An Android Mobile Expert System for the Diagnosi of Pneumonia with Object-Oriented Methodology

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Abstract- Pneumonia is an infection of the lungs that is caused by bacteria, viruses, fungi, or parasites and since the health of an individual is proportional to his or her productivity and life span. Therefore, a healthy population leads to a more productive country with a higher life expectancy rate. The aim of this paper is to develop an android mobile expert system for the diagnosis of pneumonia using Imo State University Teaching Hospital as a case study in order to improve the health condition of the people using android smart phone. In this paper we have developed a mobile expert system that can be used to diagnose pneumonia patients by taking various check-up either by patient or it's assistance that can able to take his /her medical check-up by using medical peripherals and upload the report by its mobile phone to server where expert system could suggest precautionary steps or diagnosis along with patient status. We used PHP as a scripting programming language while MySQL was used as our database. To deal with this problem, a computerized system is needed. Methods used in analyzing and designing of the pneumonia problem is Object Oriented Analysis (OOA) with unified modeling language (UML)

Keyword: Mobile Phone, Expert System, OOADM, PHP/MySQL, symptoms, Unified Modeling Language.

I. INTRODUCTION

Mobile healthcare applications receive progressively more consideration due to the ability to reshape healthcare delivery, for example, enabling self-management of patients while they pursue their daily activity. Mobile healthcare applicants using Android can provide benefits to patients by helping them to query their symptoms and get the expert response from the Expert System in the form of identification of the disease and medications to cure the illness. In sub-Sahara Africa, the mobile phone has proven to be an innovative and transformative tool for positive social and economic change, empowering individuals, communities and organizations in a variety of ways. One key area of a mobile transformation is a reality in the healthcare services.

Medicine is one of the areas that has benefited from the use of artificial intelligence since the advent of machine intelligence. Different expert systems for diagnosing diseases have been developed. However, they are either standalone or Web-based systems (Sara et al., 2009). This puts a vast majority of Africans in general and Nigerians in particular at a disadvantage, because of computer literacy, accessibility, and usage are very low. Recent advances in the capabilities of mobile phones and increased usage however, have opened up new opportunities for innovative and complex applications that can be accessed via mobile phones. This study presents a pneumonia diagnosis system that can be accessed via mobile phones to cater for the needs of the vast majority of users in places where healthcare seems to be inadequate.

However one are now interested in providing such applications that will look forward to health care and provides remote diagnosis to patient suffering from pneumonia. The mobile phone based medical diagnostic system is an expert system for diagnosing diseases using a computer which is located remotely. This system provides ease diagnosis of diseases as long as a user has a mobile phone which can be used to send a text message. The system provides automated help through a mobile phone. This system has an expert knowledge base which is used to diagnose a particular disease or symptoms sent by a patient. A patient uses an android mobile phone to send a text message to the system which is used to search through the expert knowledge base. The search results into a system to state the problem of the patient and suggest the medicines required for the diagnosed disease. This diagnosis is will sent back as a reply to the mobile phone that sent the text message [1].

In this project we propose an idea on how a mobile android expert system can be used for the diagnosis of pneumonia by using the symptoms to check-up the patient. The patients uses this expert system to enter the symptoms he/she is noticing in his body to the website through his android smart phone and an instant message will be sent back to him suggesting whether he is suffering from pneumonia or not,

the medication he will take will be suggested without him physically visiting a doctor or hospital.

Pneumonia remains a major cause of death in developed countries. Patients with community-acquired pneumonia (CAP) are most often managed in an outpatient setting. The mortality rate in this patient population is low (1%) in contrast to patients who require hospitalization, who have a mortality rate of approximately 15%. Because most patients with pneumonia are managed by emergency and primary care physicians, infectious disease specialists tend to see a population of patients with pneumonia that is skewed toward more complicated and severe infections. Emergency physicians may be less inclined than infectious diseases specialists to pursue aggressive diagnostic testing and cultures, except in patients who are seriously ill. Whereas in the past decisions regarding initial antibiotic therapy were deferred to admitting primary care and consulting physicians, quality standards currently reinforce timely initiation of antibiotics in the emergency department (ED). The practicality and ultimate consequences of arbitrary time standards are debated.

An expert system solves problems by simulating the human reasoning process and applying specific knowledge and interfaces. Expert systems also use human knowledge to solve problems that normally would require human intelligence. These expert systems represent the expertise knowledge as data or rules within the computer. These rules and data can be called upon when needed to solve problems. Books and manual guides have a tremendous amount of knowledge but a human has to read and interpret the knowledge for it to be used. A computer program designed to model the problem solving ability of a human expert.

Expert systems and Artificial intelligence encompasses such diverse activities as game playing, automated reasoning, natural language, automatic programming, machine learning, robotics and vision, software tools, modeling human performance and expert systems for complex decisions. Complex Medical decisions are central in each phase and our system help to design an expert system for diagnosing diabetic patients.

Artificial intelligence and expert system is a computer system that emulates the decision-making ability of a human expert. Expert System as programs that mimic the behavior of a human expert. Expert systems are designed to solve complex problems by reasoning about knowledge, represented primarily as if–then rules rather than through conventional procedural code [2].The first expert systems were created in the 1970s and then proliferated in the 1980s. Expert systems were among the first truly successful forms of Artificial Intelligence (AI) software. An expert system is divided into two sub-systems; Inference engine and the knowledge base.

The knowledge base represents facts and rules. The inference engine applies the rules to the known facts to deduce new facts. Inference engines can also include explanation and debugging capabilities. Pneumonia is an infection of the lungs that is caused by bacteria, viruses, fungi, or parasites. It is characterized primarily by inflammation of the alveoli in the lungs or by alveoli that are filled with fluid (alveoli are microscopic sacs in the lungs that absorb oxygen). At times a very serious condition, pneumonia can make a person very sick or even cause death. Although the disease can occur in young and healthy people, it is most dangerous for older adults, babies, and people with other diseases or impaired immune systems. Bacteria and viruses are the primary causes of pneumonia. When a person breathes pneumonia-causing germs into his lungs and his body's immune system cannot otherwise prevent entry, the organisms settle in small air sacs called alveoli and continue multiplying. As the body sends white blood cells to attack the infection, the sacs become filed with fluid and pus - causing pneumonia.

II. SYMPTOMS OF COMMON PNEUMONIA

Symptoms of pneumonia caused by bacteria usually come on more quickly than pneumonia caused by virus. Elderly persons and small children may actually have fewer or more mild symptoms than expected for such high risk groups. Most people with pneumonia begin with cold and flu symptoms and then develop a high fever, chills, and cough with sputum.

Although symptoms may vary greatly depending on other underlying conditions, common symptoms include:
- Cough
- Rusty or green mucus (sputum) coughed up from lungs
- Fever
- Fast breathing and shortness of breath
- Shaking chills
- Chest pain that usually worsens when taking a deep breath (pleuritic pain)
- Fast heartbeat
- Fatigue and feeling very weak
- Diarrhoea
- Nausea and vomiting
- Sweating, Headache
- Muscle pain
- Confusion or delirium
- Dusky or purplish skin colour (cyanosis) from poorly oxygenated blood.

III. AIM AND OBJECTIVES OF THE PAPER

The aim of this paper is to develop an android mobile expert system for the diagnosis of pneumonia using Imo State University Teaching Hospital as a case study in order to

improve the health condition of the people using android smart phone. The objectives of this paper include:

1 To provide expertise medical diagnosis services (that is, those that a professionally trained personnel will do) in areas that have under qualified medical personnel.
2 To make students and patients using android smart phone to have access to diagnosis of pneumonia in Imo State University Teaching Hospital via the internet.
3 To empower everyone to an equal share of medical attention, so that even people in areas with very poor medical systems and lack of trained personnel, will be catered for as an android smart phone can work effectively even in very remote places.
4 To provide a low cost of treatment service to people who have no money to pay for consulting professionally trained medical personnel. All that is needed is an android smart phone to access such services from the system.
5 To provide instant medical attention as there is no need for appointments as is the case with the current manual system where you are required to make an appointment with a medical practitioner.
6 To enable people know whether they have pneumonia or not at their fingers tip.
7 To develop an expert system for diagnosing pneumonia.

IV. SIGNIFICANCE OF THE PAPER

Medical researches and questionnaires declare that there are approximately millions of pneumonia patients in the world. But unfortunately most of pneumonia patients either do not visit physician regularly or do not know that they are already suffering from this sickness.

Hence, this study would assist health practitioners, advice pneumonia patients and also offer assistance in administering common drugs (diagnosis) to cure these patients with common symptoms. It will also have a system in place to remind users of medical review with their doctors. Diagnosis needs the integration of different sources of data and the on-line or off-line collaboration of different kinds of specialists would be crucial for any software. Using application that stores knowledge from these experts in the medical field would speed up accurate diagnosis processes. Some of the benefits that would be derived from this research work include:

1 Increased availability of supervised administration of healthcare in rural areas.
2 Reduced cost to accessing healthcare.
3 Reduced the danger and level of drug abuse.
4 Increase productivity or performance.
5 Providing expertise to nurses and pharmacist to proper diagnosis and treatment where medical doctors are not adequate or absent.
6 Increased reliability to treatments for patients.

7 Hence, this project is useful to pneumonia patients since it is an avenue for them to have daily tips about their ill-health without physically meeting a doctor.

V. REVIEW OF RELATED LITERATURES

In 2002, Isabel database was launched in UK for pediatrics. The Isabel Database featuring a clinical checklist and topic-specific knowledge components. The system consists of two parts, Isabel Diagnosis Checklist system (IDCS) and the knowledge component. Isabel uses proprietary natural language processing software to search its database of medical textbooks and journals. The database comprises of more than 11,000 diagnoses and 4,000 drugs.

[3] Designed a Decision Support System for Tuberculosis Diagnosis. It was designed as a fuzzy expert system for diagnosis of tuberculosis which was developed for providing decision support platform to tuberculosis researchers, physicians, and other healthcare practitioners in tropical medicine. In this research, a proposed fuzzy expert system for the diagnosing pneumonia in children was developed. The objective of the system is to provide a decision support platform to researchers in the field of pediatrics, physicians and other healthcare practitioners.

[4] Developed NxOpinion as a mobile platform to address limited portability of health information in resource-poor areas. It utilizes a cell platform with an integrated data management system and a Bayesian inference engine. NxOpinion has been developed into a proven medical diagnostic decision support and a tool for gathering data in the hands of minimally trained health extension workers. The platform has been adapted to function on low end, readily available cell phones for use in remote and low resource settings, providing critical and connected medical infrastructure.

According to [5], a diagnosis system for pneumonia is implemented to diagnose pneumonia with the input symptoms given by the user. The system proves to be advantageous in aspects, such as accuracy and time consumption due to the rough set based knowledge representation. The system is adaptable for any number of symptoms and is evaluated with respect to the rule based system containing the symptoms in terms of rules. The results obtained through the rough set based system are comparatively better than the rule-based system. Though the system is developed with respect to some aspects, such as accuracy and time consumption in mind, there are still a few limitations existing.

The few limitations of concern include that the present system knowledge base is designed only for one disease. The symptoms accommodated for the disease are based only on the patients' input. The system mainly focuses on

diagnosing a disease with the user input and comparing the input with the knowledge base.

VI. METHODOLOGY

Methodology is the documented collection of policies, processes and procedure used by a developer. Object-Oriented-Analysis-Design and Methodology (OOADM) is adopted in this paper. One adopted this methodology because it improves the quality of the system due to program reuse and maintenance. In this OOADM, there is no separation between the analysis and the design phases, which improves communication with the users throughout the project development. OOADM is the industry-proven methodology for developing high-quality object oriented systems. This prevailing software development methodology, involves three aspects namely: Object Oriented Analysis, which deals with the design requirements and overall architecture of a system, and is focused on describing what the system should do in terms of key objects in the problem domain; Object Oriented Design, which translates a system architecture into programming constructs(such as interfaces, classes, and method descriptions); and Object Oriented Programming(OOP) which implements these programming constructs.

The main idea behind object oriented language is object decomposition which is the breaking down of complex software system into its various objects, containing the data and the functions that operate on the data into a single unit. Object-oriented analysis and design (OOADM) is a popular technical approach for analyzing, designing an application, system, or business by applying the object oriented paradigm and visual modeling throughout the development life cycles to foster better stakeholder communication and product quality. According to the popular guide Unified Process OOADM in modern software engineering is best conducted in an iterative and incremental way. This method does not only expose the hidden system requirements, but also simplifies the implementation of the proposed system by giving a clear picture of how the system components interact with each other.

VII. ANALYSIS OF THE EXISTING SYSTEM

The existing system uses traditional method in diagnosing pneumonia patient. In this system, for a medical doctor to diagnose a patient, in Imo State University Teaching Hospital he will ask the patient series of questions before he will finally conclude on the type of pneumonia sickness that is disturbing the patient, the patient in some cases might not be diagnosed on that very day due to the booking processes which takes a long time. It is reported that in Imo State University Teaching Hospital patients must go to Administrative Office and fill the booking form, after which the patient will be directed to see the Head of Department and get permission. After that, patient also -must see the Clerk at the Administrative Office to check the booking time or date for diagnosing. And sometimes the patient from the clerk office will be referred to see the Director or Executive Officer to get permission. If the Director or Executive Officer signs the form, the booking application for pneumonia diagnosis is approved. In most cases, after testing the patient the result of one patient is mistaking for someone else, this is because documentation of patient's record is in paper form and it is stored in a file. It is also very difficult to avoid uncertainties such as fire disaster or flood. If the data are kept on paper, to make backup for the data is impossible. This method wastes lots of time and is risky in case of emergency.

VIII. ANALYSIS OF THE PROPOSED SYSTEM

The proposed system is an android expert system that can be used to diagnose pneumonia. This system is fast and informative. It does not discriminate in operations and does not get tired. This proposed system has the ability of telling the doctor whether the patient has pneumonia or not. It can also prescribe drugs for the user based on the symptoms. This system will perfectly work on any android enabled gadget. With this system, we can now help ourselves without physically going to a doctor or to the hospital for test or diagnosis.

Use case Diagram of the Proposed System
There are two classes of users represented by actors. They are the admin and the patients. Any of them must login first before having access to the system. The patients can register him/her, enter his/her details, choose diagnosed option and view pneumonia information. While the admin can post pneumonia information that are in the database as well as manage the database such as edit passengers and delete passengers etc. respectively.
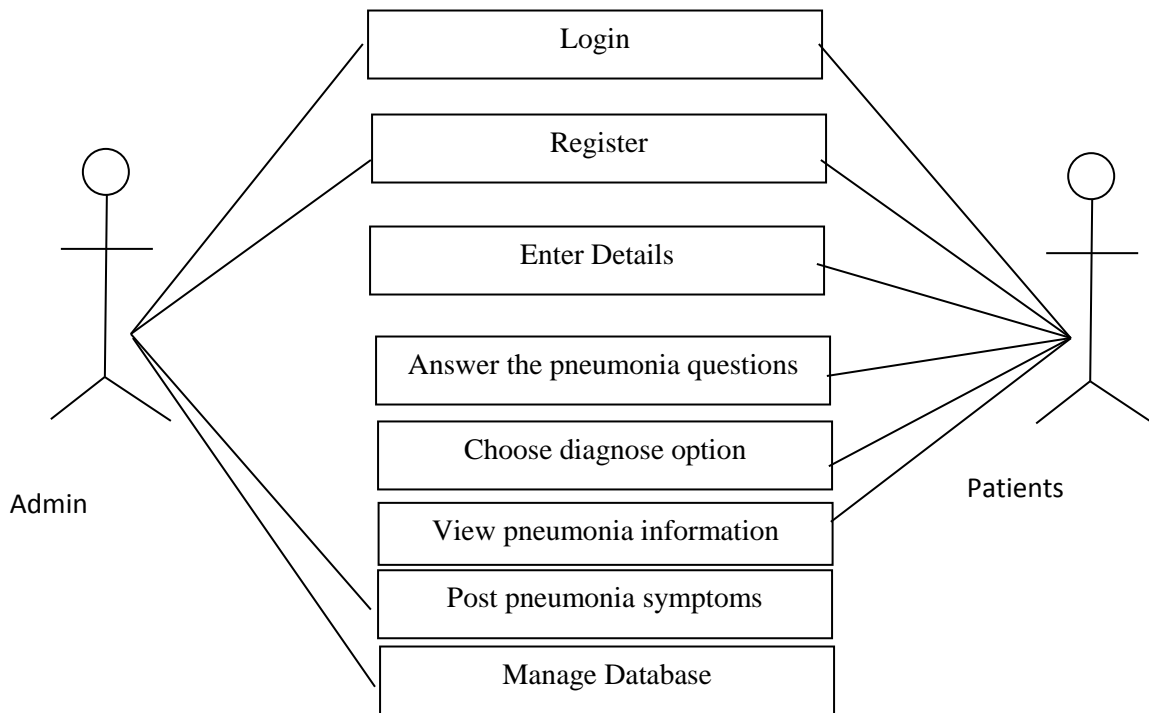
Figure 1: Use case Diagram of the Proposed System

Class Diagram
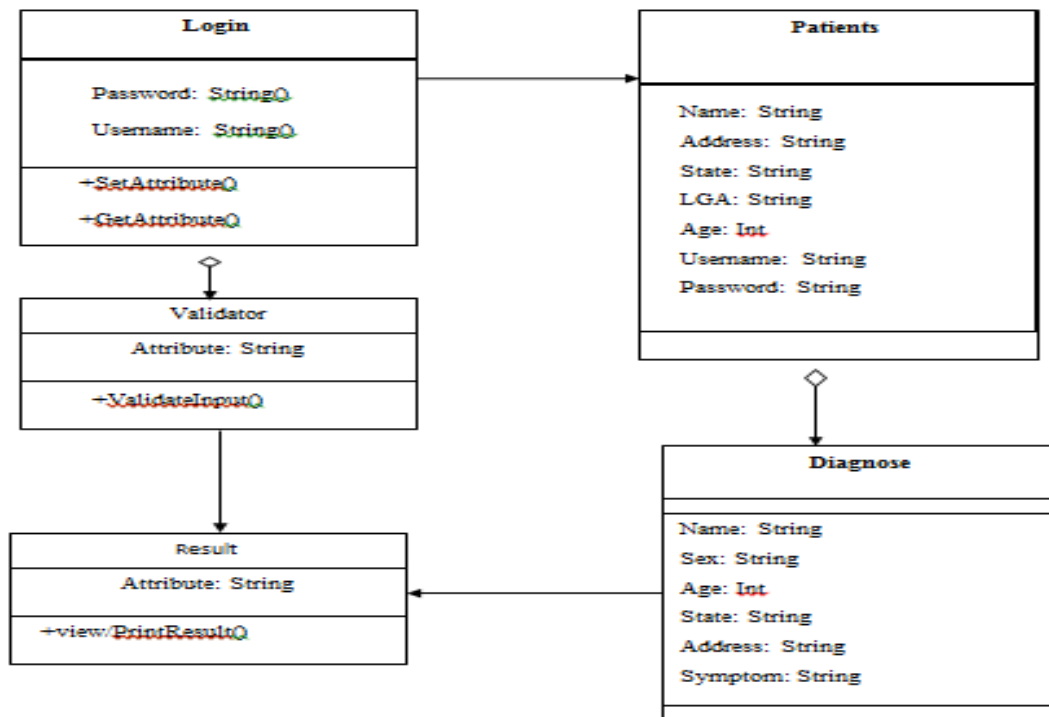A class diagram contains classes, their attribute and behavior respectively.

Figure 2: Class Diagram of the Proposed System

The Login enables the users to access the system. The validator ensures that all inputs are entered correctly. The result helps the patient to print his result after diagnosing. The diagnoses help the patient to check for symptom for a particular pneumonia. The patient is the main user of this system.

Activity Diagram of the Proposed System
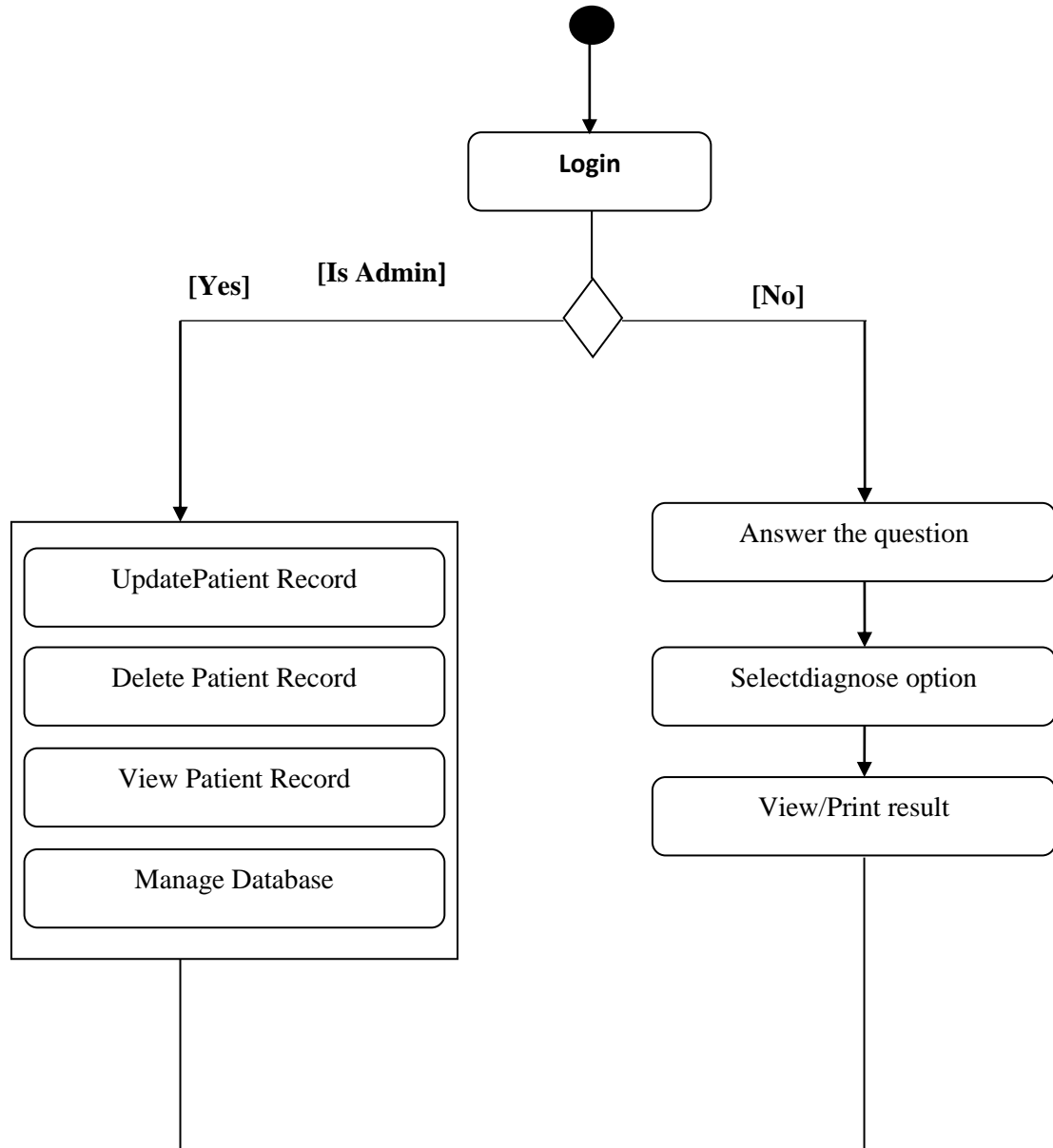
Figure 3: Activity Diagram of the Proposed System

The entire activities of the system are described. As the admin logs in, this will perform some sensitive actions like update, delete, view, and manage patient details. The patient can answers on pneumonia and select diagnose option and print result.

Entity Relationship Diagram
Entity relationship diagram is a graphical explanation of database component objects and the relationship existing between them. It is used in structuring tables in the database to ensure that the database is normalized.
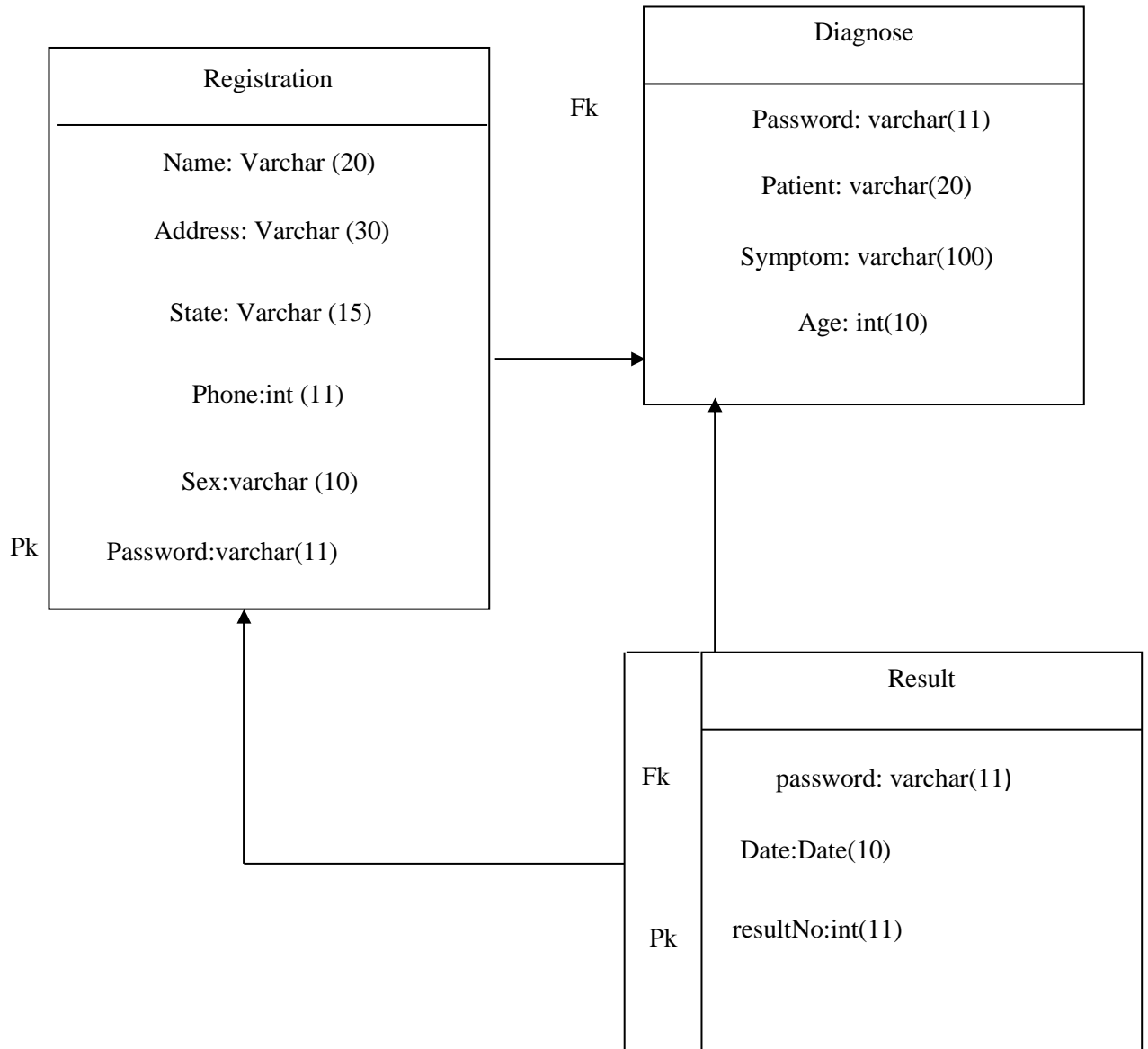
Figure 4: Entity Relationship Diagram

High Level Model of the Proposed System
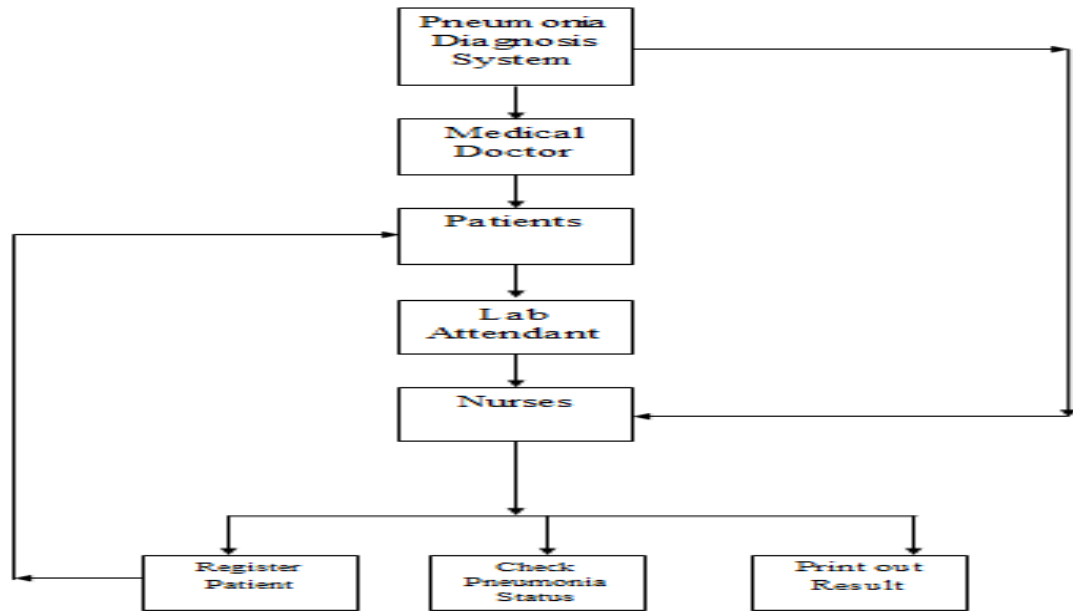
Figure 5: High Level Model of the Proposed System

Decomposition and Cohesion of High level Model

The decomposition and the cohesion of the high level model is the interconnection of different components of the system that is used to accomplish this task for the effectiveness of android pneumonia diagnoses.
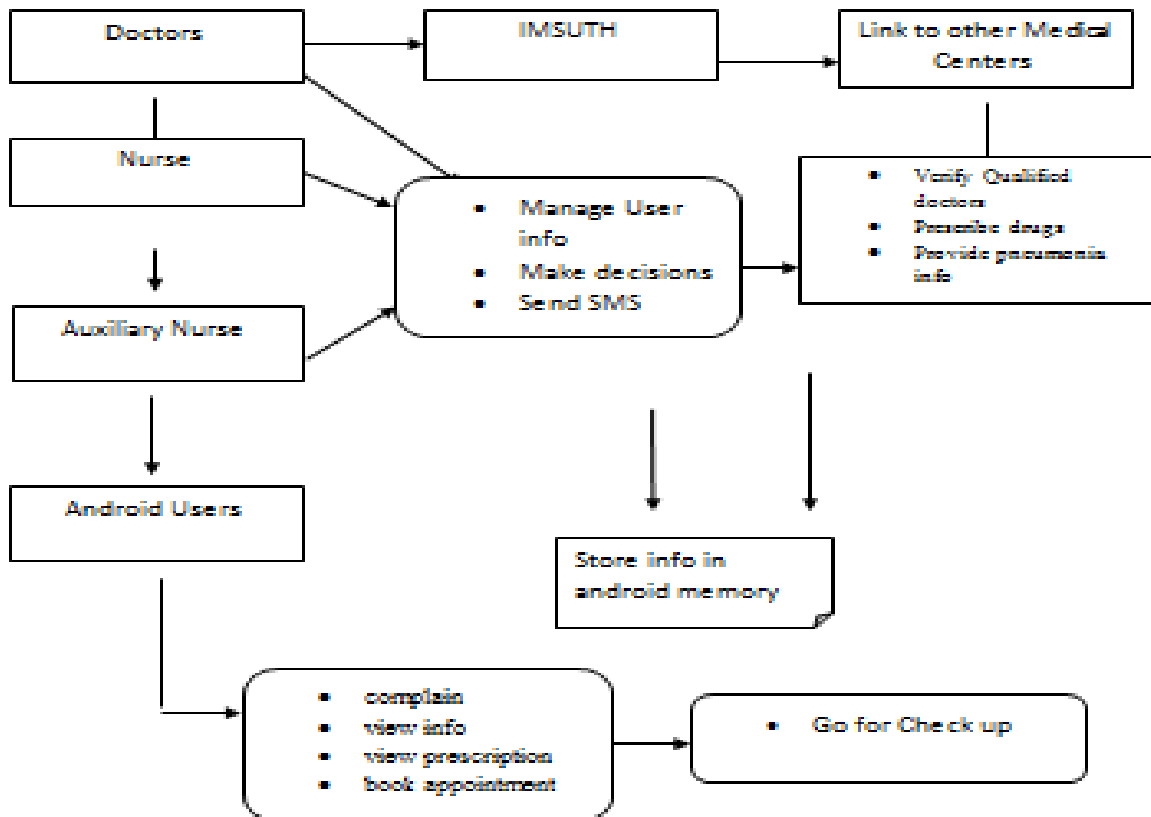

Figure 6: Decomposition and cohesion of the high level model

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Mathematical Specification

Table 1: Mathematical Specification Question Table

S/N	Question	Answer
1	Did you feel cold	Yes
2	Is your legs numbing you	No
3	Are you having pains	No
4	Do you have sleepless night	No

From the experiment above the numbers of answers that are yes is one (1) and the number of answers that say no is three (3).
Then % of answer with yes = ¼ x 100%
$$= 25\%$$
% of answers with No = ¾ x 100%
$$= 75\%$$
From the calculation above we can conclude that the patient is not suffering from pneumonia since the % of symptoms noticeable is less than the % of the symptoms noticeable.

Table 2: Mathematical Specification Population Table

Population	No of patients with symptom	No of patients without symptoms
2000	58	45
10000	100	120

From the table two above, in row 1:
% of patients with symptoms = 58/2000 x 100/1
$$= 2.9\%$$
% of patients without symptoms = 45/2000 x 100%
$$= 2.25\%$$
Row 2,
% of patients with symptoms = 100/1000 x 100%
$$= 1\%$$
% of patient without symptoms =120/1000 x 100%
$$= 1.2\%$$

From the percentage obtained, in row1 the % of patient without symptom is lesser than the % of patient with symptom while in row2 the revise is the case, we conclude that the patient infected with pneumonia is in range with the population without pneumonia.

Input Output Format
The input is the initial step of sending information into database. The output, which is the final result of data processing, can be derived from the computer through different approaches based on information required. Considering the input data during the entering of new records, it is derived from the following information. Patients Names: Blood type, Age, User name, Password, Address, Contact No, Email, Enter the above code, Confirm Password.

A: Input Format

ANDRIOD MOBILE EXPERT SYSTEM FOR THE DIAGNOSIS OF PNEUNOMIA

HOME | SERVICES | ABOUT US | CONTACT US | LOG IN

REGISTER

Patients Names:

Blood type:

Age:

User name:

Password:

Address:

Contact No:

Email:

Enter the above code

Confirm Password:

SIGN UP

Fig. 7

B: Output Format

ANDRIOD MOBILE EXPERT SYSTEM FOR THE DIAGNOSIS OF PNEUNOMIA

HOME | SERVICES | ABOUT US | CONTACT US | LOG OUT

USER'S DETAILS

Names:	Character
Blood type:	Character
Age:	Int
User name:	Character
Password:	Character
Address:	Character
Contact No:	Int
Email:	Character
Enter the above code	Character
Confirm Password:	Character

PRINT

4.4.6 Algorithm

Figure 8: Output Format

PROGRAM FLOWCHART
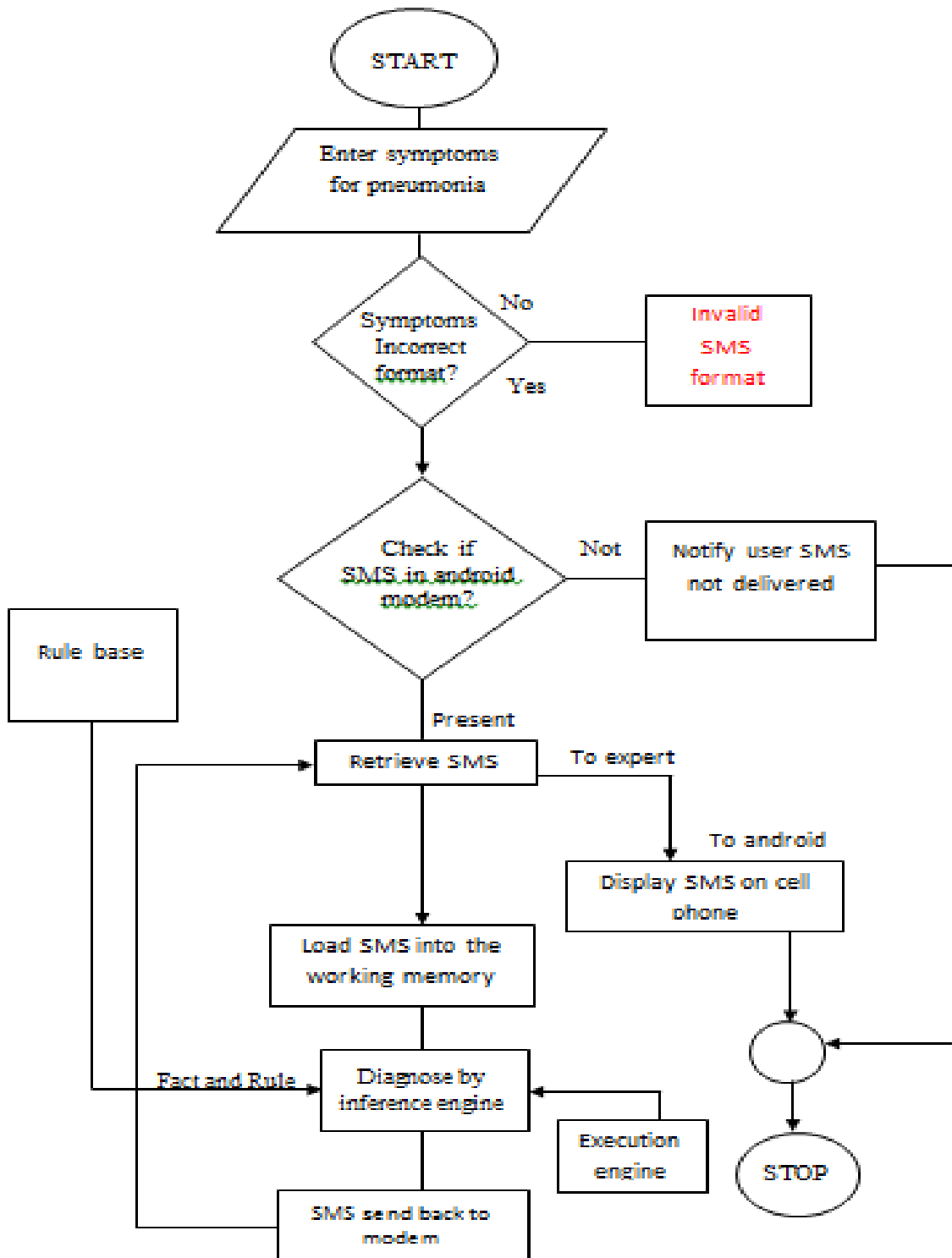
Figure 9: Program Flowchart
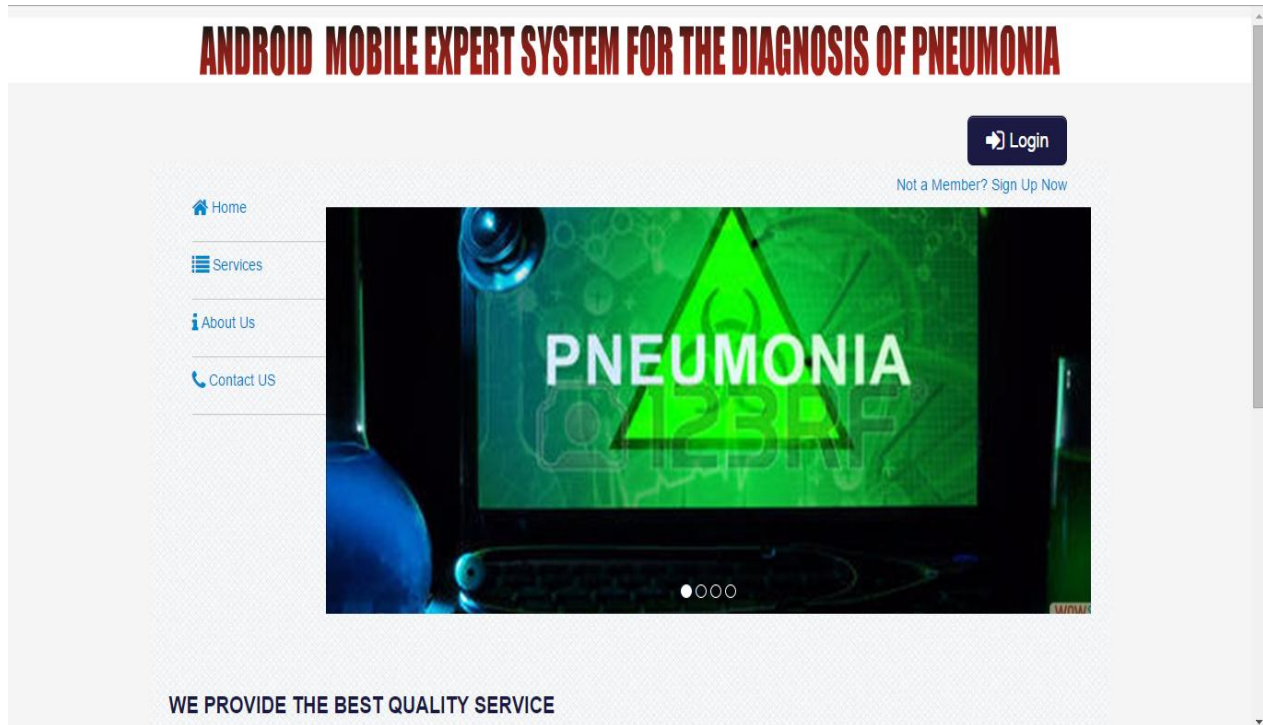
Output Display Form/ Draft Screen
    Home Page

Login Page

Pneumonia Symptoms Page

ASSESSMENT REPORT FOR ANDROID DIAGNOSIS OF PUENOMONIA

Patient's Name: Ifeoma Umenwanne

NNAMDI AZIKIWE UNIVERSITY
P.M.B 5025, AWKA
Phone: (234)-30000000

Diagnosed Synthoms:	4
Date	August 18, 2016
Blood Group:	O Positive
Email:	ifeoma@yahoo.com
Age:	24

Android Mobile Diagnosis Pneumonia Test Result	
Condition 1	Between 0 - 4 points. It is highly important that if an expert system diagnosed result fell within 0 to 4. Therefore, it can be established that you may just need to see doctor for medical check up because
Condition 2	More than 4 points. Sorry Ifeoma Umenwanne.It seems your health condition is not encouraging at all, therefore You are advised to meet with doctor for immediate further pneumonia diagnosis.

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WARNING: This is just a pneumonia self examination which may not be absolutely correct. Thus, only a Doctor can categorically tells your health status, so visit one today for further confirmation.

Diagnosis Result Page

Recommendation

In order to improve on this paper, we recommend that the future work should focusing on developing a mobile apps icon that will be install directly into mobile phones so that users can access the application quickly. Also we recommend that the users of this application should have basic computer knowledge.

Conclusion

Medical researches and questionnaires declare that there are approximately millions of pneumonia patients in the world. But unfortunately most of pneumonia patients either do not visit physician regularly or do not know that they are already suffering from this ailment. In this paper, one developed an expert system that is capable of diagnosing pneumonia patients. We achieved this by providing pneumonia patient with several questions by our expert system based on symptoms stored into the database with the aid of knowledge base and the patients will be mandated to provide an adequate answers in respect to his/her body condition. Once the pneumonia is found, the right drug and treatment advice will be provided by the system thereby making the entire system interactive and informative. Thus, one can say categorically that this paper is a huge success since its aim and objectives were achieved.

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