Design and Development of Health Centre Management System with Fingerprint Identification

Oluwagbemiga O. Shoewu[1*]; Oluwafemi J. Ayangbekun[2]; Mary A. Adedoyin[1]; Egwakhide Aigbovbioise-Job[1]; Lateef Adesola Akinyemi[3]; and Folorunso Comfort Oluwaseyi[4]

[1]Department of Electronic and Computer Engineering, Lagos State University, Epe, Lagos State, Nigeria.
[2]Department of Computer Science, Redeemer's College of Technology & Management, Mowe, Ogun State, Nigeria.
[3]Department of Electrical Engineering, University of Cape Town, South Africa.
[4]Department of Systems Engineering, University of Lagos, Akoka, Lagos, Nigeria.

E-mail: engrshoewu@yahoo.com*
ayangbekunoj@gmail.com, ltfaki001@myuct.ac.za, lateef.akinyemi@lasu.edu.ng
cfolorunso@unilag.edu.ng

ABSTRACT

The poor efficiency of the present manual management system in hospitals today results from the inordinate length of time it takes to search for and locate patient folders and the ineffective filling system adopted. The purpose of this study is to develop a computerized Health Centre Management System that will upgrade the quality of information management and efficiency of the hospital employees by adopting two – way authentication system involving the use of fingerprints. As every cooperate organization, institution or government agency requires data and good quality information to function effectively, It is however not an over statement to say that many organizations, institutions or government agencies have become critically dependent on the use of database system for their successes especially in the hospital.

This research paper uses the Waterfall methodology model that followed a linear structure starting from preliminary investigation, requirement analysis, design phase, implementation, and maintenance. This study produced the module that would administer patient registration and admission details, a module that could monitor medicine inventory of the Health Centre Pharmacy, etc.; thereby resulting to a better improvement of the hospital transactions. However, it has been recommended in this research need to enhance the front end design of the system; add modules for the laboratory and billing module, generate hospital reports that could help the users to provide an overview of the hospital transaction within specific date.

INTRODUCTION

Hence, the health sector in any economy forms the backbone of its growth and development [1] to [3]. However, the healthcare system is experiencing many problems among others is the medical record issue involving patient having multiple records, records loss as a result of fire, difficulty in retrieving patient data, and errors due to manual calculations. Therefore, provision of security measures that will safeguard both the medical records and its information content, whether in electronic form or paper form against loss, damage, alteration is becoming of serious concern in today's [4] global health system.

When a patient enters the Health Centre, the Medical Records Unit of the Centre is the first point of call in the Health Centre where documentation on the patient is initiated. It is the pivot on which other units revolves and, the image maker of the Health Centre. The patient medical records are initiated by documentation of the vital patient information which is basically identification data including; name, age, sex, address, next-of-kin contact and other relevant information that will aid in the treatment, monitoring and follow-up of the patient. The allocation of a unique hospital number to the patient is hereby done which facilitates easy retrieval of patients' medical records at subsequent visits to the Health Centre. Then the patient goes to the nurses' workbench for examination (vital signs), the nurses then carries

the patient folder to the doctor's workbench for diagnosis.

Thereafter, patient is directed to the laboratory for test or to the pharmacy for collection of drugs. Meanwhile, the pharmacy section checks the patients prescribed drugs and cost them before the folder is sent to the bill office for billing [20]. After diagnosis the patient can also be referred to another clinic or to see a consultant in the hospital if necessary.

With the present technological trend, the manual system involving tedious paperwork and hardship of going through various registers/files [1] to find out patient's medical record has become obsolete. In an attempt to involve Health Information System (HIS) in the manual workflow of the Health Centre, computers for each department are deployed and Microsoft Excel Sheet is used for data organization. Each staff looks through their Excel files or printed files for each patient profile. But, since all the computers are not connected to each other via any repository database, updating of information is done separately. For this reason, recording and maintaining all the records is highly unreliable and error prone.

Therefore, efficient medical delivery in hospitals may not be achievable without better management systems as strong health systems are central to achieving better health outcomes [2]. This forms the basis of this research paper to overcome the challenges being encountered daily thereby automating the traditional failed systems in hospital managements by designing and implementing Healthcare Management System with fingerprint Identification to maintain the records of both indoor and outdoor patients, as well as employee records.

The study is important to the Health Centre patients since they could have medical information without experiencing delays and incorrect information. With this development, accessing patient's medical record and information now becomes an easy task using fingerprint [2] as means of identification without delay. This is because, biometric identification systems employ user's biological data, in the form of voice, face and signature scans. Issues of identity theft, human errors and security breaches [3] using biometric identification will certainly become thing of the past.

Staff will be able to register, update, delete, and search information within the system remotely since all the computers from various units are all linked to only one system acting as the main server/databank for the hospital

LITERATURE REVIEW

According to Toussaint, hospitals can't improve without better management systems as this plays an important role in today health care system [1]. Prasanth and Sailaja stated that hospital management system is to computerize the front office management which deals with collection of patient information, diagnosis details, and even the billing details [8] [20].

It has been found out that the computerization of Health Centre has become a necessity and has become the new standard which must be implemented as the need for easy access to patient information and history are significantly increasing. According to Kaelber, et al. [11], patients, policymakers, providers, payers, employers, and others have increasing interest in using personal health records (PHRs) to improve healthcare costs, quality, and efficiency. They stated that many healthcare information technology vendors and healthcare providers already have the tools available to PHRs to their customers and patients [10].

According to Kaelber, et al. [11], the use of an electronic medical record (EMR) system for mandatory reporting of drug hypersensitivity reactions has been shown to improve the management of patients in the university hospital in Korea. The researchers found out that the report rate of past DHSRs (drug hypersensitivity reactions) was greatly increased and the estimated incidence of new events decreased under the new system. The occurrence rate of new DHSRs during hospitalization, which were caused by the repeated administration of the agents previously suspected as culprit drugs enormously, decreased from 15% of previous system to 1% of new system. The researchers concluded based on the study that the mandatory reporting system for past DHSRs and the supervision by allergy specialists appear to be important in improving the management of patients with drug hypersensitivity and in preventing the occurrence of DHSRs in a general hospital.

According to Blumenthal and Tavenner (2010) [18], the widespread use of electronic health records (EHRs) in the United States is inevitable. EHRs will improve caregivers' decisions and patients' outcomes. Once patients experience the benefits of this technology, they will demand nothing less from their providers.

According to Wager et al. [13], physicians and staff indicated that the EMR system has changed not only how they manage patient records but also how they communicate with each other, provide patient care services, and perform job responsibilities. The EMR is also perceived by its users to have an impact on practice costs. Although in most practices physicians and staff were unaware of actual expenses and cost savings associated with the EMR, those in practices that have eliminated duplicate paper-based systems believe they have realized cost savings.

Finally, Shachak [13], stated that there exists both negative and positive impacts of an EMR when considering physician–patient relationships in healthcare delivery. Though he later stated that the negative impact can be reduced to its barest minimum significantly with a better design of an EMR systems using a qualitative approach and grounded theory-like approach for data analysis.

Meanwhile, research has also clearly shows that those hospitals that adopt the use of an electronic health management systems for their records activities experiences great improvements in terms of quality of care in their healthcare delivery activities.

METHODOLOGY

The Health Centre Management System with Fingerprint Identification is divided into the following: the hardware, the software and the network components. The Hardware components are the devices that are used to access the server on which the database resides. The software is the Graphical User Interface (GUI), the database, both of which reside on an online server and other supporting software (e.g., API for the Fingerprint scanner) integrated with the software to enable fingerprint capture and authentication. The system is web accessible with a web browser (e.g., Chrome).

This system was developed using an iterative waterfall model. The system is however accessible when connected to the internet but the database is hosted on the web server - the centralized database which is shared by all medical facilities.

Patient information is only accessible by authorized personnel. This is made possible by the use of username and password (Encrypted with MD5 algorithm) in order to protect the confidentiality of patient records. Patient records are retrieved with fingerprint of the patient; this will serve as an additional means of identification together with the use of file number. Any intruder with malicious intent will not have access to the system, even with the use of reconnaissance.

The Health Centre Management System with Fingerprinting Identification System was implemented using the following technological requirements in terms of software and hardware.

Software Technical Requirements

Front End: Hyper-Text Markup Language (HTML), Cascading Style Sheet (CSS), AJAX and JSON, and JavaScript.

Backend/Database (DBMS): PHP and MYSQL (for querying and manipulation of the database) Framework: Bootstrap and JQuery are the framework used for the User Interface and for the front-end.

Platform: The IDE for the fort end is Visual Studio Code and XAMPP Server is used as the local web host server.

Hardware Requirements: Fingerprint Scanner, Complete System - Intel® Core(TM) i3-6100U CPU@ 2.30GHz, 6.00GB (RAM), 64-bit Operating System, x64-based Processor, 1TB HDD.

DESCRIPTIVE MODEL DESIGN

The model design of this system subdivided the health Centre into five (Figure 1) categories based on their Units / departmental functions in the hospital.
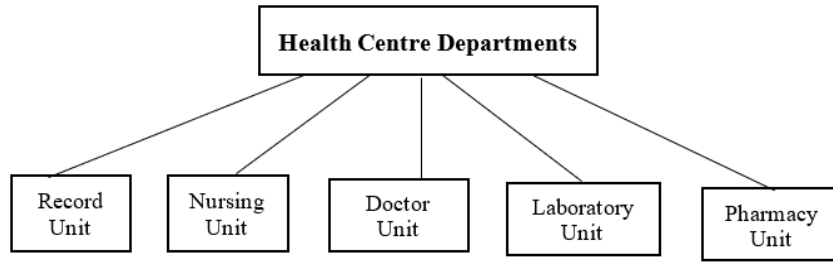
Figure 1: Health Centre Departments / Units.

The Centre management system is however broken down into modules. Few of these modules are as stated below:

A. Administrator Module

The Administrator has the highest level of authorization over the system and is responsible for the general monitoring of system performance. The administrator could add a patient, delete, modify, and view all reports generated form the gathered data (Figure 2).
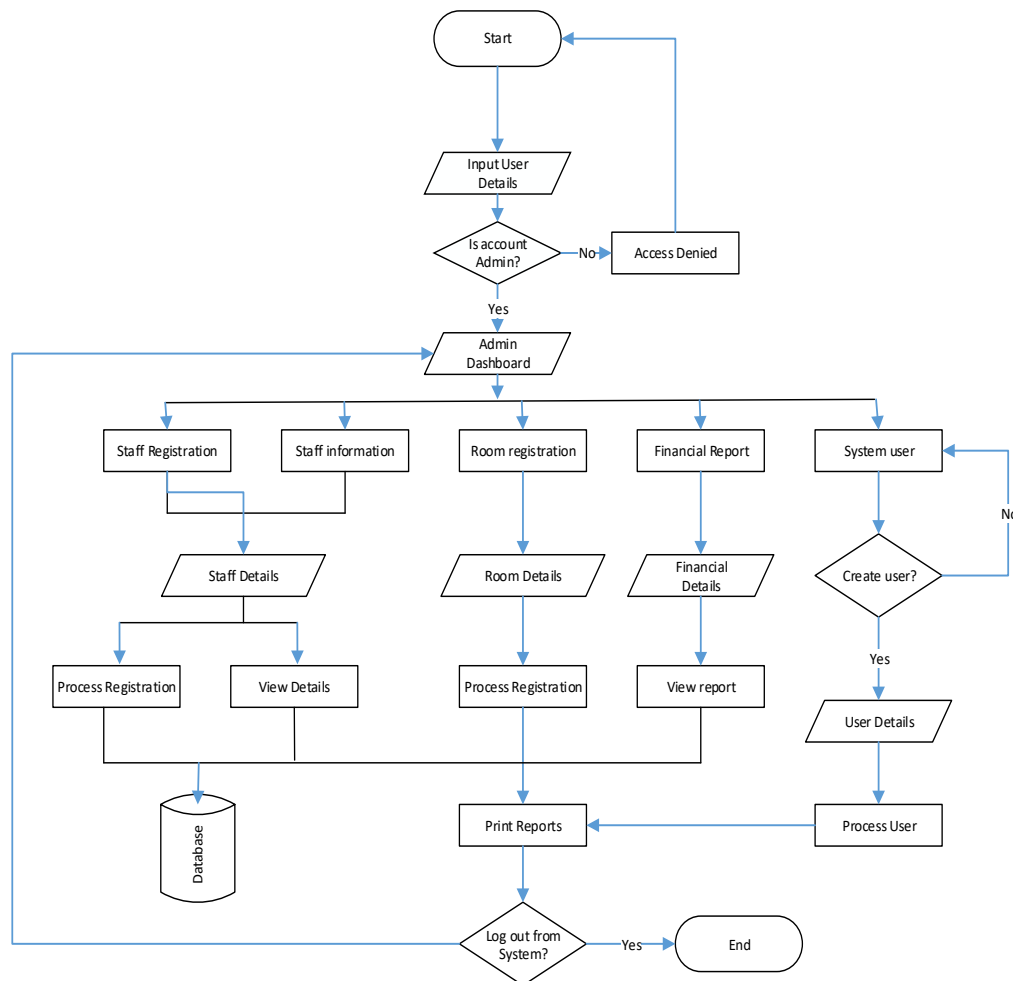

Figure 2: Flowchart of Administrator Module.

B. Patient Registration / Record Module

This module deals with registration of patients as either OPD (Out-Patient-Department) or IPD (In-Patient-Department). The fingerprint scanner is used to capture biometric data (during registration) or match the finger of the patient with the one stored in the database. In addition to the fingerprint, a unique identification number is issue to the patient after complete registration for flexibility in searching for patient records (Figure 3).
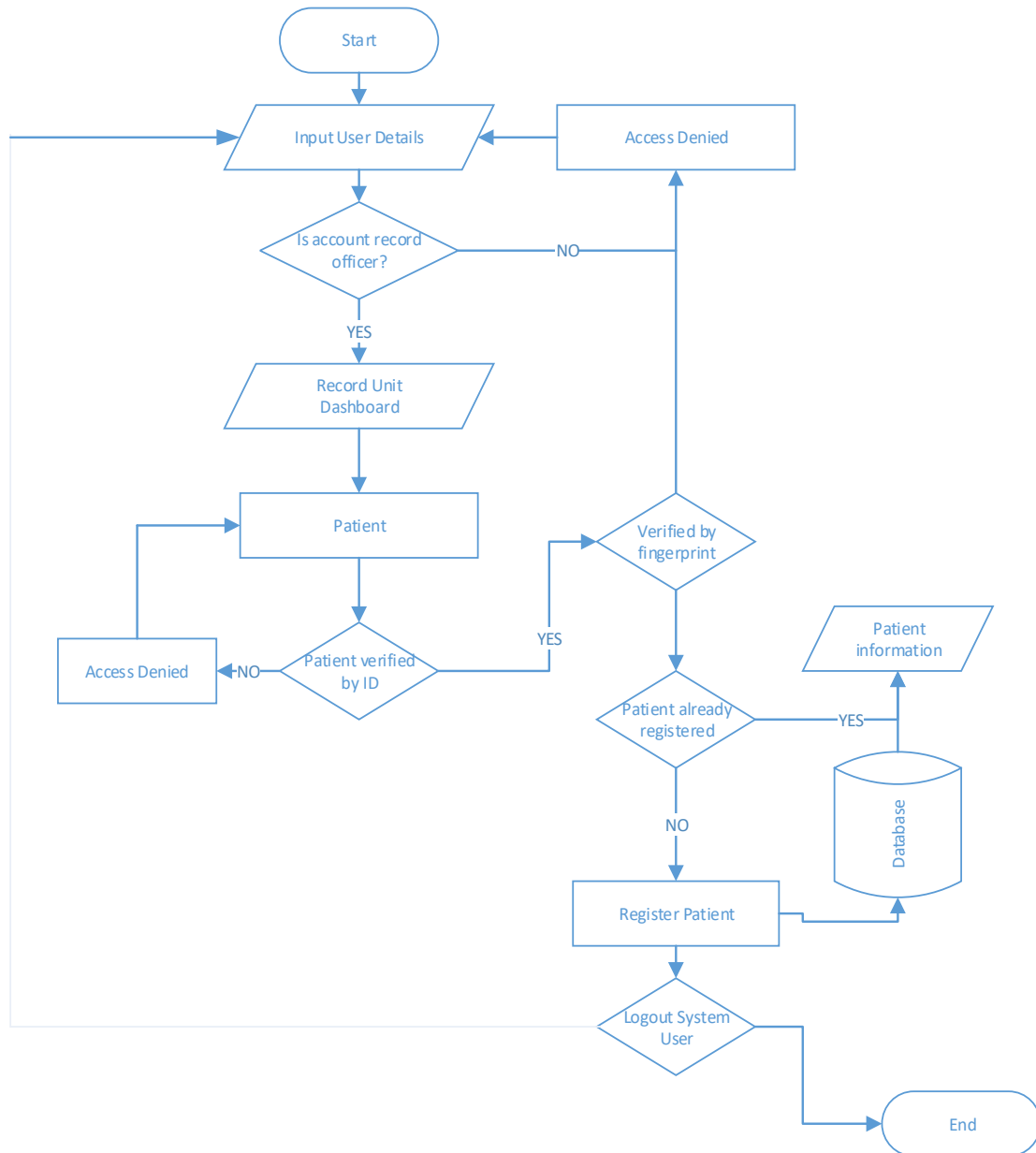
Figure 3: Patient Registration Flow Diagram.

C. Nurses Work Bench

Nurses with right authentication could view the patient history. By logging into the system, the head nurse could manage whether the patient was ready to go home or not (Figure 4). Preliminary examination involves taking vital signs (temperature reading, blood pressure, height and weight of the patient). They also keep records of the drug administered and the injection given (consumables).
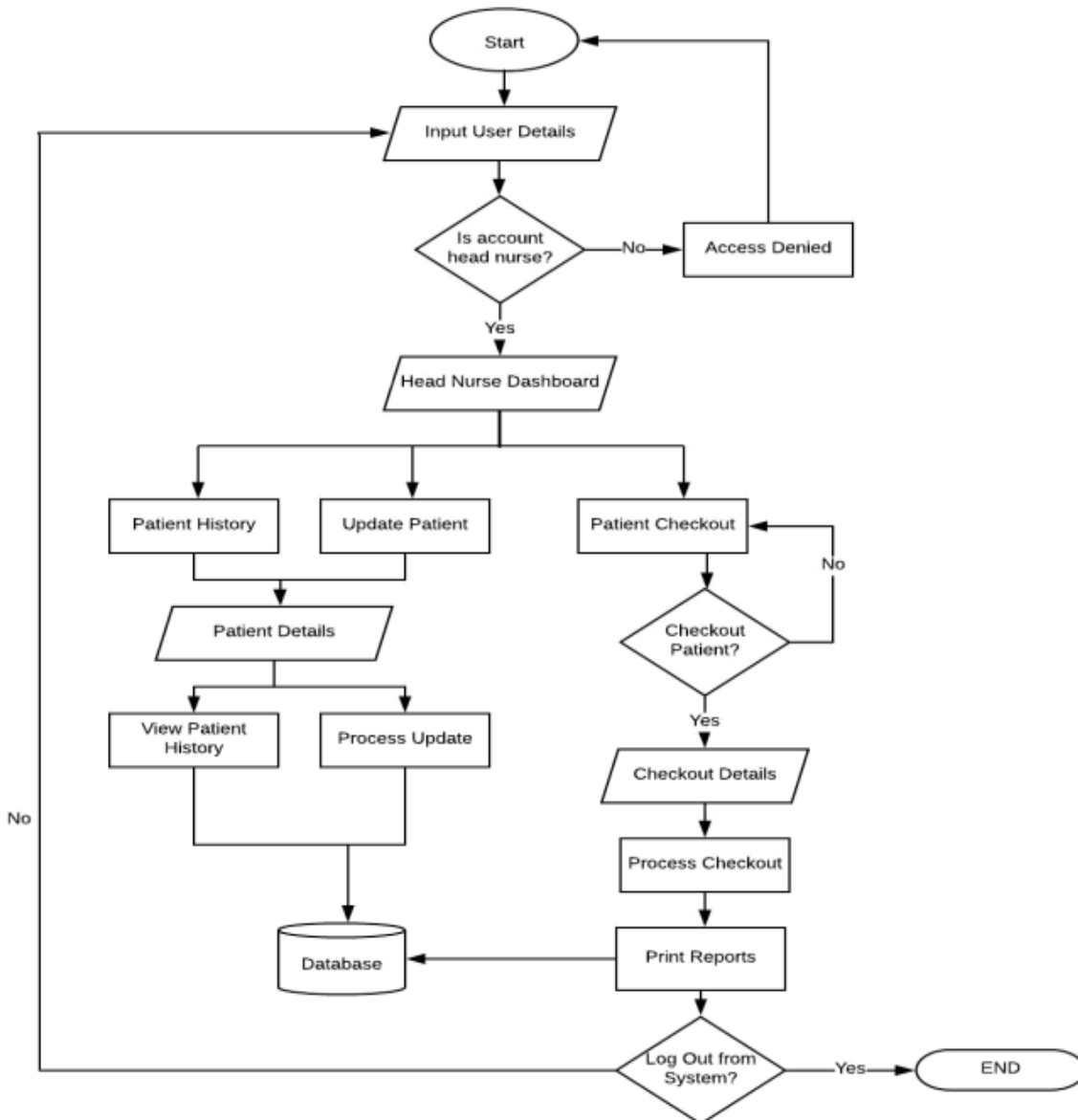

Figure 4: Flowchart of Nurse Module.

D. Pharmacist Module

The Pharmacist is granted some privilege to manage the inventory and check the current medicine available. He or she could also print the pre-ordered list medicines to the patient (Figure 5).
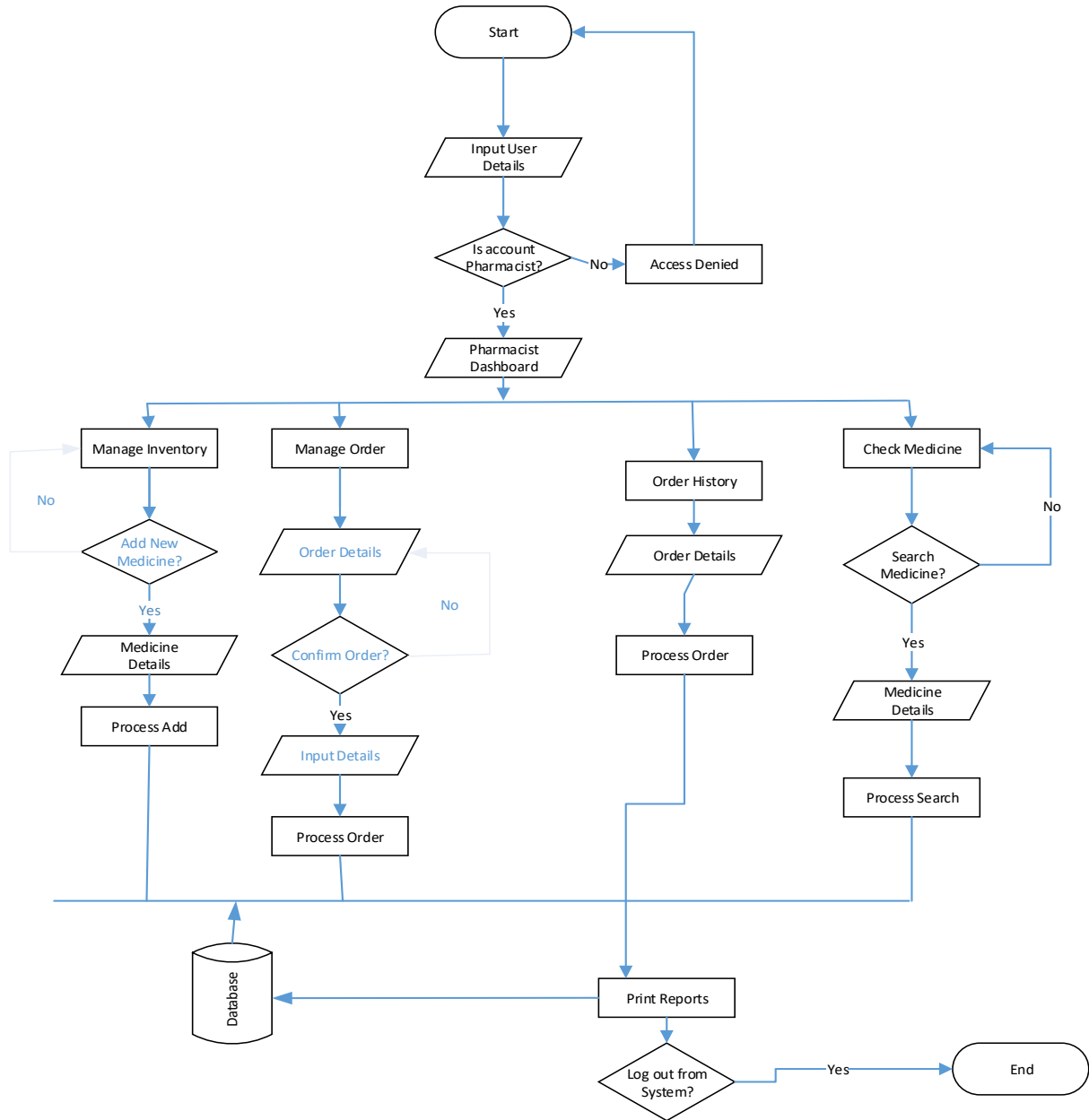

Figure 5: Flowchart of Pharmacy Module.

E. Appointment / Waiting List Module

This module assists in the management and control of appointments waiting lists and queuing. The module integrates a special patient reporting system (Figure 6). This makes it possible for doctors to view and monitor Patient's appointments any time on the system.
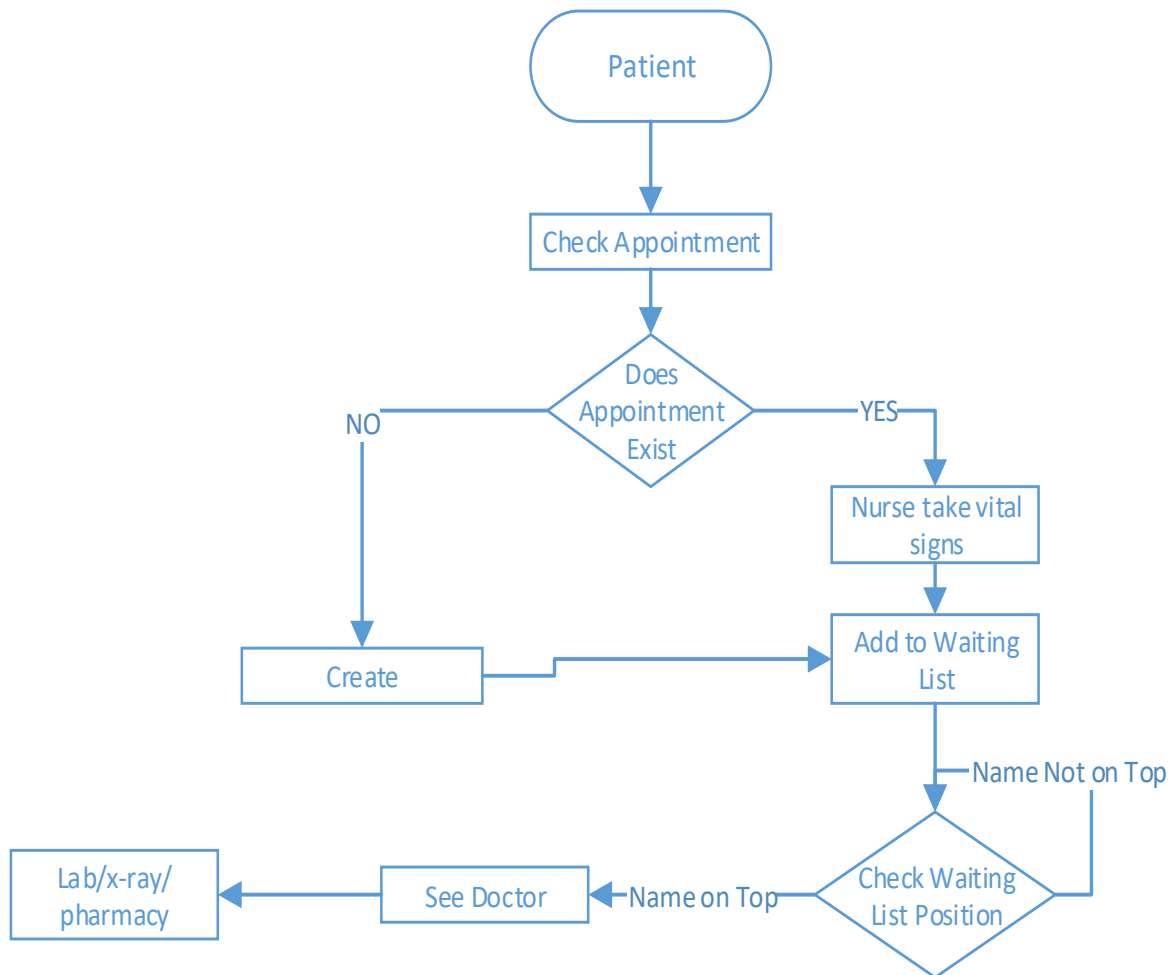

Figure 6: Flowchart of Appointment / Waiting List Module.

OBJECT MODELLING

The diagram below illustrates the roles of the people covered by the system and their interactions. There are five users of the system: the administrator, the billing officer, receptionist, pharmacist, and the head nurse. However, the descriptive system diagram for the Health Centre Management System is made up of three different actors: nurse, doctor and administrator; with large number of actions available to each of these actors. Meanwhile, the class diagram shows different classes under Health Centre Management System. The entities and its subclasses are being illustrated by the arrow; indicating that the source type had a relationship with the target type (Figure 7).
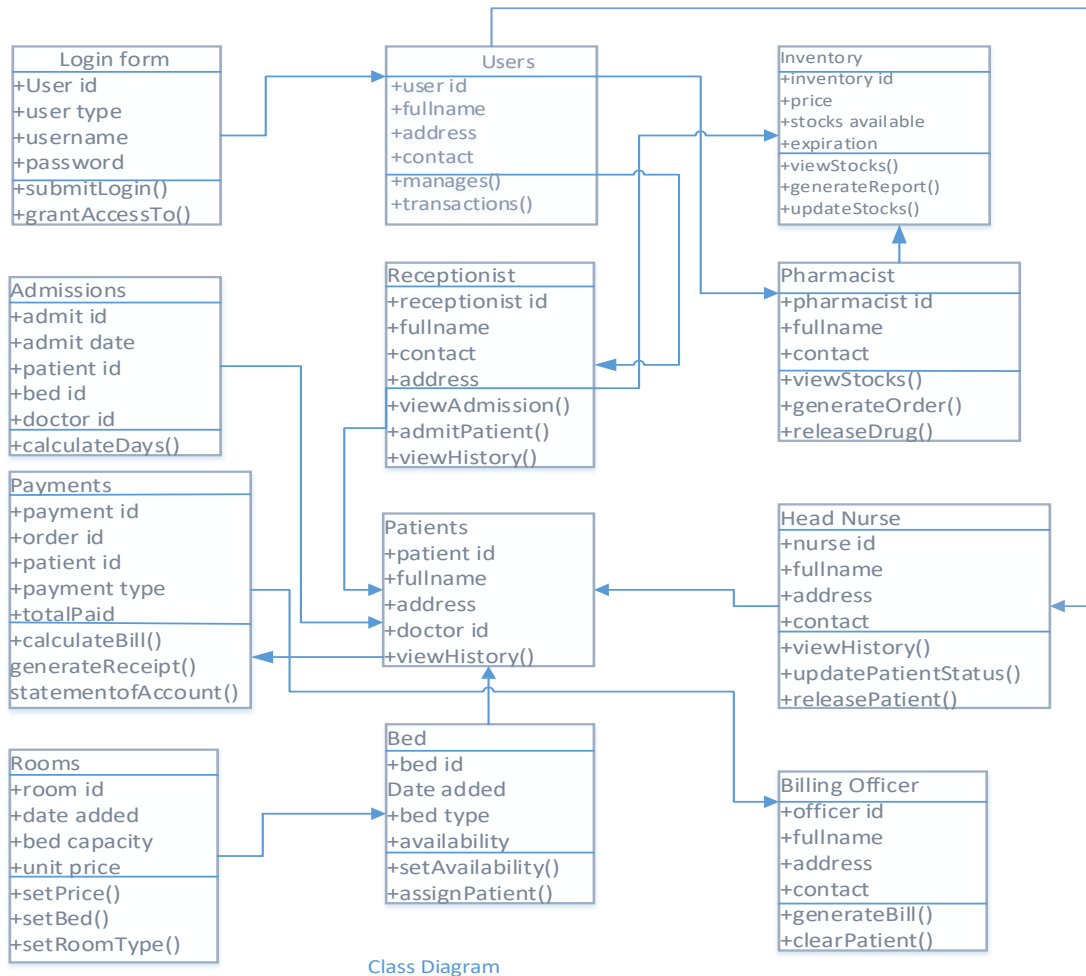
Figure 7: The Class Diagram.

FINGERPRINT VERIFICAITON

The fingerprint verification architecture involves four (4) stages – Capturing, Enrolment, Matching and Identification (Figure 8).

Capturing: fingerprint capturing is the process of input fingerprint image from the optical fingerprint scanner into the computer system. When the fingerprint donor presses his/her finger on the sensor, a dialog box displaying the captured fingerprint will appear on the screen

Enrollment: during enrollment stage, biometric data are obtained, linked with identity, and encoded for storage, retrieval and matching. Fingerprint scanner is used to collect data and verify identities. The biometric process begins with enrollment, depending on the system and the type of algorithms used, certain key features are extracted during enrollment and used to create a template. Each biometric vendor has its own enrollment algorithms, and some are better than others. A template can be stored locally on a PC or a network server.

Matching: The matching algorithm compares a current fingerprint image against the previous enrolled print, checking whether they come from the same finger or not.

Verification/Identification: An Identification process is conducted to verify the live scanned fingerprint of an individual from that stored on the database. A guest identity may either be Verified or rejected.
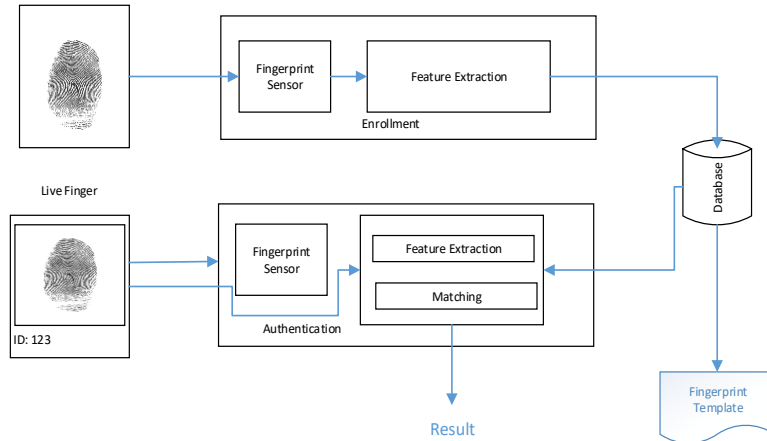
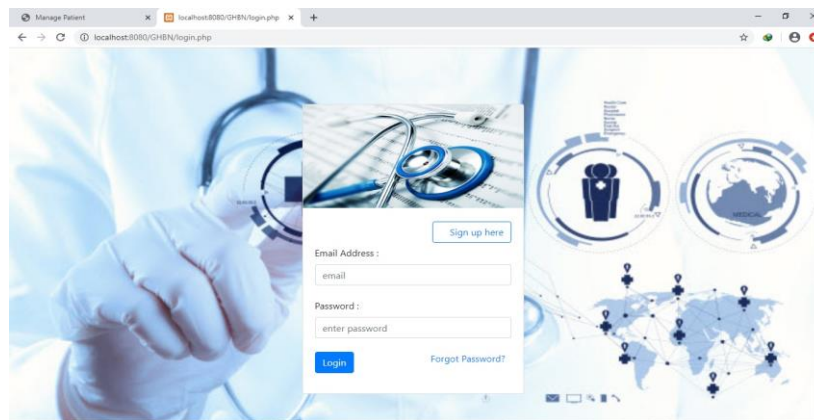**Figure 8:** Fingerprint Verification Architectural Design.

Figure 9: User Login Platform for Login Details.

Figure 10: Patient List and Verifiable Records.

SYSTEM RESULTS AND TESTING

The system development software interphase for the hospital management system provides the login platform (Figure 9) where users gain access to the system.

Through this system, the registered data (Figure 10) can be accessed by the healthcare workers with granted authorization into the system for necessary action.
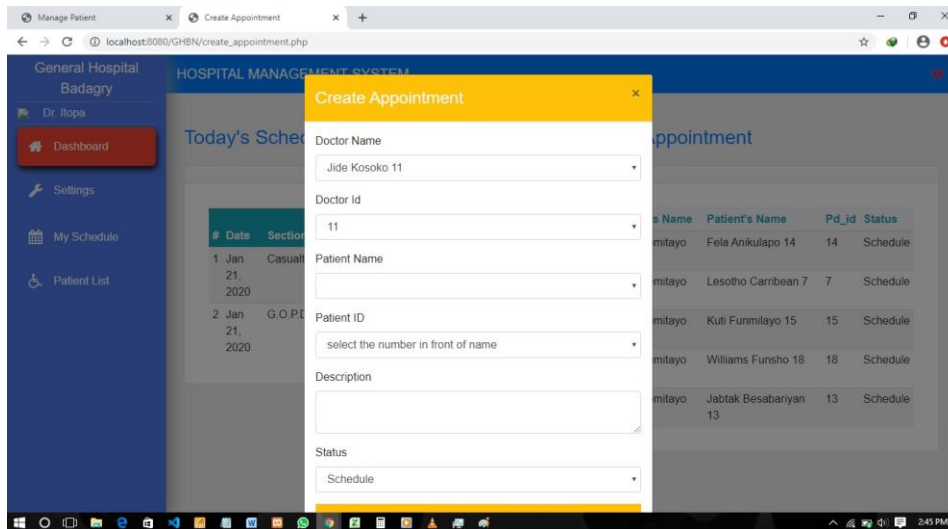
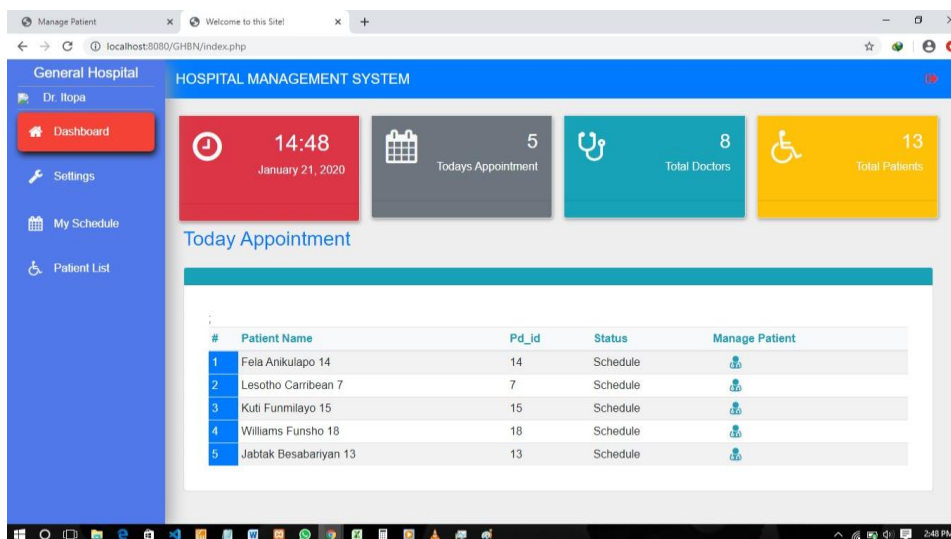**Figure 11:** Create Appointment Interface or Platform.

Figure 12: Doctor Dashboard Platform.

With the access to this system based of the model design and description, Doctors can book, view / scheduled (Figure 12), and create (Figure 11) appointments with patients when necessary through the modules shown below using Doctors dashboard.

Doctors can however do the aforementioned using Doctor's dashboard platform (Figure 12) created on the system.

CONCLUSION

There is an anxious race to find the best method of securing healthcare data and ameliorate mistakes which are considered hazardous to the healthcare delivery system all over the world. Despite the financial burden, more healthcare organizations are turning to biometrics as a means to increase security, privacy and improve patient safety. This is however achievable by both adopting and deploying two factor authentications system for its effectiveness which could include a user name (what you know) and fingerprint (what you are) authentication.

The computerized Health Centre management System will provide better services for the Nurses and Doctors, Pharmacist, Laboratory, and the Records such as reduction in time taken to find a folder, accuracy and timeliness of record

preparation, etc., as well as preventing unauthorized access to available data / information. In this design we have conveniently demonstrated the workability for Lagos State University, Health Center Department and much has been done to eliminate data redundancy, inconsistency, and improve on the integrity of the data stored in the system. The software model used is the iterative waterfall model and the structured design was also employed in the design stage.

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