Design and Implementation of Health Management System

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Abstract—**This work aim at developing health management system capable of storing and retrieving the medical record of patients as well as diagnose, give health tips to patients and prescribe medication for five major diseases -Hepatitis, Malaria, Cholera, Tuberculosis and Typhoid. The system is to provide assistance to the human health expert in reaching logical conclusion about diagnosis of certain disease, and to create reference tool on the symptoms of the disease. This health management system comprises both management and expert system capable of diagnosing five major diseases and storing and retrieving the records of patients.**

Keywords: *health management system, medical record, diagnosis, expert system and disease*

I. INTRODUCTION

Disease has been one of the humanity's greatest enemies. *In* the early years, most people were treated of illnesses by neighbors and friends in the confinement of their homes; which is costly both in energy usage, and the risk of damaging their bodies.

Health care management is evolving rapidly. There has been constant search for new drugs, effective treatments and an advanced way of diagnosing and administering drugs to patients. There is a need to communicate to the general populace different matters that influence public health. Due to increase in general health literacy levels of the population, it has become essential to disseminate information and address valid concerns. Some of the primary areas where management needs to focus on are disease prevention, health awareness, doctor-patient relations and overall understanding of general health care issues. There continues to be a need for comprehensive health care practices because of increase in population as well as the unending advance in science that have helped to increase the life expectancy of people in most developed countries. Thus, there is need for continually improvement on the practices involved in health care management to satisfy an ever-increasing population. There is a need to establish system of leadership that has the ability to apply modern organizational techniques to successfully deliver maximum benefits to the population. There is also a corresponding increase in the effectiveness of modern technologies that have made health care very sophisticated today. Professionals in this field need to be guided in the proper use of increasing knowledge as well as skills so that they can deliver the best possible services. These have moved researchers to look into new ways of 'how' and 'where' health care can be provided.

The problems associated with the conventional health care system include:

1. Lack of immediate retrievals: It is very difficult to retrieve information .For instance, to find out about the patient's history, the user has to go through various registers.

2. Lack of immediate information storage: The information generated by various transactions takes time and efforts to be stored at right place.

3. Preparation of accurate and prompt reports: This becomes a difficult task since information needed may not be available as at when due.

Health Management System (HMS) has been developed as one of the ways of encouraging proper management of diseases and health cases. It is an evolutionary medicine regulative process proposed by Nicholas Humphrey in which actuarial assessment of fitness determines the body's regulation of its physiology and health. It was developed to assist hospitals in helping people live longer, happier, having more active lives with less suffering and disability. Health Management System exists today because health care personnel are not evenly distributed among the world's population; also, wealthy industrialized countries have more physicians than poorer developing countries.

Health Management System is powerful, flexible, and easy to use and is designed and developed to deliver real conceivable benefits to hospitals and clinics. It is an integrated end-to-end Hospital Management System that provides relevant information across the hospital to support effective decision making for patient care. HMS is a software product suite designed to improve the quality and management of clinical care and hospital health care management in the areas of clinical process analysis. It is designed for health care centers and hospitals in order to improve its effectiveness and quality of work as well as, managing the key processes effectively to enhance the success of the hospital. It helps the hospitals to manage all points of connection with patients, thus, making their experience with the hospital a superior one. The software features empower patients to get engaged with the information process. An inbuilt settings module makes Health Management System flexibility to cater for diverse needs of

health care centers and hospitals. Health Management system is build on .NET technology, which is one of the most latest and upcoming technologies in the field of Information Technology. Health Management System brings information to the user's desktop through integration across all modules.
The main advantages of computerized health management system over manual methods are: speed in preparation of patient records and statistics, accuracy, reduced cost of processing and greater control over health systems. [1]
This work focuses on developing health management system that can aid Babcock University Teaching Hospital (BUTH) Nigeria, to improve accuracy, reduce cost and optimize decision-making. The objective of this work is to design and implement health management system that can maintain patient details; provide and prescribe drugs for patients; indicate precautions and give dietary advice to patients; improve patient satisfaction by reducing the waiting time and; reduce medication error rate by incorporating the knowledge of different experts in the areas of diagnosis and medication.

The remaining sections of this work are arranged as follows: section 2 looks into the related works, overview of the existing systems and the proposed system. Section 3 focuses on the system design, description of the design methodology, and system models. Section 4 deals with implementation and operation of the proposed system. Finally Section 5 presents the conclusion and recommendations for future works.

II. RELATED WORKS

A. The MYCIN Program for Infectious Diseases

MYCIN is one of the earliest medical expert systems developed. It was designed to diagnose and prescribe treatment for infectious diseases particularly spinal meningitis and bacterial infections of the blood. It first decides what bacterium caused the disease and then based on this decision; it suggests what antibiotic to give the patient. It is very helpful for physicians that lack expertise at certain diseases.

B. PNEUMOCONIOSIS X-RAY Diagnosis Expert System

This expert system, developed by Miriam Kubiska and Julie Herzner in 1992, incorporates the inference engine to examine the shadows on the x-ray. The shadows are used to determine the type and degree of pneumoconiosis (a lung disease). The system also includes three other modes: the knowledge base (which contains the data of X-ray representations of various stages of the disease), the explanation interface (which details the conclusions) and the knowledge acquisition mode (which allows experts to add or change information in the system).

C. XDIS

This is an expert system that was designed to assist physicians in making diagnosis.
The system contains information of more than 300 internal diseases and pathologic syndromes most frequently met in general practice. For each set of symptoms entered for a case,

the system gets the full list of possible diagnosis ranking from the most probable to the least probable. The time to work out a diagnosis is usually less than 10 minutes. XDIS helps make preliminary diagnosis on the first visit of a patient to the physician and at the same time decide on the necessity of referring the patient to a specialist and to select medical tests to make a more exact diagnosis.

D. EMERGE

This is a diagnosis rule-based expert system. It was designed to be used in an emergency room. The system uses a form of production rules which incorporates weighing factors that are determined by a neural network. The neural network is composed of input and output blocks with a hidden layer block in between which communicates input to the output. The neural network learns from examples and then predicts an output based on this knowledge.
This system also uses an IF-THEN-UNLESS statement instead of an IF-THEN statement. Because of this, the decision process may be more precise, the results more accurate and the explanations better understood.

E. CASNET

CASNET is a diagnosis system shell for building medical expert system developed and originally specified for glaucoma. A three level semantic network is used in organizing the knowledge structure. Nodes connect to nodes within their own layer casual links. Node connects to nodes outside their layer through association links. These systems belong to the first generation of expert system. A lot much is being done in the medical expert technology, applying forms of tools.

III. OVERVIEW OF THE EXISTING SYSTEM

The existing system employed at Babcock University Teaching Hospital (BUTH) Nigeria, involves tedious paperwork and rigour of going through various registers to find out patient's medical record. During the system investigation, the following problems were discovered:

- Information is very difficult to retrieve and to find particular information. For example, to find out about the patient's history, the user has to go through various registers. This results in inconvenience and wastage of time.
- The information generated by various transactions takes time and efforts to be stored at right place.
- Various changes to information like patient details or immunization details of child are difficult to make as paper work is involved.
- There is inaccurate and prompt report about patients' details because it becomes a difficult task as information is difficult to collect from various registers.

The main aim of the proposed system is to provide a quick and efficient retrieval of information. Any type of information pertaining to the patient will be available when needed and also to ensure immediate storage of patients' details. Other benefits include: providing and prescribing drugs; precautions and dietary advice; providing and maintaining all kinds of tests for a patient.

IV. SYSTEM DESIGN

The methodology used is the Waterfall Model, which involves starting the development of a system with a well-defined and understood requirement specification and moves through to deployment in a linear form. The application package used is Microsoft Visual Basic because of its ease of creating user friendly interfaces, which is an important element in any Health Management System. Also, it allows one to create executable programs that do not need the visual basic environment to run. In order to know the user and general needs of health centers we made use of the following techniques;

1. Direct asking: We asked the patients and medical experts what they really wanted in the proposed system.
2. Critical success factor: We asked them to specify the factors that are critical or vital to success of the health care center and later features where added when the users got better understanding of the system.

The approach used in designing the system is the structured design approach. It consists of starting with the "Big picture" of the proposed system that is gradually decomposed into more and more detail until it is fully understood. This approach makes full use of the data flow diagram. In designing this system, we identify each module and later break each module into its constituent sub-modules.

A. System Description

The Health Management 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 centre is situated. The processing mode is highly interactive and the processing algorithm which was used to achieve the required task is outlined below:

1. When the system is started, the Welcome Screen is displayed with a button named "ENTER". This allows the patient to view the Login window.
2. The Login window will be displayed for the patient to login to the system.
3. The user can either click on the" new user link label" if that is the patient's first time of using the software or enter his/her username and password to view the next windows
4. If the patient has clicked the link for the new user, 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. If the username and password of the patient has 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.
5. The patient can also choose to check his/her Body Mass Index (BMI) to check if he/she is obese, normal or overweight. This comes along with useful health tips that can help the patient adjust from either being obese overweight to a normal Body Mass Index.
6. The patient can also get his/her details after having been diagnosed by the health management system.
7. When the user finishes using the system, the user exits the system by closing the windows.

The graphical illustration of the procedure is illustrated in Figure 1, 2 and 3 which depict the system architecture, flowchart and the Use case diagram respectively.

V. IMPLEMENTATION

This section provides the description of the modules in the Health Management System, its functions, its navigation, as well as the hardware and software requirements to effectively use it. The system being implemented has several modules/forms listed below: Figure 4 to 13 in the appendix depicts the modules.

Welcome Form: This form is loaded when the patient runs the application from the desktop. It contains a brief introduction of the application. It shows information like the name of the application and current date.

Login Form: This form has to fields, the password and the username field. A patient logging in for the first time needs to click the new user link label to register a username and a password. If the patient already has a valid username and password, then it authenticates it.

New User Form: The "new user" link on the login form brings about the new user form. This form contains information such as; sex, name, gender, blood group, occupation etc, the new user needs to fill. Here, the user registers a username and password which he/she would use to login.

Body Mass Index Form: The "BMI" link on the login form brings about the Body Mass Index Form. This form allows users to input necessary information to calculate his/her body mass index and the user can also check his or her BMI category.

Medical Form: The medical form has in its "MenuStrip"; Diagnosis, Administrator, Medical Expert and About. A

patient that clicks medical links him/her to the diagnosis form. The Administrator is provided for the administrator and logs in with his/her password to add, delete or include new medication and health tips. The Medical Expert also logs in with his or her password to view patients' record and history.

Diagnosis Form: This form provides the patient with different disease symptoms so that the knowledge base can match symptoms with the diseases available in the database. It also provides the patient with medications and health tips on how to manage the disease.

Administrator Form: This form requests for the administrator's password to enable him/her to add, delete or include new medication and health tips. It gives an intruder

alert if the password given does not match the administrator's password.

Medical Expert Form: This form allows the medical expert input his/her password so that he/she can view the patients' record and medical history.

Disease Library Form: This allows the administrator to enter new diseases, symptoms and their medications in the database.

About Form: This form displays information about the Health Management system.
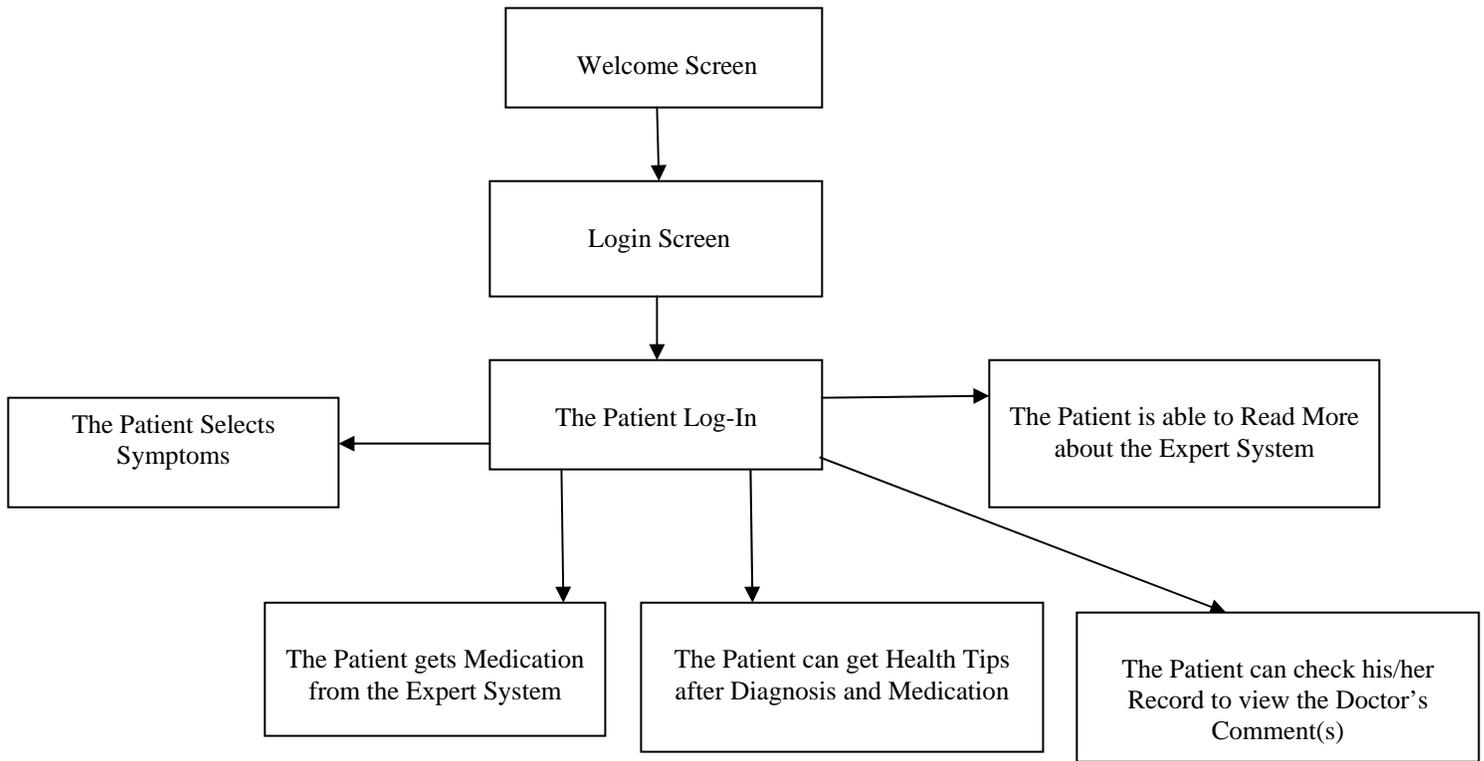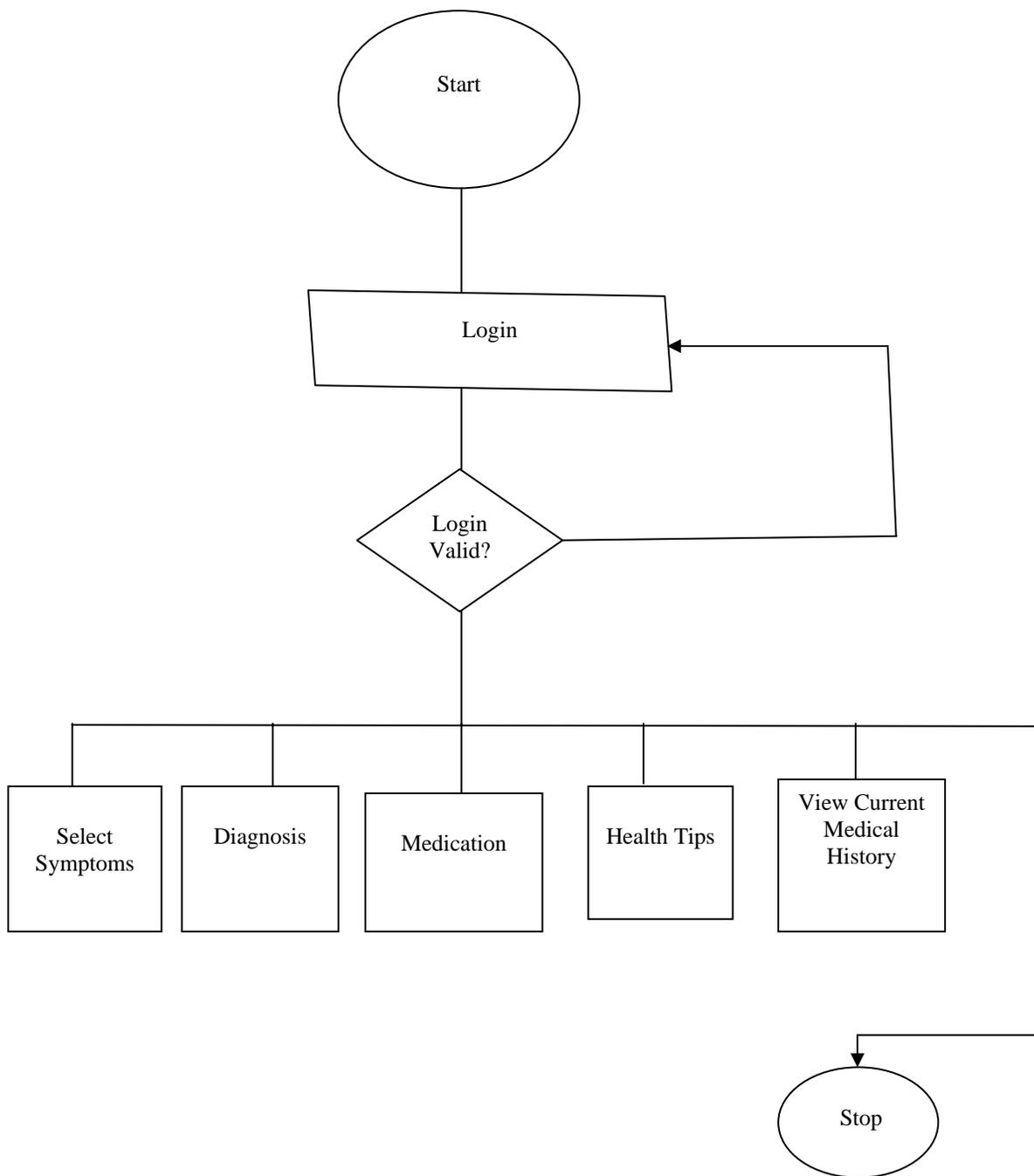

Figure 1: Architecture of the system
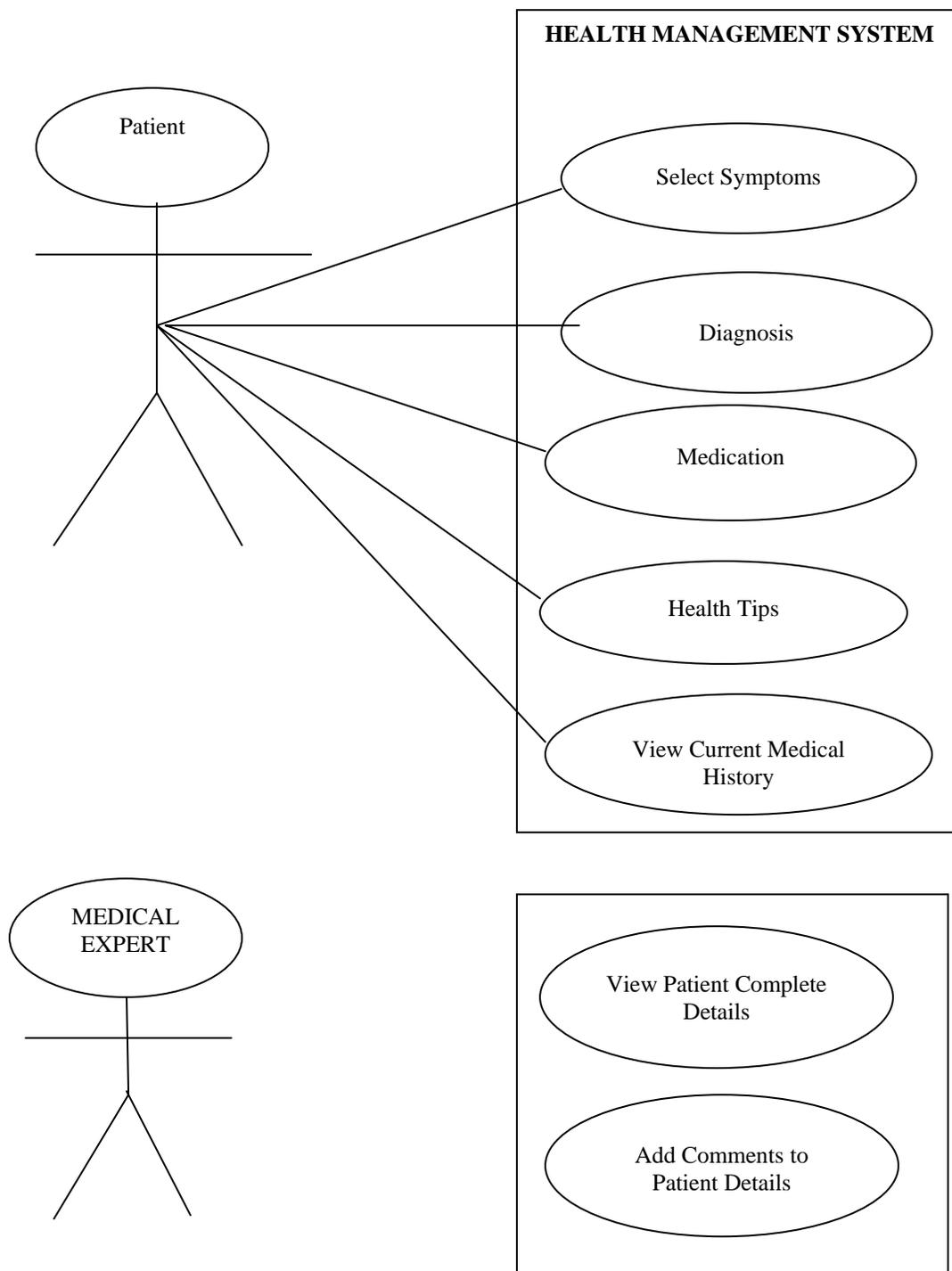
Figure 2: Flowchart of the System

Figure 3: Use case diagram of the Health Management System

VI.   CONCLUSION AND RECOMMENDATIONS FOR FURTHER WORKS

Expert systems have been found to be very useful in today's world driven by technology. When expert's knowledge is extracted and stored, such knowledge can be used to replace the expert in case of demise. Medical field benefits greatly from expert system. Knowing that specialties in the medical field cannot satisfy all the population; the knowledge of such specialist can be replicated and made use of in times of extreme necessity.

As changes in business occur, so do requirements, hence, the system has been developed in such a way that it can be modified to accommodate new requirements. Though, this system has been developed using BUTH as case study, any health organization can adopt it. This is because it is indisputable that the use of a computerized Health Management System would enhance the effectiveness, accuracy of the patient records held by the health organization.

This software has been designed to diagnose only five types of diseases- malaria, tuberculosis, hepatitis and cholera, and the system is not capable of carrying out any examination(s) on the patients. Further works can be carried out incorporating several diseases, not only this; the system can be extended to carry out examination on the patients.

REFERENCES

[1]   Bhartnager S.C., Ramania K.V. (1991), Computer and Information Management. Prentice Hall.

[2]   Chitkara.M, Khandelwal.N, Chaporka. A: (2004). Project Report on "Hospital Management System"

[3]   Delahaye J.P. (1987), Formal Methods in Artificial Intelligence. North America Academic

[4]   Fluger G., Stubblefield W.A. (1998), Artificial Intelligence: Structure and Strategies for complex problem solving. Addison Wesley Longman Incorporation.

[5]   Haag S., Cummings M., (2005), Management Information System for Information Age. McGraw-Hill.

[6]   Hudson, D. L. (2006). Medical Expert Systems. Wiley Encyclopedia of Biomedical Engineering.

[7]   Public Health. (2010). Encyclopedia Britannica. Encyclopedia Britannica Student and Home Edition. Chicago: Encyclopedia Britannica.

[8]   Rauch-Hindin W.B., (1988), A guide to commercial Artificial Intelligence. Prentice Hall.

[9]   Tiwana A., (2000), The Knowledge Management Toolkit: Practical Technique for building a knowledge management system. Prentice Hall PTR, Upper Saddle River, NJ 07458.

[10]   http://www.mitraismedical.com

[11]   http://www.hms.com

[12]   http://www.hmrc.umich.edu

[13]   http://www.ehims.net

[14]   http://www.en.wikipedia.org/wiki/Health_Management_System

[15]   http://en.wikibooks.org/wiki/The_Computer_Revolution/Artificial_Intelligence/Expert_Systems#Medical_Expert_Systems_-_AI

APPENDIX

Figure 4 Welcome form

Figure 5 BMI form

Figure 6 Login form

Figure 7 Medical form

Figure 8 New user form
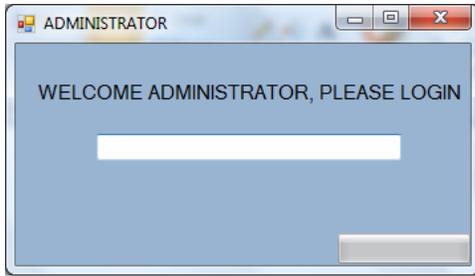

Figure 9 Diagnosis Form
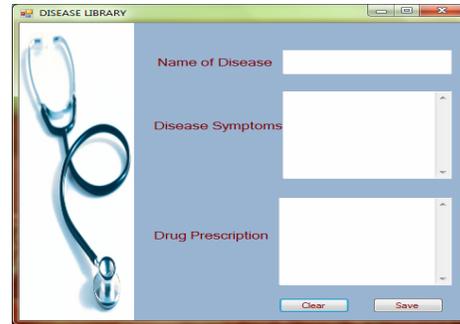
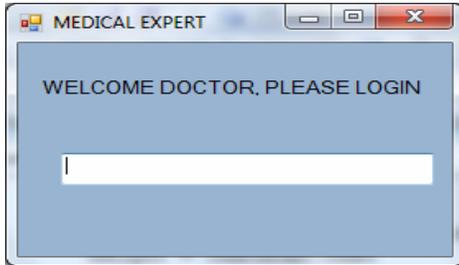*Figure 10 Administrator's form*

Figure 11 Disease Library Form

Figure 12 Medical Expert form

Figure 13 About Form