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An Online Student Medical Diagnosis and Information Management System

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Abstract

The Online Student Medical Diagnosis and Information Management System is a web based electronic health recordsystem that enables users to have access to the services of the Igbinedion UniversityOkada (IUO) Student free medical center through a portal. The proposed system possesses an online information system containing databases of patients, staff medical record, patient's appointment list, doctor's schedule, laboratory test results and so on that can be used to adequately manage the students' healthcare services. It also provides health tips and prevention guide to patients.Presently, the IUO student free medical center uses the manual processing approach to carry out their various activities to their teaming patients. This research is aimed at proffering a solution that will eradicate the problems associated with the present manual processes of diagnosis and information management in the free medical center. Problems like difficulties in searching patients' files, updating patients' records, documenting patient file, booking appointment with the doctor, and waiting for queues to see medical personnel can be eradicated by the implementation of this system. Therefore, the main purpose of the research is to computerize the manual processing of health services to the students of the university. The development of this research followed a very well defined software development life cycle which involves planning, analysis, design, implementation, monitoring and control processes and also utilize the various languages: Hypertext Markup Language (HTML), Cascading Style Sheet (CSS), Java Script, MySQL, Hypertext Preprocessor (PHP) for its design and implementation.

Keywords: Online based, Igbinedion University free medical center, Paper-based, Electronic Medical Record (EMR), Unified Markup Language (UML), Hypertext Preprocessor (PHP), Object Oriented Design (OOD), CRUD Matrix

1.0 Introduction

Igbinedion University Okada (IUO) is the first private university in Nigeria. It is located at Okada Wonderland in Okada, a town beside Benin City, Edo state. Igbinedion University Student free medical center is situated at Crown Estate, Okada. It is a sub-part of the Igbinedion University Teaching Hospital, with the major aim of providing free medical treatment and advice to the students of Igbinedion University Okada.Igbinedion University Student free medical center is affiliated toIgbinedion University Teaching Hospital(IUTH), Okada.It attends to matters pertaining to the medical aids of the students in the university which includes activities such as blood testing, diagnosis and treatment of various ailments.The clinic also provides a broad range of in-patient and out-patient health care services to match the needs of the students of the university. The in-patient services include medical, surgical, pediatric, obstetric and rehabilitation services.The out-patient services includes emergency services, day procedures, diagnostic and assessment services, and therapy services .Since the opening ofIgbinedion University Student free medical center, the healthcare services to the students has been the highest priority.As such the need to computerize this process cannot be overemphasized.

2.0 Statement of the Problem

This study is intended to look into the problems inherent in the manual process of performing health care services inIgbinedionUniversity Student free medical center.The current system prevalent in the Student Free Medical Center has

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proven to be a much of a problem due to the general problems associated with manual processing systems (e.g. difficulties in updating records, no flexible method of data integration, cumbersome process of carrying manual filing and documentation etc.). The use of paper-based (also known as manual processing system) medical records has proven to be less rewarding leading to the driving force for the automation of medical records in the university. In a nutshell, the problems associated with the present system can be itemized as follows: (a) Lack of accurate and detailed records of patients information, (b) Inefficient patient's data storage, organization and retrieval, (c) Inefficient patient records security and confidentiality, (d) Scheduling an appointment with a doctor is a major challenge due to the fact thatwithout the patient's presence; appointments with a doctor cannot be made and (e) Inadequate communication with the health personnel. The proposed system is therefore aimed at designing and implementing a system that will eliminate these problems currently associated with the manual processes being used in the student Free Medical Center.

3.0 Objectives of Study

Online application is an internet based web services to clients. With the advent of internet technology, enhanced capabilities of portable/mobile devices to support the Information and Communication Technology (ICT) infrastructures and advanced Human Computer Interaction (HCI), online applications have become the computerized solutions to most organization needs [1]. We are therefore motivated to take advantage of these technologies with the aim to design and implement an Online Student Medical Diagnosis and Information Management system using Igbinedion university free medical center as a case study.The objectives of this research are: (a) To keep track of patient's records, (c) To efficiently ease, update, retrieval and storage of patients records, (d) To provide automated platform where patients can book for appointment online, (e) To provide easy access of emergency services to patients as a result the computerized process of administration in the hospital, (f) To provide immediate access to data, (g) To ensure adequate confidentiality of data by maintaining a secured access control mechanism in the online system.

4.0 Some Related Literatures

The world of Electronic Medical Record (EMR) is evolving; starting with *computer stored medical records*, and then *ComputerizedPatient Record (CPR), Computerized Medical Record (CMR), Computer-Based Patient Record system(CBPR), Electronic Health Record (EHR)* and *Automated Medical Record (AMR)*[2].The term of EMR is defined as computerized medical records that can be accessed with concern of patient privacy, confidential and security from multiple integrated systems at any point of care within the health care enterprise [3]. One of the healthcare experts [4], defines EMR as a computer-based information system that integrates patients-specific information from diverse sources and tracks that information overtime to facilitate clinical management and information retrieval, analysis and reporting. Bates [5]defines EMR as a confined medical record offering little integration with other system and is much restricted in its scope.The EMR replaces the paper records as the primary record of care meeting all clinical, legal and administrative requirements. An EMR is a structured and integrated approach to managing patient data with the end result of improving care by reducing the number of incomplete charts, reducing the waiting time for paper-based test results and enhancing clinical decision making with real-time or on-line access to patient information [6-7]. This way, a physician can have a complete view of a patient's medical history, which may allow him or her to check for duplicate prescriptions, overdosing, over treatments and such, thus reducing medical errors. At the same time, a nurse can access the same patient record, without waiting for the chart to be physically transferred [8]. One of the huge advantages of EMR is the ability to incorporate evidence based practices; and in this way improve the quality of the services they provide [9]. For example, placing orders and prescriptions, setting reminders and alerts, communicating with others through a messaging system, if used properly can improve the efficiency and quality of the services of the health organization.

Adegbenjo et al. [10]developed a Health Management System (HMS) capable of storing and retrieving the medical records of patients as well as diagnosis of some diseases. However, this HMS application is a standalone application. Although, standalone applications are computerized, they do not support services that will allow for online access to information contained in their database. Raenukolandaisamy [11] developed a web based online medical diagnosis system that helps the user to get the appropriate information needed regarding hypertension and overall health conditions. The system did not offer the complete personalized service including diagnosis, medicine, appointment reservation, treatments and file integration; preparing data connection between the laboratory information system, so that the doctors can send laboratory test request and read test results from the his computer system.With modern technology in the delivery of healthcare system, cloud-based electronic medical record (CloudMR) system was developed to improve the delivery of healthcare system in the rural communities of Nigeria [12].

5.0 System Methodology

A feasibility study of our case study was articulately carried out. The existing medical system operates the manual processing of data. To establish the purpose of our research objectives, we carried out a system investigation on the existing

system and employed interviewing, direct observation and inspection of documents as our fact findings techniques.The interview was set up with key stake holders at all levels and department in the organization to ensure a rich and complete view of what is happening in the hospital. This research work employed open ended questionnaires technique to achieve effective interviewing. Some of the open ended questions are: (a) How often do you visit this hospital, (b) How do you find the registration process in this process, (c) How well do you relate with your doctors, (d) How long do you have to wait to see a doctor, (e) Do you feel better booking an appointment before coming to the hospital, (f) Does it help knowing your doctor's schedule. To achieve thoroughness of information, four doctors, five nurses and one pharmacist, two laboratory scientists and two clerical staffs in the free medical center were put under direct observation. The staffs under observation were notified of the aim of the research to avoid suspicion. The main objective of the direct observation carried out was to have full insight on the workflow of activities in the medical center. Several documents such as test result, diagnosis sheet, drug prescription sheet, and other important patient file information were carefully examined and analyzed. Data filtering was carried out to enable us know the relevant information needed in the research.

Based on the analysis of the existing system, the following setbacks were identified:

(i) **Inefficient patient's data storage, organization and retrieval**: Data within the system is generally stored in a way which makes it difficult for the management to retrieve useful information. Data are stored in separate folders each with the patient's name and are organized in cabinets indexed with probably letters. Due to this poor data storage and organization, retrieval of data proves much of a challenge. For instance, in the case of emergency reports, data cannot be retrieved on time.

(ii) **Inefficient patient records security and confidentiality**:The possibility of medical papers slipping out from the patient's file is very high and patient's privacy can also be invaded.

(iii) **Scheduling an appointment:** the existing manual procedure poses a major challenge due to the fact that without the patient's presence, scheduling appointments with a doctor cannot be done.

(iv) Inadequate documentation and integration of medical files:files containingpatient fees payments, drugs prescriptions and other vital information are not integrated. This makes decision making cumbersome as patients may have to open files at various units in the hospital where they are in need of services.

Considering the setbacks of the existing manual system, there is a strong need and motivation to develop a system that will proffer a technology aided solution by developing a computerized system which can be used to render effective online medical services to the student free medical center in particular and in any manually operated hospital in general.

6.0 System Design

Object Oriented Design technique was used to carry out the proposed system design.Software design is a description of the structure of the software to be implemented, the data models and structures used by the system, the interfaces between system components and, sometimes, the algorithms used [13-14]. Our system design employs bothhigh-level design and detail level design.The high level design section provides information about the architectural analysis and real time design. The architectural design is further subdivided into the component model, deployment design,logical component view and CRUD MATRIX.The Detail level design section provides information about the data flow diagram, lower level data flow diagram, and data structure, use case and use case specification. Figure 1 represents all the various components and the relationship that exist among them.

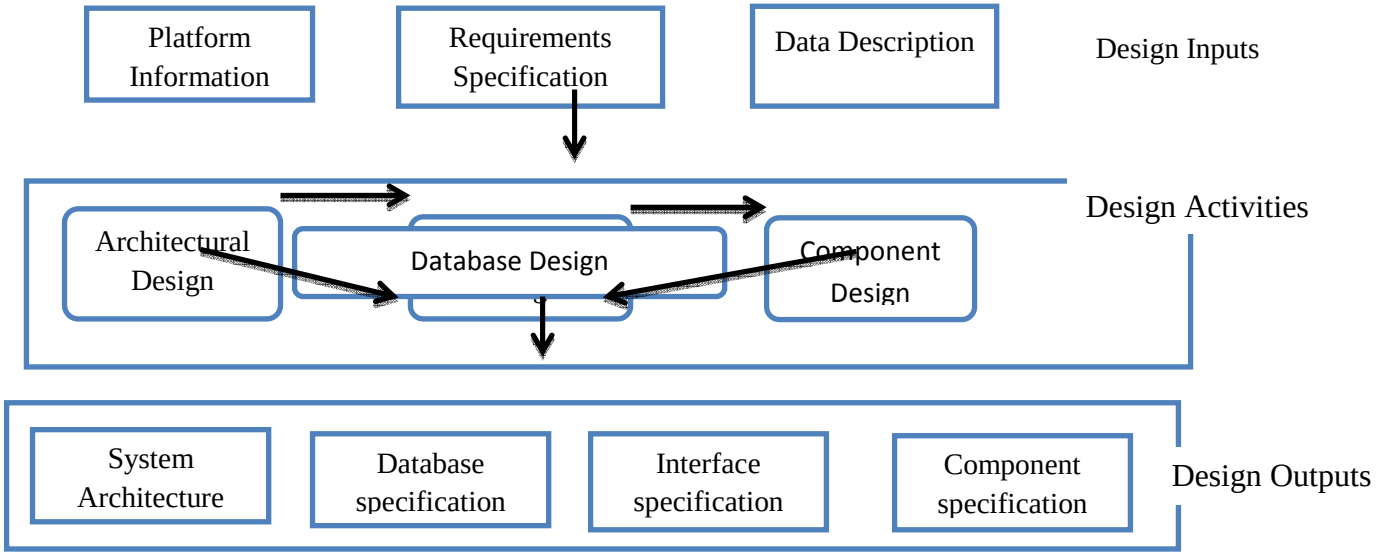

Figure 1: An Abstract model of the design phase

This research employs the following design inputs; Platform information, Requirements specification and Data description (Figure 1).Platform informationrefers to information about the environment in which the software will execute. For the course of this research, the software platform that will be employed is Windows XP or higher version of Windows Operating System.Requirements specification is a description of the functionality the software must provide and its performance and dependability requirements. The project considers the system, functional and non-functional requirements. Some of the functional requirements include (the patient shall be able to book appointment online, the patient shall be able to login in online, the patient shall be able to lookup the doctor's schedule etc.) while some non-functional requirement includes (the system should provide a simple and user friendly interface, the system should be able to detect any incorrect input, the system should be able to authenticate users' information when logging in etc.).The architectural analyses consist of component, behavior and Enterprise classification models that depict the Online Student Medical Diagnosis and health information Management System of Igbinedion University Free Medical Center. Figure 2shows the physical components of our proposed system and also depicts the system from a general view.

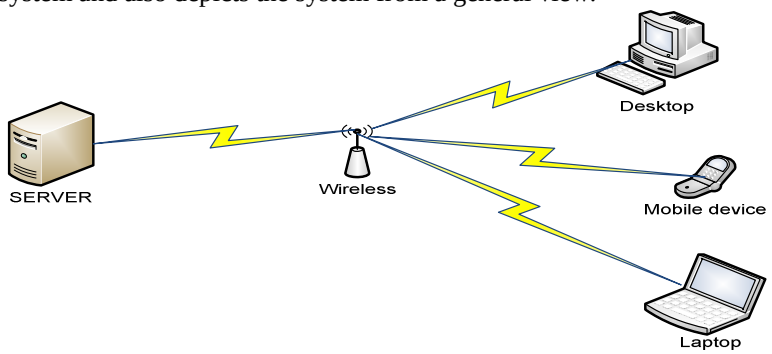

Figure 2: Deployment diagram for component model

The deployment diagram shows the top-level view of how the system will be deployed and it interaction with the devices used by the users of the system. It also depicts what components of each part of the system: The Server consists of the Web Interface, Logic Layer/Business Logic and the Database, the devices also has web browser that would be used to access the web interface. Figure 3 represent the access control mechanism used in determining the type of access rights granted to users. For example, the System Administrator can perform Create, Read, Update and Delete operations, when a patient wants to book for an appointment, Create and Read Operations is required.

	Patient	**Doctor**	**Nurses**	**Adminstrator**
Login	R	R	R	CRUD
Account	C			CRUD
Appointment	CR	RU	R	CRUD

Create	Read	Update	Delete
C	R	U	D

Figure 3: CRUD MATRIX of the Online Student Medical Diagnosis and Health Information Management System

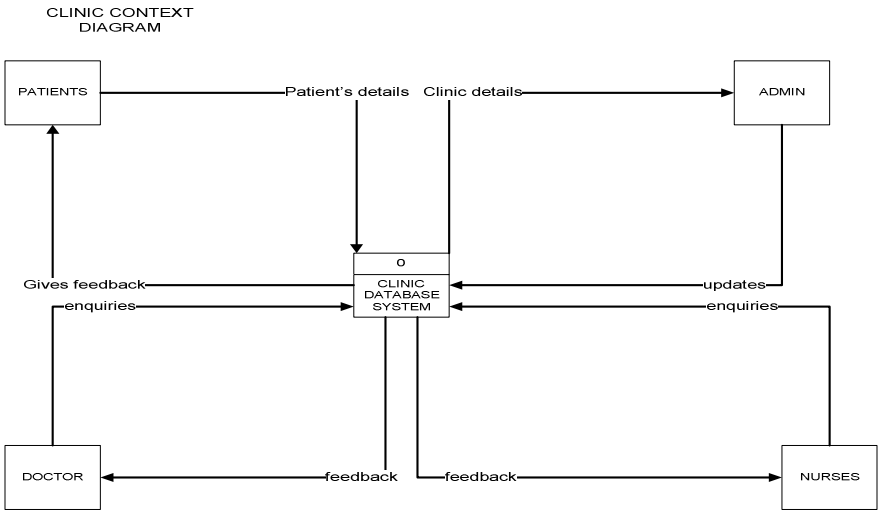

Figure 4: Detailed level design of Online Student Medical and Health Information Management System.

Figure 4: represent a detailed design illustrating that the various users (patients, doctors, nurses and admin officer) of the online system operates on a centralized database which can be accessed from their various location through the network. Information processing, enquires and updates are also stored in the clinic database system.

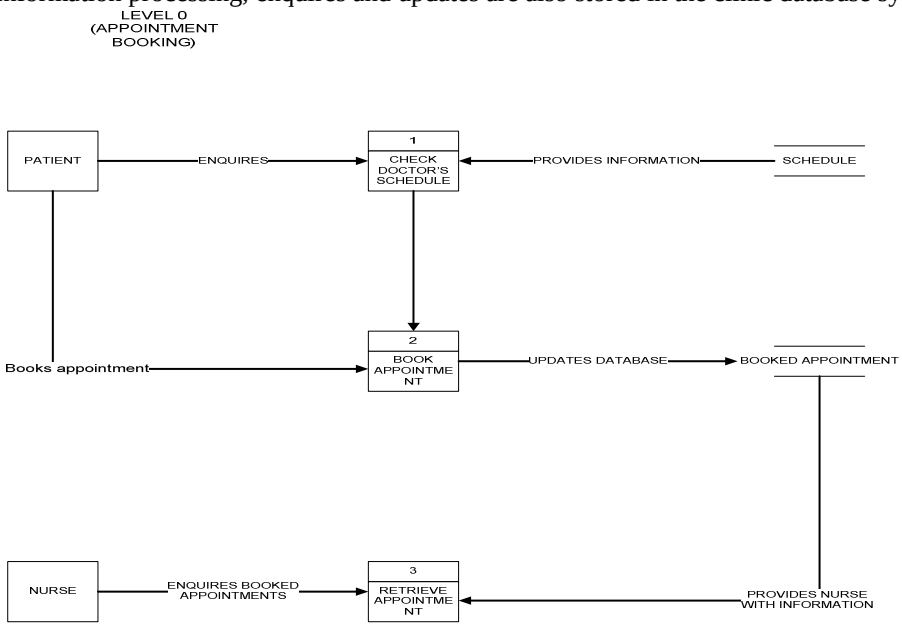

Figure 5: Lower Level Data Flow Diagram of Patient Booking Appointment with the Doctor

Figure 5 shows a lower level diagram of processes in a patient booking an appointment with the doctor. First, patient check doctor's schedule; this is provided by the schedule module, if the doctor is free at that time, the appointment can be booked and the database is updated else patient cannot book appointment. The users have access to the appointment listing and such information is used in preparing the necessary information that is required prior to the booked date.

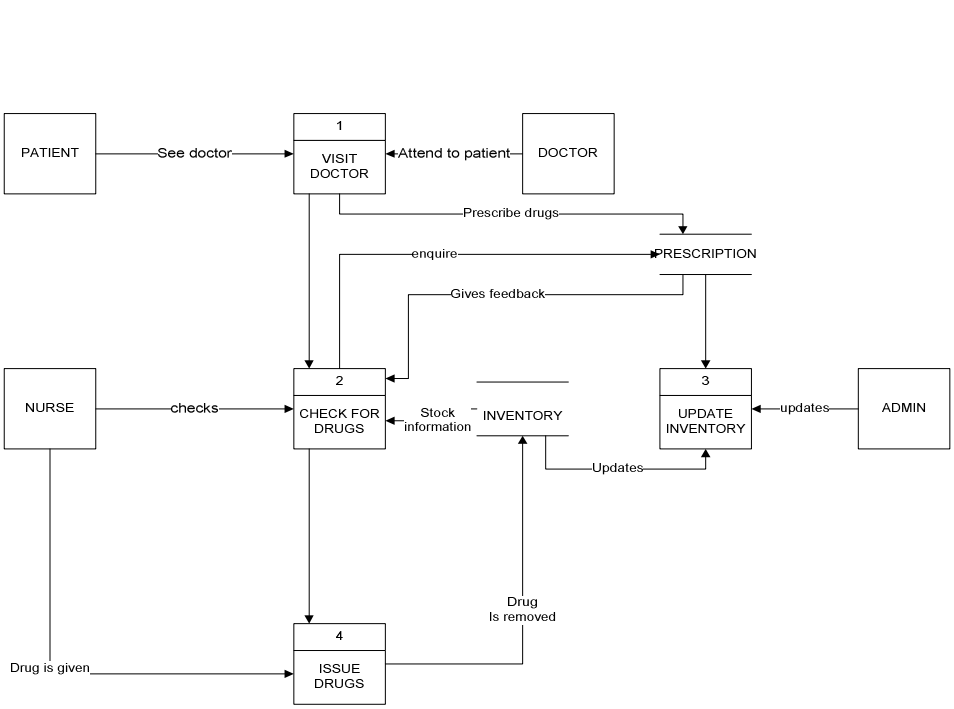

Figure 6: Data Flow Diagram Of Online Student Medical Diagnosis and Health Information Management System

Figure 6 represents the dataflow design structure of the various system components. It represents the design sequence of activities that the patient follows to see a doctor, diagnose the patient illness, prescription of drugs module, and the admin module updates drug inventory module, the nurses check patient module and issues drugs and the stock information is sent to the database for update.

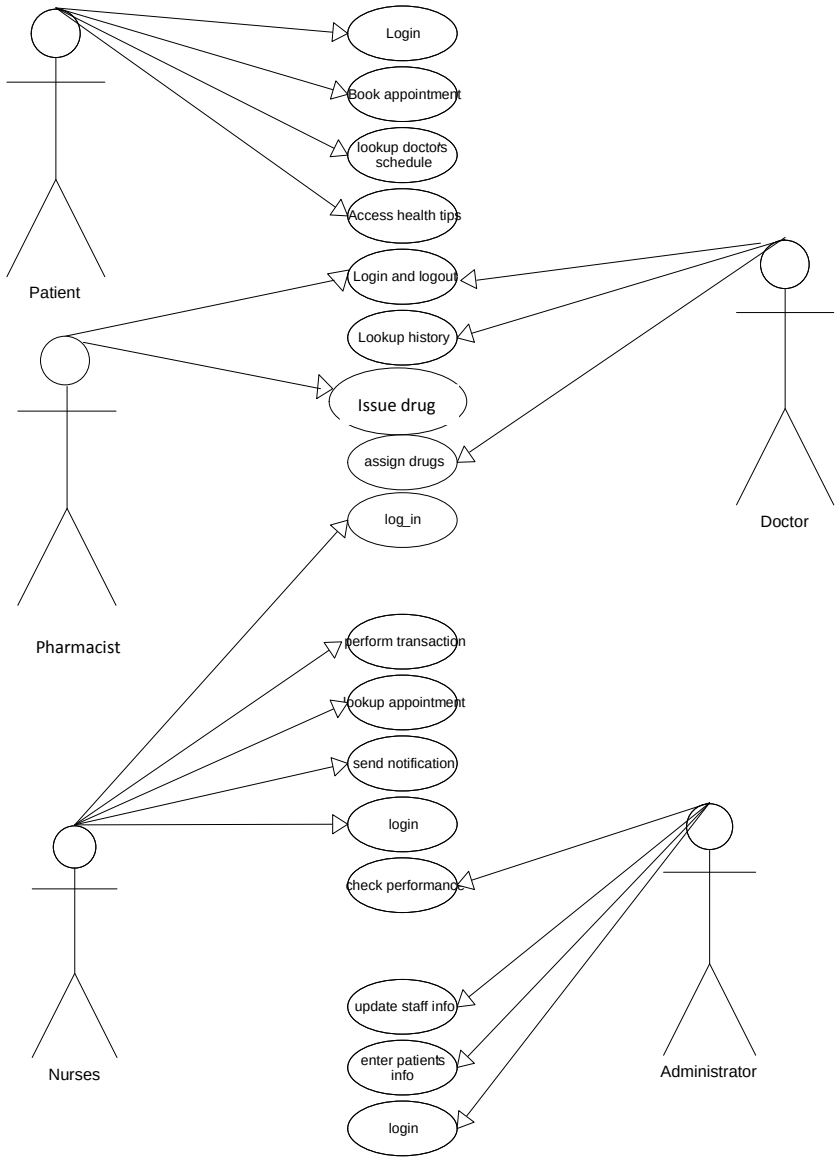

Figure 7: Use Case Diagram Of Online Student Medical Diagnosis and Health Information Management System

The use case diagram(Figure 7) represents the various actor and the actions that they can perform on the system. For example, all users of the online application must have to login to before they can be authorized to perform their operations. The Pharmacist for example, can issue drugs, but the nurses and doctors cannot. But the nurse can administer drugs.

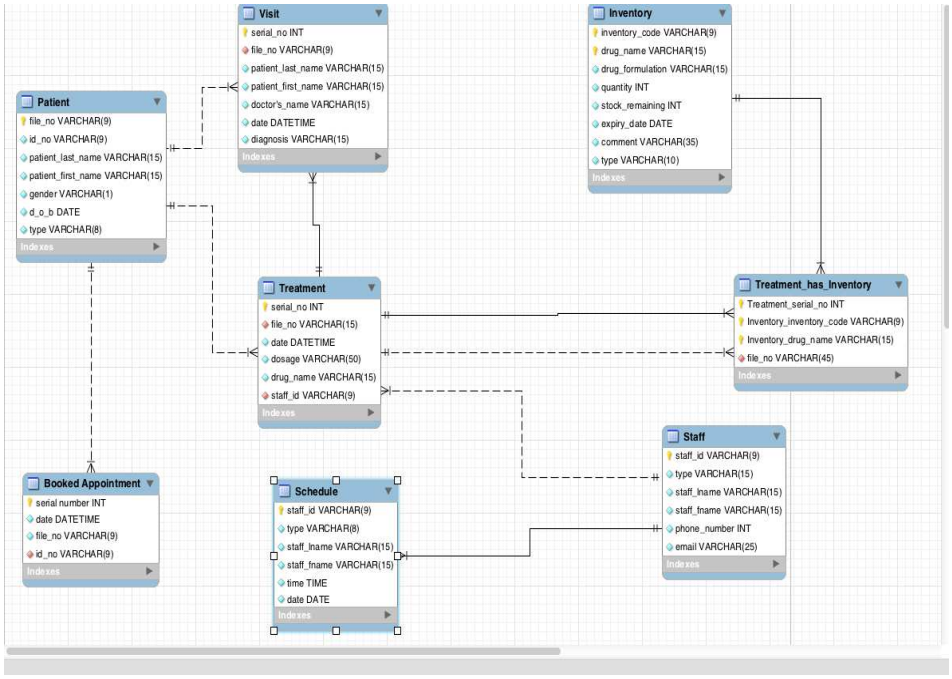

Figure 8: Entity Relationship Diagram Of Online Student Medical Diagnosis and Health Information Management System
Entity Relationship Diagram (Figure 8) the various component design structure of the various actors in the system and the interaction among them.

7.0 Design Implementation and Results

Hypertext Markup Language (HTML) was used to design the front end of the application (display images and Graphical User Interface). The Hypertext Preprocessor (PHP) and JavaScript languages were used to develop both the server and client side. The HTML also used the Style Sheet known as Cascading Style Sheet (CSS) for styling the web pages. The backend utilizes the Microsoft Server for the database Management component.Each of the designed web pages was tested as units, especially the login, Register, Appointment, medical history pages where tested. The various units were integrated and the entire system test was conducted. The implementation and testing of the system was carried out using three personal computers and one server with internet facilities meeting the minimum software and hardware requirements. When the online application is launched, the homepage is displayed (Figure 9). In the homepage, the patient can log in by clicking on patient log in icon, doctor can login by clicking the doctor log in icon and the Administration Officer can log in by clicking Staff log in icon. This log in icons when selected displays a log in page (Figure 10, 11 and 12). The log in page is interactive and user friendly; the patient, doctor or administration officer requesting authorization enters his log in Identification (e.g. username) and password, the system compares the details with those in the database and grants access to the respective user.

Figure 9: Home Page the Online System

Figure 10: Patient Login Page

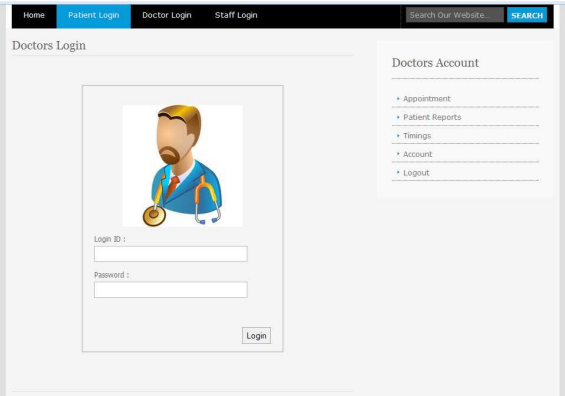

Figure 11: Doctor Login page

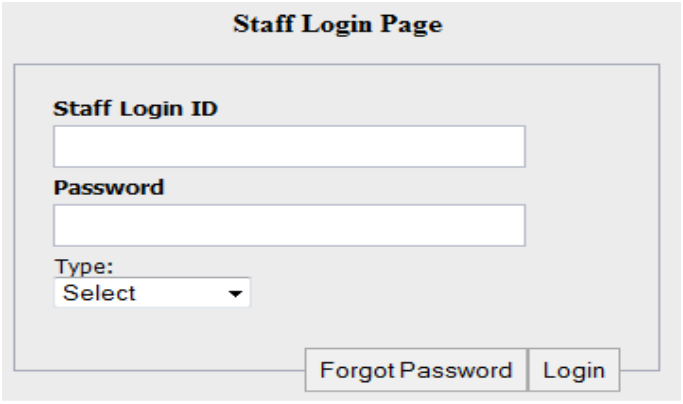

Figure 12: Staff Login page

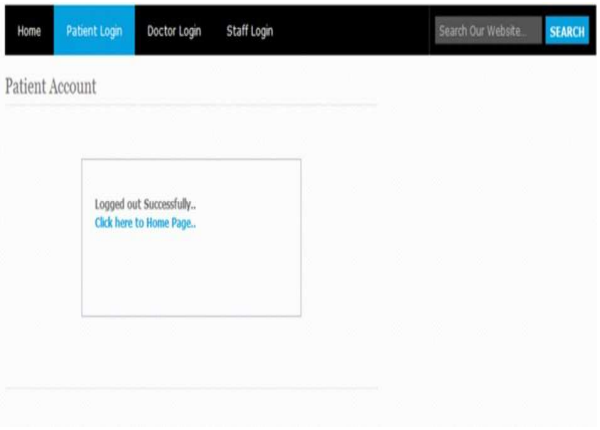

Figure 13: Patient log out page

Users of the system can always log out by clicking on the log out icon. Figure 13 represents a patient clicking on log out and in return a pop up page showing log out successfully is displayed.

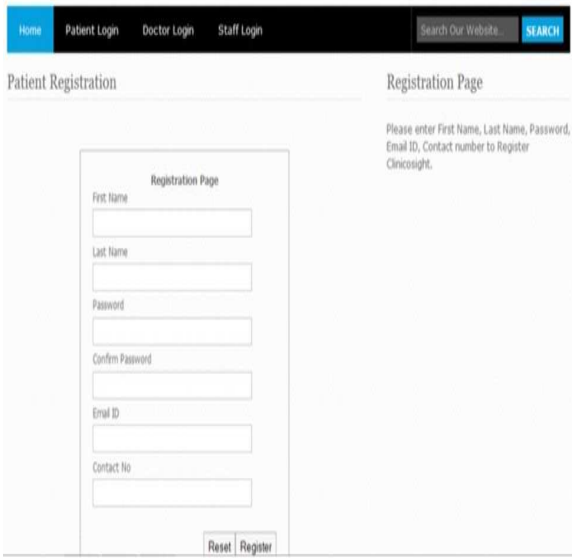

Figure 14: Patient Registration page

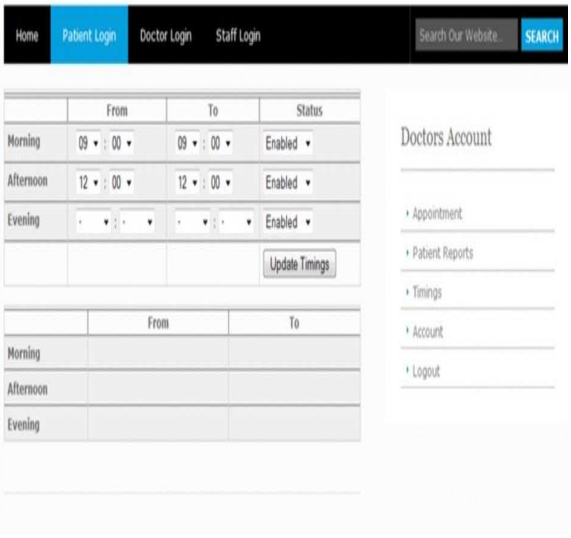

Figure 15: Patient booking appointment

It is to be noted that before any user can have access to the online system, registration of the users data is first carried out. Figure 14 represents a registration page that is required by a patient to fill if he/she wants to fully use the services of the

application. Upon registration and login in, the patient can perform a lot of activities. However, for illustration, figure 15 represents a web page that can be used to book an appointment by a patient. The web page contains various periods of the day (morning, afternoon and evening) that the patient can decide to book an appointment. Once the appointment is booked, the doctor can view the appointment page when he/she sign in. At the backend, the databases are integrated so it is possible for the doctor to view the appointment list (Figure 16) when he logs in with his ID and password. The doctor can also view the time logs of all appointment time (Figure 17).

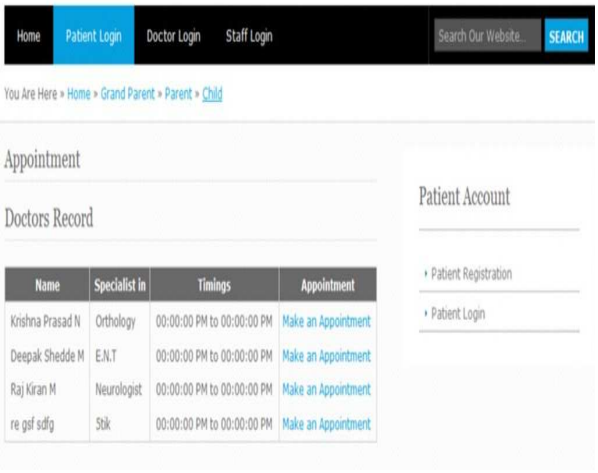

Figure 16: Doctor viewing Appointments

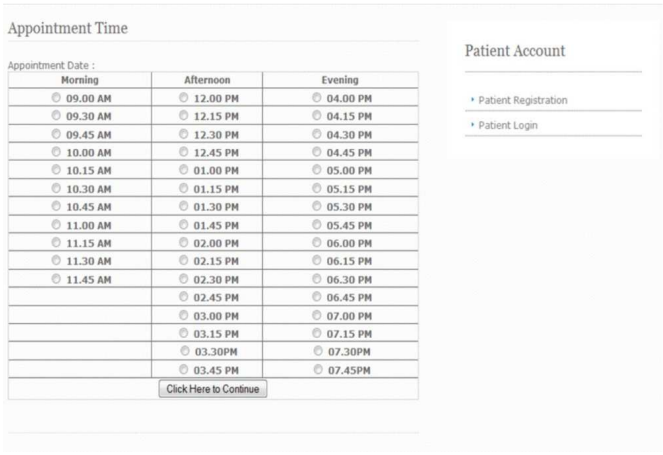

Figure 17: Time Appointment Log

8.0 Conclusion

The proposed benefits of an online medical diagnosis and Information Management system from an integrated health record and information system are eagerly anticipated, e.g., for improved decision making, better medication management, effective booking of appointment, effective administration and improved resource utilization. These promise significant advantages over the current manual-based system for clinicians, students and the healthcare system generally. The proposed online system is an event driven, friendly and easy to use. Although it may be costly to implement such technology and even to maintain, since maintenance cost is more expensive than development cost but enormous gain out weights the cost of implementation.The need to tackle the problems associated with the current manual based system can be eradicated by the implementation of the Online Student Medical Diagnosis and Health Information Management for the Student Free Medical Center IUO, as a means to surmount the current system.Management should allow for a parallel conversion of the newly developed system with the existing manual processing system. When satisfactorily convinced, they can do away with the manual processing system. To reduce cost, the newly developed system can be put into use by first deploying few systems in the clinic center.Staff training should be made mandatory for all involved staffs.Unauthorized persons should not granted access to the computer's system resources so as not to circumvent the advantages of the newly developed system when fully deployed.

9.0 References

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