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An Intelligent Online Diagnostic System With Epidemic Alert

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Abstract—In many parts of the world and especially in developing nations, qualified doctors are overworked. This situation is the direct result of not ensuring that the number of qualified and available doctors keep pace with the exponential population growth rate that is obtainable in developing countries. Despite this, accurate diagnosis of ailments is a must. This paper proposes a novel way to ease the work burden on doctors with an intelligent online diagnosis system that can accurately diagnose diseases and prescribe medications without the need for physical interaction between patient and doctor. The proposed system uses an application programming interface (Infermedica) and has the added advantage of being able to give alerts at the onset of any epidemic.

Keywords—Artificial Intelligence, Machine Learning, Diagnosis, Prescription, Epidermics.

I. INTRODUCTION

Accurate diagnosis is as important as the prescription of drugs because without correct diagnosis of the patient's medical condition there is no chance for right prescription. In many developing nations, like Nigeria, the doctor to patients' ratio is 1:6000 [1] as against the recommended standard of the world health organization of a doctor to every community of 600 people [2]. There is need to provide a solution to compensate for the poor statistics and to ensure that quality health-care services can be accessed by patients without the need to queue for an extended period of time to see a doctor. This led to the idea of developing an online medical diagnostic system which provides accurate diagnosis for patients' symptom based on the data provided.

The customary way of medical diagnosis has proven to be imprecise especially if doctors are overwhelmed with many patients when it comes to serious medical conditions and this has led to loss of lives. To militate against this, computer-aid programs and software are used to get accurate diagnosis in medicine [3]. Medical diagnostic processes are carried out with the aid of computer-related technologies, which are on the increase daily [4]. The traditional methods of diagnosis identified by [5] are olfaction, taste, visual diagnosis, tactile or palpation, auscultation or auditory diagnosis. Visual diagnosis is the physical examination of the patient's senses like eyes, tongues, skin colour, behavior, and the demeanor. The use of stethoscope to listen to the patient's breathing, heartbeat, lungs sounds was referred to as auscultation or auditory diagnosis. The olfaction diagnosis is a method used to smell the body odor and breadth of patients. Taste method is used to diagnose diabetes.

An intelligent online diagnostic system is an internet based system that makes use of a user friendly application programming interface to diagnose patients. It is web based and uses artificial intelligence diagnose the ailment of patients. The system makes use of Hyper Text Mark-up Language, Cascading Style Sheets, Javascript, Ajax and PHP as well as MySQL for the database.

The designed intelligent online diagnostic system makes use of the application programming interface (API) made by Infermedica. Infermedica is a state of the art medical diagnostic engine which analyzes information sent to it and gives the result. The system has a broad medical knowledge-base and with the help of artificial intelligence the system learns and gives better results.

When a disease becomes widespread, the designed system, based on the number of patients with the disease as indicated by what is stored in the database, gives an epidemic alert. The online diagnosis system can recommend medical prescriptions to patients thereby avoiding self-medication.

II. RESEARCH METHOD

A. Systen Modelling

The system modeling is the concept that is used to describe and represent the system. A system modeling type called unique modelling language (UML) was employed to build formal representations of the system. The unified modelling language is a general purpose modelling language that provides a set of graphical notation for creating visual models of objected-oriented software-intensive systems. It can be used to model an application structure, the behavior and the processes. It offers diagrams that provide different perspective of the system parts. UML allows users to express their structures in various ways ranging from data flow diagram to use case, flow chart, sequence diagrams and entity relationship diagrams.

This proposed system is web based and developed using HTML, CSS, Javascript, JSON, Ajax, PHP and MySQL for the database and could be accessed through a web browser.It

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uses a symptom checker to analyze and narrow down the possible diagnostic options for proper treatment of the patient and API performs the diagnosis analyses. The system specifications for the web application cover the requirement definition, hardware requirement, software design tools.

The design model used for the web application is the Incremental Development Model. This model is a method of software development whereby the web application is designed, implemented and tested incrementally with little changes added to the application until it is completed. This model was used because frequent changes were made to the application and it was easier to implement the changes to the system. The model was used to prioritize the requirements of the system and then implement them in groups. The processes involved in this model are detailed analysis of the system, system design, development and implementation of the system, testing and maintenance of the system.

B. Functional requirement

The functional requirements give a detailed description of the services offered by the system. The functional requirements for the web application are;

- Signup for Patient/login: The patient would be able to sign up and login in order to diagnose after providing basic information such as username and password.
- Doctor login: The doctor would be able to login after inputting the assigned username and password.
- Patient Info: The user would be able to input patient info such as age, sex, region that would be sent to the API.
- Symptoms: The patient/doctor would be able to add symptoms to get diagnosis result.
- Diagnosis: The patient/doctor would be able to process those symptoms to get the result for the diagnosis.
- View Charts: The doctor would be able to view charts showing analytical statistics covering the web application.
- View Submissions: The doctor would be able to view all the submissions made by patients.
- Conditions on Alert: The doctor would be able view the diagnosed conditions that are on alert based on the number of occurrence from the regions stipulated.
- Health and Nutrition: The doctor/patient would be able to view the health and nutrition page which gives tips on health and nutrition.

C. Use case Diagram

From figure 1 below, it can be seen that the system has four actors namely patient, doctor,, intermediacy (which is the application programming interface used) and the administrator. It gives the interaction between the actors and the environment.

D. Sequence Diagram

Figure 2 shows the relationship between the major actors (i.e. the patients and doctors) and the system as well as the components of the system. It adds more information to the case by showing interaction between system objects.

E. Application Programming Interface: Infermedica

Intermediacy is an open source program used to develop health analytics tools. It is extensively used to develop smart software that help doctors and patients get better diagnoses and make accurate medical decisions.

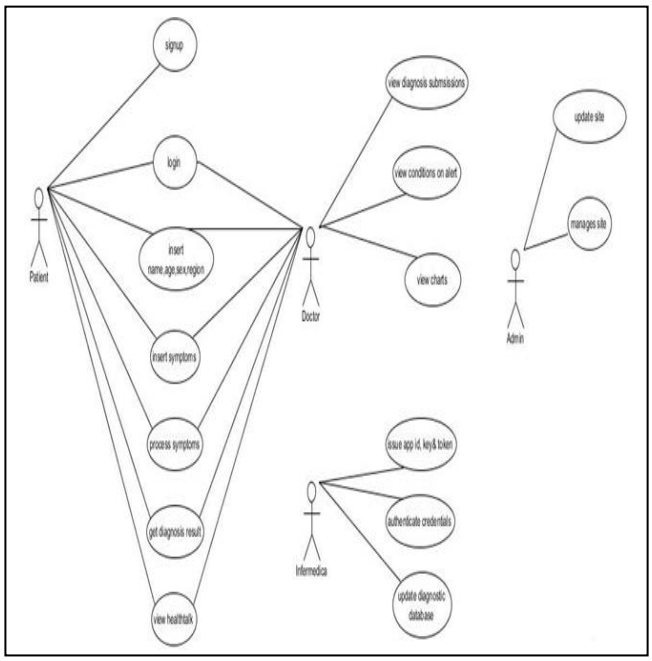

Fig. 1. Use case diagram of Proposed Online Diagnostic System *(powered by Visual Diagram)*

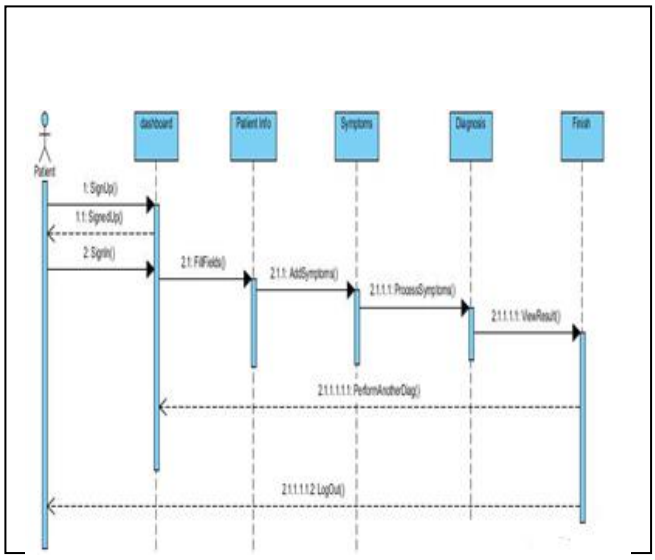

Fig.2 Sequence Diagram of Proposed Online Diagnostic System *(powered by Visual Diagram)*

The system keeps learning and updating its knowledge-base. This enables the system to make smarter and more accurate decisions in the future. The information that makes up the knowledge-base of Infomedica is stored in a used in giving a diagnosis. A special application programming interface (API) called Representational State Transfer (REST) API can be used to access the information on the database. The API consists of a highly synchronized set of architectural constraints that are usually applied to connectors, components, and data elements within a distributed system.

III. METHODOLOGY

A. *Algorithm*

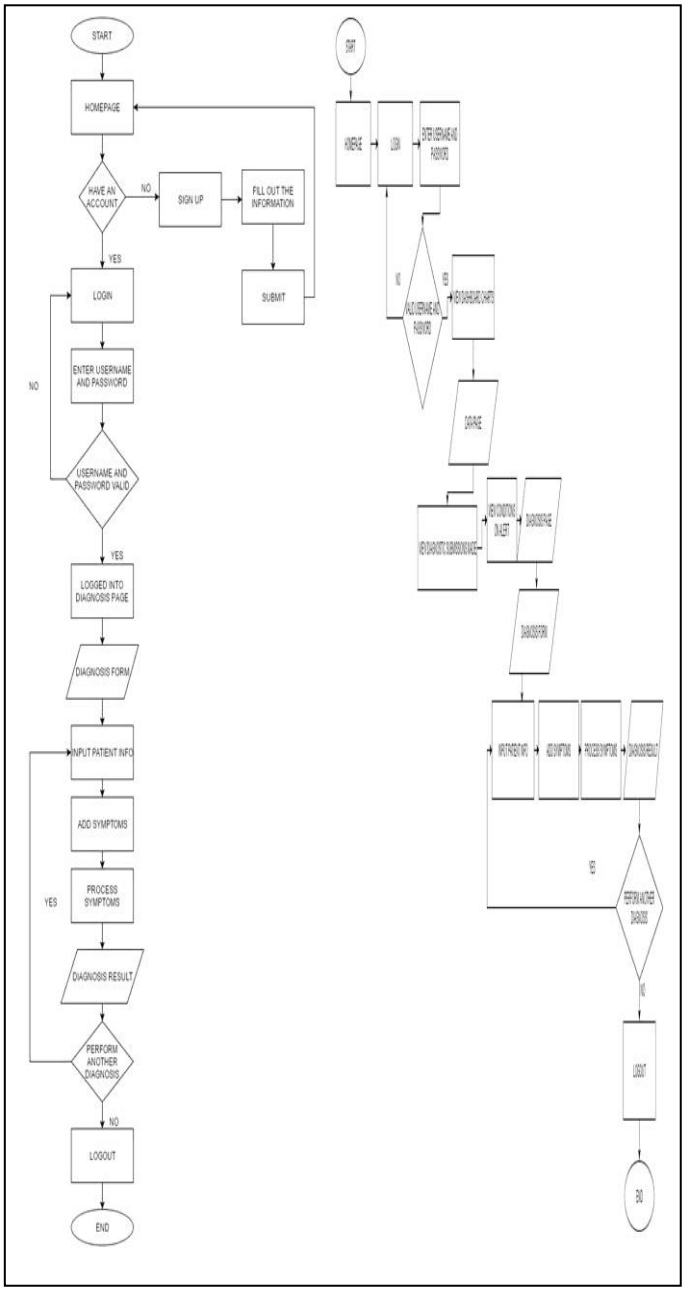

Fig. 3 Algorithm of the Designed Online Diagnistic System

B. *Home Page*

When the website When the website is accessed, the first interaction between the patient and the software is the home page where the patient is provided with the option to either register as a new users by clicking “SIGN UP” option or login with the UserID and Password provided during initial registeration as a new user by clicking “LOGIN” option.The homepage also provide information concerning the mission of the web application, a brief statement on the web application and contact information. Also, the Doctor’s Login is on the homepage as shown in Figure 4 below.

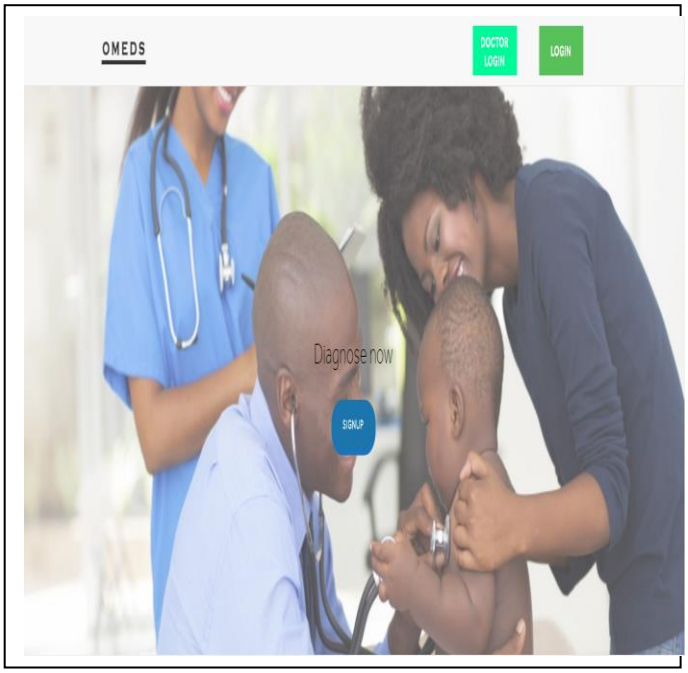

Fig. 4 Homepage of Designed Diagnostic System

C. *Patient Registration*

On selecting the sign-up button a sign up form pops up for the user to provide the information required in the fields. The patient registration form shown in figure 5 is used to collect patient data and these will be used to authenticate the user/patient later during log-in. All the fields in the form are required for successful registration and the fields are; name, username, password, repeat password, security question and answer.

D. *Patient Login*

This is where the patient sign-in after a successful sign-up. The user/patient is required to input his/her username and password In a case where a user/patient forgets either of the login details, then the security question with the answer will need to be provided to continue. After a successful login, the user is directed to the patient data, symptoms and diagnosis page.

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E. Patient Data, Symptoms and Diagnosis Pages

This section requests the user/patient to input some required fields that would be analyzed to get the diagnostic result. The following fields are required in this section; name, age, gender, and region as shown in figure 7.

The user/patient is required to add the symptoms of the sickness in the field provided as shown in Figure 8. As the patient type the symptom in the field provided, suggestions of all the possible symptoms are displayed in alphabetic order for the patient to choose. The symptoms are then processed and sent to the API which will analyze the data using its inference engine in order to come up with a diagnosis result.

After processing the added symptoms, the symptoms are diagnosed and the result is printed. This is then given as weighted condition of 3 probabilities as shown in figure 9.

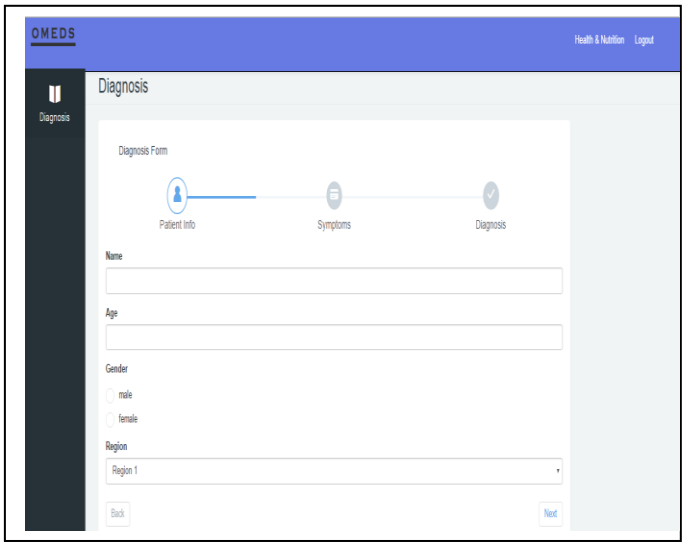

Fig. 7 Patient Data Page

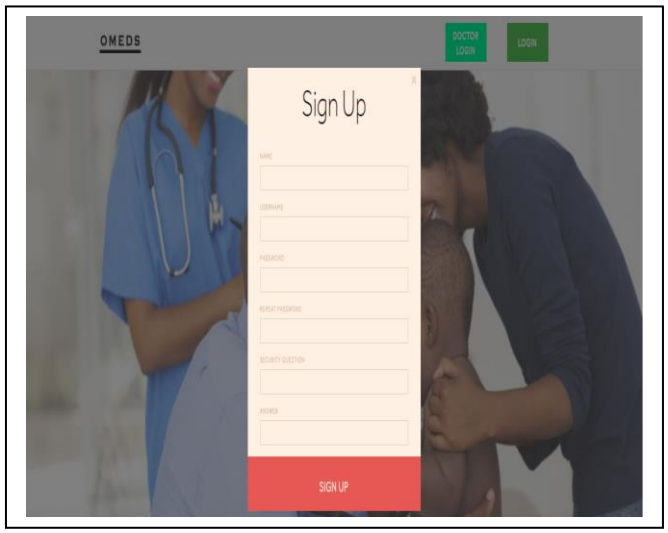

Fig. 5 Patient Registration Page

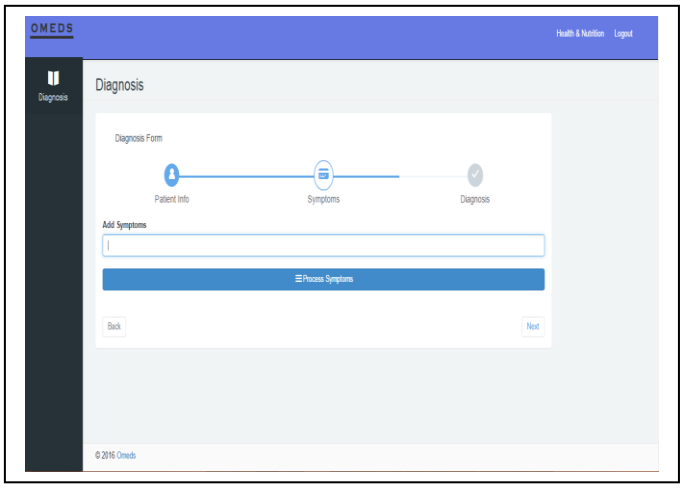

Fig.8 Symtoms Page

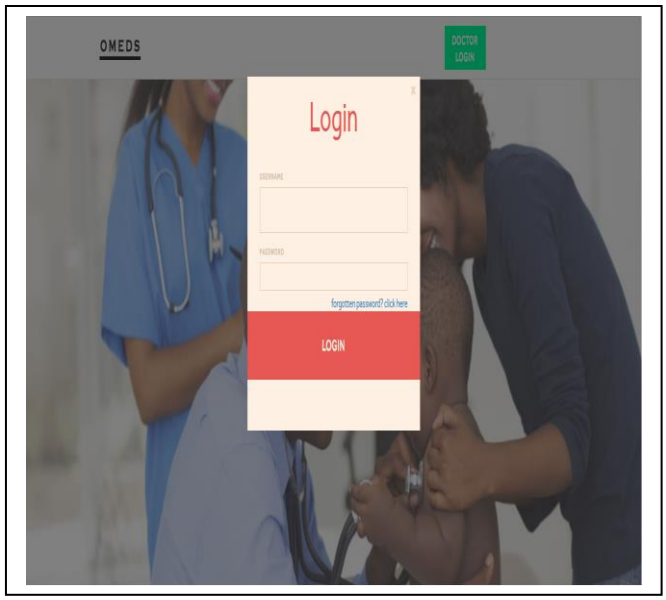

Fig.6 Patient Login Page

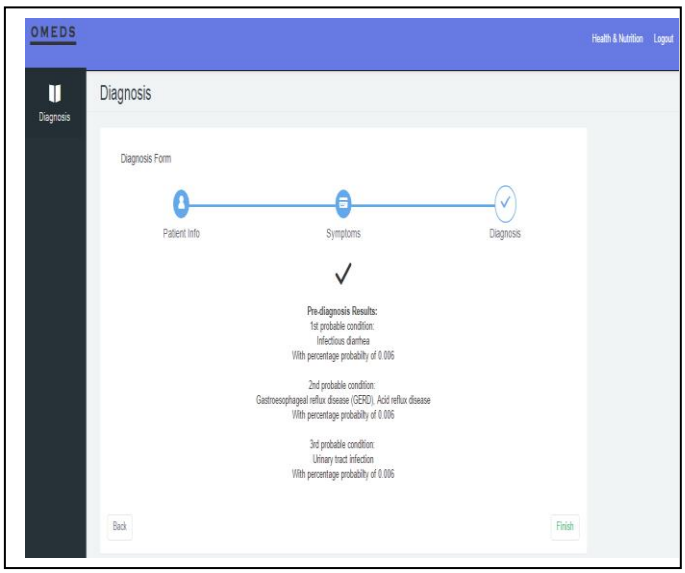

Fig. 9 Diagnosis Page

F. Login and Dashboard (containing epidemic alert console) for Doctors

The doctor and the user/patient login are both on the homepage as shown in Figure 6. A doctor cannot log in without an assigned username and password from the system administrator. This is to safeguard the data collected and the information of the users. So the module is restricted to only authorize personnel.

The dashboard consists of charts which analyze the data from the web application. This is the page which displays all the diagnosis submissions in a tabulated form and the conditions related to the sickness is put on alert based on the number of occurrence to avoid epidemic.

Fig. 10 Doctor's Dashboard

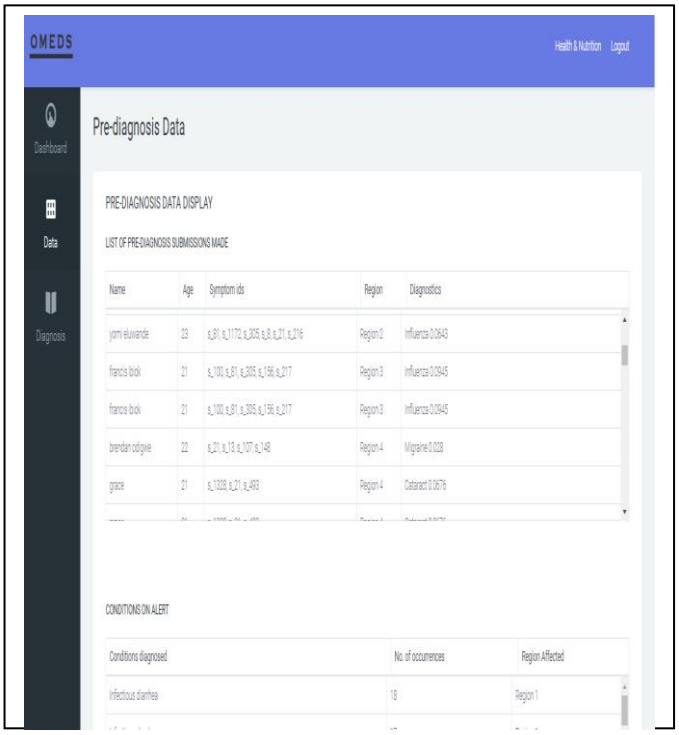

Fig. 11 Doctor's Epidermic Alert Page

IV. CONCLUSION

The designed system helps to diagnose symptoms based on the data provided by the user/patients and then prescribes proper medication. The system is robust and employs the use of artificial intelligence via the infermedica web application. The designed online diagnostic system helps to prevent the outbreak of epidemics by creating an alert whenever the threshold for each case diagnosed online is crossed.

V. ACKNOWLEDGMENT

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