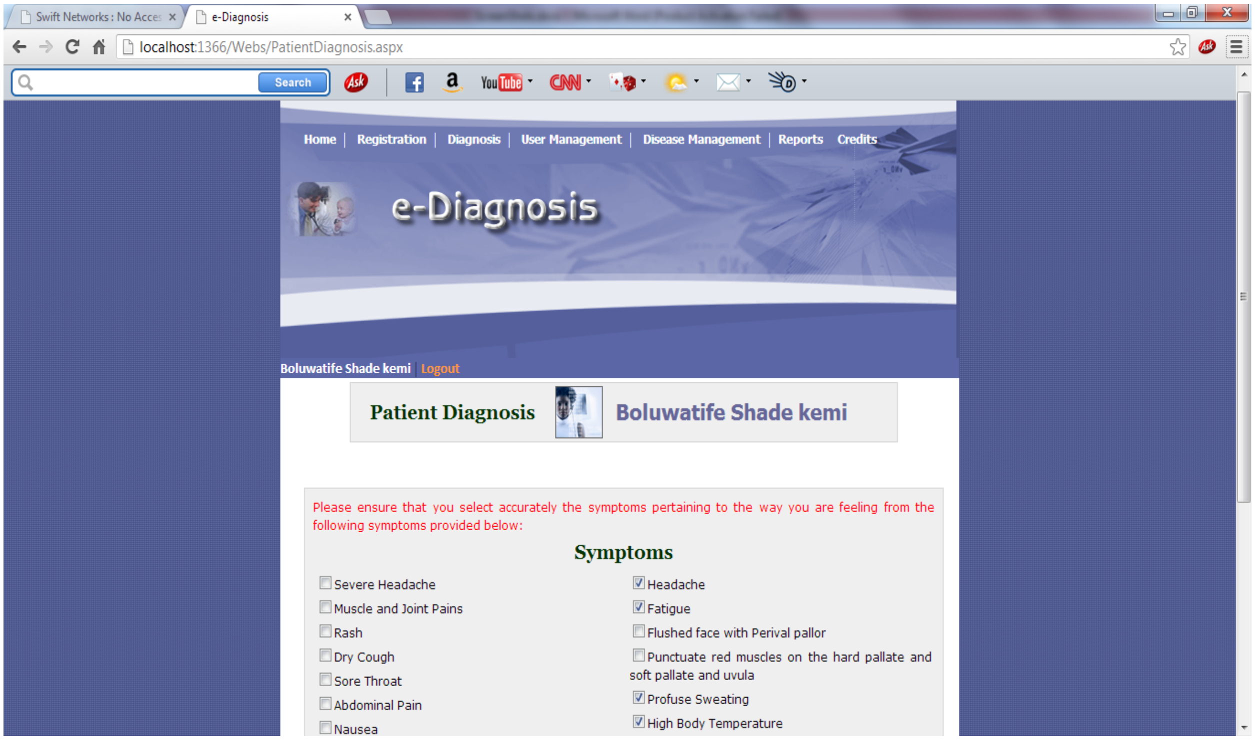

Figure 4: Snapshot of diagnosis page

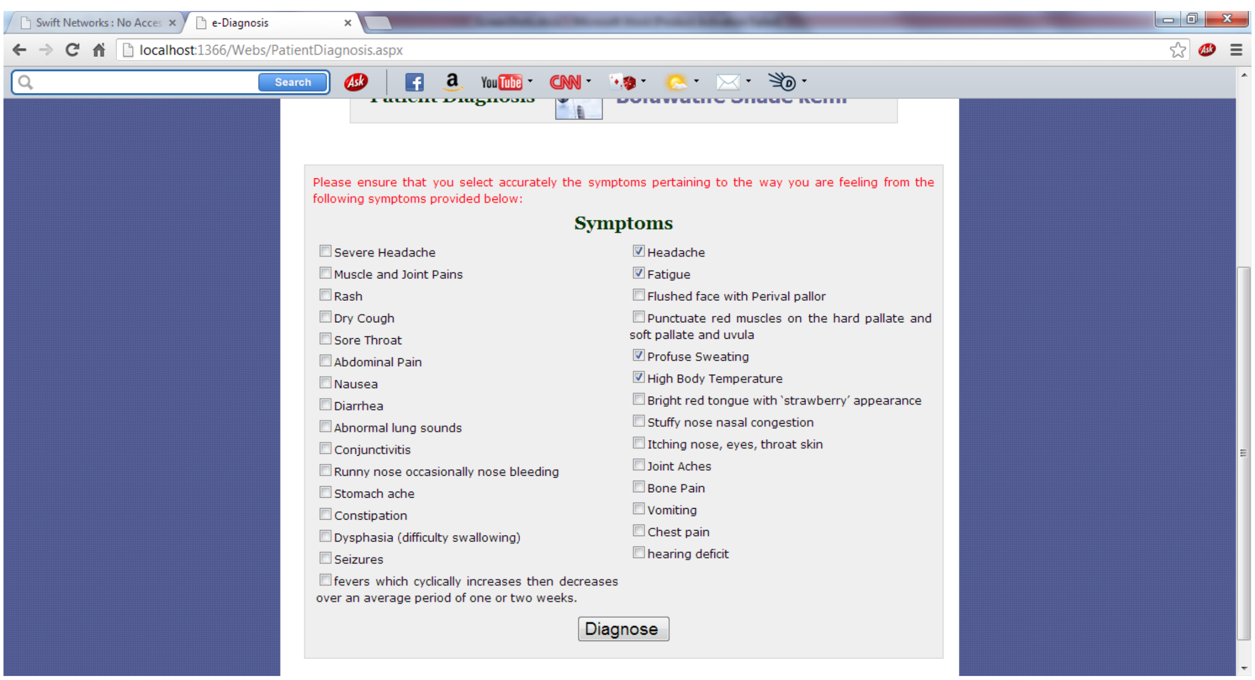

Figure 5: Snapshot of diagnosis page continues

Figure 6: Snapshot of diagnosis result

Conclusion

This paper presents the design of a rule based expert system for the diagnosis of fever such as malaria fever, typhoid fever, pel-ebstein fever, leptospirosis fever, scarlet fever, dengue fever, rheumatic fever, hay fever and lassa fever. The design, called e-Diagnosis, is a program developed in VB.Net version 2008 and Microsoft Access 2000 was used as the database. This design shows the benefits of using a rule based expert system for diagnosing sick patients. The merits include reduction in congestion at the hospitals, cost reduction, reliability and accuracy of result. The designed system, e-Diagnosis, can also be updated if need arises.

References

Cuena J., Fernandez G., Lopez de Mantaras R. and Verdejo M. F. (1985). Inteligencia Artificial: Sistemas Expertos (Alianza Editorial).

Hatzilygeroudis I., Vassilakos P.J. and Tsakalidis A. Proceedings of the 1st International Conference on Medical Physics and Biomedical Engineering (MPBE’94), Nicosia, Cyprus, May 1994, Vol. I, 148-152.

Malaria Site [Internet]. Clinical features of Malaria. cited Sep 20, 2012. Available from: http://www.malariasite.com/

Medical research council (2001). Malaria Advice for southern Mozambique, Swaziland and South Africa. Available from: http://www.malaria.org.za/Malaria_Risk/riskadv/General_Malaria_Info.pdf.

Ryan K.J., Ray C.G. (2004). Sherris Medical Microbiology. 4th ed. New York: McGraw Hill.

Sarah S.L. (2005). Distinguishing among prolonged, recurrent, and periodic fever syndromes: approach of a pediatric infectious diseases subspecialist. *Pediatric clinics of North America*, 811-835.

WHO (2003). Background documents: The diagnosis, treatment and prevention of typhoid fever. Available from: www.who.int/vaccines-documents/