Mobile Compactable Expert System for the Treatment of Typhoid Fever in Developing Countries

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ABSTRACT
Expert systems are software that uses knowledge base of human expertise for problem solving, or to clarify uncertainties where one or more human experts would need to be consulted. Typhoid fever is an infection caused by a bacterium known as *Salmonella enterica* serovar Typhi and rampant in developing nations with over 21.6 million cases and at least 250,000 deaths occurring annually. Victims when not diagnosed and treated in time fears death. Hence, this research work present a computer based treatment modality inform of an expert system, accessible on computers and mobile devices with internet browser. The expert system was developed using PHP server side scripting language and HTML 5.0. Media queries are used to ensure the expert system interface readjust itself to clients screen and Mysql as the database to store various symptoms, severity level and prescriptions for differentials of typhoid fever. Symptoms and prescriptions were sourced from internet to populate the database. The developed application was tested using apache server on a local network and random symptoms were selected to view prescriptions and diagnosis. The research showed that larger populace can be reached, helped and treated for typhoid in cases where doctors are not accessible, available or on industrial strike action when the application is deployed online and well publicized..

General Terms
E-health.

Keywords
Mobile compactable, Expert system, Treatment, typhoid fever, developing countries.

1. INTRODUCTION
Typhoid fever is an infection that is common in developing countries. The infection is caused by a bacterium known as *Salmonella enterica* serovar Typhi (*S. typhi*) a Gram-negative bacterium [1]. Though similar, it is different from the Salmonella that causes food poisoning. Typhoid Fever continues to be a global public health problem with over 21.6 million cases and at least 250,000 deaths occurring annually [1]. Typical presentations in older children include splenic abscess, liver abscess, cerebellar ataxia, meningitis, cholecystitis, chorea, palatal palsy, osteomyelitis, peritonitis, aphasia and even psychosis [4]. Due to these atypical presentations, it is common for typhoid fever in children to be diagnosed late or even remain unrecognized. Also, no vaccine against typhoid fever is available commercially for children under two years of age [3]. To complicate matters further, in the last two decades, multidrug-resistant (MDR) S. Typhi strains have emerged and spread worldwide, resulting in high rates of morbidity and mortality [3].

Consequently, researchers seek to deploy various approaches for the treatment of typhoid fever at large. This treatment includes orthodox, clinical and electronic approaches. Electronic approach seek to use available technology especially information technology to solve medical problems. Expert system is a computer software that attempts to act like a human expert on a particular subject area, which is often used to advise non-experts in situations where a human expert in unavailable or inaccessible (for example it may be too expensive to employ a human expert, or it might be a difficult to reach location), the introduction of mobile based expert system in the treatment typhoid fever will help reduce the menace of the illness by increasing the accessibility to medical care on mobile platforms.

Expert system developments today are either web based or stand-alone application. In other to reduce the restriction inherent in the platforms earlier stated, this paper presents the development of a mobile browser compatible expert system that could run on the mobile browser of any mobile device for the diagnosis and prescription of drugs for the treatment typhoid fever. This will increase the access to quality healthcare for the diagnosis and treatment of typhoid fever and inherently reduce the death rate as a result of the menace of the ailment.

The scope of the application developed was limited to diagnosis and treatment of Typhoid Fever only. This implies that the system can only be used for the prescription and diagnosis of Typhoid fever.

2. LITERATURE REVIEW
All Health problems have been in existence since man was created. Nigeria needs to expand the scope of it national program for the eradication of preventable diseases. Health care provision in Nigeria is a concurrent responsibility of the three tiers of government in the country. However, because Nigeria operates a mixed economy, private providers of health care have a visible role to play in health care delivery, which is the more reason why expert systems are needed a great deal in the country [5]. The claim has been that expert systems were not adopted because it was too difficult to extract knowledge from the experts, and the systems were only able to recommend actions based on the context in which the experts provided the knowledge [6]. Expert systems occupy a type of micro world that is self-contained and relatively uncomplicated. For such Artificial Intelligence (AI) systems, every effort is made to incorporate all the information about some narrow field that an expert (or group of experts) would know, so that a good expert system can often outperform any single human expert. There are many commercial expert systems, including programs for medical diagnosis, chemical analysis, credit authorization, financial management,

corporate planning, financial document routing, oil and mineral prospecting, genetic engineering, automobile design and manufacture, camera lens design, computer installation design, airline scheduling, cargo placement, and automatic help services for home computer owners [7].

This section gives a review of the definition of expert systems, development of expert systems, major components of expert system, applications of expert system and a brief study on typhoid and its symptoms.

2.1 Expert Systems

An expert system is a computer system that emulates the decision making ability of a human expert [11]. It is software that uses a knowledge base of human expertise for problem solving, or to clarify uncertainties where normally one or more human experts would need to be consulted. An expert system can also be defined as computer applications which embody some non-algorithmic expertise for solving certain problems. For example expert systems are used in diagnostic applications, making financial planning decisions, configuring computers, monitoring real time systems, underwriting insurance policies and performing many services which previously required human expertise [7]. Expert systems are most common in a specific problem domain, and are a traditional application and or subfield of AI.

2.2 Development of an Expert System

Steps in the expert systems development process include determining the actual requirements, knowledge acquisition, constructing expert system components, implementing results, and formulating a procedure for maintenance and review. Knowledge acquisition is the most important element in the development of expert system [12]. Knowledge could be obtained by interviewing domain experts and/or learning by experience.

2.3 Components of Expert System

Expert systems cannot function without their components; the major components of any expert system must include the user interface, the knowledge base, and the shell or inference engine [10]. The user interface is the means of communication between a user and the expert systems problem-solving processes. A good expert system is not very useful unless it has an effective interface. It has to be able to accept the queries or instructions in a form that the user enters and translate them into working instructions for the rest of the system. It also has to be able to translate the answers, produced by the system, into a form that the user can understand. Careful attention should be given to the screen design in order to make the expert system appear 'friendly' to the user. The knowledge base stores all the facts and rules about a particular problem domain. It makes these available to the inference engine in a form that it can use. The facts may be in the form of background information built into the system or facts that are input by the user during a consultation. The rules include both the production rules that apply to the domain of the expert system and the heuristics and rules-of-thumb that are provided by the domain expert in order to make the system find solutions more efficiently by taking short cuts. The inference engine is the program that locates the appropriate knowledge in the knowledge base, and infers new knowledge by applying logical processing and problem-solving strategies. It can also be said to be the software that controls the search of the expert system knowledge base and produces conclusions. An Inference engine fits the user's problems into the knowledge base and derives a conclusion from the rules and facts it contains [10].

3. METHODODLOGY

In developing this cross platform mobile compatible expert system; object oriented programming approach is used. Here the methods that define the functional part of the system are encapsulated in a class and the class is instantiated from various part of the application to inherit the public methods of the class. To ensure that the site works perfectly on mobile browser and be responsive on other devices, media queries are used in styling the interface during the Graphical User Interface (GUI) design. The user interface was designed using Hypertext Markup Language Version 4.0 (HTML 4).

3.1 Simulation Tools

The following software applications were used in the implementation, deployment and hosting of the application developed. The software include

- Apache Web server

- Mysql database

- PHP (Hypertext processor)

The Apache web server is an open source web server. In this application development, apache is used as an intermediary between PHP and the web browser. PHP is a server end programming language. The only language understood by the browser is HTML and CSS. Apache is used to interpret the PHP language into HTML and CSS which are the languages understood by the browser. Mysql is used as the application database. It was used to store information such as thyroid differentials, collection of symptoms for different differentials, different prescriptions and administrative users' login parameters.

3.2 Application Framework

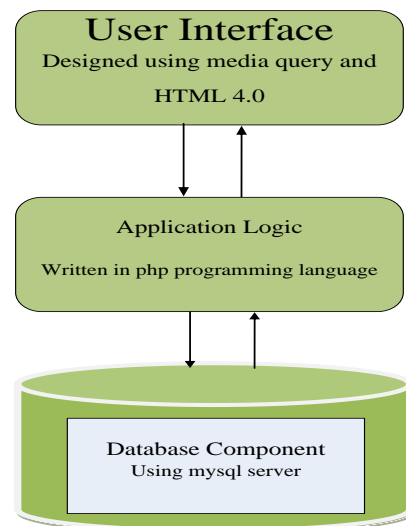The application framework is divided into three parts as shown in Figure 1.

Fig 1: Application framework block diagram

3.3 Application Algorithm

In the development of the mobile browser compatible expert system, the steps stated below were followed.

1. Start
2. Enter login details
3. Search database for login information
4. If found goto 5 else goto registration

5. Show expert system dash board
6. Select from selected symptoms
7. If number of effective symptoms >=minimum symptoms required then goto8 else11
8. Show ailment and ailment category
9. Prescribe for ailment category
10. Goto 12
11. Output "symptoms did not suggest thyphoid, please see a doctor"
12. Exit
13. Registration:
14. Start
15. Enter Name, Age and Sex
16. Give random username
17. Save entered data and username to database
18. Goto 5 of main algorithm

The flowchart is has shown in Figure 2.
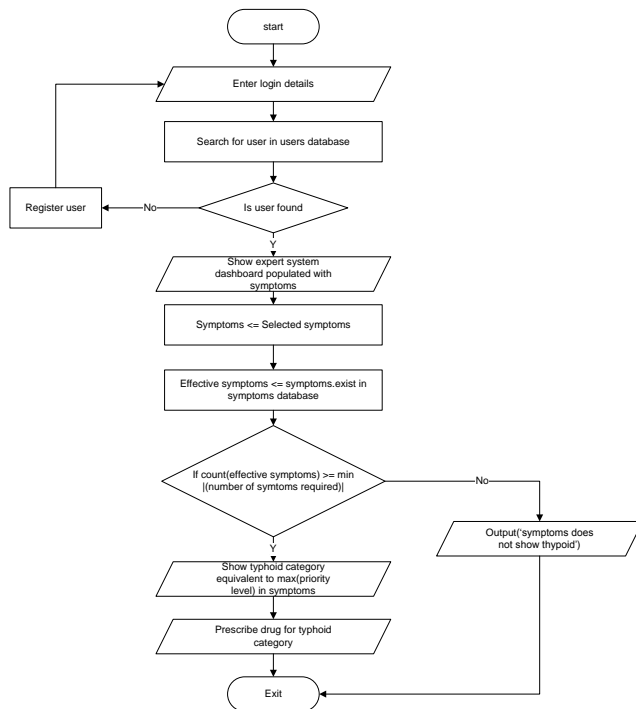
Fig 2: Application flowchart

4. SYSTEM IMPLEMENTATION

The application was tested on a computer system as shown in the output interfaces figure 3 to figure 5. The expert system dashboard was the interface that displayed symptoms as collated into the database. Users were meant to select symptoms noticed and click "submit" button to state the diagnosis and prescribe drugs. This is shown in figure 3 & 4. The administrator's page was the interface where various categories of typhoid fever where given minimum symptoms and peak symptoms with severity level for proper ailment categorization. It further displays the page to enter prescriptions for different category as shown in figure 5.

Fig 3: Thypoid symptoms dashboard

Fig 4: Output interface after submitting symptoms

ADMIN HOME

Disease
Name

Prescription

Fig 5: Admin Interface to enter prescription for different level of severity

5. CONCLUSION

The role of expert system in almost every part of human's life is increasing. The advent of information technology has contributed positively in solving medical related problems. The mobile browser compatible expert system developed in this research work has further proven that a larger populace can be reached, helped and treated for typhoid in cases where doctors are not accessible, available or on industrial strike action.

5.1 Recommendation

The great impact and role that the expert system has played in solving medical problems could not be overemphasized. This study recommends that the government and non governmental agency, organize a lot of campaigns to create more awareness on the use and benefit of expert system in medicine. I also recommend that government and the NGOs should fund more computer literacy and mobile awareness programs in the rural areas, to ensure common settlers in rural area can use the internet facility on a mobile phone. This in turn will empower more people in the rural areas to benefit from using this type of expert system in cases where doctors are not available. Further work is advised in the area of text to speech enabled expert system to extend the use of this application software to the blinds and other physically challenged individuals.

6. ACKNOWLEDGMENTS

7. REFERENCES

[1] Crump, J.A., Luby, S.P., and Mintz, E.D. 2004. The global burden of typhoid fever.

[2] Chuttani, C.S., Prakash, K., Gupta, P., Grover, V. and Kumar, A. 1977. Controlled field trial of a high-dose oral killed typhoid vaccine in India.

[3] Zaki, S.A., and Karande, S. 2011. Multidrug-resistant typhoid fever: a review.

[4] Mushayabasa, S., Bhunu, C.P., and Ngarakana-Gwasira, E.T. 2013. Assessing the Impact of Drug Resistance on the Transmission Dynamics of Typhoid Fever.

[5] Audu, W. 2009 Commercialization of Public Health Service Delivery in Nigeria. Technical Report. Nigerian Institute of Social and Economic Research at Ibadan.

[6] Davenport, T.H., and Prusak, L. 1998 Working Knowledge: How Organizations Manage What They Know. Harvard Business School Press.

[7] Sehgal, U. 2012. Introduction to expert systems.

[8] KARATAŞ, M., and GEÇİLİ, H. 2012. The role of decision support systems in steel industry.

[9] Gath, S.J., and Kulkarni, R.V. 2012. Expert System for Diagnosis of Myocardial Infarction.

[10] Patkar, M.K., and Kulkarni, R.V. 2013. Research Review of Expert Systems for Newborns.

[11] Bassil, Y. 2012. Expert pc troubleshooter with fuzzy-logic and self-learning support.

[12] F.W. Nasuti, 2000 Knowledge Acquisition Using Multiple Domain Experts in the Design and Development of an Expert System for Disaster Recovery Planning. Doctoral Thesis Proposal. Nova Southeastern University.