**ABSTRACT**

Detecting diseases at early stage can enable to overcome and treat them appropriately. Identifying the treatment accurately depends on the method that is used in diagnosing the diseases. This research points towards the design and implementation of an electronic diagnosis system. This system is a web based expert system that is able to diagnose patients based on their symptoms in other to determine if they are sick or not. However, due to some limitations encountered, the proposed system is able to diagnose and identify malaria in patients only. This will be used to analyze the impact of an electronic diagnosis in the economy, after which further research can be made to improve on the system. Structured System Analysis and Design Methodology (SSADM) was used in this research. Development tools used for developing the proposed system includes; HTML for structuring the web interface, CSS for designing the structured interface, Javascript for user interface friendliness, PHP for the business logic, and MySQL for the database.

**CHAPTER ONE**

**INTRODUCTION**

**1.1 Background of the Study**

During recent years there have been great advances in the field of Biomedicine. The incorporation of computational and artificial intelligence techniques to the field of medicine has yielded remarkable progress in predicting and detecting diseases (Shortliffe et al, 2006).

Artificial Intelligence is seen as the brainpower exhibited by an artificial unit. It is a division of computer science dealing with sharp behavior, knowledge. Research in artificial intelligence is anxious with producing machines to computerize jobs requiring sharp actions. Examples include capability to answer diagnostic and user question, speech and facial recognition (Eugena et al, 2009). Artificial intelligence is separated into two categories. These two categories are conventional artificial intelligence and computational intelligence. Conventional artificial intelligence includes machine learning and statistical analysis. Computational intelligence includes neural networks and fuzzy systems. The other applications of artificial intelligence are automation, computer vision, artificial creativity, expert system and knowledge management (Jimmy, 2013).

Expert System is one of the most common applications of artificial intelligence. It is a computer program that simulates the decision and actions of a person or an association that has specialist facts and experience in a particular field. Normally, such a system contains a knowledge base containing accumulated experience and a set of rules for applying the knowledge base to each particular situation. The major features of expert system are user interface, data representation, inference, explanations etc. Advantages of expert system are increased reliability, reduced errors, reduced cost, multiple expertise, intelligent database, reduced danger etc. Disadvantages of expert system are absence of common sense and no change with changing environment (Mohammed et al, 2011).

Computer-based methods are increasingly used to improve the quality of medical services. Artificial Intelligence (AI) is the area of computer science focusing on creating expert machines that can engage on behaviors that humans consider intelligent (Russell et al, 2002). An expert system is a system that employs human knowledge captured in a computer to solve problems that ordinarily require human expertise. Expert system seeks and utilizes relevant information from their human users and from available knowledge bases in order to make recommendations (Santosh et al, 2010).

Diagnosis system is a system which can diagnose diseases through checking out the symptoms. Knowledge based online diagnosis system is developed for diagnosis of diseases based on the knowledge given by doctors in the system. A computer Program Capable of performing at a human-expert level in a narrow problem domain area is called an expert system. Management of uncertainty is an intrinsically important issue in the design of expert systems because much of the information in the knowledge base of a typical expert system is imprecise, incomplete or not totally reliable (Negnevitsky, 2005).

An expert system (ES) is a kind of information system and acts as a human expert for users by using knowledge base rules in the specific area. The ES consists of the knowledge base and a software module that has an inference engine for decision support to end users in the form of advice. To analyze large volumes of data, data mining that integrates techniques such as artificial intelligence, machine learning, statistics, database systems, and pattern recognition is used. There are a great number of data-mining algorithms for deferent data analysis tasks. Expert systems are used successfully in the medical diagnosis field. The knowledge base of medical expert systems consists of medical information, rule-extracted patient symptoms, and advice for the diagnosis of the patient's diseases. Successful implementations of the artificial neural network (NN)-fuzzy integrated approach in medicine have been reported for diagnosis, treatment, and prediction (Shu-Hsien, 2005).

**1.2 Statement of the Problem**

The health of individuals is said to be very important. Currently in hospitals, doctors may have to see many patients in other to determine their health problems. This is time consuming and may cause so much stress on the doctor hence medical decision making becomes a very hard activity because the human experts who have to make decisions can hardly process the huge amounts of data. Eventually, treating patients become extremely difficult if the diagnosis method is not good.

Also, most individuals are so busy that they lack the time to visit hospitals when there is a symptom of illness in their body hence coursing body break down or sometimes may even lead to death.

**1.3 Aim and Objectives of the Study**

The aim of this research work is to design and implement an electronic diagnosis system that will be able to diagnose malaria patients in other to ease the stress of doctors and patients in hospitals.

The objectives are as outlined below:

1. To identify Malaria fever which could be diagnosed using expert system
2. To save time and effort of patients by replacing the traditional malaria diagnosis system through an expert system
3. To assist patients in diagnosing their urination problems before visiting physicians
4. To ease doctors the stress of diagnosing so many patients

**1.4 Significance of the Study**

This study will serve as a relief to those who are too busy or feel too lazy visiting hospitals since there will be a system that can technically replace doctors in the area of diagnosis.

Also, this study may aid in decreasing the percentage of individuals that fall seriously sick within a particular period due to the fact that they remain unaware of their illness symptoms, and might even decrease the death rate of individuals caused by malaria fever within the system implementation period.

**1.5 Scope of the Study**

This research work covers the design and implementation of an electronic diagnosis system with special focus to malaria fever as the illness to be diagnosed. The system will only be able to diagnose malaria symptoms in other to determine whether a patient has malaria fever or not.

**1.6 Definition of Terms**

* **Artificial Intelligence:** The theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.
* **Expert System:** This is a computer program that is designed to emulate and mimic human intelligence, skills or behavior.
* **Diagnosis:** This is the identification of the nature of an illness or other problem by examination of the symptoms.
* **Symptom:** This is a physical or mental feature which is regarded as indicating a condition of disease, particularly such a feature that is apparent to the patient.
* **Patient:** This is a person receiving or registered to receive medical treatment.
* **Hospital:** This is an institution providing medical and surgical treatment and nursing care for sick or injured people.
* **Doctor:** This is a person who is qualified to diagnose and treat ill people.

**CHAPTER TWO**

**LITERATURE REVIEW**

**2.1 Diagnosis**

Diagnosis is the identification of a condition, disease, disorder, or problem by systematic analysis of the background or history, examination of the signs or symptoms, evaluation of the research or test results, and investigation of the assumed or probable causes. Effective prognosis is not possible without effective diagnosis.

Making a diagnosis is a complex cognitive task that involves logical reasoning and pattern recognition (Scott et al, 2002). Although the process happens largely at an unconscious level, we can identify two essential steps according to Scott et al (2002).

In the first step, you enumerate the diagnostic possibilities and estimate their relative likelihood. Experienced clinicians often group the findings into meaningful clusters, summarized in brief phrases about the symptom, body location, or organ system involved, such as “generalized pruritus,” “painless jaundice,” and “constitutional symptoms.” These clusters, or clinical problems, may be of biologic, psychological, or sociologic origin, and they are the object of the differential diagnosis (Scott et al, 2002).

In the second step in the diagnostic process, you incorporate new information to change the relative probabilities, rule out some of the possibilities, and, ultimately, choose the most likely diagnosis. For each diagnostic possibility, the additional information increases or decreases the likelihood (Scott et al, 2002).

**2.2 Applications of Expert Systems in Medical Diagnoses**

The most prolific application of expert systems to date has been in the area of medical diagnosis. This is probably because of the expert systems have been very effective in this area. The expert system can be used to assist a physician in diagnosing medical problems of a patient or else be used in the interpretation of medical test results.

A classical medical diagnosis expert system is the MYCIN. It was developed to capture the knowledge of medical experts in infectious blood diseases. MYCIN captured the expertise of clinicians on blood diseases to provide accurate and quick diagnosis of the present disease and the proper therapeutic recommendation. Another feature that made MYCIN valuable apart from its ability to diagnose infectious blood diseases is its contributions to the understanding of introducing an expert system into the workplace (Anthony et al, 2015).

Aside from MYCIN, another expert system, Diagnosis Pro provides differential diagnosis in the field of general internal medicine, family practice, paediatrics, geriatrics and gynecology. After the physician has entered the most important attributes (signs, symptoms lab result, X-ray results) the system generates a list of possible diseases arranged in a hierarchical format. By highlighting any disease in the list, the physician gets an instant review, including clinical presentation and characteristics, recommended lab tests, pathophysiology, rule outs, complications and more. The physician can also rule out or confirm a disease by entering the name of the disease and receiving all the information associated with it. Another expert system used in medical diagnosis is the Global Infectious Diseases & Epidemiology Network, GIDEON. In addition to diagnosis, GIDEON is used for simulation and informatics in the fields of geographic medicine and infectious diseases, and Clinical Microbiology. The expert system was designed to diagnose all the world’s infectious disease, based on symptoms, signs, laboratory testing and dermatological profile. Though, GIDEON is country specific. The database incorporates 327 diseases, 205 countries, 806 bacterial data and 185 antibacterial agents. Gideon’s diagnostic module enables the user to access all epidemiological parameters, clinical hints, diagnostic tests, and optimal therapy. After specifying the suspected country of disease, acquisition and entering the sign and symptoms of the patient, GIDEON provides a ranked list of differential diagnosis. Then, Post-Operative Expert Medical System, POEMS provides decision support system for post-operative care. POEMS was developed to give advisory and decision support to less experienced staff. It interactively receives data obtained from the patients based on the standard strategy used by the medical staff, viz., past medical history, operative history, examinations and investigative tests. From these data, POEMS presents an ordered list of likely, possible and not-likely candidate diagnosis and can answer questions on how the diagnosis was reached, and what further investigative action could be taken to focus on a particular diagnostic candidate (Kenneth et al, 2018).

**2.3 Malaria and Related Diseases**

Malaria is a potentially life-threatening disease caused by infection with Plasmodium protozoa transmitted by an infective female Anopheles mosquito. Infection caused by a particular specie of the protozoa called Plasmodium falciparum caries a poor prognosis with high mortality if untreated, but it has an excellent prognosis if diagnosed early and treated appropriately (Herchline, 2017).

Commonly presenting clinical symptoms for malaria include: paroxysmal fever, shaking chills and sweats (every 48 or 72 hours, depending on the species), headache, cough, fatigue, malaise, arthralgia and myalgia. Many other diseases have some of these symptoms in common with malaria. As a result these other diseases are said to constitute the differential diagnosis of malaria and referred here as malaria-related diseases. The most important malaria-related diseases include: dengue fever, zika virus infection, chikungunya virus, pneumonia, influenza, enteric fever (typhoid infection), pyogenic infection, leptospirosis, infectious mononucleosis, HIV seroconversion, amoebic liver abscess, African trypanosomiasis (sleeping sickness), rickettsia infection, legionnaire’s disease and pulmonary tuberculosis. In such situations, confirming the diagnosis of malaria becomes a difficult task for the clinician. Best clinical practices require that this be done by placing the differentiating signs/symptoms side by side with the differentiating investigations. This will rule out the least likely diagnosis leaving only a most likely one. This elimination methodology is applied serially until the specific diagnosis of malaria or otherwise is made. It is true that in some cases a patient may be affected by more than one disease sharing similar signs and symptoms. In such cases the patient can be diagnosed with more than one disease. But then, providing reliable data gathering as in signs, symptoms and investigations as well as diagnostic decision support is a complex and herculean process. Yet this is the goal of public health efforts. To improve on healthcare delivery, the tools to accomplish these are continuously being rendered digital in form of intelligent healthcare informatics. Though, these tools have been expensive, unsupportable, and inaccessible, especially for developing countries (Kenneth et al, 2018).

**2.4 Review of Related Literature**

In this research work, related works are reviewed to enable the researcher to follow the trend of thought in the area of health diagnosis. The review serves as an advantage in a way that it enables or help researchers situate or relate their study to previous works done in the area of concern.

**2.4.1 Development of a Medical Expert System as an Expert Knowledge Sharing Tool on Diagnosis and Treatment of Hypertension in Pregnancy**

This research paper outlined the development of a Medical Expert System for the diagnosis and treatment Hypertension in Pregnancy to be used in the Reproductive Health Division, at Moi Teaching and Referral Hospital in Eldoret, Kenya. The Diagnostic and Treatment Expert System for Hypertension in Pregnancy has so far remained at the testing phase of its life cycle and is yet to be implemented. During the research, it was found that there is an acute shortage of specialist obstetricians in the Reproductive Health Division which implies that there is also scarce expert knowledge on the diagnosis and treatment of Hypertension in Pregnancy, yet the condition continues to kill many women of reproductive age in Kenya, hence the need to develop the Medical Expert System (MES) as an expert knowledge sharing tool to be used by other medical personnel within the Reproductive Health Division who are not specialists in diagnosis and treatment of Hypertension in Pregnancy (Gudu et al, 2012).

**2.4.2 UnPatient: A Knowledge Base for Medical Diagnostic Expert Systems**

Medical diagnosis is based on a variety of tasks: accumulation of patient data, application of patient-independent knowledge, generation and evaluation of diagnostic hypotheses, and the integration of patient-dependent and -independcnt findings. UnPatient supports the application and the integration of patient-indepe:ndent findings. It provides a knowledge representation mechanism which can be applied to any medkal problcm domain used for diagnosis. The medical knowledge can be accessed by symptoms as well as by diseases. Finally, it supports the integration of static knowledge and procedural heuristics for effective diagnostic support (Christian et al, 2002).

**2.4.3 Human Disease Diagnosis Using a Fuzzy Expert System**

Human disease diagnosis is a complicated process and requires high level of expertise. Any attempt of developing a web-based expert system dealing with human disease diagnosis has to overcome various difficulties. This paper describes a project work aiming to develop a web-based fuzzy expert system for diagnosing human diseases. Now a days fuzzy systems are being used successfully in an increasing number of application areas; they use linguistic rules to describe systems. This research project focuses on the research and development of a web-based clinical tool designed to improve the quality of the exchange of health information between health care professionals and patients. Practitioners can also use this web-based tool to corroborate diagnosis. The proposed system is experimented on various scenarios in order to evaluate its performance. In all the cases, proposed system exhibits satisfactory results (Mir et al, 2010).

**2.4.4 Medical Expert Systems for Diagnosis of Various Diseases**

Diseases should be treated well and on time. If they are not treated on time, they can lead to many health problems and these problems may become the cause of death. These problems are becoming worse due to the scarcity of specialists, practitioners and health facilities. In an effort to address such problems, studies made attempts to design and develop expert systems which can provide advice for physicians and patients to facilitate the diagnosis and recommend treatment of patients. This review paper presented a comprehensive study of medical expert systems for diagnosis of various diseases. It provided a brief overview of medical diagnostic expert systems and presented an analysis of already existing studies (Jimmy, 2013).

**2.4.5 An Advanced Automatic Electronic Diagnosis System**

Every complex system is liable to faults or failures. In most general terms a fault is any change in a system that prevents it from operating in the proper manner. In this research study, the diagnosis of catastrophic defects in complex digital circuits. In fact, in current days, the technical diagnosis is great challenge for design engineers because diagnostic problems are generally under determinate. It is also a deductive process with one set of data creating, in general, unlimited number of hypotheses among which one should try to get the solution. So the diagnosis methods are based on proprietary knowledge and personal experience, although they were built into integrated diagnostic equipment. The approach proposed in this research paper is an alternative to existing solutions, and it is expected to encompass all phases of the diagnostic process: symptom detection, hypotheses generation, and hypotheses discrimination (Prabhakar et al, 2010).

**2.4.6 Automated Medical Health Diagnosis System**

According to Akanksha et al (2017), in most large cities such as Mumbai, Bangalore, Delhi, most patients prefer to go to large hospitals to visit the doctors. As a result there is congestion in the large hospitals. Consequently most doctors usually only had roughly 5 minutes on average to make their diagnosis on the patients. Doctor may not think about all diseases at once by listening to patient’s symptoms. This problem grew even worse for radiologists also. In the large hospitals there are usually more than thousand examinations including images being performed (e.g., CT, MR, DR/CR) per day. Radiologist has to read more than 50 studies daily. They have only around 10 to 15 minutes to read images and to write a report for each study (e.g., CT or MR examination). Basically there is no time to review the patient’s history if such patients had multiple historical studies. So there is a big need to store all the valuable data and the symptoms on a web platform portal to make diagnosis efficient and accurate. An automated medical health diagnosis system is a web platform portal to facilitate doctors to enter patients’ symptoms and get the list of probable diseases, which enables doctors to start diagnosis quickly. In this system security is maintained as only the registered doctors can enter or update the system accordingly. The system enables the registered doctors to record the new diseases and symptoms if they find any. The project reduces the diagnosis time as well. Data handling technique is dealing with large amount of data with a great accuracy and reliability. This system has a database containing data about all diseases and their corresponding symptoms. When the patient details are entered, the system indicates the possible diseases the patient may be suffering from. The performance is measured by taking input from the registered doctor and from a patient who enter his symptoms and then analyzed. An Automated Medical Health Diagnosis System compares all entries in the database and updates it if needed and finally gives the result in the form of diagnosed disease. Moreover it acts as disease and symptoms repository (Akanksha et al, 2017).

**2.4.7 Disease Diagnosis System**

The main objective of this research paper was to implement an Android based Healthcare Information System. This system will help the users to identify certain diseases by answering certain questions asked by the system. Based on the diagnosis received, the user will be getting some suggestion of medicines that are available at the local chemist without prescription with an advice to visit the doctor. The database was developed with open source software. This application will also provide online help to the patients to get more detail about the already diagnosed disease (Shivam, 2014).

**2.4.8 Expert Doctor Verdis: Integrated medical expert system**

In this research work, an integrated medical ES called Expert Doctor Verdis (Ex-Dr Verdis) is developed, which combines an advanced medical information system containing various medical services supported by information technologies, with ES capabilities in a single system. This system is also one kind of decision support system. Implementation of this system is applied for vertebral column diseases. Ex-Dr Verdis is a strong decision support tool with 94% sensitivity, 71% specificity, 87% positive, and 86% negative predictive values for the diagnosis of vertebral diseases. In addition to its facilities of medical information, Ex-Dr Verdis, with a sharing platform, provides physicians with the opportunity to share and discuss their own patients, cases, experiences, and expert knowledge with other colleagues. This integrated medical ES can be used in all hospital services, such as hematology, neurology, or cardiology, by adding new expert modules for other diseases (Ayturk, 2014).

**2.5 Conceptual Framework**

Over the years, several systems have been suggested, implemented, and reviewed in other to decrease the rate of death due to undiagnosed illness. These systems have the ability of performing many operations that are manually performed by doctors.

Mohammed et al (2011) built up a fuzzy expert system for judgment of back pain diseases based on the experimental examination symptoms using fuzzy rules. The user has to key in parameters such as body mass index, age, gender of patient and experimental examination symptoms for this fuzzy expert system. On the basis of these parameters, this fuzzy expert system makes suitable judgment of back pain diseases and gives some medical suggestion to the patient. The accuracy achieved from this fuzzy expert system was high.

Eugene et al (2009) enlarged an expert system which is applied to detect major kidney diseases. The diagnosis was made using the readings obtained from clinical exam and the Para-clinical exam. This system helps the medical expert in making the suitable analysis of a patient. A lot of common symptoms often occur in kidney diseases and many of them are alike, and that makes it difficult even for a kidney doctor to place an exact diagnosis. This expert system eliminates this trouble. This expert system has a very well-built knowledge base. It has knowledge of twenty seven diseases from nine dissimilar categories.

K.Abdelhamied et al (2002) developed an expert system to aid health employees working in crowded outpatient clinics in Egypt make quick and perfect judgment. In this system, the medical knowledge of more than 300 major and minor common diseases is encoded in the form of production rules. These rules are invoked in collections according to one or more presenting symptoms and diagnostic hypotheses are devised for the diseases most expected to reason these symptoms. Once a disease is identified, recommendation is given for cure. The system will be assessed in 10 outpatient clinics.

Solomon (2002) built up a prototype self-learning knowledge-based system that can offer advice for physicians and patients to assist the diagnosis and cure of diabetic patients. Knowledge is obtained using both structured and unstructured interviews from domain experts which are chosen using purposive sampling technique from Black Lion Hospital Diabetes Center. It brings into play backward chaining which initiates with possible solutions and tries to assemble information that verifies the result.

Qeethara et al (2011) evaluated artificial neural network in diagnosis of diseases. Two cases were considered. The first one was acute nephritis disease; data was the disease symptoms. The second was the heart disease; data was on cardiac Single Proton Emission Computed Tomography images. Each patient classified into two categories: infected and non-infected. Categorization is an important tool in medical diagnosis decision support. Feed-forward back propagation neural network is applied as a classifier to distinguish between infected or non-infected person in both cases. In the diagnosis of acute nephritis disease; the percent correctly classified in the model sample by the feed-forward back propagation network is 99 percent while in the finding of heart disease; the percent correctly classified in the model sample by the feed-forward back propagation network is 95 percent.

Dr. Sandeep (2003) planned and put into operation a medical expert system for the diagnosis of some Pulmonary Disorders. One of the endings accomplished throughout the route of this research was that the process of knowledge acquisition is a continuous process and for this reason an expert system cannot be made in a single pass fashion – an incremental approach is certain.

S Ali et al (2003) presented an automated delivery system for clinical guidelines (DSCG) that supports clinicians in diagnosing and treating patients bearing from chest pain in the emergency department. Strategies are adaptively selected from a knowledge base server that has a library of clinically defined, graphical guidelines. The system acquires patient data, such as illness and assessment results, and matches these data with eligibility criteria. It recommends most favorable treatment plans and analysis based on the most feasible diagnosis. Clinicians may either use the recommendations as a suggestion or trigger a selection to check the patient’s circumstance during the cure using an intelligent agent.

John et al (2005) proposed an expert system that offers advice about oliguria arising on the Intensive Care Unit. Justifications are raised by discovering probable paths in a causal network of physiological states. The expert system shell expanded for this purpose is written in Prolog and runs on the IBM PC. Investigative deeds are scheduled using an schema and may be suspended and continued as required. Although the shell is wide-ranging, it maintains the definition of knowledge representation languages tailored to a fussy application. This competence is applied to build a frame notation for the representation of physiological states.

Freasier et al (2005) constructed a medical expert system using the multiplication model of support logic programming so as to establish the predominant stenosis in one of the three main coronary arteries. The features taken in the determination of the analysis were data got from preprocessed scintigraphic myocardial perfusion images of the left ventricle in use in three views: anterior, left lateral and left lateral frontal oblique. Stress thallium-201 planar scintigrams from long-sufferings who had coronary arterial stenosis confirmed by coronary arteriography included the data set used for this reading. A prolog-based system was put up to discover the knowledge base so as to find out the site of the predominant stenosis. With the current set of production rules, the system properly recognized the site of coronary artery stenosis in over 90% of the long-sufferings taken into account.

Jimmy (2013) developed an expert system to identify the most important lung diseases between the patients. The judgment is made using the symptoms that can be felt by the patient. This medical expert system aids the doctor or expert in building the proper diagnosis of the patient. The lung diseases have many regular symptoms and some of them are very much alike. This creates much complicatedness for the physician to reach at a right conclusion. This expert system can take away this complicatedness and it is having acquaintance of thirty-two lung diseases.

Samy et al (2008) developed an expert system that urges the patient with conditions for suitable analysis of some of the eye diseases. The eye has always been viewed as a tunnel to the inner workings of the body. The disease states frequently generate symptoms from the eye. CLIPS language is used as a tool for drawing expert system. A preliminary evaluation of the expert system was passed out and a optimistic response was acknowledged from the users.

Ahmad (2012) presented a Rule-Based Expert System for Neurological Disorders. This system diagnoses and treats more than 10 types of neurological diseases. It helps the patients to acquire the required recommendation regarding the unusual disorders attack to them due to their nervous system disorders. The expert rules were built up on the symptoms of each type of neurological disease, and they were offered using decision tree and deduced using backward-chaining technique. The knowledge base contains information, gathered from volumes and practitioners about neurology and its disorders.

**2.6 Summary of Literature Review**

Detecting diseases at early stage can enable to overcome and treat them appropriately. Identifying the treatment accurately depends on the method that is used in diagnosing the diseases. A Diagnosis expert system can help a great deal in identifying those diseases and describing methods of treatment to be carried out taking into account the user capability in order to deal and interact with expert system easily and clearly. Research has been done thus far to determine the best possible ways through which efficiency can be achieved in expert diagnosis.

However, in this chapter it is observed that most expert systems uses inference rules and plays an important role that will provide certain methods of diagnosis for treatment, this can also be improved. The literature review of this study constitutes in aiding the researcher understand the need to implement some other features into the system.

**CHAPTER THREE**

**METHODOLOGY**

**3.1 Methodology**

Methodology is a standard process followed by an organization to conduct all the steps necessary to analyze, design, implement, and maintain information systems. Among the components of methodology are tools and techniques used in all phases of the development of a system. Structured System Analysis and Design Methodology (SSADM) was adopted in other to actualize the proposed system.

**3.2 Method of Data Collection**

Method of data collection is the various methods through which data was collected for this research work; the methods may include interview, questionnaire, observation, etc. However, the methods adopted in this research work are divided and categorized into two main sources which are the primary and secondary source.

**Primary Source**

This has to do with the major sources through which data was collect. Observation method of data collection was adopted whereby the researcher observed that many patients go to hospitals and leave without seeing a doctor due to the excess queue in the hospital. This is disastrous as the patient is leaving without knowing their health status.

**Secondary Source**

This has to do with other sourced through which data was collected. Apart from the method adopted in the primary source, several Journals, web sites, etc. were visited in other to retrieve relevant data in the field of study.

**3.3 Analysis of the Existing System**

Currently in hospitals, clinics and other health centers, patients are manually diagnosed of various illnesses not minding how critical the illness may be. In the existing system of diagnosis, patients visit hospitals in other to see a doctor for diagnosis. The doctor may however have to attend to so many patients within a given period in the hospital.

**Disadvantages of the Existing System**

1. Excess stress is posed on doctors due to the large number of patients they attend to within a given period
2. Patient may have to wait longer period of time before they see a doctor due to the large number of patients ahead
3. Most patient may have to go far distances in other to locate a hospital for diagnosis

**3.4 Analysis of the Proposed System**

The proposed system is an attempt to override the manual method of diagnosing patients in the existing system. The development of the proposed system is very necessary because from the analysis of the existing system it is obvious that its working conditions are stressful and time consuming. The proposed system will assuage some of the problems encountered by the present system.

**Advantages of the Proposed System**

1. Doctors will have to attend to lesser number of patients since the system already handles most of the patients diagnosis
2. Waiting time of patient is reduced since the number of available number of patients may no longer be excessively large
3. The movement of patients to far distance in search of a hospital is countered

**3.5 System and Program Flowchart**

System and program flowchart is a pictorial representation depicting the flow of steps in a program through the use of some special shapes and linking arrows. Below is the program flowchart of the proposed system.

Start

Is user admin?

Register and manage symptoms

Logout

YES

Select symptom

View diagnosis report

End

Login

Is user registered?

Register

YES

NO

NO

**Fig 3.1 System and Program Flowchart of the Proposed System**

**3.6 High Level Model of the Proposed System**

High Level Model also known as High Level design (HLD) explains the architecture that would be used for developing a software product. The architecture diagram provides an overview of an entire system, identifying the main components that would be developed for the product and their interfaces. High level models uses possibly nontechnical to mildly technical terms that should be understandable to the administrators of the system. Below is the high level model of the proposed system.

**Electronic Diagnosis System**

Administrator

Patient

Login

Register and manage symptom

Logout

Login

Select symptom

View diagnosis report

Logout

**Fig 3.2 High Level Model of the Proposed System**

**3.7 Database Design**

Database design is the organisation of data according to a database model. The designer determines what data is stored and how the data elements interrelate. With this information, they can begin to fit the data to the database model.

Table 3.1: Database Structure for Login

|  |  |  |
| --- | --- | --- |
| **Field** | **Data Type** | **Key** |
| login\_id | VARCHAR(30) | Primary |
| role | VARCHAR(15) |  |
| password | VARCHAR(30) |  |

Table 3.2: Database Structure for Symptom

|  |  |  |
| --- | --- | --- |
| **Field** | **Data Type** | **Key** |
| symptom\_id | VARCHAR(30) | Primary |
| symptom\_title | VARCHAR(50) |  |
| symptom\_level | VARCHAR(20) |  |
| symptom\_status | VARCHAR(20) |  |

Table 3.3: Database Structure for Patient

|  |  |  |
| --- | --- | --- |
| **Field** | **Data Type** | **Key** |
| patient\_id | VARCHAR(50) | Primary |
| fullname | VARCHAR(60) |  |
| dob | DATE |  |
| gender | VARCHAR(10) |  |
| address | TEXT |  |

**3.8 UML Diagrams**

UML, short for Unified Modeling Language, is a standardized modeling language consisting of an integrated set of diagrams, developed to help system and software developers for specifying, visualizing, constructing, and documenting the artifacts of software systems, as well as for business modeling and other non-software systems.

**3.8.1 Use Case Diagram**

UML use case diagrams are usually referred to as behavior diagrams and are used to describe a set of actions (use cases) that some system or systems (subject) should or can perform in collaboration with one or more external users of the system (actors). Each use case provides some observable and valuable result to the actors or other stakeholders of the system.

**Electronic Diagnosis System**

Patient

Login

Register and manage symptom

Select symptom

View diagnosis report

Logout

Administrator

Register

**Fig 3.3 Use Case Diagram of the Proposed System**

**3.8.2 Class Diagram**

In relation to software, a class diagram in the Unified Modeling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among objects.

connection

+user

+host

+password

+db

+connectDb()

diagnosis

+symptom

+status

+diagnosPatient(), +diagnosisResult()

user

+userid

+password

+role

+symptom

+getSymptom(), setSymptom()

symptom

login

**Fig 3.4 Class Diagram of the Proposed System**

**3.8.3 Activity Diagram**

Activity diagram is another important diagram in UML used to describe the dynamic aspects of a system. It is basically a flowchart to represent the flow from one activity to another activity. The activity can be described as an operation of the system.

The control flow is drawn from one operation to another. This flow can be sequential, branched, or concurrent. Activity diagrams deal with all type of flow control by using different elements.

**Administrator**

**Patient**

**Diagnosis System**

Login

Register

Select symptom

Register and manage symptom

Diagnose based on symptom

Diagnosis report

Logout

**Fig 3.5 Activity Diagram of the Proposed System**

**CHAPTER FOUR**

**IMPLEMENTATION AND RESULT**

**4.1 System Requirements**

In order for this proposed system to be implemented, there were a few requirements needed to be put in place and the requirements are known as system requirement. The requirements comprise both hardware and software for effective functionality of the system. Software and hardware requirement are needed for the implementation of the software proposed in this project. The requirements are discussed in the subheads below:

**4.1.1 Hardware Requirement**

These are the physical machine or equipment involved in the system. They can be seen, touched, and felt. The hardware requirements for this project include:

1. A complete personal computer or internet enabled mobile phone/pad
2. At least Pentium IV microprocessor of 1.0GHZ or higher
3. At least a RAM size of 1GB or higher

**4.1.2 Software Requirement**

Software refers to those set of instructions written in a programming language which a computer follows in order to perform a given task. The software requirements for this project include:

1. Windows operating system (Windows 7, and later versions)
2. System type (32 or 64 bits operating system)
3. XAMPP Server (contains PHP Apache and MySQL Database)
4. Web browser such as internet explorer, chrome, opera, mozilla, etc.

**4.2 Program Main Menu**

The program main menu depicts the various links a user will encounter upon launching the system, these links point to other areas of interest. The figure below shows the program main menu for the system.

FOOTER

MAIN BODY

HOME

DIAGNOSE

LOGOUT

ABOUT

**Fig 4.1 Program Main Menu**

Each of the main menus is linked to other submenus of information that will serve the users interest.

**4.3 Choice and Justification of the Programming Language**

This software is a web-based software, this means it will have to run on a web server platform (online). For this reason, PHP (Hypertext preprocessor) was chosen as a good programing language that will fit the software as well as the developer.

PHP has a lot of inbuilt functions that will help the program do a lot of task as intended. PHP is best for this software because of its developer friendliness and debugging facilities, hence making it flexible enough for use.

**4.4 Choice and Justification of the Development Tool**

Based on the analysis made in the previous chapter, the developer therefor chooses Adobe Dreamweaver as the web development tool. dreamweaver is an integrated development environment (IDE) that supports several programming languages which includes PHP scripts that enables posting, getting and retrievals of information between HTML and database. MySQL database server was selected for storing and retrieving web records. Codes were written and debugged on dreamweaver, but tested on web browsers using the PHP local server popularly known as XAMPP.

All these tools mentioned are carefully chosen for this project because from analysis, they best help in achieving the aim and objectives of the system.

**4.5 Maintenance**

Maintenance is a necessary component of any business computer system or work. Each individual desktop computer and server has needs that must be met to keep them running optimally. System maintenance is necessary to ensure the software and system’s reliability. It is easy to overlook this maintenance and as a result, systems can perform slowly or have issues that seem to come out of nowhere. By regularly addressing the many items that need attention on every computer, performance and reliability can be counted on over the life of each system. For the purpose of maintenance, we have stated out some important things that should be considered in order to obtain a more accurate result while using the system.

1. The administrator of the system should at least once in a year make a review on the system to know how effective it has been and correct defected errors to optimize its reliability.
2. Ensure to keep the system’s server running on a reliable system to ensure unending access at all times.
3. Ensure proper monitoring of the system to ensure that errors encountered are promptly attended to accordingly.

**CHAPTER FIVE**

**SUMMARY, CONCLUSION AND RECOMMENDATION**

**5.1 Summary**

The rate in which medical facilities are accessed these days is becoming alarming. Most hospitals may have to attend to a large number of patients within 24hours. This is an issue in a way that doctors may get tired thereby making quick prescriptions in order to attend to all the patients. This research document aims at solving the problem by attending to minor illnesses. This in a way may reduce the number of individuals that may need expert advice on their symptoms. The proposed system in this research work is an expert system that will store the symptoms of an illness and advice patients if they are ill or not, based on the stored information in the knowledge bank. For the purpose of this study, the software is only able to diagnose patients for malaria illness.

**5.2 Conclusion**

Based on the outcome of the system during the testing phase, we conclude that this software will be of great advantage to the country in a way that it will reduce the rate through which individual lives are lost based on malaria illness. This software will also aid to reduce the rate at which minor symptoms are unattended to. Hence the rate of malaria illness in the country is drastically reduced.

**5.3 Recommendation**

According to analysis made in this research, the developed software is thereby recommended for use by medical facilities that diagnose malaria illness and individuals that wish to know their malaria status. This will aid in improving on the standard at which patients are efficiently attended to. Also, for more accuracy of results, the below recommendations are made and advised to be followed.

1. High number of symptoms should be registered in the system in order to give more options for patient selections. This improves the system in terms of decision making.
2. Proper monitoring of the system should be done to ensure that any error encountered is promptly countered and solved.

**5.4 Suggestion for Further Research**

This system is limited to the diagnosis of malaria illness. It only checks for the presence of malaria illness in patients by analyzing their selected symptoms. However, further research can be made on the system to improve its efficiency in result production. Research can be made to give the system the ability to diagnose for several other illnesses as well as make it possible for the system to be able to differentiate between two or more illnesses with similar symptoms. Also, further research can be made on the system in order for it to have the ability of prescribing drugs for patients in cases where the diagnosis shows ill. These features will further broaden the functionality of the system thereby making useful to the economy.

**REFERENCES**

Ahmad A. Al-Hajji (2012), “Rule Based Expert System for Diagnosis and Symptom of Neurological disorders”, proceedings of ICCIT.

Anthony Costa Constantinou, Mark Freestone, William Marsh, and Jeremy Coida (2015), “Causal inference for violence risk management and decision support in forensic psychiatry”, Decision Support Systems Volume 80, December 2015, Pages 42-55.

Ayturk KELES (2014), “Expert Doctor Verdis: Integrated medical expert system”, Turk J Elec Eng & Comp Sci (2014) 22: 1032-1043.

Christian Stary and Karl Fasching (2002), “UnPatient: A Knowledge Base for Medical Diagnostic Expert Systems”, School of Computer Science, Florida International University, University Park, Miami, Florida 33199, USA.

Dr. Sandeep Pachpande, and Ramesh Mahadik (2003), “Expert System for Diagnosis of Pulmonary Disorders”, ASM’s International E-Journal of Ongoing Research in Management and IT, INCON 13-IT-018, pp 01-08.

Eugena Roventa and George Rosu (2009), “The Diagnosis of Some Kidney Diseases in a PROLOG Expert System”, Proceedings of the Third International Workshop on Soft Computing Applications 2009 IEEE.

Freasier R. E, Cios K. J, and Goodenday L.S (2005), “Determination of Predominant Coronary Arterial Stenosis by a Knowledge Based System”, proceedings of IEEE Engineering in Medicine & Biology Society tenth Annual International Conference IEEE.

Herchline T.E. (2017), “Malaria”, Medscape, Retrieved from <https://emedicine.medscape.com/article/221134-overview>.

J. Gudu, D. Gichoya, P. Nyongesa, and A. Muumbo (2012), “Development of a Medical Expert System as an Expert Knowledge Sharing Tool on Diagnosis and Treatment of Hypertension in Pregnancy”, International Journal of Bioscience, Biochemistry and Bioinformatics, Vol. 2, No. 5, September 2012.

Jimmy Singla (2013), “The Diagnosis of Some Lung Diseases in a PROLOG Expert System”, International Journal of Computer Applications, vol. 78, no. 15, pp. 37-40, September 2013.

John G. Holman and Anthony H. Walff (2005), “An Expert Driver for OLIGURIA occurring on the Intensive Care Unit”, proceedings of IEEE Engineering in Medicine & Biology Society tenth Annual International Conference IEEE.

K. Abdelhamied, S. Hafez, W. Abdalla, H. Hiekal, and A. Adel (2002), “A Rule Based Expert System for Rapid Problem Solving in Crowded Outpatients Clinics in Egypt”, proceedings of the IEEE Engineering in Medicine and Biology Society tenth Annual International Conference IEEE.

Kenneth Ikechukwu Nkuma-Udah, Gloria Azogini Chukwudebe, and Emmanuel Nwabueze Ekwonwune (2018), “Medical Diagnosis Expert System for Malaria and Related Diseases for Developing Countries”, E-Health Telecommunication Systems and Networks, 2018, 7, 43-56, ISSN Online: 2167-9525, ISSN Print: 2167-9517.

L. Shu-Hsien (2005), “Expert system methodologies and applications - a decade review from 1995 to 2004", Expert Systems with Applications, Vol. 28, pp. 93{103, 2005.

M. Negnevitsky (2005) “Artificial intelligence: A guide to intelligent systems”, Addison Wesley Longman.

Mir Anamul Hasan, Khaja Md. Sher-E-Alam, and Ahsan Raja Chowdhury (2010), “Human Disease Diagnosis Using a Fuzzy Expert System”, Journal OF Computing, Volume 2, Issue 6, June 2010, ISSN 2151-9617.

Mohammed Abbas Kadhim, M. Afshar Alam, and Harleen Kaur, “Design and Implementation of Fuzzy expert System of Back Pain Diagnosis”, International Journal of Innovative technology & Creative Engineering, vol. 1, no. 9, pp16-22, September 2011.

Ms. Akanksha Yadav and Mr. Shivam Shukla (2017), “Automated Medical Health Diagnosis System”, GRD Journals- Global Research and Development Journal for Engineering | Volume 2 | Issue 7 | June 2017 ISSN: 2455-5703.

P. Santosh Kumar Patra, Dipti Prava Sahu, and Indrajit Mandal (2010), “An Expert System for Diagnosis of Human Diseases”, International Journal of Computer Applications (0975 – 8887) Volume 1 – No. 13.

Prabhakar Dubey and Mahendra Kumar (2010), “An Advanced Automatic Electronic Diagnosis System”, National Journal of Physical Sciences, Engineering and Technology (Samriddhi) January-June, 2010, Volume 1, Number 1, pp. 1-4.

Qeethara Kadhim (2011), “Artificial Neural Networks in Medical Diagnosis”, IJCSI International Journal of Computer Science Issues, vol. 8, issue 2, pp 150-154, March 2011.

Russell S. and P. Norvig (2002), “Artificial Intelligence: A Modern Approach”, Prentice Hall, Second Edition.

S Ali, P Chia, and K Ong (2003), “Graphical Knowledge Based Protocols for Chest Pain Management”, proceedings of the Computers in Cardiology IEEE.

Samy S. Abu Naser and Abu Zaiter A. Ola (2008), “An Expert System for Diagnosing Eye Diseases Using CLIPS”, Journal of Theoretical and Applied Information Technology, pp. 923-930, 2005-2008 JATIT.

Shivam Srivastava (2014), “Disease Diagnosis System”, BEST: International Journal of Humanities, Arts, Medicine and Sciences (BEST: IJHAMS) ISSN 2348-0521 Vol. 2, Issue 9, Sep 2014, 67-72.

Shortliffe E. H. and Cimino J. J. (2006), “Biomedical Informatics”, Computer Applications in Health Care and Biomedicine, Springer 2006.

Solomon Gebremariam (2002), “A Self Learning Knowledge Based System for Diagnosis and Treatment of Diabetes”, Master’s thesis, Addis Ababa University, Ethiopia.

W. Scott Richardson, Mark Wilson, and Gordon Guyatt (2002), “The Process of Diagnosis”, American Medical Association.