

**DESIGN AND IMPLEMENTATION OF EXPERT  
SYSTEM FOR CLINICAL PRESCRIPTION OF ILLNESS  
(A CASE STUDY OF AUCHI POLYTECHNIC COTTAGE HOSPITAL)**

**BY**

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## **CERTIFICATION**

We the undersigned hereby certify that this project work was carried out by **ORIABURE OSEMUDIAMEN GODWIN** with Matriculation Number: **ICT/625180277** of Computer Science Department.

We certify that this work is adequate in scope and quality in partial fulfillment of the requirements for the award of Higher National Diploma (HND) in Computer Science.

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Date

## **DEDICATION**

This project work is dedicated to God Almighty for his grace and strong will, for leading me through and granting me academic breakthrough. And also, I am dedicating this project to my Late Dad; also my mother for her timely prayers and support that led to my academic success.

## **ACKNOWLEDGEMENT**

My exceedingly appreciation goes to God Almighty for his love, mercies and opportunities upon my life.

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## TABLE OF CONTENTS

TITLE PAGE .....	i
CERTIFICATION .....	ii
DEDICATION .....	iii
ACKNOWLEDGEMENT .....	iv
TABLE OF CONTENTS.....	v
ABSTRACT.....	viii
<b>CHAPTER ONE: INTRODUCTION.....</b>	<b>1</b>
1.0 Introduction.....	1
1.1 Statement of the Problem.....	2
1.2 Aim and Objectives of the Study.....	3
1.3 Significance of the Study.....	3
1.4 Scope of the Study.....	4
1.5 Limitation of the Study.....	4
1.6 Definition of Terms.....	4
<b>CHAPTER TWO: LITERATURE REVIEW.....</b>	<b>6</b>
2.0 Introduction.....	6
2.1 Artificial Intelligence and Clinical Guidelines .....	8
2.1.1 Group Decision Making.....	8
2.1.2 Expert System.....	9
2.1.2.1 Types of Expert System.....	12
2.1.2.2 Areas of Application.....	13
2.1.3 Case-Based Reasoning (CBR).....	14
2.2 Importance of Clinical Expert Systems .....	16
2.3 Impact and Effectiveness of Expert.....	18
2.4 Clinician Motivation to Use expert systems .....	19
2.5 Current Clinical Expert Systems.....	20
<b>CHAPTER THREE: SYSTEM ANALYSIS AND DESIGN.....</b>	<b>22</b>
3.0 System Analysis.....	22
3.1 Method of Data Collections.....	22
3.2 Analysis of the Existing System .....	22

3.3	Problems of the Existing System .....	23
3.4	The Proposed System.....	23
3.4.1	Objective of the Proposed System .....	24
3.4.2	Advantages of the Proposed System.....	24
3.4.3	Benefits of the Proposed System .....	25
3.5	System Design .....	26
3.6	Architectural Design .....	28
3.6.1	Main Components of Expert Systems.....	31
3.7	System Flowchart.....	32
3.8	System Modeling .....	33
3.8.1	Use Case Diagram of the Proposed System.....	34
3.9	Database Design.....	36
3.10	Input Design.....	37
3.11	Process Design.....	38
3.12	Output Design .....	39
	<b>CHAPTER FOUR: PROGRAM AND IMPLEMENTATION .....</b>	<b>40</b>
4.0	Choice of Programming Language Development Tools .....	40
4.1	System Implementation .....	40
4.2	System Changeover Plan .....	40
4.3	Education and Awareness .....	41
4.4	System Requirements.....	42
4.4.1	Hardware Requirements.....	42
4.4.2	Software Requirements.....	42
4.5	The Interface Design.....	43
4.5.1	Home page .....	43
4.6	Program Flowchart.....	44
4.6.1	Diagnosis Flowchart .....	45
4.7	System Testing.....	46
4.7.1	Unit Testing .....	46
4.8	System Maintenance .....	47
4.9	Documentation.....	47

4.10	Program Debugging .....	48
<b>CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATION.....</b>		<b>49</b>
5.0	Summary .....	49
5.1	Conclusion .....	49
5.2	Recommendation .....	49
REFERENCES .....		51
APPENDIX.....		54

## ABSTRACT

*This work design and implementation of an expert system for prescription of drugs of illnesses, is considered to be one of the most powerful tools for assistance in the hospital and at home. Diseases have become a threat to the entire human race and since its existence; man have been finding various and quick ways to solve this life threatening problem. The medical diagnostic expert system has been designed to diagnose based on the individual's symptoms using knowledge base rule and suggests basic precautionary steps subject to the time the patient can access medical personnel. Designing an expert system was the cure to the problem. The proposed system is a patient to computer interactive system instead of the patient to doctor interaction. It put forward some list of symptoms of all forms of diseases which the user is expected to select from. It carries out a diagnosis by going through its knowledge base where some preprogram signs and symptoms associated with some specific diseases are stored. Help facilities, disease name and prescription of drug to the associated disease. The database was designed and implemented using MySQL as a database platform for storing the knowledge-based. Hypertext mark-up language and JavaScript were used to develop both the user and administrator interfaces while PHP was used as the server side scripting language to implement the functionality of the system. The system was implemented on XAMPP server. The advantage of this system is to speedy up diagnoses and makes it easy and fast for doctors or users. Its main purpose is to diagnose and prescribe drugs for the various diseases.*

**Keywords:** Diagnosis, Prescription, Knowledge-based, Expert system

## **CHAPTER ONE**

### **INTRODUCTION**

#### **1.0 Introduction**

In recent years, the internet which has caused a revolutionary impact on office automation is currently influencing the industrial automation systems. The rising Web-services technology has been manipulated to provide various services to mankind which has been making life easier by the day. Computer technology also has gone through significant changes which have influenced many areas of the human race. One of this aspect of life that has been affected positively by the use and application of computer technology is medicine and healthcare through the application of a branch of artificial intelligence (AI) called Expert System (Nohria, 2015).

Alan Turing described intelligent behaviour as the ability to achieve human-level performance in all cognitive tasks (Daniel and Udo, 2017; Abu Naser and Alawar, 2016). An expert system is an intelligent computer program which captures the knowledge of a human expert as depicted. This information is then used to solve real-world problems in an automated fashion. The mode of operation of these systems is simply that expertise on a specific subject is transferred from a human to a computer. The main purpose of knowledge-based expert systems is to make the knowledge of a human expert and their experiences to be more commonly available, particularly in areas where they are not readily available. The quality, efficiency, and competitive control of expert system operations have increased over the years. Expert systems are applied in many diverse areas such as medicine, education, and engineering (Nohria, 2015).

An Expert system has brought about many positive changes to the field of medicine ranging from the data and file processing of patient's record, use of robotics in performing surgical operations to the use of Wireless Body Area Networks for sensing and sending information on

the health of the patients. Medical expert systems have helped in creating various types of application systems to complement and support the duties of a doctor in effectively performing their duties. The main advantage of the expert system is the ready availability and easy access of patients to expert knowledge and advice at all times (Nohria, 2015; Amarathunga et al., 2015).

According to Mrouf, (2017) an expert system for long-term abdominal pain was proposed which was able to give probable causes and cure for the diseases. A medical expert system for diagnosis and treatment of hypertension among pregnant women who are patients of the Reproductive Health Division, Moi Teaching Hospital in Kenya was developed, tested and found to be effective and accurate (Gudu et al., 2012). Furthermore, Asabere (2012) presented a mobile-based medical expert system deployed for medical institutions across the nation in Ghana. With the deployment of the system, it has resulted in fast and quality service delivery as licensed medical practitioners can accelerate diagnosis and attend to patient on-the-go.

This work was carried out generally to achieve an accurate and reliable diagnosis of some common ailments encountered and frequently reported at the Auchi Polytechnic Campus Cottage Hospital. This work aims to improve the health service delivery within the Auchi Polytechnic Cottage Hospital especially for students who are based off-campus and in need of emergency care as the medical expert system is web-based. The system has been designed for use of the students prior to getting medical attention from professional medical practitioners.

## **1.1 Statement of the Problem**

Children who are 18 years and below are prone to drugs prescription errors, they are more prone to the errors when using the paper prescription because, besides illegibility, certain calculations (based on the child's weight, height, age, body surface area, etc) need to be carried out to obtain dosage to be prescribed for a child and the importance of these calculations are

often underemphasized and most times, the prescriber simply assumes a dosage for the child which could lead to cases of adverse drug effects since the child's body system is still developing unlike in adults where their system is fully developed.

Prescribing error rates in children were estimated to be between 5% and 27% in a systematic review by Alhanout et al (2017). Prescribing errors are most prevalent with antibiotic agents but may also occur with medications that don't require weight-based dosing (Cresswell et al, 2016). Medication errors in children may lead to more severe complications due to the inability of some children to communicate adverse effects.

## **1.2 Aim and Objectives of the Study**

The aim of this project is to design and implement an Expert System for diagnosing and prescription of drugs for illness.

The objectives are as follows:

- Provide accurate diagnosis to patient in the hospital
- Bringing to an end the rodent attacks of patients document and introduce totally the use of system of storing information.
- Bring up an efficient database for the advancement of medical research and analysis to take over the conventional paper system etc.

## **1.3 Significance of the Study**

The proposed system is targeted to help medical experts, seek advice with evidences that are hard to diagnose and to suggest preventive measures of self-care where medical experts have difficulty, and to illustrate how Expert System are best possible alternative where human expertise are limited.

#### **1.4 Scope of the Study**

The research work will cover diagnosing of common illnesses such as malaria, typhoid, cholera, etc by Expert System (ES) and addresses the prescription of drugs. The research area of this project work focuses on Auchi Polytechnic Cottage Hospital, Auchi, Edo State.

#### **1.5 Limitation of the Study**

Every limitation of an expert system presents opportunities for research, limitations are difficult to ignore and proposed improvements have to pass, time constrain, finance, Research resources are militating factor against this propose system.

#### **1.6 Definition of Terms**

**A.I:** Known as artificial intelligence in full and can be defined as the branch of computer science that deal with writing computer programs that can solve problems creatively.

**Ailment:** An often persistent bodily disorder or disease; a cause for complaining

**Diagnostic:** This is concerned with diagnosis; used for furthering diagnosis or can be defined as characteristic or indicative of a disease.

**Hospital:** A medical institution where sick or injured people are given medical or surgical care.

**Malaria:** An infective disease caused by sporozoan parasites that are transmitted through the bite of an infected Anopheles mosquito; marked by paroxysms of chills and fever

**Medication:** The act of treating with medicines or remedies

**Paramedics:** A person trained to assist medical professionals and to give emergency medical treatment

**Physician:** A licensed medical practitioner

**Software:** These written programs or procedures or rules and associated documentation pertaining to the operation of a computer system and that are stored in read/write memory

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.0 Introduction

Medical artificial intelligence is primarily concerned with the construction of AI programs that perform diagnosis and make therapy recommendations. Expert systems today are more likely to be found used in clinical laboratories and educational settings, for clinical surveillance, or in data-rich areas like the intensive care setting. What is now being realized is that when they fill an appropriate role, intelligent programs do indeed offer significant benefits (OpenClinical, 2012).

One of the most important tasks now facing developers of AI-based systems is to characterize accurately those aspects of medical practice that are best suited to the introduction of artificial intelligence systems (OpenClinical, 2012).

General features of intelligent system include coping with uncertainty, data driven reasoning, data/knowledge representation, user interface, and ability of the system to explain the reasoning process that it used to reach a recommendation. General strength of intelligent system includes provision of consistent answers for repetitive decisions, processes and tasks, holding and maintenance of significant levels of information, encouraging organizations to clarify the logic of their decision-making, never "forgetting" to ask a question as a human might, all time availability, and multi-user expert system serving more users at a time. The weaknesses of intelligent transaction system include lack of common sense needed in some decision making and for fast, intuitive decisions, lack of capability for creative responses as human expert would in unusual circumstances, being clear about its logic and reasoning unlike human domain expert,

susceptibility to knowledge base errors that would lead to wrong decisions, and rigidity to changing environments, unless knowledge base is changed (WikiAnswers, 2012).

The MYCIN Program for Infectious Diseases is one of the earliest medical expert systems to have been 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 suggests what antibiotic to give the patient. It is very helpful for physicians that lack expertise at certain diseases because it gives reason for suggesting diagnosis and recommending treatment (Buchanan and Shortliffe, 1984). The setback of MYCIN is that runs on large time shared systems (slow response), and it is not suitable for the treatment of malaria.

YourDiagnosis is an online medical diagnosis and symptoms analysis system. It asks several questions about body system and symptoms. Allergies, medications and immunizations are recorded as well as family history and past medical problems. It also does a complex analysis of all information gathered about symptoms and produces a list of all possible and probable medical diagnoses. It is online and can be interacted with in stages. All provided information can be securely stored as confidential personal health record for future retrieval. It also gives a confidential medical report, which could be printed or have emailed for personal usage (YourDiagnosis, 2012). The setback of Your Diagnosis is its complexity in trying to diagnose and treat all the ailments in one sweep.

GIDEON was developed ten years ago by specialists in infectious diseases and biostatistics, and computer scientists at university-based medical schools in the United States and Israel. GIDEON is a computer program for diagnosis and reference in the fields of tropical and infectious diseases, epidemiology, microbiology and antimicrobial chemotherapy. It was

designed to diagnose all the worlds' infectious diseases based on symptoms, laboratory testing and dermatological profile (Gideon, 2012). It helps in diagnosing infectious diseases, but difficult to maintain, manage and upgrade because it is not web-based. It also attempts to diagnose all infectious diseases which introduced certain complexities.

## **2.1 Artificial Intelligence and Clinical Guidelines**

The history relation of AI and clinical guidelines is very old. The first practice started in early 80s. Clinical guidelines are supposed to represent the best clinical suggestions, records and practices. Hence, are now one of the most central areas of research in Artificial Intelligence (AI) in medicine and in medical decision making. Clinical guidelines play different roles in the clinical process: for example, they can be used to support physicians in the treatment of diseases, or for critiquing, for evaluation, and for education purposes (Tanzila et al., 2012).

### **2.1.1 Group Decision Making**

Group decision making (also known as collaborative decision making) is a situation faced when individuals collectively make a choice from the alternatives before them. This decision is no longer attributable to any single individual who is a member of the group. This is because all the individuals and social group processes such as social influence contribute to the outcome. The decisions made by groups are often different from those made by individuals. Group polarization is one clear example: groups tend to make decisions that are more extreme than those of its individual members, in the direction of the individual inclinations (Bichindarits and Marling, 2006; Bodenreider, 2006). However, during the application of clinical guidelines, there are moments when this type of decision is required. The selection among scientifically valid options during the medical process must be done based on the opinions of the parts involved (healthcare professionals and patients). Technology-assisted decision making may help the

generation of ideas and actions, the choice of alternatives and the negotiation of solutions. The existence of CIGs and a tool for execution of medical guidelines enables the implementation of automated group decision making (Bottrighi et al., 2006; Novais et al., 2012).

### **2.1.2 Expert System**

Expert System is a type of computer application program that makes decisions or solves problems in a particular field, such as finance or medicine, by using knowledge and analytical rules defined by experts in the field. Human experts solve problems by using a combination of factual knowledge and reasoning ability. In an expert system, these two essentials are contained in two separate but related components, a knowledge base and an inference engine. The knowledge base provides specific facts and rules about the subject, and the inference engine provides the reasoning ability that enables the expert system to form conclusions. Expert systems also provide additional tools in the form of user interfaces and explanation facilities. User interfaces, as with any application, enable people to form queries, provide information, and otherwise interact with the system. Explanation facilities, an intriguing part of expert systems, enable the systems to explain or justify their conclusions, and they also enable developers to check on the operation of the systems themselves. Expert systems originated in the 1960s; fields in which they are used include chemistry, geology, medicine, banking and investments, and insurance (Jagannatha and Kavitha, 2016).

Expert System was introduced by researchers in the Stanford Heuristic Programming Project, including the “father of Expert systems” with the DENDRAL and MYCIN systems. Principal contributors to the technology were Bruce Buchman, Edward Short life, Randall Davis, William van-Melle, Carliscott and others at Stanford. Expert systems were among the first truly successful forms of AI software ([en.wikipedia.org/wiki/Expert-system](http://en.wikipedia.org/wiki/Expert-system)).

Research is also very active in France, where researchers focused on the automation of reasoning and logic engines. The French Prolog computer language, designed in 1972, marks a real advance over expert systems like DENDRAL and MYCIN: it is a shell that receive any expert system and to run it prolog has an integrated inference engine using First-Order Logic, with rules and fact .Prolog is a tool for mass production of expert systems and was the first operational declarative language, later becomes the bestselling AI language in the world. However prolog is not a particularly user friendly and incorporates Horn Logic, which is an order of logic away from which is an order of logic away from human logic (en.wikipedia.org/wiki/Expert-system).

In the 1980s, Expert systems proliferated as they were recognized as practical tools for solving real world problems. Universities offered expert system courses and two thirds of the Fortune 1000 companies applied the technology in daily business activities. Interest was international with the fifth generation computer systems project in Japan and increased research funding in Europe. Growth in the field continued into the 1990s (en.wikipedia.org/wiki/Expert-system).

In 1981 the IBM PC was introduced with MS-DOS operating system. Its low price started to multiply users and opened a new market for computing and expert system. In the 80's the image of AI was very good and people believed it would succeed within a short time. The development of expert systems was aided by the development of the symbolic processing languages Lisp and Prolog. To avoid re-inventing the wheel, expert system shells were created that had more specialized features for building large expert systems (en.wikipedia.org/wiki/Expert-system).

Many companies began to market expert systems shells, some commercial developments of tools from universities, others written by ventures capital backed startup companies. These claimed to allow rules to be written in plain language and thus, theoretically, allowed expert systems to be written without programming language expertise. The best unknown tools were Guru (USA inspired by EMYCIN), Personal Consultant Plus (USA), Inexpert Object (developed by Neuron Data, company founded in California by three French), Genesis (developed by French public company Electricite de France and marketed by Steria), VP Expert (USA), Xi (developed by Expertech, UK) and Crystal (developed by intelligent Environments, UK) ([en.wikipedia.org/wiki/Expert-system](http://en.wikipedia.org/wiki/Expert-system)).

Some of these included rule induction tools which they called generators which theoretically allowed the production of rules by no experts based on raw data. But eventually the tools were only used in research projects and feasibility studies. They did not show commercial value in the business market, showing that AI technology was not mature ([en.wikipedia.org/wiki/Expert-system](http://en.wikipedia.org/wiki/Expert-system)).

In 1986, a new expert system generator for PCs appeared on the market, derived from the French academic research: Intelligence Service, sold by GSI-ECSI software had a radical innovation: it used propositional logic (“Zero order logic”) to execute expert systems, reasoning on a knowledge base written with everyday language rules, producing explanations and detecting logic contradictions between the facts. It was the first tool showing the AI defined by Edward Feigenbaum in his book about the Japanese Fifth Generation Project, Artificial Intelligence and Japan’s Computer Challenge to the World (1983): ”The machines will have reasoning power: they will automatically engineer vast amounts of knowledge to serve whatever purpose humans propose, from medical diagnosis to product design, from management decisions to education”, ”

The reasoning animal has the perhaps inevitably, fashioned the reasoning machine”, the reasoning power of these machines matches or exceeds the reasoning power of the humans who instructed them and in some cases, the reasoning power of any human performing such tasks” ([en.wikipedia.org/wiki/Expert-system](http://en.wikipedia.org/wiki/Expert-system)).

### **2.1.2.1 Types of Expert System**

The following are the main types of expert system:

#### **(a) Rule-based**

A rule-based expert system is defined as one which contains information obtained from human expert, and represents that information in the form of rules. The rule can then be used to perform operations on data to inference in order to reach appropriate conclusion. These inferences are essentially a computer program that provides a methodology for reasoning about information in the rule base or knowledge base, and for formulation conclusions.

Application of rule-based systems on expert systems includes: State transition analysis, psychiatric treatment, production planning, advisory system, teaching, electronic power planning, automobile process planning etc. (Jahid et al., 2016).

#### **(b) Case- Based Reasoning**

The basic idea of case-based reasoning is to adapt solutions that were used to solve previous problems and use them to solve new problems. In CBR, descriptions of past experience of human specialists, represented as cases, are stored in a database for later retrieval when the user encounters a new case with similar parameters. The system searches for stored cases with problem characteristics similar to the new case similar to the new one, finds closest fit, and applies the solutions of the old case to the new case. Successful solutions are tagged to the new case and both are stored together with the

other case base along with explanations as to why the solutions did not work (Kiyong et al., 2006).

Some of the applications implemented by CBR include: manufacturing process design, knowledge management, power system restoration training, ultrasonic inspection, fault diagnosis-learning etc.

### **2.1.2.2 Areas of Application**

There are many different applications of expert systems. The following list describes the various application of expert system.

**i. Diagnosis:** Diagnosis types of expert systems are used to recommend remedies to illnesses, trouble-shoot electronic or mechanical problems or as debugging tools.

**ii. Repair:** Expert systems that define repair strategies are also very common. As well as diagnosing the problem they can suggest a plan for the repair of the item. The repair plan typically contains a scheduling structure and some control structure to validate the repair process. Such systems have been employed in the automotive repair field and similar areas. **Instruction:** Instructional expert systems have been used for individualised training or instruction in a particular field. The system presents material in an order determined by its evaluation of the user's ability and current knowledge and monitor's the progress of the student, altering the sequence depending on this progress.

**iii. Interpretation:** Interpretive expert systems have the ability to analyse data to determine its significance or usefulness. The knowledge base often contains models of real world situations which it compares to its data. These are often used in exploration for mineral, gas and oil deposits as well as in surveillance, image analysis and speech understanding.

**Prediction:** Predictive expert systems are used as a method to "guess" at the possible outcomes of

observed situations, usually providing a probability factor. This is used often in weather forecasting.

**iv. Design and Planning:** This allows experts to quickly develop solutions that save time. These systems do not replace experts but act as a tool by performing tasks such as costing, building design, o material ordering and magazine design.

**v. Monitoring and Control:** In certain applications expert systems can be designed to monitor operations and control certain functions. These are particularly useful where speed of decision making is vitally important, for example in the nuclear energy industry, air traffic control and the stock market.

**vi. Classification/Identification:** These systems help to classify the goals in the system by the identification of various features (these can be physical or non-physical) For example various types of animals are classified according to attributes such as habitat, feeding information, colour, breeding information, relative size etc. These systems can be used by bird watchers, fishing enthusiasts, animal rescue shelters (to match animals to prospective owners) to name a few (Retrieved from: <http://year12ipt.ash.com/untitled-6.html>) .

### **2.1.3 Case-Based Reasoning (CBR)**

Case-based reasoning (CBR), broadly construed, is the process of solving new problems based on the solutions of similar past problems. An auto mechanic who fixes an engine by recalling another car that exhibited similar symptoms is using case-based reasoning. A lawyer who advocates a particular outcome in a trial based on legal precedents or a judge who creates case law is using case-based reasoning. So, too, an engineer copying working elements of nature (practicing bio-mimicry), is treating nature as a database of solutions to problems. Case-based reasoning is a prominent kind of analogy making (Seto et al., 2012).

It has been argued that case-based reasoning is not only a powerful method for computer reasoning, but also a pervasive behaviour in everyday human problem solving; or, more radically, that all reasoning is based on past cases personally experienced. This view is related to prototype theory, which is most deeply explored in cognitive science (Saba et al., 2012; Bekhti et al., 2011). Case-based reasoning has been formalized for purposes of computer reasoning as a four-step process (Saba et al., 2012):

**Retrieve:** Given a target problem, retrieve from memory cases relevant to solving it. A case consists of a problem, its solution, and, typically, annotations about how the solution was derived. For example, suppose Fred wants to prepare blueberry pancakes. Being a novice cook, the most relevant experience he can recall is one in which he successfully made plain pancakes. The procedure he followed for making the plain pancakes, together with justifications for decisions made along the way.

**Reuse:** Map the solution from the previous case to the target problem. This may involve adapting the solution as needed to fit the new situation. In the pancake example, Fred must adapt his retrieved solution to include the addition of blueberries.

**Revise:** Having mapped the previous solution to the target situation, test the new solution in the real world (or a simulation) and, if necessary, revise. Suppose Fred adapted his pancake solution by adding blueberries to the batter. After mixing, he discovers that the batter has turned blue, an undesired effect. This suggests the following revision: delay the addition of blueberries until after the batter has been ladled into the pan.

**Retain:** After the solution has been successfully adapted to the target problem, store the resulting experience as a new case in memory. Fred, accordingly, records his new-found

procedure for making blueberry pancakes, thereby enriching his set of stored experiences, and better preparing him for future pancake-making demands.

## **2.2 Importance of Clinical Expert Systems**

Clinical expert systems are systematically developed statements to assist healthcare professionals and patients about appropriate healthcare in specific clinical circumstance (Haron et al, 2012). Initially, guidelines are only based on the consensus of groups of experts, but with the growth of evidence-based clinical practice, other techniques are included in guideline development. The Delphi and nominal group techniques are some of the methodologies that are later included in the development process and are still used today.

Currently, clinical expert systems development is more focused on an extensive research of the literature and thorough analysis of empirical evidence. The process usually starts with the choice of the guideline topic or subject, based on the problems that motivate the development. Clinical guidelines can be developed to a wide range of subjects and clinical areas, including health conditions bound to diseases and economical costs. To choose the topic, it is necessary to do a preliminary check of the available evidence in order to ascertain the validity of the theme (Haron et al., 2012).

Many of the technology differences described in the previous section need not be apparent to the user. The following factors may be more relevant to the clinician user or those assisting with implementation:

- 1) The primary need or problem and the target area of care for which the expert is being considered (e.g., improve overall efficiency, identify disease early, aid in accurate diagnosis or protocol-based treatment, or prevent dangerous adverse events affecting the patient);

- 2) To whom and how the information from the expert will be delivered; and
- 3) How much control the user will have in accessing and responding to the information.

A key decision is whether expert can help solve the need or problem identified (Samwald et al., 2012).

Expert can provide support to clinicians at various stages in the care process, from preventive care through diagnosis and treatment to monitoring and follow up. expert as implemented today can include, for example, order sets tailored for particular conditions or types of patients (ideally based on evidence-based guidelines and customized to reflect individual clinicians' preferences), access to guidelines and other external databases that can provide information relevant to particular patients, reminders for preventive care, and alerts about potentially dangerous situations that need to be addressed (Samwald et al., 2012).

The most common use of expert is for addressing clinical needs, such as ensuring accurate diagnoses, screening in a timely manner for preventable diseases, or averting adverse drug events. However, expert can also potentially lower costs, improve efficiency, and reduce patient inconvenience. In fact, expert can sometimes address all three of these areas simultaneously. For example, by alerting clinicians to potentially duplicative testing. For more complex cognitive tasks, such as diagnostic decision making, the aim of expert is to assist, rather than to replace, the clinician whereas for other tasks (such as presentation of a predefined order set) the expert may relieve the clinician of the burden of reconstructing orders for each encounter. The expert may offer suggestions, but the clinician must filter the information, review the suggestions, and decide whether to take action or what action to take (Shiffman et al., 2000).

### **2.3 Impact and Effectiveness of Expert**

This section focuses on evaluations of the impact of expert on health care quality, using Donabedian's classic definition of quality comprising structure, process, and outcomes of health care. Donabedian advocated that organizational outcomes such as cost and efficiency, as well as individual patient health outcomes, be evaluated. Donabedian's model is expanded by Carayon and her colleagues' formulation of structure, which includes people, organization, technologies, tasks, and environment. This expanded definition of structure is used here so that expert impact on cost and efficiency are addressed and included as part of impact on structure (Antoniou and Harmelen, 2009; Novais et al., 2010). As outlined below, evaluation of impact includes care process and patient health outcomes. Structural outcomes are also addressed below.

Most published evaluations of the impact of expert on health care quality have been conducted in inpatient rather than ambulatory settings, and most have been in large academic medical centers, often using - homegrown systems, where there is a culture that is accustomed to their use and adequate resources (including expertise, time, and infrastructure) to build and maintain them. Although many commercial EMRs have expert capabilities, there has been little systematic research on the outcomes or even on the implementation strategies of commercial expert in community settings. These omissions, and the narrow focus responsible for them, are particularly problematic since most hospitals will deploy commercial systems in the future, and their culture and resources are likely to differ from those of large academic medical centers. In addition, the impact of expert in ambulatory settings needs more attention. Some of the projects within the AHRQ Ambulatory Safety and Quality Program are beginning to address this need (Oliveira et al., 2012; Conference-DCAI, 2012).

The research on expert has other noteworthy limitations. First, although a number of expert studies have been published, comparatively few are Randomized Controlled Trials (RCT). Second, most research has examined the effects of expert on the process of care (rather than the outcomes or structure) and has focused primarily on clinician decision making. Third, the diagnostic programs have had limited use in practice settings. Finally, the results of the research to date are mixed in terms of the effectiveness of expert for particular conditions or particular types of expert. These limitations point to gaps in the literature. Although RCTs are considered the gold standard for research studies, qualitative studies may be better able to determine why expert intervention succeeds or fails (Rehman, 2012).

The following section reviews the results of RCT studies and other studies of expert. Because most of the studies deal with process and patient health outcomes, these aspects is discussed first, followed by a discussion of structure (Rehman, 2012).

#### **2.4 Clinician Motivation to Use expert systems**

For expert to be effective, clinicians must be motivated to use these systems, and many features of the health care environment may decrease, rather than increase, this motivation. Even when efforts are made to engage clinicians and integrate expert into clinician workflow, the use of expert may still be resisted by clinicians, especially if use of expert exacerbates the increasingly time-pressured patient care process, which may occur.

One of the challenges for expert implementation that is also faced by the patient safety and quality improvement movements is that the culture of medicine has always emphasized individual physician autonomy. System changes are not always well-received if physicians are concerned about maintaining that autonomy, as surveys of clinicians' views about expert have shown. In addition to worries about autonomy, physicians have been concerned about over

reliance on an outside device, and the legal and ethical ramifications of listening to, or overriding, the expert (Rehman & Saba, 2012c).

These concerns have some basis. For example, use of expert is not currently part of the standard of care and, although the expert systems can frequently provide useful advice, the advice is not foolproof. It should be recognized that these concerns are not new, nor are they confined to expert. Few researchers discussion of the history of the use of the blood pressure cuff shows that in the early part of the last century physicians are uneasy about relying on the cuff to determine a patient's blood pressure, instead of using their palpation skills, as is the practice at the time. Over time, physicians became more comfortable with using the cuff, as long as a skilled physician is using it and interpreting its output. Today, not only are non-physicians usually the people in the health care setting who take the patient's blood pressure, but automated devices even allow patients to do it themselves at home. This example illustrates how new devices or systems that appear to challenge what clinicians perceive as their unique skills are likely to be resisted (Rahim et al., 2012). Because expert is still fairly new, many clinicians today have misconceptions about how expert systems work and may not be interested in using it. However, over time, as expert is used more, and the legal situation in regard to liability for its use or non use becomes clearer, clinicians' resistance to expert will lessen. However, until the use of expert is as routine as the use of the blood pressure cuff, it is important to be sensitive to resistance to using these systems (Rehman, 2012).

## **2.5 Current Clinical Expert Systems**

Early expert systems are derived from expert systems research, with the developers striving to program the computer with rules that would allow it to think like an expert clinician when confronted with a patient. From this early research there is growing recognition that these

systems might be useful beyond research, that they could be used to assist clinicians in decision making by taking over some routine tasks, warning clinicians of potential problems, or providing suggestions for clinician consideration (Rehman, 2012).

This review focuses on expert systems of a type known as knowledge-based expert because they include compiled clinical knowledge. There have been several descriptions of types of expert and their characteristics. Authors have provided a detailed taxonomy of expert functions. Many of the early expert systems provided expert consultation to the clinician for diagnosis and medication selection. Expert today also encompasses a range of options, from general references, through specific guidelines for a given condition, to suggestions that take into account a patient's unique clinical data. Expert can include nationally recommended guidelines at one end of the continuum and customized order sets designed by an individual clinician at the other (Rehman & Saba, 2011a).

Currently, few clinical expert systems/DSSs are available; however, they lack application in real desired clinical guidance. In this paper, we address them by their features and also report the decision criteria for each one, as well as the standard adopted (Rehman & Saba, 2011b).

## CHAPTER THREE

### SYSTEM ANALYSIS AND DESIGN

#### 3.0 System Analysis

System analysis solves business problem through analyzing the requirement of information systems and designing such system by applying analysis and design techniques. These deal with the concept, skills, methodologies, techniques, tools, perspectives essential for system analyst.

#### 3.1 Method of Data Collections

The methods of data collection used in this project are:

- **Observation Method:** Due to the importance attached to the collection of accurate information from the right, authentic and reliable source, information was gathered on observing the activities that took place in the Cottage Hospital, Auchi Polytechnic. This method of data collection is known as the primary method.
- **By Browsing Method:** Information was gathered from eBooks, journals, publications and articles concerning computerized clinical drugs prescriptions system. This method of data collection is known as the secondary method.

#### 3.2 Analysis of the Existing System

In medicine one of the key difficulties experienced by physicians in diagnosing is the complication that arises when more than one disease have very close and similar symptoms with another.

Most physicians adhere to the methodology of the first, having general assumption about a suspected disease and then gradually build on that assumptions removing or adding facts that will help in diagnosing a disease accurately. Therefore to obtain an optimal diagnosis of diseases,

it is required of a medical doctor to have large information reservoir and a special ability to draw inferences correctly with the information he has acquired.

Diagnosis is the balancing of probabilities based on the application of scientific method.

### **3.3 Problems of the Existing System**

The problems of the existing system are;

1. The level of familiarity between doctor and the patient. When a patient is not familiar with the doctor, he/she might not find it hard to confide in the doctor to reveal some information.
2. How much background information the doctors possess. The background knowledge of a medical doctor goes long way to determine how effective he / she will be diagnosing a disease. For instance a doctor that has a vast knowledge of various diseases and vast knowledge of malaria will be in a better place to diagnose a patient having malaria or any other form of illness.
3. The patient state of mind will determine if he/she will reveal the correct information needed for the diagnosis or not.

### **3.4 The Proposed System**

The proposed system is a web application system for diagnosing diseases which will tend to solve the problem of diagnosis related Malaria, Typhoid, Cholera, etc diseases. This will be made possible as the system is an interactive one; hence it is a patient to computer interactive system instead of the patient to doctor interaction. The web application submits the username and password to the server by posting it; this information is processed by authenticating the credential of the application by confirming the username and password registered with the server. The information sent is then been processed and sent to the destination if it exists. When

the system is consulted, it put forward some list of symptoms of all forms of diseases which the user is expected to select from. It carries out a diagnosis by going through its knowledge base where some preprogram signs and symptoms associated with some specific diseases are stored. Help facilities, disease name and prescription of drug to the associated disease.

### **3.4.1 Objective of the Proposed System**

Despite the existing expert system, this software was developed because none of the already existing expert system deals mainly with heart disease unlike the other expert system which focuses on other disease such as malaria etc. There is also a need to introduce a system that will assist a doctors and medical personnel's in the prescription and diagnosis of diseases. After patients has been able to tell the system of signs and symptoms that relates to a particular ailment. Furthermore, I also have an objective to ensure that human error in diagnosis are reduced such as error as patient's insincerity which the computer would be able to take care of, as the patient will be relating to his computer instead of the medical team . With this, the attitude of shyness, which comes into play when a male patient faces a female health worker, or vice versa, is reduced if not, eliminated. The system will also to reduce the problems of delay which the patient experience in any health institutions since the computer can diagnose a patient as quickly as possible.

### **3.4.2 Advantages of the Proposed System**

The proposed system should have the following;

- i. The quick retrieval of the information as the computer can accomplish this task in a matter of second
- ii. A large number of patients can be diagnosed within a few minutes thereby reducing time wastage.

### **3.4.3 Benefits of the Proposed System**

Clinical Expert Systems serves for several aspects to assist clinical decisions. Medication-related expert systems could provide basic and advanced decision support. The potential benefits of using clinical expert systems practice fall into three broad categories:

- i. Improved patient safety e.g. through reduced medication errors and adverse events, improved medication and test ordering;
- ii. Improved quality of care e.g. by increasing clinicians' available time for direct patient care, increased application of clinical pathways and guidelines, facilitating the use of up-to-date clinical evidence, improved clinical documentation and patient satisfaction;
- iii. Computer-based decision support is more effective than manual processes for decision support.
- iv. Expert interventions that are presented automatically and fit into the workflow of the clinicians are more likely to be used.
- v. Expert that recommends actions for the user to take are more effective than expert that simply provides assessments.
- vi. Expert interventions that provide information at the time and place of decision making are more likely to have an impact.
- vii. Improved efficiency in health care delivery e.g. by reducing costs through faster order processing, reductions in test duplication, decreased adverse events, and changed patterns of drug prescribing favoring cheaper but equally effective generic brands. Additionally, importance of expert systems from clinical guidelines and managerial point of view is detailed below.

- viii. **Administration:** Supporting clinical coding and documentation, authorization of procedures, and referrals.
- ix. **Managing clinical complexity and details:** Keeping patients on research and chemotherapy protocols; tracking orders, referrals follow-up and preventive care.
- x. **Cost control:** Monitoring medication orders; avoiding duplicate or unnecessary tests.
  - Help healthcare professionals and patients in decisions about clinical
  - Procedures;
  - Describe appropriate care based on scientific evidence;
  - Act as the focus for quality assessment and activity improvement,
  - Audits.

### 3.5 System Design

System design deals with planning the development of information system through the understanding and specifying in details what a system should do and how the component of the system should be implemented and work together.

The system design of this medical diagnostic expert system serves as the blueprint for a robust implementation. The design is divided into stages:

- i.) **Logical design:** This is an implementation-independent design which lays out the components of the system and their relationships to one another as they will appear to the users. It describes input/output procedures, processing functions to be performed, business procedures, data models and controls. The system is comprised of logical modules such as registration, login, diagnosis and contacts.

ii.) **Physical design:** This is an implementation-dependent design which is concerned with those aspects of the system that are dependent on the implementation platform. At this stage, the abstract logical model is translated into the specific technical design for the system. It produces the specification for the hardware, software, physical storage, input/output media and etc. The physical design gives structure in terms of look & feel and functionality to the logical design of the system. A system module block diagram is shown in Figure 2.

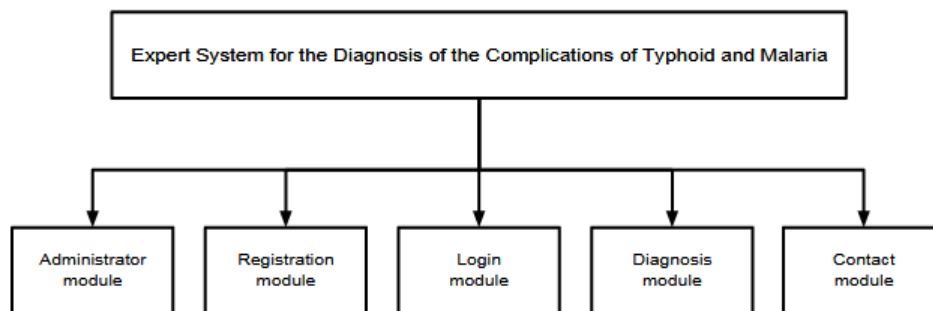


Fig. 3.1: Block diagram of system modules

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 HTML, PHP, CSS, JavaScript and MySQL (database) because of its ease of creating user friendly interfaces, which is an important element in any Health Management System. In order to know the user and general needs of cottage hospital, 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 were 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, each module was identified and later breaks each module into its constituent sub-modules.

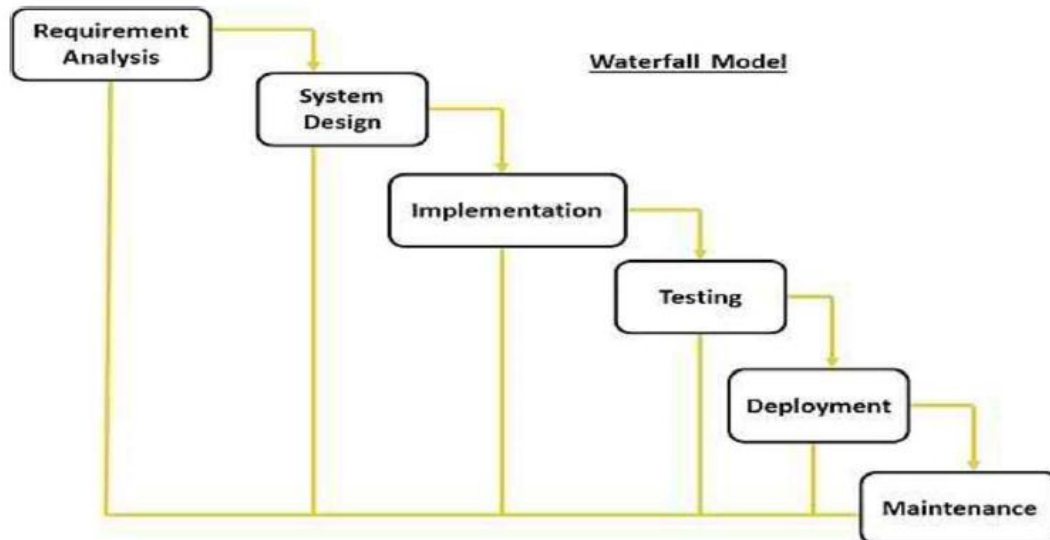


Fig. 3.2: Waterfall Model for Software Development Life Cycle

Source: Yogi, B. (2012)

### 3.6 Architectural Design

The operation of the expert system is categorized into 3 stages as follows;

**Knowledge Acquisition:** This involves the knowledge engineer liaising and consulting with professionals in the relevant field with relevant knowledge. Medical practitioners in the school health centre were consulted to acquire knowledge and information on the basic ailments most commonly encountered by students. The data captured is inputted and stored into the knowledge base of the expert system using the various interfaces (Daniel & Udo, 2017).

**Consultation or querying:** The user interacts with the expert system by giving information necessary and the system responds by a method of deductive reasoning (Roventa & Rosu, 2006). The user interacts by entering data in English and the system responds using a backward chaining (deductive reasoning) process to derive an answer to the questions posed by the user.

**Results:** This involves the expert system providing result and answers based on the queries entered with sufficient explanations of how it has been able to conclude, and these are provided through the interface (Mottalib et al., 2016).

The medical diagnosis expert system internal structure comprises of the knowledge base which is the database that gives the context of the problem domain and what is generally considered to be a set of useful facts (Oktoria et al., 2016); the rule base that holds the set of rules of inference (mostly IF-THEN rules) that are used in reasoning/decision making; and inference engine which is the 'brain' of the system, and controls how the IFTHEN rules are applied to the facts (Abu Naser & Alhabbash, 2016).

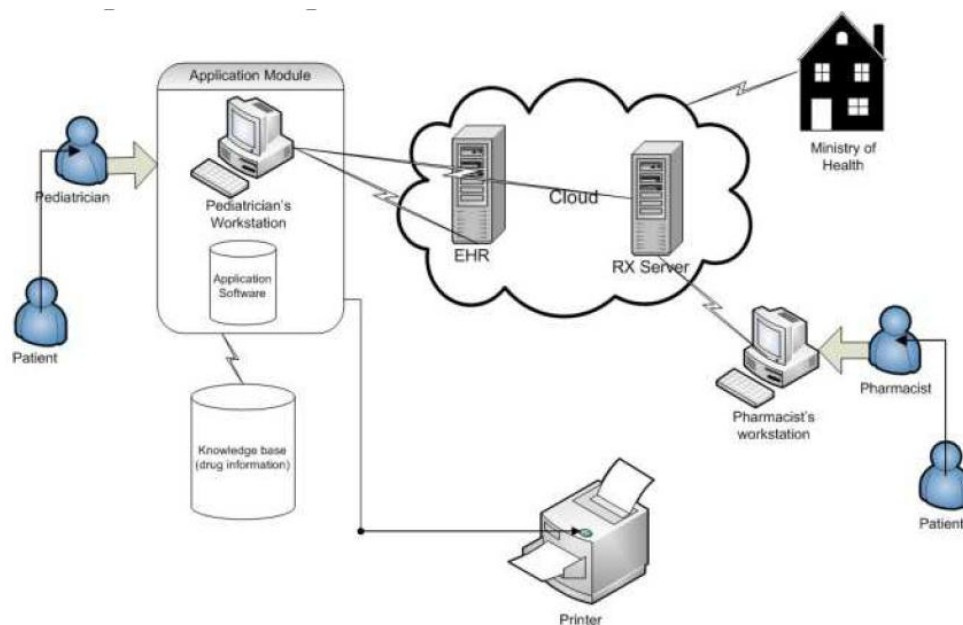


Fig. 3.3: Proposed System Architecture for an Expert System Drug Prescription

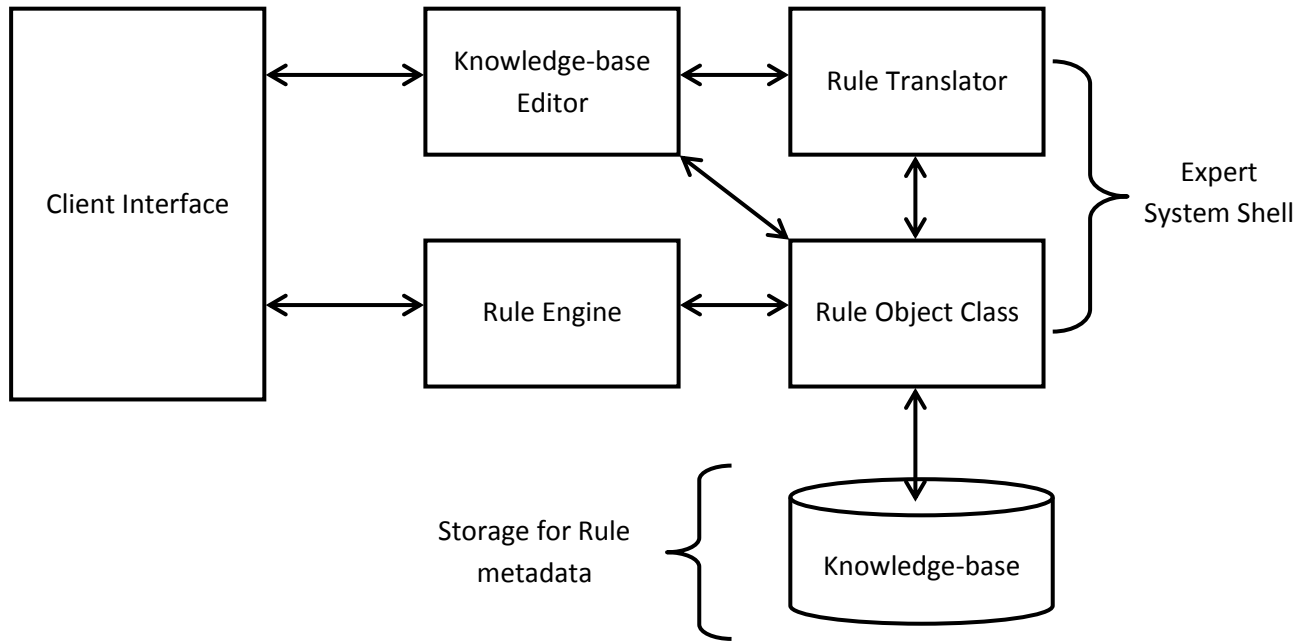


Fig. 3.4: Expert System Structure for the Proposed System

Source: Munassar & Govardhan (2010)

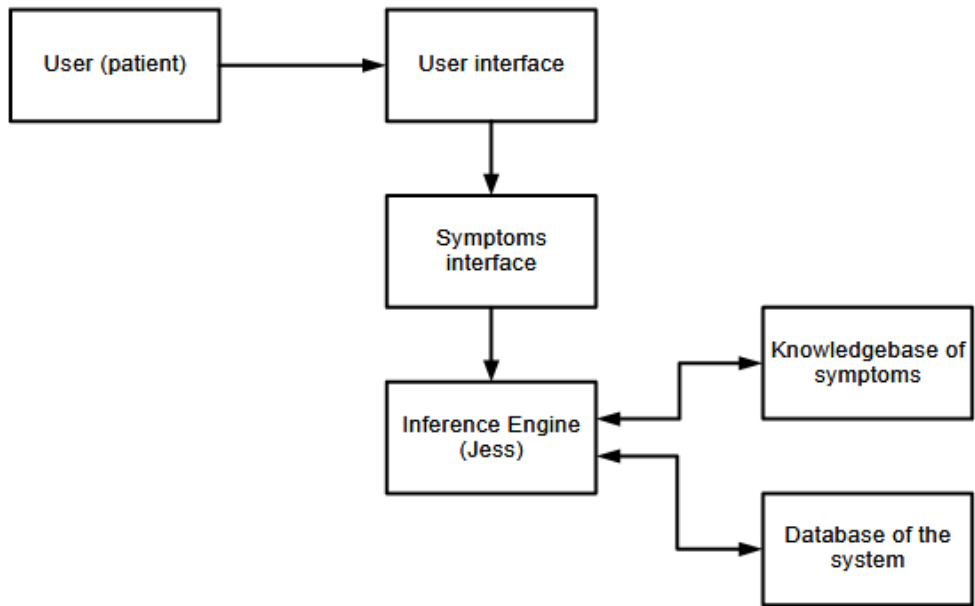


Fig. 3.5: Medical Expert System Architecture

### 3.6.1 Main Components of Expert Systems

The diagnosis expert system will have the components of a standard expert system depicted in Fig. 3.3.

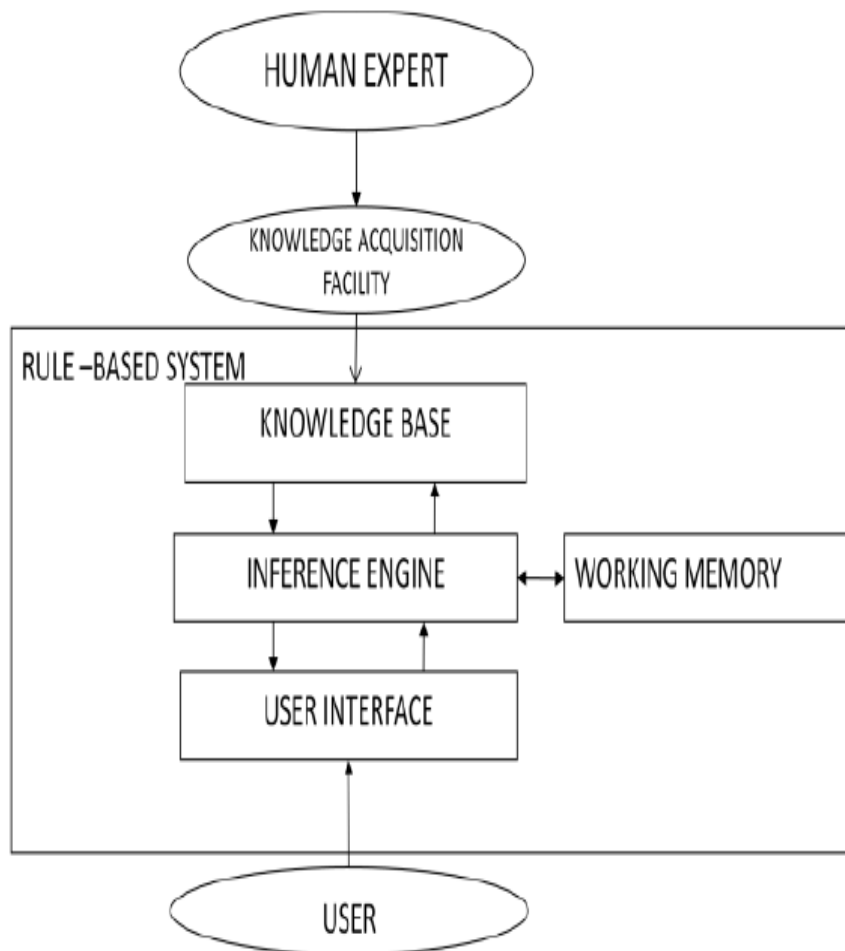


Fig. 3.6: Main Components of Expert Systems

**Source:** Stair & Reynolds (2007)

Human experts, which in this case are doctors, solve problems by using a combination of factual knowledge and reasoning ability. In an expert system, these two essentials are contained in two separate but related components: a knowledge-base and an inference engine. The

knowledge-base provides specific facts and rules about the subject, and the inference engine provides the reasoning ability that enables the intelligent system to form conclusions.

The knowledge acquisition facility is used to acquire necessary expert information about diagnosing and treatment of diseases. This information which serves as knowledge is stored in the knowledge base. This is the store in which knowledge of malaria acquired from doctors would be kept. This knowledge would be stored in a database using a relational database management system. The inference engine manipulates the knowledge stored in the database used as a knowledge base. The inference engine accepts query from the user, processes the query and sends required information back to the user through a user interface. It performs its function by using the working memory as temporal storage for facts generated during processing. A scripting language will serve as an inference engine for this diagnosis expert system. The Scripting language will be used to express rules and facts associated with the malaria expert system.

A user-friendly user interface for interacting with the system is defined. Users' queries would be sent to the online, web-based, expert system that would process it and return the result to the users. The online part of the system would be made up of the knowledge base, inference engine and the working memory. A mark-up language would be used to develop the website.

### **3.7 System Flowchart**

The system flowchart for the design is shown in Fig. 3.3. The system requires a new user to register and an existing user to login before its use. The user selects to either go for a daily check which calculates the Body Mass Index (BMI) or check for diagnosis by supplying different symptoms. To access the "check yourself" portal, there is a need for user registration

which would capture the basic information including demography. The user after registration is prompted to select as many symptoms the patient is having and submits thereafter.

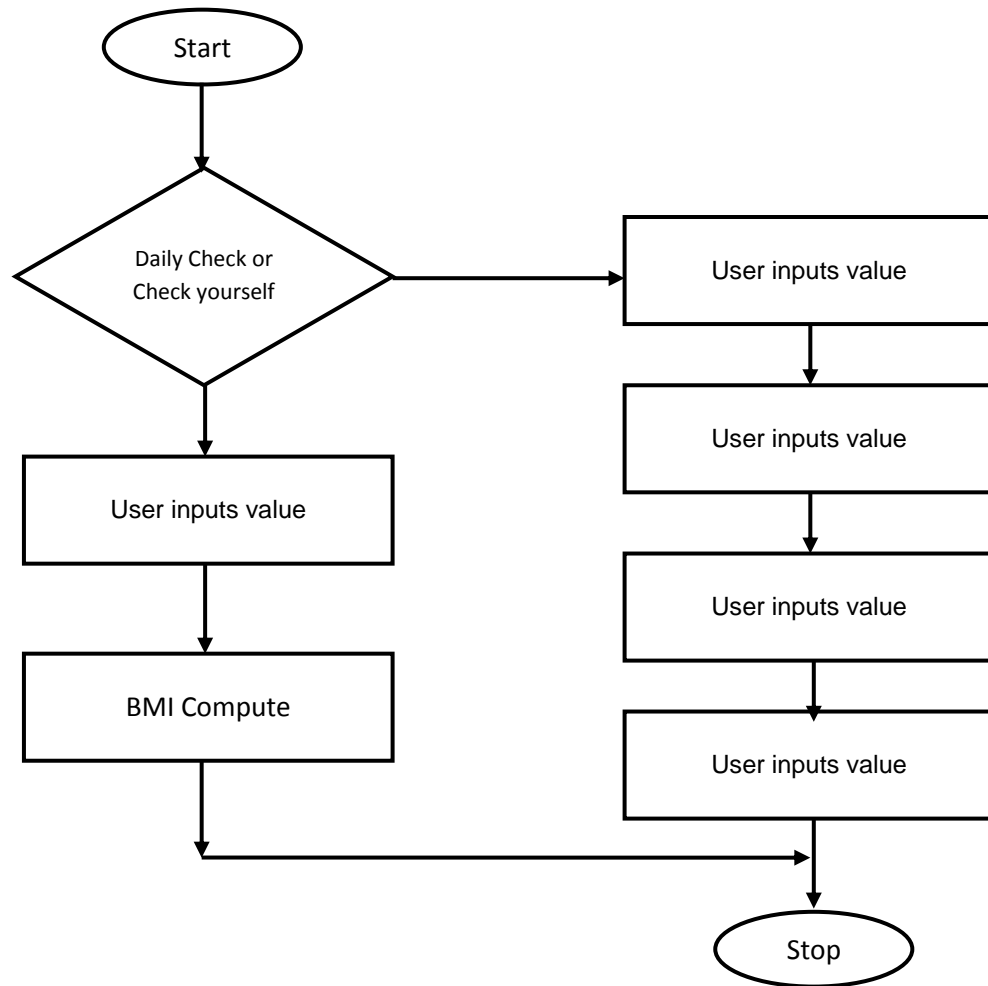


Fig. 3.7: System Flowchart of the Proposed System

### 3.8 System Modeling

A formal model of the proposed system is built using Unified Modeling Language (UML). The UML is a modeling system which provides a set of conventions that are used to describe a software system in terms of objects. It offers diagrams that provide different perspective views of the system parts. The UML diagrams used to model the system are; Use Case, Sequence and Activity diagrams.

A use case diagram graphically depicts the interactions between the system, the external system and the user. Use case diagrams play a major role in system design because it acts as a roadmap in constructing the structure of the system; it also defines who will use the system and in what way the user expects to interact with the system. The Use Case diagram for our expert system is shown in Fig. 3.8.

### 3.8.1 Use Case Diagram of the Proposed System

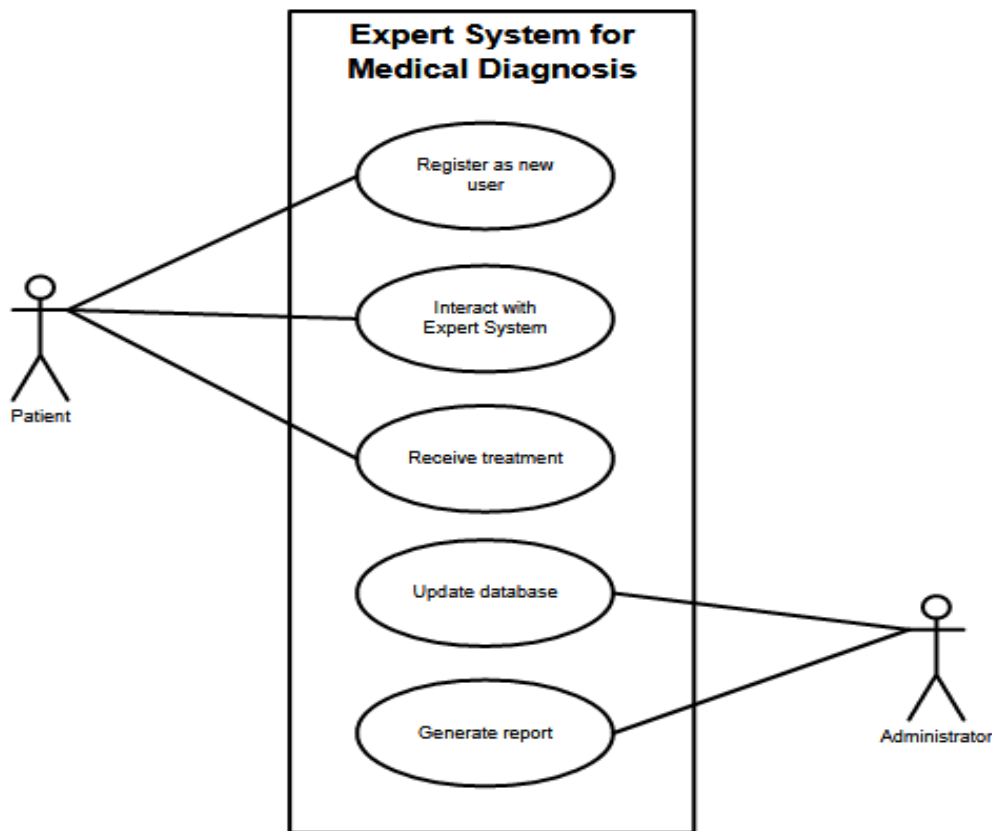


Fig. 3.8: Use-Case Diagram of the Proposed System

Activity diagrams graphically represent the performance of actions or sub-activities and the transactions that are triggered by the completion of the actions or sub-actions. It is a means of describing the workflow of activities. The purpose of an activity diagram is to provide a view of

flows and what is going on inside a Use Case. The Activity diagram for the proposed system Use Case is shown in Fig. 3.8 while Fig. 3.10 shows the Sequence diagram for the register Use Case.

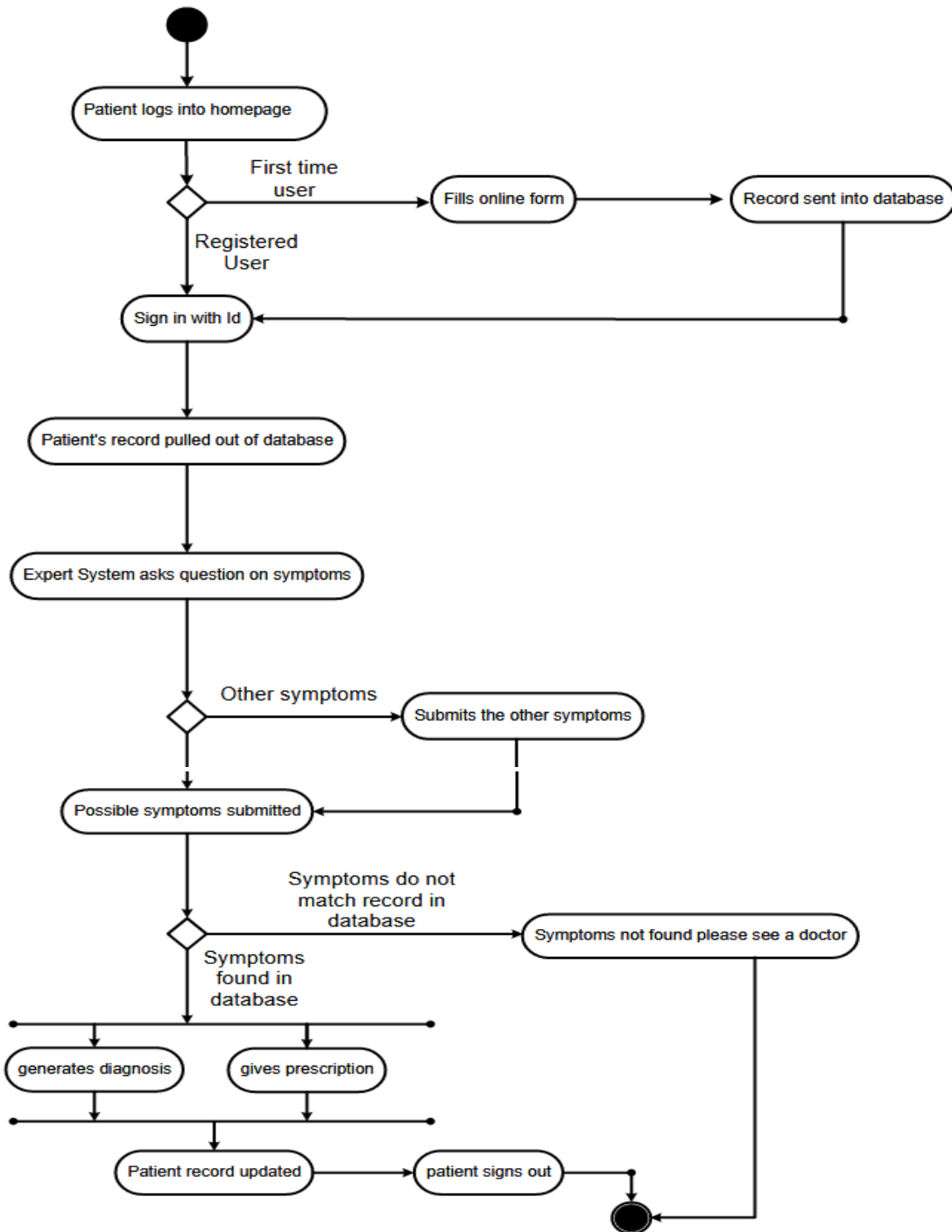


Fig. 3.9: Activity diagram of the Proposed System

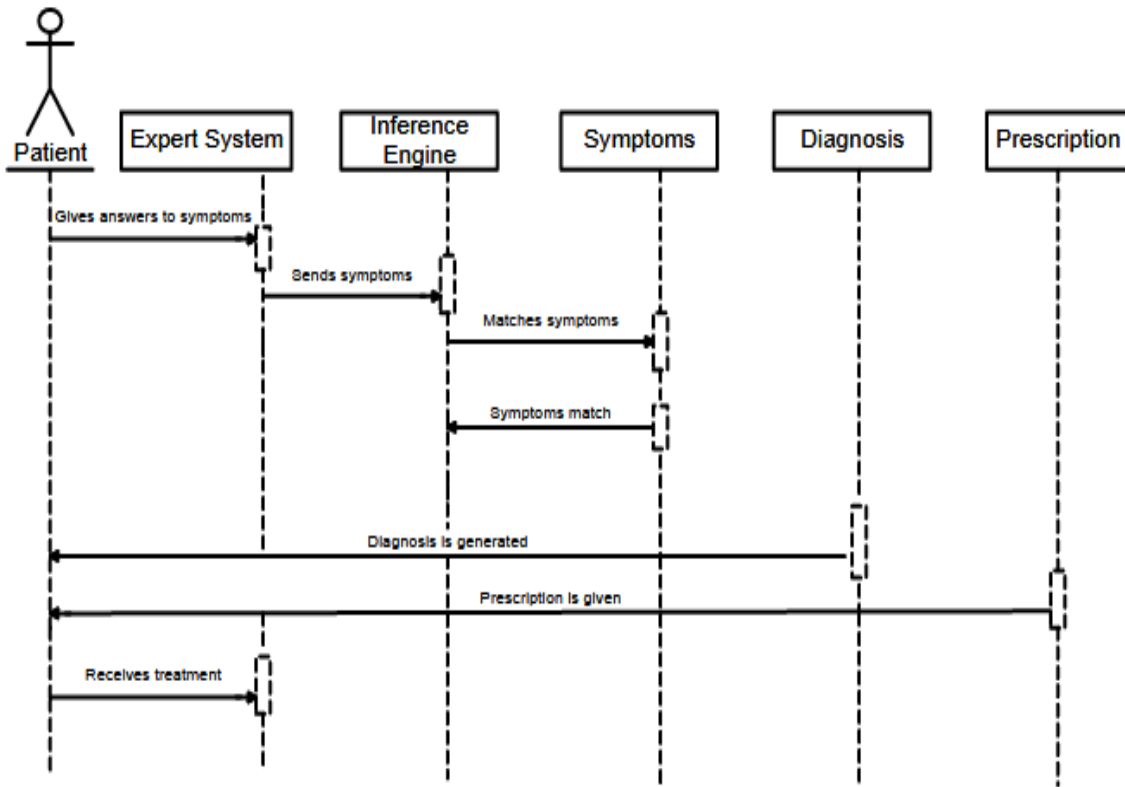


Fig.3.10: Sequence diagram for the Proposed Expert System' Use Case

### 3.9 Database Design

The database is comprised of 5 relations (tables), they include: admin table, disease, prescription, users, users\_test tables

**Table 1: Admin Table**

FieldName	FieldType	Field length
Username	varchar	20
Password	varchar	20

**Table 2: Disease Table**

FieldName	FieldType	Field length
Id	Integer	11
Symptoms	varchar	200
Disease	Varchar	200
Statue	varchar	50

**Table 3: Prescription Table**

<b>Filed Name</b>	<b>Field Type</b>	<b>Field</b>
Id	Integer	11
Disease	Varchar	200
Prescription	Varchar	200
Medications	Varchar	200

**Table 4: User Table**

<b>Field Name</b>	<b>Field Type</b>	<b>Field Length</b>
Surname	Varchar	50
Other name	Varchar	50
Address	Varchar	200
Email	Varchar	200
Username	Varchar	200

**Table 5: User test table**

<b>Field Name</b>	<b>Field Type</b>	<b>Field Length</b>
<b>Id</b>	Integer	11
<b>Username</b>	Varchar	50
<b>Password</b>	Varchar	50
<b>Disease</b>	Varchar	200
<b>Treatment</b>	Varchar	200

### 3.10 Input Design

This web based expert system will have a user interface that receives user input and displays desired output. The user interface consists of different web pages. The homepage (Figure 6) of the application will have different links that a user can navigate through, and accepts administrator's user name and password. Disease diagnosis link first page would have textboxes to fetch the name, password, email addresses and other necessary inputs, checkboxes that enable users tick their symptoms and activate processing.

**Expert System:** This is the page that is used by the patient to answer some few questions asked by the expert system.

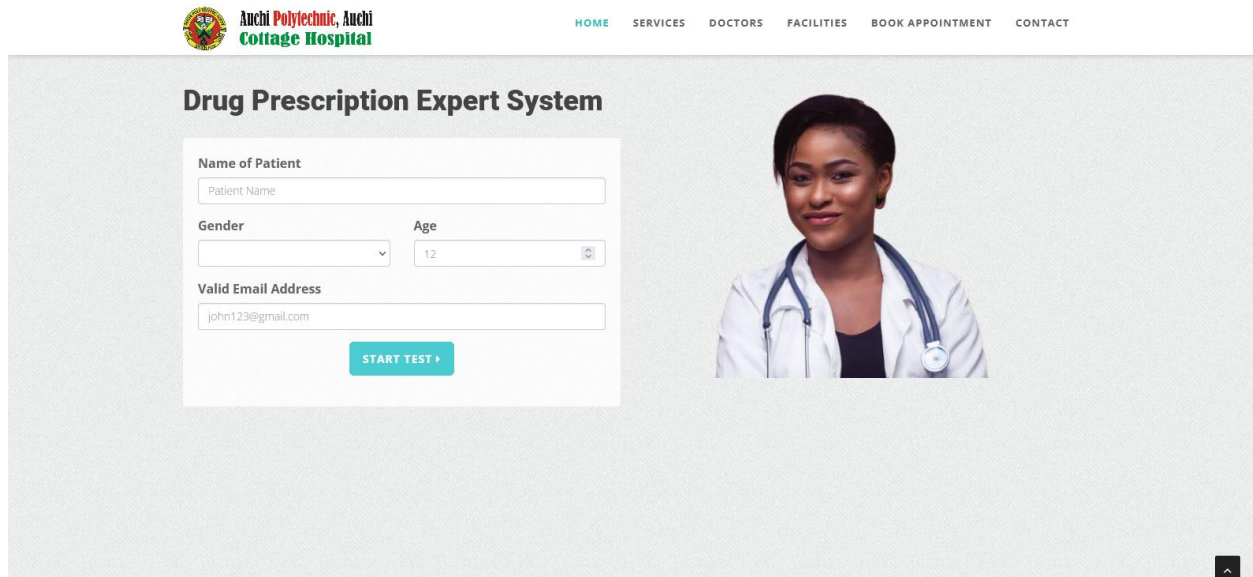


Fig. 3.11: Proposed System Expert System

**Login Page:** The administrator types in his/her user name and password in order for them to navigate to the main page where he/she to perform updates and settings.

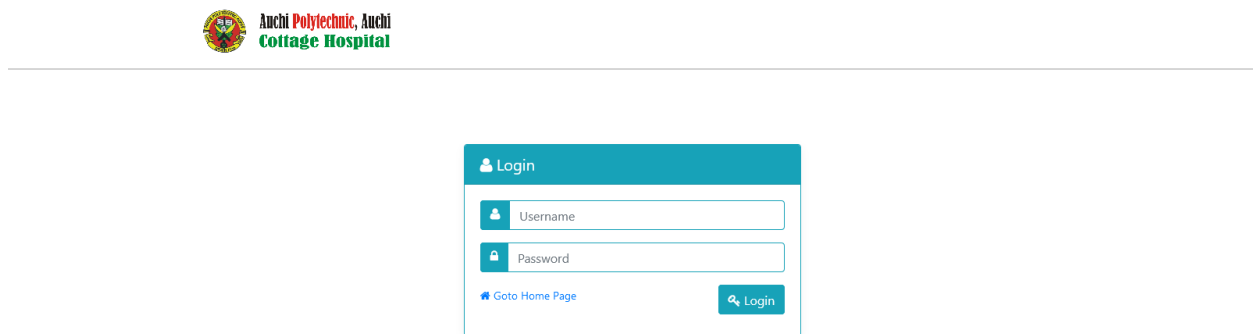


Fig. 3.12: Proposed System Login Page

### 3.11 Process Design

The two main actors of this expert system are the users and administrator. This expert system will have a database that stores needed information, created and maintained by relational

database management software. Input from users would be manipulated with a scripting language (serves as inference engine). The scripting language and the relational database management software would store data in the database, fetch needed information from the database, and send required output back to the user. The administrator is able to access the database, after valid login, to update drug prescriptions, view malaria drug prescriptions and view email addresses in the database.

### 3.12 Output Design

This web based expert system will also use the user interface to display desired output to users. WebPages and java scripts alerts will display output to the user. List of outputs from the system include information on disease, Email addresses, disease diagnosis result, and disease drug prescription.

**Drug Prescription:** This page output the result of expert system and its possible drug prescription.

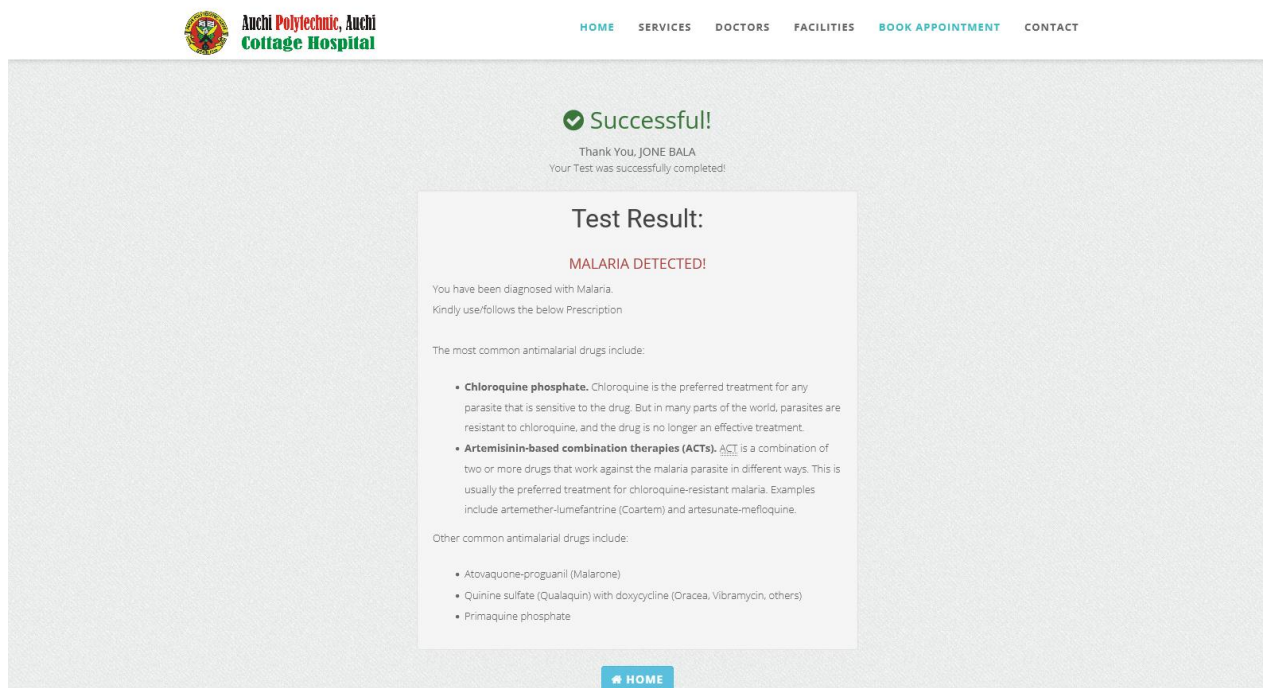


Fig. 3.13: Test Result and drug prescriptions

## CHAPTER FOUR

### PROGRAM AND IMPLEMENTATION

#### 4.0 Choice of Programming Language Development Tools

The system uses PHP and JavaScript are used for creative Graphical User Interface on the websites to give the best user experience to the user and the administrator by providing good Human-Computer Interaction capabilities. MySQL has been utilized as an open-source SQL database to store data and files which serves as the backend of the system.

#### 4.1 System Implementation

System implementation can be defined as the means by which the purpose of the system is achieved. This chapter explains how the website and the database will be implemented by Auchi Polytechnic Cottage Hospital. It involves the acquisition, development and installation of the hardware and software testing of the system and training the people that will use the system. It also covers the conversion and use of the new system by the management of Auchi Polytechnic Cottage Hospital.

The system was implemented using MySQL 5.0 as the backend database and PHP 5.3.1 as the scripting language. The diagnosing parameters were used as the rule based parameters to determine the diagnosing of each patient. The system was fed with valid data to test its robustness.

#### 4.2 System Changeover Plan

There are three various forms or types of changeover which are as follows

1. **Direct changeover:** Under this method of changeover, the old system is permanently disconnected and the new system is fully implemented or installed for use.

2. **Parallel changeover:** in this method of changeover from a new system to an old system, both the old and the new system are allowed to run concurrently over a period of time before the old system is discontinued.

3. **Phased changeover:** in this method of changeover, the changeover may involve several installations. This method therefore emphasizes the complete and successful installation of one location before advancing to the next location to commence installation.

The kind of changeover is that to be implemented in this kind of system is that of the parallel changeover which allows the old system to work concurrently with the new system before the existing system is dropped and the new system being implemented.

#### **4.3 Education and Awareness**

This is one of the important phases of a system implementation as it ensures the efficiency, effectiveness and proficiency of the users. In the design of this new system, it is not intended that a permanent system operator be employed, but rather that the prospective users should have a fair knowledge of the computer. Apart from this, it is the opinion of the designer of this system to;

- (i) Give seminar on the new system and
- (ii) Mount in-house short training program for the users (medical staff) of the system.

The training program is intended to highlight major aspects of this new software, the things that different modules can do and how to make best use of the software.

Two-week lecture programmes that will entail the following courses are recommended.

- i. *Computer Literacy and Application:*** This will comprise basic computer operation training, MS-DOS and Windows Operating System.

- ii. **Software Packages:** This course will focus on Word Processing using Microsoft Word and introduction to Database Management using Microsoft Access, and then, the Software developed for the new system.

#### **4.4 System Requirements**

The specification of the requirement which be met for the proper and smooth operation of a new system and this must be viewed carefully to avoid & prevent errors. This system requirement can be categorized into the following:

1. Hardware requirement.
2. Software requirement.

##### **4.4.1 Hardware Requirements**

A System unit with the following specification

- i. RAM 4gb
- ii. Processor 2.8Ghz
- iii. Operating system : 32 bit operating system
- iv. Windows: windows 7

##### **4.4.2 Software Requirements**

- i. Windows 7
- ii. MySQL
- iii. JavaScript, PHP/HTML, CSS
- iv. Browser e.g. Mozilla Firefox, Safari, chrome, Flock
- v. Local Server e.g. WAMP Server, XXAMP, AMPP or EasyPHP Server

## 4.5 The Interface Design

This is the physical structure of the visible side of the system, mainly to the users. That is the front end of the system, which the users of the system interacts with, it comprises of both inputs and output forms. The interface of the system is a graphical user interface and not a command type; it is also an interactive, clear and not clumsy interface. It is easy to use and user friendly.

The implementation of the new system supports a user interface based on the interactive web browser known as internet explorer and access is gain by supplying the username and password both of which aid the control of access to the website. The selection of each main menu leads to the sub-menus, which calls on inference procedure associated with that menu. The inference procedure is interactive and it guides intelligently to supply appropriate information.

### 4.5.1 Home page

This is the center that provides link to all other pages in the site. It consists of modules: Home, Register, Login, etc. The page gives a brief introductory message about the Web based multi-criteria system for Cottage Hospital. This is shown in Fig 4.1.

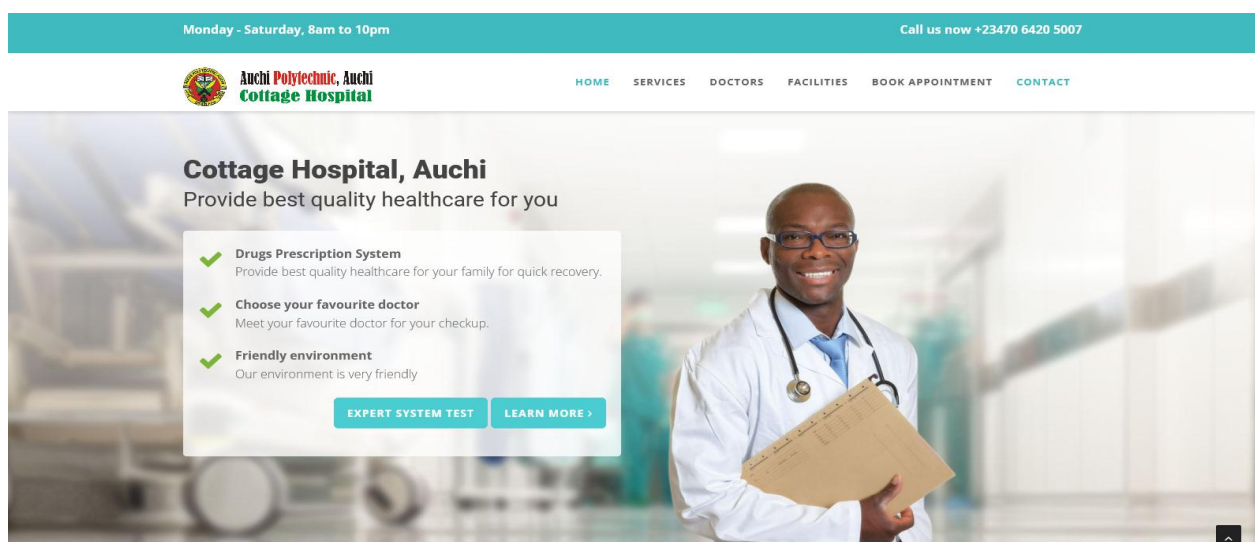


Fig. 4.1: Home Page

4.6 Program Flowchart

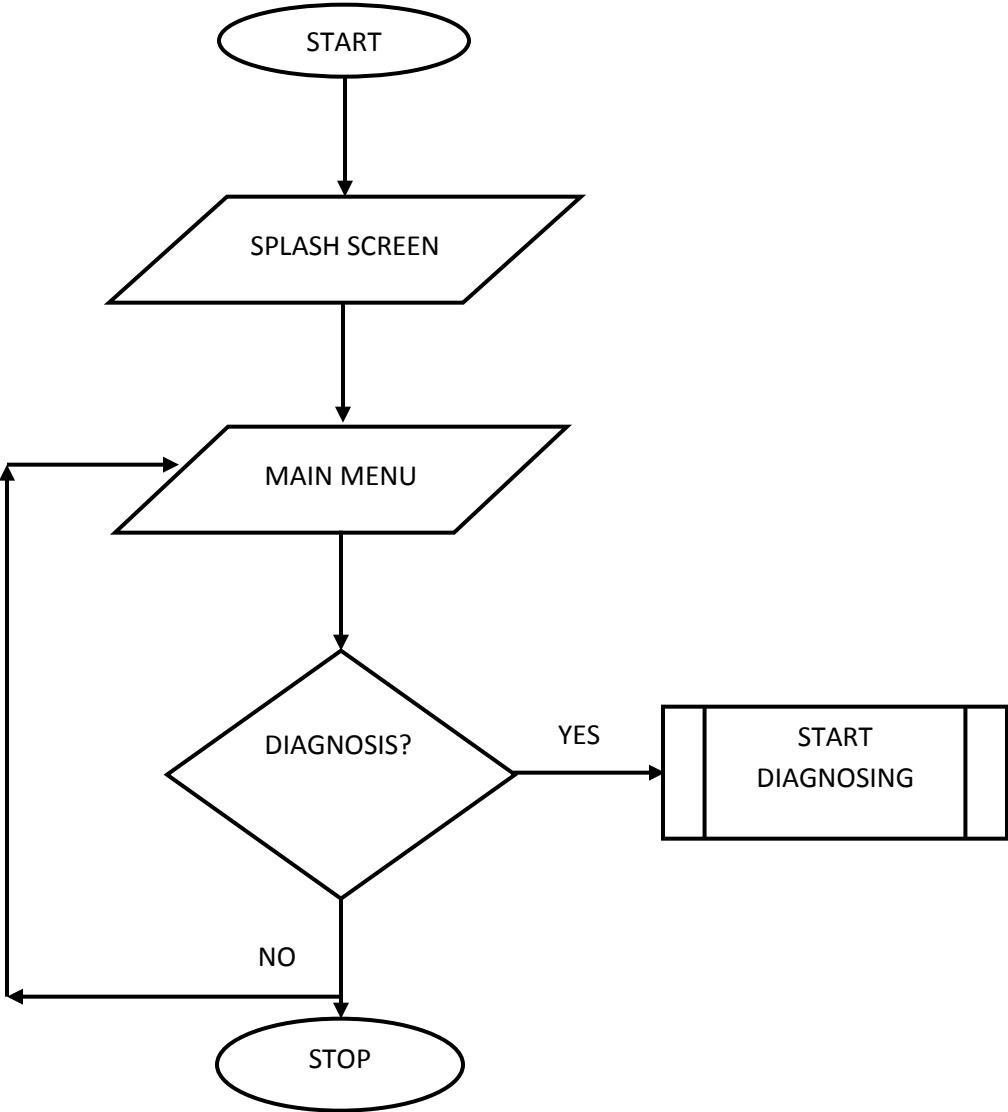


Fig. 4.6a: Program Flowchart

### 4.6.1 Diagnosis Flowchart

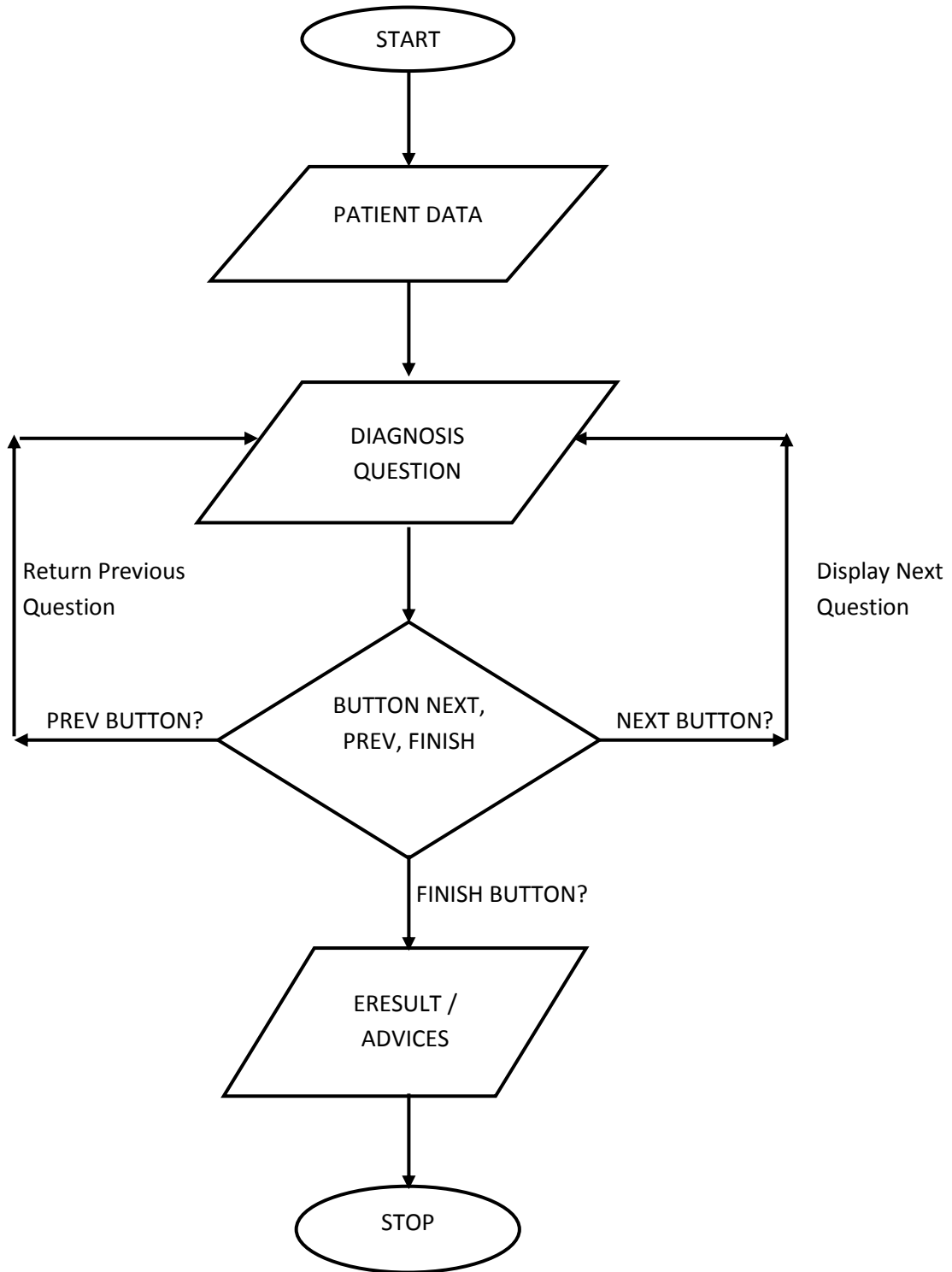


Fig. 4.6b: Diagnosing Flowchart

## 4.7 System Testing

In testing the database, it was ensured that the database captured the specified fields according to the respective attributes, and that the storage and retrieval functions of the database functioned properly. In process testing, it was ensured that every feature works satisfactorily. The application interface was properly tested to ensure that it queried the database as required and fetched required information for any particular page. The whole system was also tested to ensure that every part was well integrated and functional (black-box and white-box testing) the system.

### 4.7.1 Unit Testing

Unit testing deals with testing a unit as a whole. This would test the interaction of many functions but confine the test within one unit.

**Table 6: Unit Testing**

The Test Data	Expected Data	Actual Result
Home Page Form	The expected result was the screen from where you can decide to call up any of the sub systems	The home page enables user to have access to other sub systems
Log In Form	Expected to see the Log In command button so that one can log in.	When clicked on log in, a form appeared where you now supply your password to gain access to the software.
Register into Expert System	It is expected to enable patient register into the database	When clicked on registration, a form appears on the screen which the user can make use of in entering the personal data of the patient
Interacts with the Expert System	It is expected to enable patient to interact with the expert	This describes the event where the user interacts with the system,

	system. that is, gives response to the questions asked by the Expert System.	that is, gives response to the questions asked by the Expert System.
Report	When clicked on the system, it is expected to display the result of disease diagnosed by the expert system along with the prescriptions	When clicked on the button, the system displays prescriptions to diagnosed disease.
About Form	It is expected to see some information about the developer here.	In this module, the information about the developer is available.

#### 4.8 System Maintenance

The maintenance involves the monitoring, evaluation and periodic modification of the system so as to make necessary or desired improvements. This is carried out by the personnel with the use of the available software and hardware. The forms of maintenance that this system will adopt include the following:

- Inserting new data into the database by the administrator.
- Deleting redundant information from the database.
- Altering the database structure by adding new tables or editing existing ones in order to meet the changing needs of the website in relation to development (socialization)
- Changing the CSS (Cascading Style Sheet) document for the website which affects the layout and general theme of the website that is visible to the users.

#### 4.9 Documentation

To comfortably use the web application, the administrator should have access to a web server with PHP, HTML, CSS, JavaScript, MySQL Server and Internet Information Service (IIS)

web server installed and running. Once this is achieved, the administrator can easily upload the relevant files / web resources and other information to the server, and save as a Webpage which can be browsed from any system connected to the network. The Webpage can also be used as part of a website to enable easy access to visitors and personnel. A database administrator should be called upon to properly manage the database which will be used by the store. The database administrator should work hand-in-hand with the management of NYSC in order to fully understand and represent the needs of the system before building the database and its schema. The new website should be tested on a sample of staff and customers before being fully implemented as the new way of combating crime. This is to note and address any unexpected shortcomings of the system, or oversight on the part of the system designer or the staff of NYSC.

#### **4.10 Program Debugging**

Programmers tend to make errors, or programs tend to have errors (bugs) during the testing process. But the ability of the programmer to correct such errors makes the programmer competent. The process of identifying and removing these errors is termed program debugging. The program is run continually until all errors (bugs) are detected and corrected.

## CHAPTER FIVE

### SUMMARY, CONCLUSION AND RECOMMENDATIONS

#### 5.0 Summary

In summary, to ensure its effectiveness, the implementation of ePrescription in a large hospital requires system customization guided by the specific needs of particular departments, at both the initial and the maintenance stage. This task is best achieved by a multidisciplinary team in collaboration with the end-user (the representatives of the prescribing physicians).

#### 5.1 Conclusion

The implementation of an expert system on diseases diagnosis system is aimed at achieving efficiency and proficiency. The application program was tested and found to be efficient. The program was design with HTML, PHP, JavaScript, and MySQL as the database which can easily be understood by the users. The advancement in computer technology has no doubt helped and will continue to help man in his decision making process; thus facilitating efficiency in all aspect of human endeavors.

#### 5.2 Recommendation

In the light of our finding in the course of this project, it may be pertinent to make the following recommendation:

- i. The computerization effort should gradually be extended to cover all other forms of diseases.
- ii. The computerization effort should also gradually be extended to cover all operations and other forms of diagnosis in the hospital as indicated in this study

- iii. Having regard to resource constraint, the hospital should acquire a mini computer with large memory to cater for the number of patients that was diagnosed.
- iv. This hardware should be located close to the front desk or office to allow easy and early interaction between the user and the computer.
- v. More research work should be carried out on diagnostic, treating all forms of diseases.
- vi. The system should be updated from time to time since the symptom varies and medication should be improved on the system because scientists are tending to discover better drugs.

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## APPENDIX I: PROGRAM SOURCECODES

```
<!DOCTYPE html>
<html>
<head>
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <link href="css/bootstrap.min.css" type="text/css" rel="stylesheet">
  <link href="css/font-awesome.min.css" type="text/css" rel="stylesheet">
  <link href="css/font-size.css" type="text/css" rel="stylesheet">
  <title>GPS/GPRS RMIS</title>
</head>
<body>

<div class="container">
  <p class="h3 font-weight-bold mb-3 text-center bg-danger text-white p-4">GPS/GPRS Road Maintenance Information System
    <button type="button" class="btn btn-primary float-right"
onclick="javascript: window.location.href='signin.php';">Sign in</button>
  </p>

  <div class="font-weight-bold row pl-3 h5 mb-4">CURRENT LOCATION</div>

  <div class="row">
    <div class="col-12 col-md-5">
      <div class="row">
        <div class="form-group col-6 col-md-6">
          <label class="font-weight-bold ">Latitude: </label><br />
          <input type="text" name="lat" id="lat" class="form-control"
readonly="readonly" />
        </div>

        <div class="form-group col-6 col-md-6">
          <label class="font-weight-bold ">Logitude: </label><br />
          <input type="text" name="long" id="long" class="form-control"
readonly="readonly" />
        </div>

        <!-- <div class="form-group mr-2">
          <label>&emsp;</label><br />
          <button onclick="getLocation();
document.getElementById('demo').innerHTML='Obtaining Location...';
document.getElementById('lat').value = '';
document.getElementById('long').value = '';" id="btnRefresh" class="btn btn-
info"><i class="fa fa-refresh"></i> Refresh</button>
        </div> -->
      </div>

    <div class="form-group">
      <label for="state" class="font-weight-bold">State</label>
      <select id="state" class="custom-select custom-control">
        <option selected="selected" value="">Select State</option>
      </select>
    </div>
  </div>
</div>
```

```

        <option value="Edo State">Edo State</option>          </select>
    </div>

    <div class="form-group">
        <label for="lga" class="font-weight-bold">LGA</label>
        <select id="lga" class="custom-select custom-control">
            <option selected="selected" value="">Select LGA</option>
            <option value="Etsako Central">Etsako Central</option><option
value="Etsako East">Etsako East</option><option value="Etsako West">Etsako
West</option>          </select>
        </div>

        <div class="form-group">
            <label for="situation" class="font-weight-bold">Situation of
Road</label>
            <select id="situation" class="custom-select custom-control">
                <option selected="selected" value="">Select Road Condition</option>
                <option value="Good">No Potholes, No Alligator Cracks & No Slippage
Cracks</option>
                <option value="Fair">No Potholes But Alligator Cracks</option>
                <option value="Failed">Potholes & Alligator Cracks</option>
                <option value="Bad">Potholes, Alligator Cracks & Slippage
Cracks</option>
            </select>
        </div>

        <div class="form-group mt-4 mb-5 text-right">
            <button onclick="getLocation();" id="btnRefresh" class="btn btn-info
mr-3"><i class="fa fa-refresh"></i> Refresh</button>
            <button type="button" class="btn btn-success" id="btnSubmit"
disabled="disabled">
                <i class="fa fa-external-link"></i> Submit
            </button>
        </div>

        <div class="demo"></div>
    </div>

    <div class="col-12 col-md-7 col-lg-7">
        <div id="country"></div>
        <div id="region"></div>
        <div id="city"></div>
        <div id="ip"></div>
        <pre id="response"></pre>

        <div id="mapholder" class="text-center" style="position: relative;
overflow: hidden;"></div>
    </div>

</div>
</div>

<!-- key=AIzaSyBu-916DdpKAjTmJNigngS6HL_kDIKU0aU -->
<script src="js/jquery.min.js"></script>

```

```

<script
src="https://maps.googleapis.com/maps/api/js?sensor=true&callback=getLocation
" async defer></script>
<script>
getLocation();
var x=document.getElementById("mapholder");

$('#btnSubmit').click(function(){
var lat=$.trim($('#lat').val());
var lng=$.trim($('#long').val());
var lga=$.trim($('#lga').val());
var state=$.trim($('#state').val());
var situation=$.trim($('#situation').val());

if(situation.length === 0){
$('#situation').addClass('is-invalid').focus();
return false;
}
else if(state.length === 0){
$('#state').addClass('is-invalid').focus();
return false;
}
else if(lga.length === 0){
$('#lga').addClass('is-invalid').focus();
return false;
}
else{
$.ajax({
type:'POST',
url:'process.php',
dataType: 'text',

data:'lat='+lat+'&lng='+lng+'&situation='+situation.replace(/&/g, '~')+'&state
='+state+'&lga='+lga,
success:function(msg) {
if($.trim(msg) === 'success'){
$("#demo").html('<div class="alert alert-success font-13"><i
class="fa fa-check-circle"></i> Your Message has been received successfully!
Thank you.</div>');

setTimeout(function(){window.location.href=window.location;},
2000)
}else{
$("#demo").html('<div class="alert alert-danger"><i class="fa
fa-times"></i> '+msg+'</div>');
}
}
});
}
});

function getLocation()
{

```

```

    document.getElementById('mapholder').innerHTML='<i class="fa fa-spinner
fa-spin"></i> Obtaining Location...';
    document.getElementById('lat').value = '';
    document.getElementById('long').value = '';
    if (navigator.geolocation){
        navigator.geolocation.getCurrentPosition(showPosition,showError);
        $('#btnSubmit').attr('disabled', false);
    }
    else{
        x.innerHTML="Geolocation is not supported by this browser.";
        $('#btnSubmit').attr('disabled', true);
    }
}

function showPosition(position) {
    var lat=position.coords.latitude;
    var lon=position.coords.longitude;
    var latlon=new google.maps.LatLng(lat, lon);
    var mapholder=document.getElementById('mapholder');
    var coordinates = [lat, lon];

    mapholder.style.height='480px';
    mapholder.style.width='100%';
    x.innerHTML = "";

    document.getElementById('lat').value = lat;
    document.getElementById('long').value = lon;

    var myOptions={
        center:latlon,
        zoom:15,
        mapTypeId:google.maps.MapTypeId.ROADMAP,//'satellite',
        //mapTypeIdControl:false,
        navigationControlOptions:{style:google.maps.NavigationControlStyle.SMALL}
    };
    var map=new
    google.maps.Map(document.getElementById("mapholder"),myOptions);
    var marker=new google.maps.Marker({
        position:latlon,
        map:map,
        title:"You are here!"
    });
}

function showError(error)
{
    switch(error.code)
    {
        case error.PERMISSION_DENIED:
            x.innerHTML="User denied the request for Geolocation."
            break;

```

```

case error.POSITION_UNAVAILABLE:
    x.innerHTML="Location information is unavailable."
    break;
case error.TIMEOUT:
    x.innerHTML="The request to get user location timed out."
    break;
case error.UNKNOWN_ERROR:
    x.innerHTML="An unknown error occurred."
    break;
}

$('#btnSubmit').attr('disabled', true);
}

// Step 2: Get city name
function getCity(coordinates) {
    var xhr = new XMLHttpRequest();
    var lat = coordinates[0];
    var lng = coordinates[1];

    // Paste your LocationIQ token below.
    xhr.open("GET",
"http://maps.google.com/maps/api/geocode/json?latlng="+lat+","+lng+"&sensor=true&format=json", true);
    xhr.send();
    xhr.onreadystatechange = processRequest;
    xhr.addEventListener("readystatechange", processRequest, false);

    function processRequest(e) {
        if (xhr.readyState == 4 && xhr.status == 200) {
            var response = JSON.parse(xhr.responseText);
            var city = response.address.city;
            document.getElementById('city').innerHTML=city;
            return;
        }
    }
}
</script>
<!-- <script
src="https://apis.google.com/js/client.js?onload=checkAuth"></script> -->
</body>
</html>

```

## APPENDIX II: PROGRAM SCREENSHOTS

### Home Page

Monday - Saturday, 8am to 10pm Call us now +23470 6420 5007

**Auchi Polytechnic, Auchi**  
**Cottage Hospital**

[HOME](#) [SERVICES](#) [DOCTORS](#) [FACILITIES](#) [BOOK APPOINTMENT](#) [CONTACT](#)

### Cottage Hospital, Auchi

Provide best quality healthcare for you

- ✓ **Drugs Prescription System**  
Provide best quality healthcare for your family for quick recovery.
- ✓ **Choose your favourite doctor**  
Meet your favourite doctor for your checkup.
- ✓ **Friendly environment**  
Our environment is very friendly

[EXPERT SYSTEM TEST](#) [LEARN MORE >](#)

### Expert System

**Auchi Polytechnic, Auchi**  
**Cottage Hospital**

[HOME](#) [SERVICES](#) [DOCTORS](#) [FACILITIES](#) [BOOK APPOINTMENT](#) [CONTACT](#)

### Drug Prescription Expert System

**Name of Patient**

**Gender**  **Age**

**Valid Email Address**

[START TEST >](#)

## Login Page



### Login

[Goto Home Page](#)

## Test Result and drug prescriptions



**Successful!**

Thank You, JONE BALA  
Your Test was successfully completed!

### Test Result:

**MALARIA DETECTED!**

You have been diagnosed with Malaria.  
Kindly use/follows the below Prescription

The most common antimalarial drugs include:

- **Chloroquine phosphate.** Chloroquine is the preferred treatment for any parasite that is sensitive to the drug. But in many parts of the world, parasites are resistant to chloroquine, and the drug is no longer an effective treatment.
- **Artemisinin-based combination therapies (ACTs).** ACT is a combination of two or more drugs that work against the malaria parasite in different ways. This is usually the preferred treatment for chloroquine-resistant malaria. Examples include artemether-lumefantrine (Coartem) and artesunate-mefloquine.

Other common antimalarial drugs include:

- Atovaquone-proguanil (Malarone)
- Quinine sulfate (Qualaquin) with doxycycline (Oracea, Vibramycin, others)
- Primaquine phosphate

[HOME](#)