

DIAGNOSIS AND RECOMMENDER SYSTEM FOR SOME NEGLECTED TROPICAL DISEASES

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ABSTRACT

Failure to promptly diagnose and treat of some tropical diseases such as chicken pox, cholera and typhoid fever is affecting the community-based management of such diseases. The high mortality rates caused by these diseases make the quest for effective diagnoses and appropriate treatment an essential task. Thus, precise diagnosis of these diseases coupled with appropriate treatment will result in their control, especially in the tropical regions, which also constitute the developing countries. The system works for this research was based on the client/server architecture, structured as a 3-tier application. The Web browser constituted the first tier, a middleware engine using some dynamic Web content technology active server pages (ASP) constituted the middle-tier and the database was the third tier. The implementation of the system had a front- end web based graphical user interface (GUI) application and back-end relational database management system (RDBMS). The Front-end was implemented with ASP.NET (using vb.net-programming language), while the back-end was designed with Microsoft queried language (MS SQL) server 2005. With this development, a prompt medical diagnosis, effective drug recommendations and promulgation of effective policies could be provided at community settings where there are shortages in material and human resources for managing these neglected tropical diseases.

Keywords: Tropical diseases, recommender system, VB.Net programming language, MS SQL

INTRODUCTION

One of the major problems currently confronting the human race, especially in the tropical regions of the world is the menace of some neglected tropical diseases. The tropics are noted for its hot, humid, stifling and steamy climatic conditions, which is largely favorable to the prevalence of certain kinds of diseases. Other factors such as poverty, poor sanitation as well as the presence of the rainforest have contributed to the spread of such diseases. Tropical diseases include chicken pox, cholera, typhoid fever, malaria, yellow fever, river blindness and sleeping sickness among many others.

Typhoid is a bacterial infection and a type of enteritis caused by the *Salmonella typhi*, ingested in food and water. Man is its only host. Hence, the source of infection is usually an infected individual, who is either suffering or is a carrier. After ingestion of the microbe there is an incubation period of about 10 to 14 days before signs appear. During this period the lymphatic tissues in the small and large intestines are primarily affected because they are invaded by the microbes, especially the aggregated lymph follicles (peyer's patches) and solitary lymph nodes. The salmonella organisms then enter the blood vessels and spread to the liver, spleen and gall bladder. In the bacteraemic period, acute inflammation develops with necrosis of intestinal lymphoid tissue and ulceration of overlying mucosa.

Cholera, on the other hand, is a disease caused by *Vibrio cholerae* and contaminated water, foods, hands and fomites spread it. Again, the only host is a man. The organism produces a very powerful exotoxin, which stimulates the intestinal glands to secrete large quantities of water, bicarbonates and chlorides, leading to persistent diarrhea, severe dehydration and electrolyte imbalance and may cause death due to hypovolaemic shock. The microbes occasionally spread to the gall bladder where they multiply and are then excreted in bile and feces. The incubation period of *Vibrio cholerae* varies from a few hours to four or five days, with the onset being sudden alongside with severe cramps in the backs or limbs. It may begin with diarrhea and colicky pains, shortly after the onset the stools become thin and contain small, white curdlike masses.

Chicken pox on the other hand, is extremely contagious occurring in all parts of the world including Africa. It is a disease caused by a virus (*Varicella-zoster virus*, VZV) and appears commonly in

children under the ages eight. It is characterized by general symptoms of mild illness and skin rash evidenced by crops of lesions, which pass through the sequence of macules (red spots), papules (small pox), vesicle (small blisters), and crust. Chicken pox usually begins 10-15 days after contact with someone who has the disease. At onset, there is the presence of slight fever, feeling of chilliness, aching in the back and extremities and vomiting. The symptoms appear more severe in older patients. The skin rash starts to appear a day after symptoms begin, and appear in crops, which usually develop first and on the scalp and face and eventually become most numerous on the chest and upper back. Chickenpox is transmitted through the air. When a patient with chickenpox coughs or sneezes, they expel tiny droplets that carry the chicken pox virus.

The aim of this research is to design a diagnosis, prevention and recommender system for selected tropical diseases such as cholera, typhoid and chicken pox in Nigeria, using a computational approach. It is hoped that with the realization of this aim, proper awareness will be created as regards the diagnosis, prevention and control measures to be taken on such diseases, which will further improve the quality of health of citizens within the country.

MATERIALS AND METHODS

Literature review/ Review of related works: Several research works have been carried out in the areas of neglected tropical diseases (Panigrahi *et al.*, 2009). Recently, scientists took some preventive measures against cholera in an African country (Amabéla, 2009). Furthermore, a scientific analysis was recently conducted, and the conclusion was reached that in sub-Saharan Africa, the infections categorized as "neglected tropical diseases (NTDs)" are collectively responsible for a disease burden equal to twice that caused by tuberculosis, half of that due to malaria, and a third of that resulting from HIV/AIDS. From this analysis, two countries, Nigeria and the Democratic Republic of Congo face a particularly high NTD burden (Paul *et al.*, 2009). Another review discussed the typhoid fever epidemic in Nigeria (Obionu, 2009).

A new resource for evidence-based tuberculosis diagnosis by the Stop TB Partnership's New Diagnostics Working Group (NDWG) was carried out in 2010 (Minion and Pai, 2010). An Integrated Biosensor and Simulation System for diagnosis and therapy of cancer, diabetes and infectious diseases were developed. It acted as a computational means of treatment of some diseases like cancer and diabetes (Dennis *et al.*, 2005). Studies have also shown how computational techniques have been applied towards tropical disease research. In a work carried out by McKendrick (2000) a Bayesian Belief Network was used to aid differential diagnosis of tropical bovine diseases. Another study assessed the effect of a pregnant and postpartum host on typhoid disease expression in order to explore the relationship between typhoid fever and pregnancy outcome. This study was undertaken because of the increased mortality rate among pregnant women due to so many diseases but typhoid was the major study disease (Sulaiman, 2007). Similarly, advanced research has also been carried out to proffer solutions to cholera (Jing *et al.*, 2006).

Data collection: Data for this work was collated by conducting discrete interview with medical doctors, public health researchers and other relevant health professionals within the health centers and hospitals around Ikeja, Mushin and Victoria Island of Lagos State, in the South Western part of Nigeria. Lagos is hosting a growing provisional population figure of about 9,013,534 people and various industries, governmental organizations and international parastatals, with a population characterized by artisans, farmers, business persons, industrialists, educationalists and other top professionals.

System architecture: The proposed system works was based on the client/server architecture, structured as a 3-tier application. That is both the server and the client application are responsible for some sort of processing. The Web browser constituted the first tier, a middleware engine using some dynamic Web content technology active server pages (ASP) constituted the middle-tier and the database was the third tier (Figure I). A fundamental rule in 3-tier architecture is that the client has no direct line of communication with the data tier. That is, all communications are routed through the middleware tier.

System modeling: System modeling is a technique to express, visualize, analyze and transform the architecture of a system. The Unified Modeling Language (UML) is a standard language for specifying, visualizing, constructing, and documenting the artifacts of software systems. The UML is a very important part of developing objects oriented software and the software development process.

The UML uses mostly graphical notations to express the design of software projects, helps project teams communicate, explore potential designs, and validate the architectural design of the

software, most importantly it will be used to model this system because it is designed to respond to the architectural needs of the system like physical distribution, concurrency, replication, security, load balancing and fault tolerance. The UML diagrams that will be used to model this system were as follows; Use case diagram, Sequence diagram and Class diagram

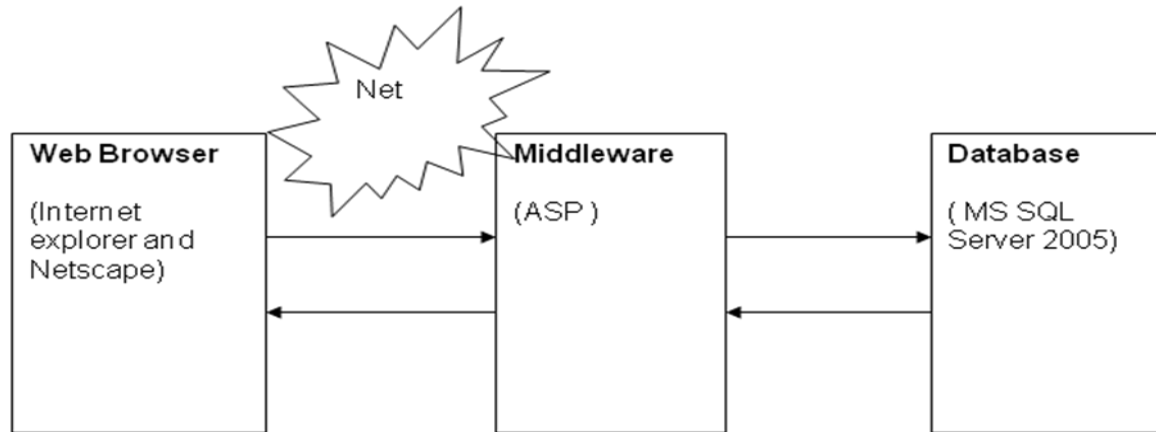


Fig. I: Architecture of the proposed diagnosis and recommender system

The use case: Use cases are UML (Unified Modeling Language) diagrams used during the analysis phase of a project to identify and partition system, their main functionality is to separate the system into actors and use cases (Figure II). Actors represent roles that could be played by users of the system. These users could be humans, other computers, pieces of hardware, or even other software systems. The only criterion is that they must be external to the part of the system being partitioned into use cases. They must supply stimuli to that part of the system, and receive outputs from it.

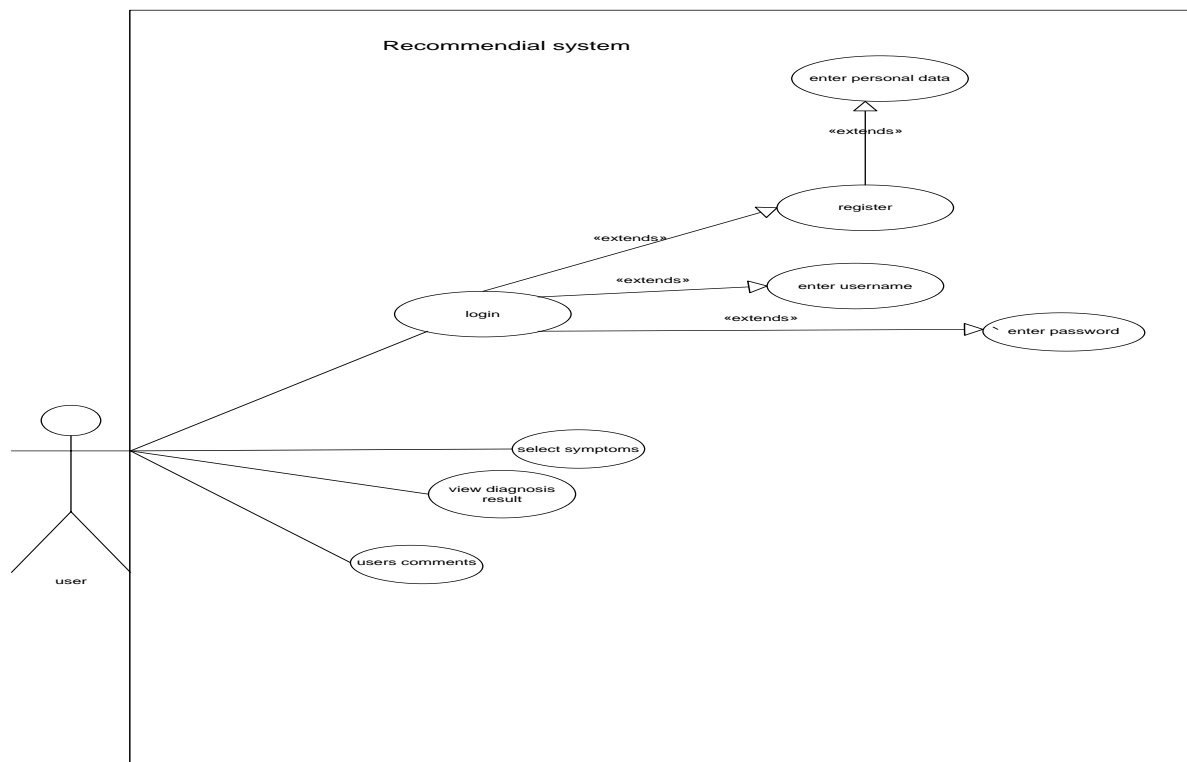


Fig. II: Use case diagram for diagnosis and recommender system

Sequence diagram: The sequence diagram is a diagram that graphically depicts how objects interact with each other via the sending and reception of messages in the execution of a use case or operation, according to the preferred sequence (Figure III).

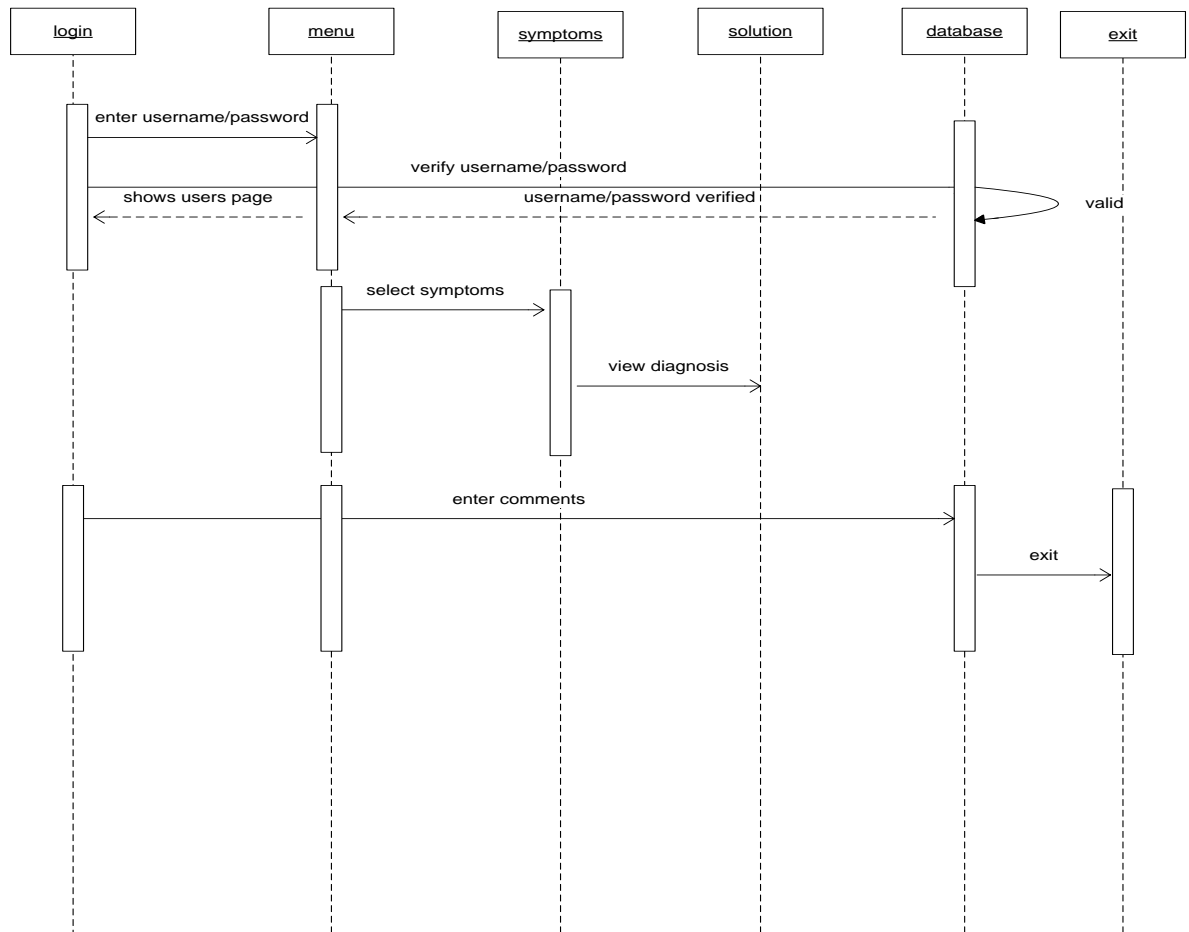


Fig. III: Sequence diagram for diagnosis and recommender system

Class diagram: The class diagram depicts the system's object structure (Figure IV). It shows object classes that the system is composed of, as well as the relationship between those object classes. It also consists of attributes and operators of the object classes present in the system.

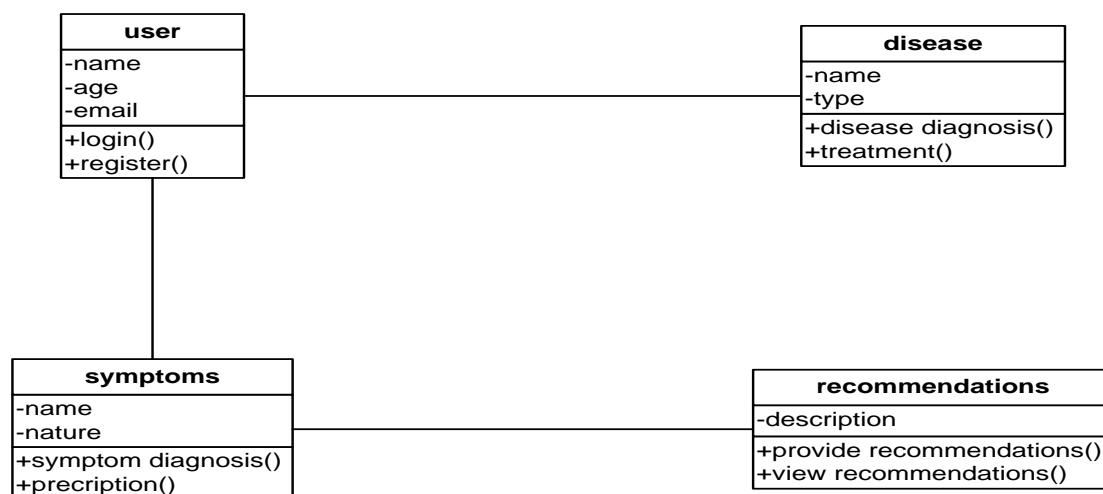


Fig. IV: Class diagram for the diagnosis and recommender system

Experiment and implementation: The implementation of the proposed system has a front- end web based graphical user interface (GUI) application and back-end relational database management system (RDBMS). The front-end was implemented with ASP.NET (using vb.net-programming language), while the back-end was designed with Microsoft queried language (MS SQL) server 2005.

RESULTS AND DISCUSSION

Figure V showed the login page. This is the first page of the tropical disease diagnosis and recommender system. It gives direction on how to log on with acquired User ID for previous users or registration option for new users. It ensures security before access into the system.

The registration page was depicted in figure VI. This is the second page available to the user, which contains a list of personal information; the user is to sincerely fill the form so as to acquire a USER ID to enable users navigate freely through pages of the proposed system. The home page of the diagnosis and recommender system provides a brief description of the type of diseases the system addresses. It gives a general view of the system. This was depicted in figure VII.

The next page within the system provided an interface for the diagnosis of three different types of neglected tropical diseases. This is the first step to logical diagnosis, whereby users sincerely answer questions from drop down menus where the option yes and no are made available. This was shown in figure VIII.

The percentage of likelihood of the presence of one of the specified diseases diagnosed in a patient and the corresponding prescription of recommended drugs was presented by the system in figure

IX. Finally, figure X showed the assessment and evaluation conducted on the view of some users of this diagnosis and recommender system.

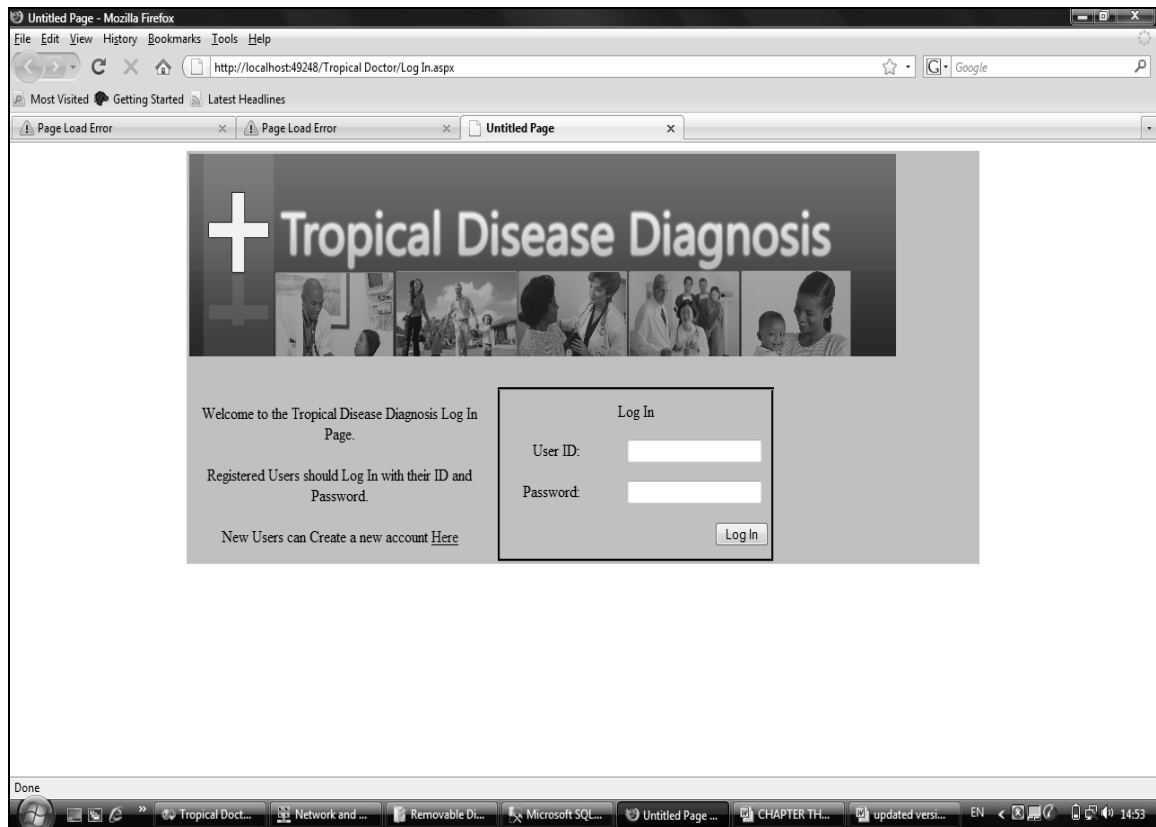


Fig. V: The login page

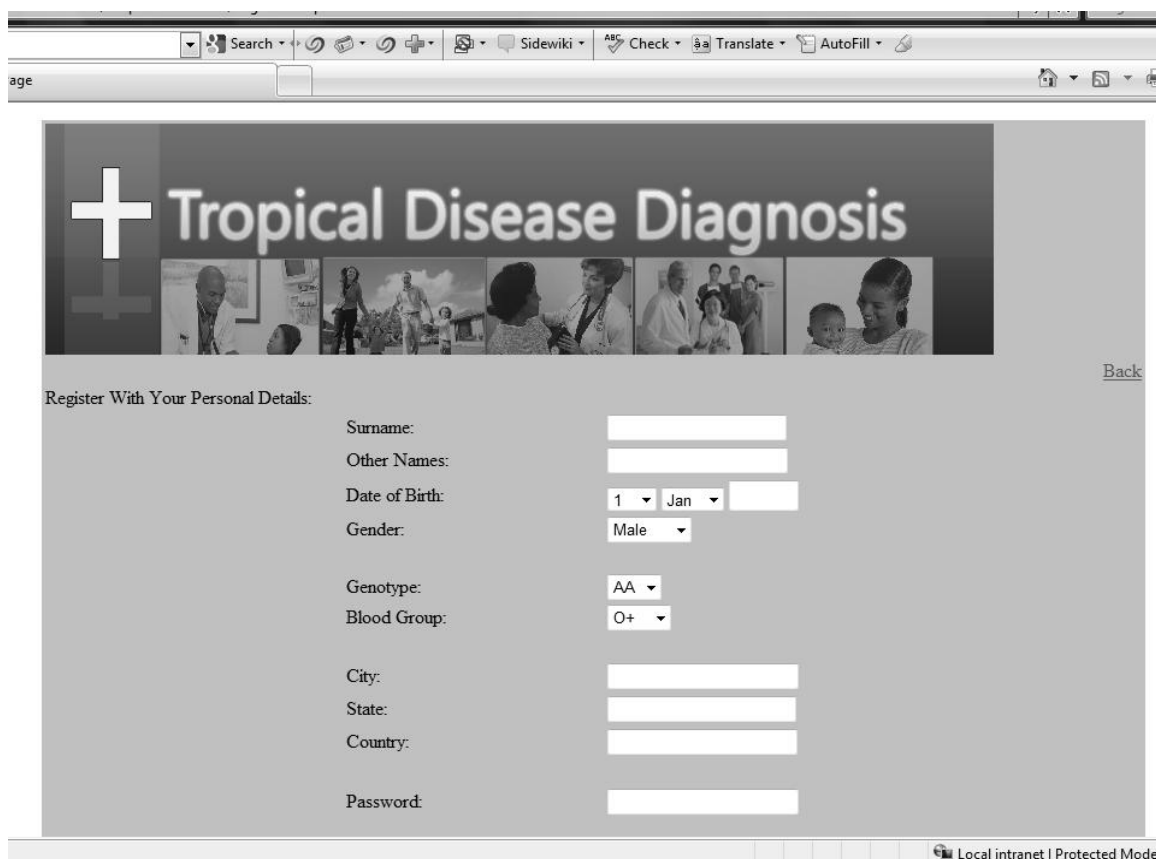


Fig. VI: The Registration Page

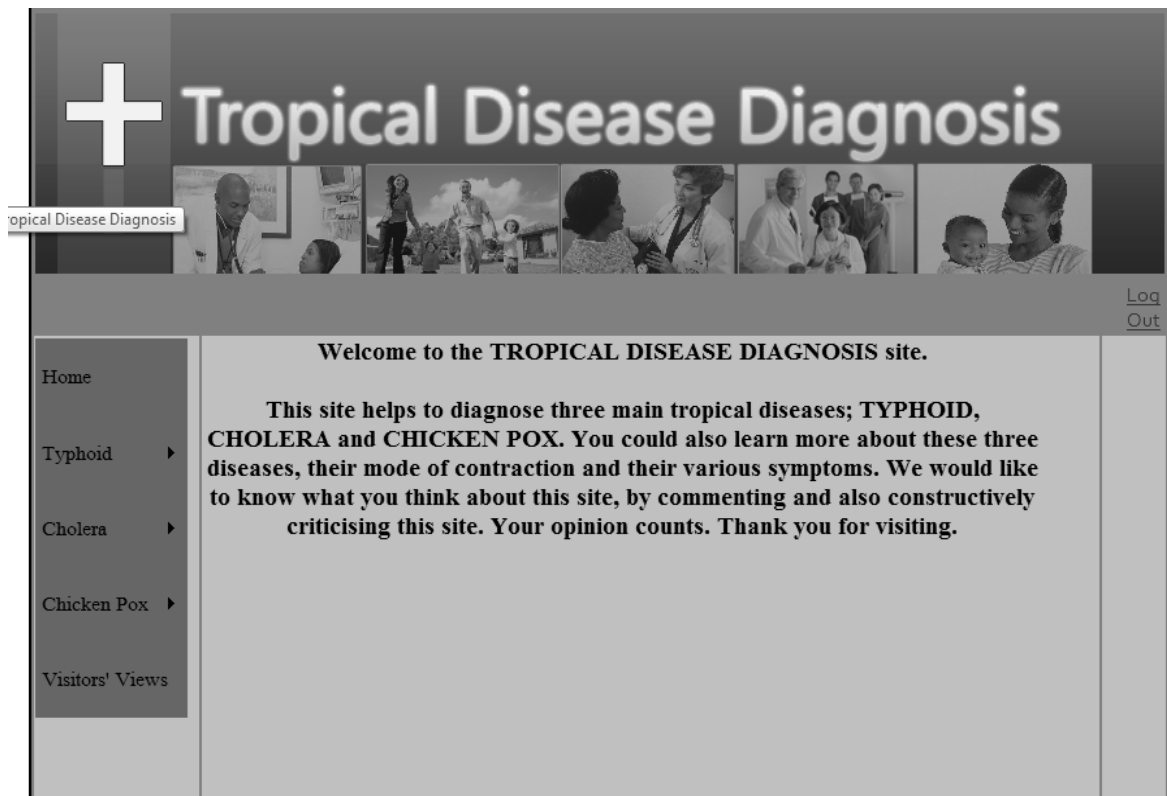


Fig. VII: The home page

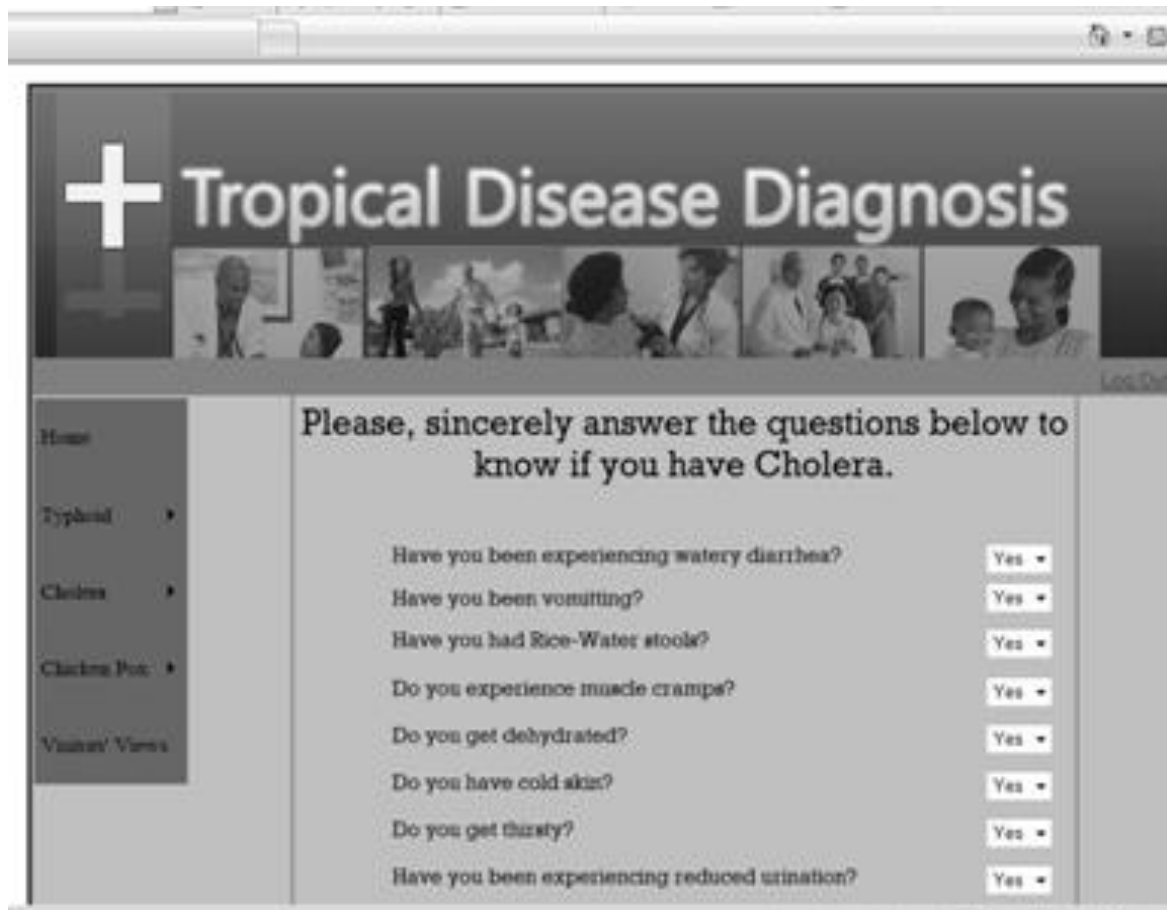


Fig. VIII: Disease symptoms page

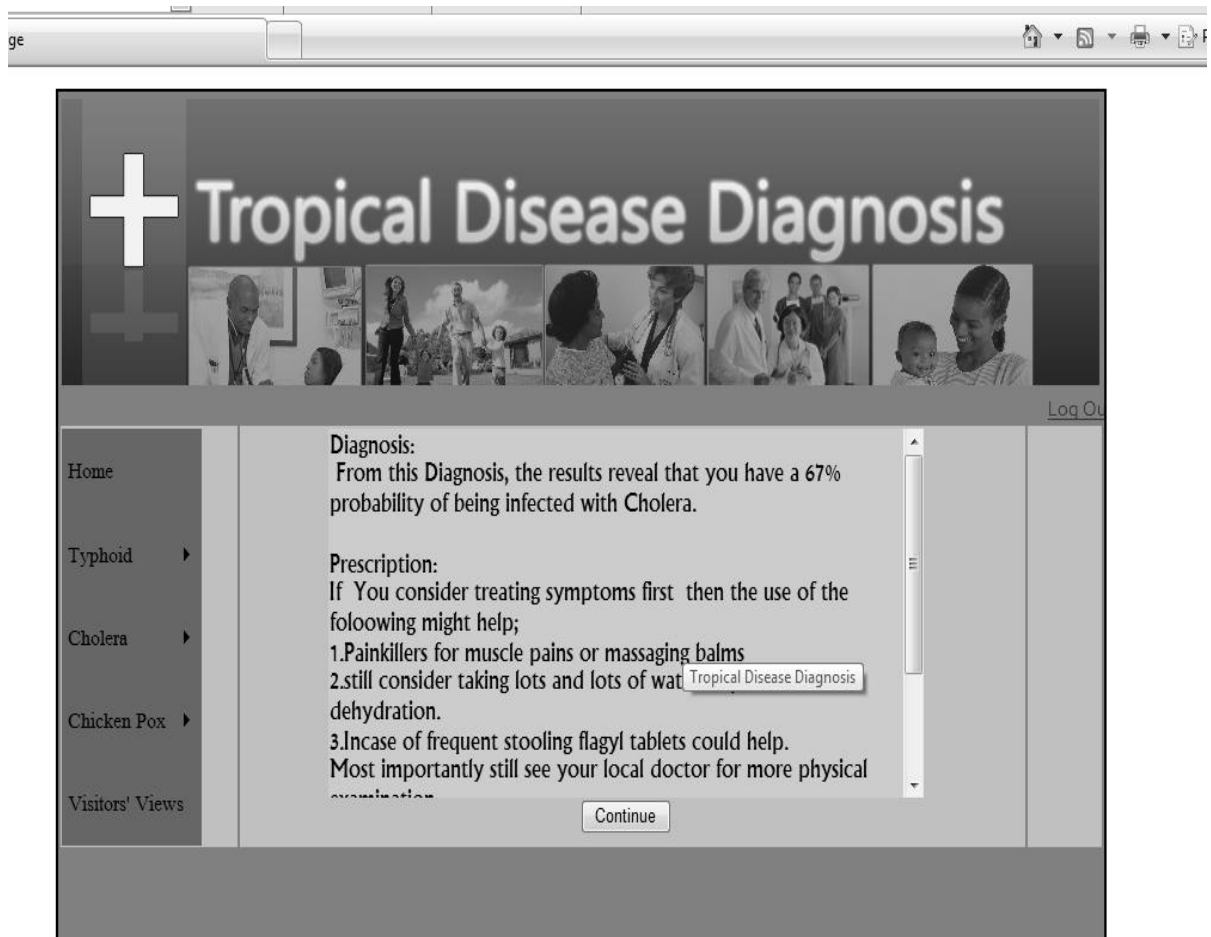


Fig. IX: Disease diagnosis, prescription and recommendation page

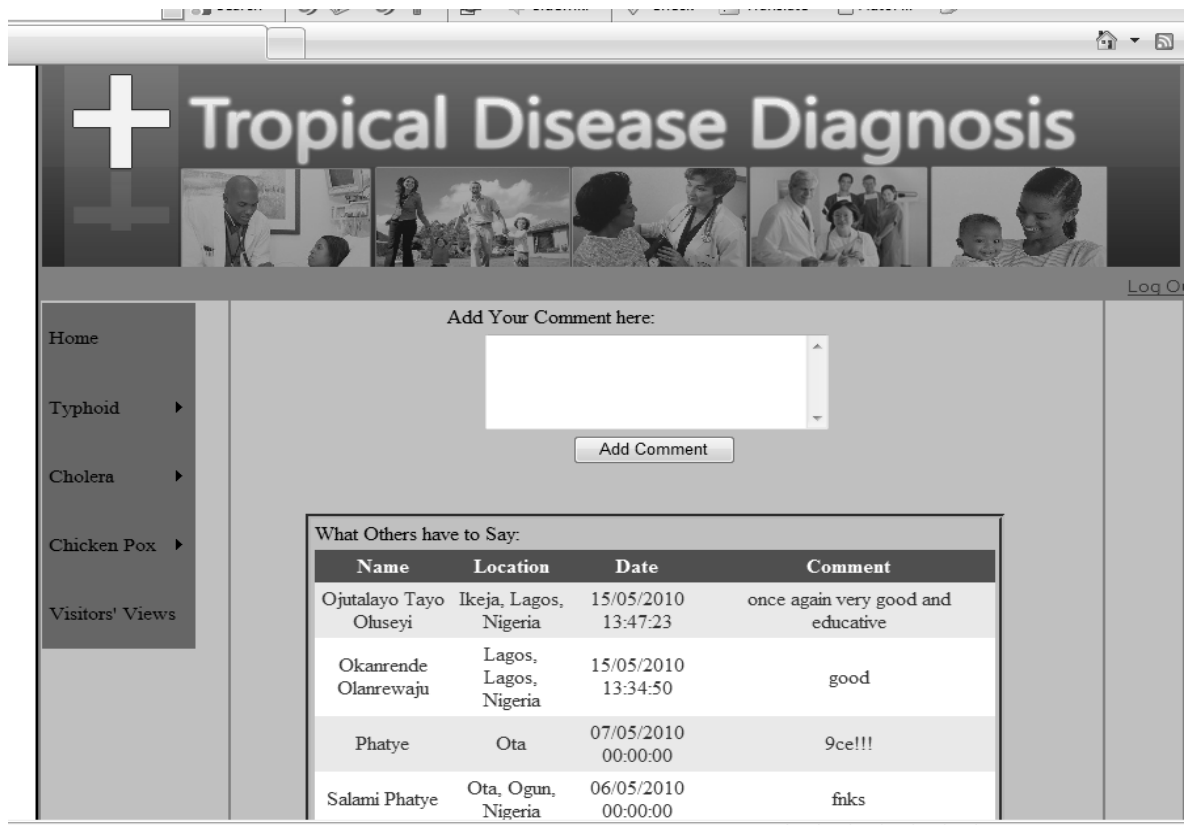


Fig. X: Visitor's view/comment page

CONCLUSION

The proposed system helped to proffer good health education and prescribe necessary treatment to the diseases under study. This will in the end help to reduce the number of death rates and increase standard of living. With this development, a prompt medical diagnosis, effective drug recommendations and promulgation of effective policies would be provided at community settings where there are shortages in material and human resources handling these neglected tropical diseases.

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