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Interlinked Hospital Management System

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Abstract: ***An Interlinked Hospitals Management System is a unique web-based health management system that links all the hospitals operating in the country for efficient hospital management operations. The motivation behind this work is to overcome the challenges experience in the hospitals day to day operations, especially to obtain historical records of patient at any hospital during emergency case(s) treatment. This is achieved by proper capturing of data, storage, retrieval, and management of information (involving medical diagnostic history and billings) that can cope with numerous patients; reducing paper work burden of manual system and aimed at improving health care system. The framework of this system development was designed and implemented using the functional requirements gathered from the problem definitions and analysis. The methodology used was Rapid Application Development (RAD). The front-end programming developing tool utilized JavaFx, HTML, CSS, JavaScript while the PHP, XAMPP Server Engine at the back-end, and Biometric Fingerprint Technology. The system was successfully implemented on Windows 7 operating system. The results was tested and the developed web solution can capture data input, storage, retrieval, and enable hospitals to access any patient's medical historical record from a unified interface. Thus emergency can be handled. Therefore this yields a great improvement in the hospitals information keeping and management towards quality of patients care.***

Keywords: Hospital Management System, Patients, Patients Emergency Case, Biometric Fingerprint Authentication. Hospital Information systems

1. Introduction

A medical institution is primarily devoted to the diagnosis and care of patients. According to [2], the appropriate and timely provision of complete and up-to-date patient data to clinicians/hospitals has for decades been one of the most demanding objectives to be fulfilled by information technology in the healthcare domain. The degree to which the patients are satisfied with the care received is relevant not only to the doctors' expertise in their field but also to the quality of services offered by the Hospital Management System to ease the processes the patient goes through [1]. Nowadays in developing countries, patients do spend a substantial amount of time in clinics/hospitals they registered for when waiting for services to be delivered by the doctors or health professionals. The cause is that most health centers and hospitals are presently using the personal computers [6], [7] and manual system in their data processing and management which results to a number of problems: lack of standardized data collection, difficulties in getting correct data from legible manual records, difficulties in storage, update of records or keeping patients historical data – diagnostic, drug prescription and billings; information can be lost when records are stolen, misplaced/ vandalized, patients are made to contend with time wastage involved in the hospital management protocols. Manual and semi-manual methods are simple and easy to implement, but cannot be efficiently used to manage large amount of patient information or handle urgent critical cases easily.

Yes, it is true that many hospitals management operations have to shift from manual operation to electronic (web based) due to improvement in technology. This has assisted in improving the quality of services rendered to patients by the medical professionals in the hospital. However; in an emergency situation where the patient data does not exist in the hospital being admitted, considerable amount of time will be involved in the registration process and diagnosis protocols. The consequence is that the patients might not survive in such situation. Therefore, an improved system should be employed to overcome the challenges. These problems necessitate the implementation of Interlinked Hospital Management System (IHMS).

To embrace the benefits of improvement in technology, hospitals management operations have to shift from manual, semi-manual and separate application system operations to a unified electronic (web based) system. This is the principle behind the workability of Interlinked Hospital Management System. In this work, maintaining records of indoor/outdoor patients, patients' diagnosis details including drugs prescription and billings, system operations of searching, update, retrieval and insertion will be done very easier by the administrator. This system will assist in handling patient in an emergent situation, thereby overcoming the challenges of the existing systems. This work employed the use of Biometric Fingerprint Technology for patient registration and patient identification during emergency cases to ensure immediate attention of patient at critical conditions. The IHMS will assist in improving the quality of services rendered to patients by the medical professionals in the hospitals.

1.1 Aim and Objectives of IHMS

The aim of this work is to develop a unified and secured Interlinked Hospital Management System for the health institution operation to manage efficiently patient records and services. The system developed should actualize the following objectives: easy hospitals and patients' registration for efficient data storage, to grant different hospitals access to the system irrespective of their locations, easy data retrieval while keeping the histories of medical diagnostic records, billings and drug prescriptions. Also, to ensure data

security, the new system will deny unauthorized persons access into the system.

The outline of the paper is as follows. Section 2.0 discusses the related works of researchers in hospital management system. In section 3.0, the researchers looked into the IHMS Architecture, Entity Relational Diagram and the flowchart that shows how the system works. The research work was concluded in section 5.0. In this publication, some explanations, database design items, implementation details were neglected to avoid complexity.

2. Review of Related Works

Interlinked Hospital Management System (IHMS) is designed for multispecialty hospitals, to cover a wide range of hospital administration and management processes of patient-centric system. It is an integrated end-to-end Hospital Management System that provides relevant information across the hospital to support effective decision making for patient care (medical records management and billings), and hospital administration, in a seamless flow. In existence, some researchers have contributed positively in the improving of health care institutions management systems. Therefore, we discuss in this section below, some of the related works done in hospital management system by researchers in the field.

The work of [8] focused on understanding the performance indicators of Hospital information systems (HIS), summarizing the latest commonly agreed standards and protocols like Health Level Seven (HL7) standards for mutual message exchange, HIS components, etc. The study is qualitative and descriptive in nature and most of the data is based on secondary sources of survey data. However, the researchers identified several modules for the implementation of E-Hospital Management and Hospital Management System in which Emergency Management was one of them. The contents operation within this module excludes the incorporation and use of Biometric Fingerprint Technology. Thus, this indicates that emergency cases in the intensive units where the registration of patients is trivial cannot be handled adequately with respect to time. It was noted that the success factors of E – HMS / HIS tend to vary depending upon leadership support, training, technology adoption, user friendliness, etc within a country.

[1] identified the challenges existing in Mother-love Hospital, such as Data redundancy, data inconsistency, difficulty in accessing data, data isolation, integrity problems, atomicity problem, concurrent access anomalies, and some security problems. They cited [4] among others which pinpointed at techniques behind Database Management technologies, and thus overcome the existing challenges. The system is visualized as a web based application with three-tier architecture. This architecture provides an increased degree of security because its multiple zones isolate protected healthcare data making it difficult for a hacker to get system-level access to the database. The solution proffered by this system did not incorporate enabling technology to handle patients' in critical condition(s).

The Smart Hospital Management System (SHS) [3] was developed in the Faculty of Engineering and IT of the University of Technology, Sydney in Australia. It is an integration of enterprise level solutions utilizing Open Group Architecture Framework (TOGAF).

The smart hospital system aims at integrating various individual legacy applications to deliver a more unified solution. It is a solution aimed to present architecture integration framework using TOGAF's Architecture Development Method (ADM) – a reliable, proven approach for developing enterprise architecture descriptions that meets the needs of the specific business. [5] developed an Integrated Hospital Management System (HIS) of the Information Management Unit (IMU), BADAS, Bangladesh. This system addresses the entire major functional areas of modern multi-specialty hospitals. The package enables improved patient care, patient safety, efficiency and reduced costs. The system provides the benefit of streamlining operations, enhanced administration and control, improved responses, cost control and improved profitability. The system was developed to maintain a secured database of patients and business information. It can perform the complex task of matching, calculating, tabulating, retrieving, printing and securing the data as required. These systems developed do not incorporate handling or managing emergency situation of patients with respect to time.

[1] noted that Hospital Management System can do nothing but benefit a clinic in terms of productivity and patient service provision. Protecting the valuable and confidential information stored within databases is vital for maintaining the integrity and reputation of organizations everywhere not to mention ensuring regulatory compliance. Since the use of cloud storage is applied for backup, the hospital should not feel that the documents on the cloud are invisible to threats, so the need for extra protection is necessary. In preserving integrity, one must have a fully secure system which means including security measures for the protected information on the cloud database.

Nowadays in the health institutions, most patients are not cared for by a single physician or one health organization, but by a collective process that includes nurses, consulting specialists, diagnostic technicians, and administrative staff. To make it possible, they must have registered in those health institutions in order to receive fast attention. However, rendering services by the medical professional to patients takes a lot of time if the patients record is not in existence in that particular domain. For instance; this condition can also be experienced in situation where people embark on a journey and underserved incident of accident occurred, they must be attended by other medical professional in a health organization where they were not previously registered. If the systems in health institutions are uniquely and seamlessly interconnected, running distributed database as our system operate over others, the nightmare of fast attention to patients critical case(s) exist no more.

3. Methodology/Procedure

The Integrated Hospital Management System (IHMS) is the state of the art technology that optimizes hospital Management to benefit citizens, healthcare professional and managers. The researchers aim is to provide hospitals with new opportunities for improvement in healthcare processes using integrated information and medical technologies, which go beyond advanced medical equipment, paper-free strategies, or information centralization/sharing. To do this the researchers have designed a complete, integrated solution to manage any healthcare centre (public and private hospitals, healthcare bodies -groups, clinics, etc). This hospital management system is complemented by clinical stations that are adapted to healthcare professionals by offering an integrated, homogenous system. The system is prepared for the new model digital hospital demanded by society, and is administered or operated by standards such as:

- **Healthcare continuity and data integration**: This provides the capability for a single health record that allows a patient's medical history to be available, accessible anywhere, any day and anytime when needed for the patient's treatment within the country.
- **Modularity, adaptability and capacity for growth**: designing an adaptable and extensive global data system that can be parameterized and configured for each organization. This will encourages uniformity and enhance standard in medical information system.
- **Interoperability services:** with standards based interoperability, information systems should be adapted to the particular needs of each organisations. The systems is prepared and made to operate for new forms of collaboration between systems This should be made possible since the hospitals will run and managed from a unique system
- **Security and reliability of data**. Implementation of the mechanisms required to comply with the efficiency of Data Protection. This can be enforced using user code based identification, or integrated with biometric systems (fingerprint) or public key certificate. Also, there should be increasing security when identifying patients, generating alerts, etc.
- **Accessibility**. The systems that must extend the scope of healthcare beyond the physical confines of the hospital.
- **Sustainability**. The activity(ies) should be always prioritize the objective of increasing efficiency.

The research approach of the system framework is used to structure, plan, control and implement the system. To avoid more complexity, the methodology details of Rapid Application Development were omitted. Thus, the general knowledge framework utilized in the process are summarized in chronological order below:

- Understanding the problem space, review existing literatures, gathering the functional requirements and thus yields the motivation that necessitated carrying out this work.
- The system frameworks, architectural designs were carried out and employed.
- The web application was developed and tested.
- The Biometric Fingerprint Scanner was incorporated and its SDK and API installed for proper workability.
- Detail testing was carried out.
- The system is deployed and ready to be used.

3.1 System Architecture

The system has a user friendly interface and need to provide consistently reliable services to the medical professionals in performing their day to today operations. The figure 3.1 below represents the architectural structure of the system implemented.

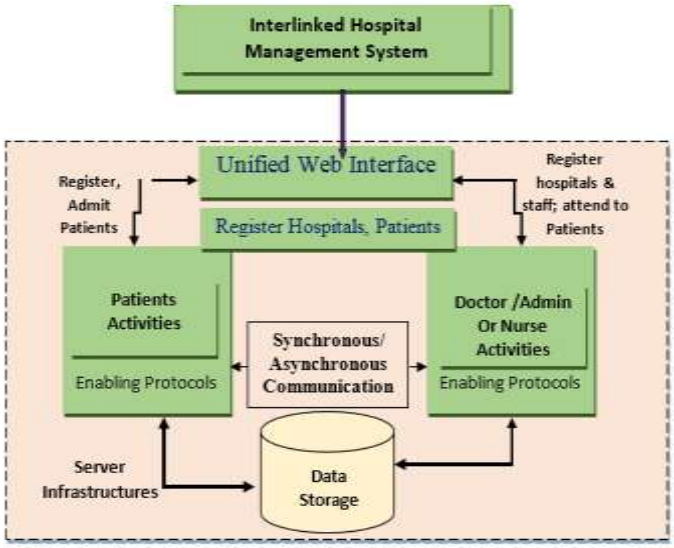

Figure 3.1: The Architecture of Interlinked Hospital Management System.

3.1.1 Components Explanation

We thus explain the components of the architecture above.

- **Unified Web Interface:** Interlinked Hospital Management System (IHMS) user Interface is a module in the system through which the user communicates with the system. User information needed by the system are being collected through this module and patient's medical records is also proffered by the system through this same module. It can also be referred to as a dashboard for asynchronous and asynchronous communication medium with the system by the users.
- **Patients Activities:** Register, admit, receive service(s) and ask questions for clarification in the hospital.
- **Staff (Doctor, Admin.) Activities:** Register staff and hospitals, attend to patients, review patients medical records and recommended services.
- **Storage:** A unique remote database for data storage mechanism.
- **Server Infrastructure:** Components communication are enabled here and access to privilege users to assess the dynamic web document. Data security and users privilege checks are employed as noted in [9].
- **Protocols:** are features in the system program used to perform specific activities or functions in the representation based on context.

3.2 Entity Relational Diagram

In software engineering, an entity–relationship model (ER model) is a data model for describing the data or information aspects of a business domain or its process requirements in an abstract way that lends itself to ultimately being implemented in a database such as a relational database. The main components of ER models are entities (things) and the relationships that can exist among them. However, entities are the Doctors, Patients, Admin, Test and thus shown below in figure 3.2.

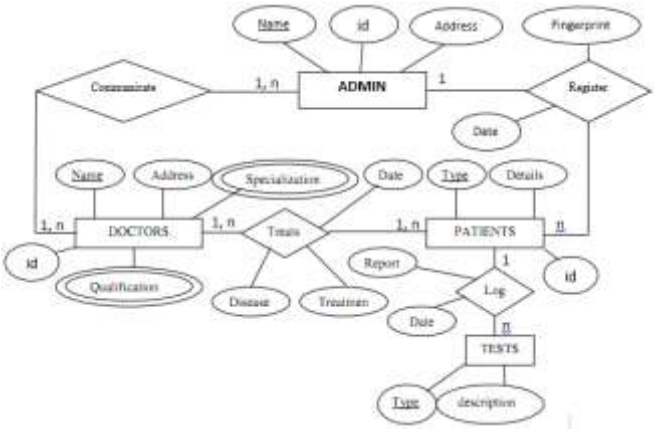

Figure 3.2: Entity Relational Diagram of IHMS showing Dataflow Design

3.3 User Interface Design

The user interface design is the point of interaction between the user and the system. It comprises of two terminal: Input Template and Output Template and Reports Format.

3.3.1 Input Template

The figure 3.3.1 below shows a conceptual view of the input template through which the system collects information from the user.

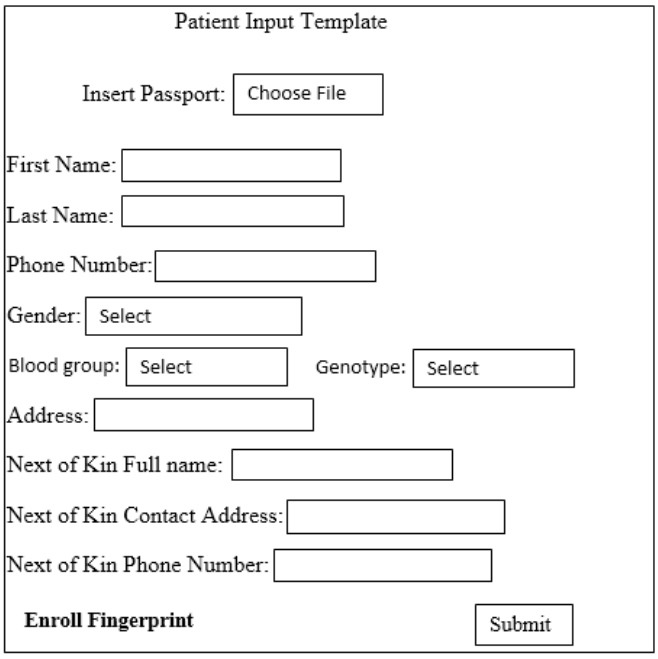

Figure 3.3.1: Data Input Format for IHMS

3.3.2 Output Template and Reports Format

The system uses the output template to show the necessary reports and recommended services to the user. The design of the output is critical to the successful implementation of the system because it is the output that provides the information the user required, and thus shown in figure 3.3.2 below.

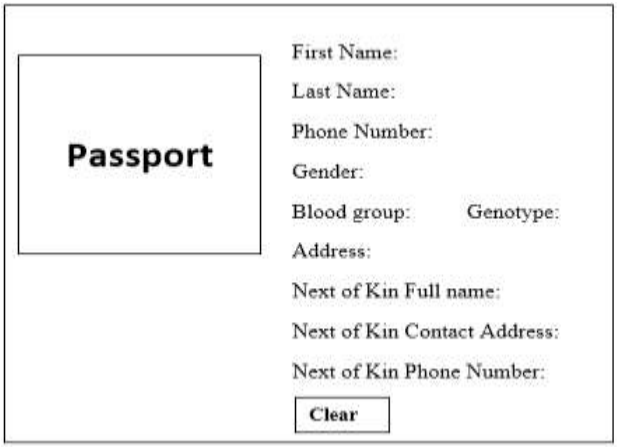

Figure 3.3.2: IHMS Output Template and Reports Format

3.4 The Flowchart of IHMS

The figure below depicts the flowchart for the workability of IHMS.

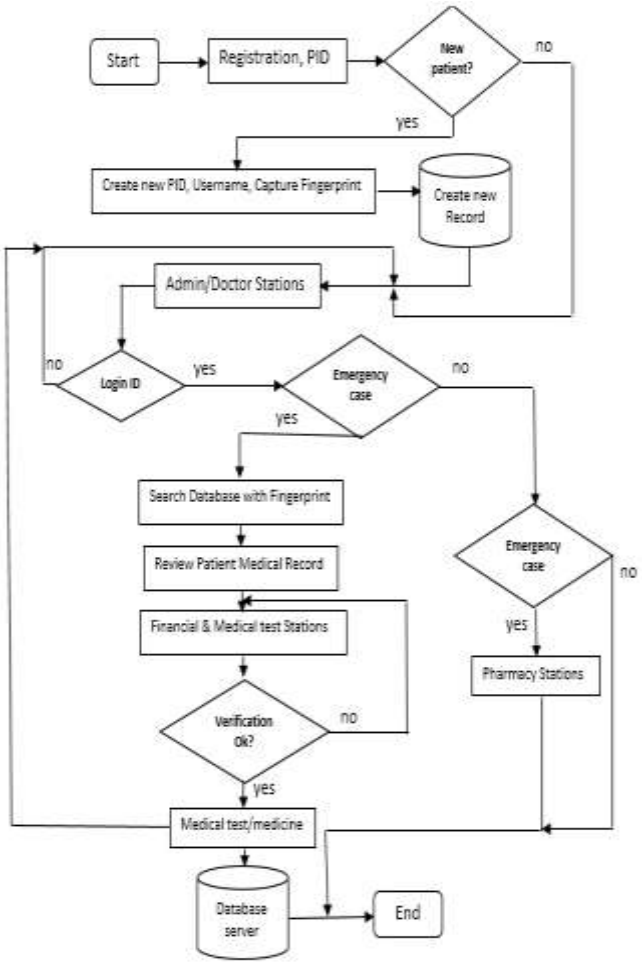

Figure 3.4: Flowchart of IHMS Depicting its Workability.

4. Implementation and Sample Results

Following the system architecture, database design and Rapid Application Development (RAD) methodology, the system coding was achieved. In the coding phase, the front-end programming developing tool utilized are JavaFx, HTML, CSS, JavaScript while the PHP, and XAMPP Server Engine were used at the back-end. The system was integrated with the Biometric Fingerprint SDK and API in the coding framework. The implementation was thereby achieved. The system was tested and we obtain the following sample output (screen shots) depicted in figures 4.0 (a – f) respectively.

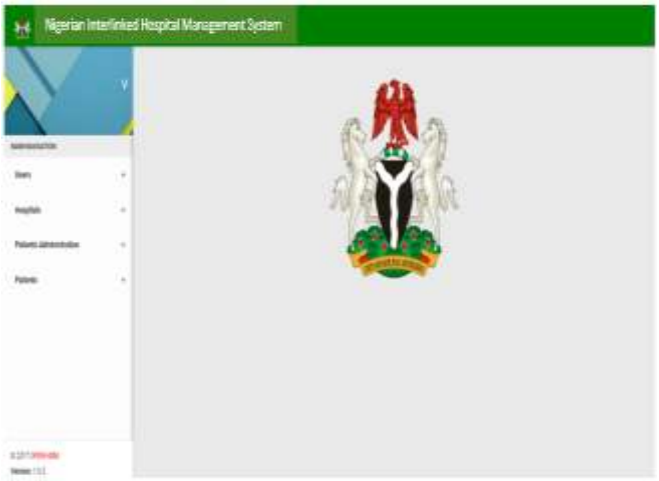

Figure 4.0(a): Home Page of IHMS.

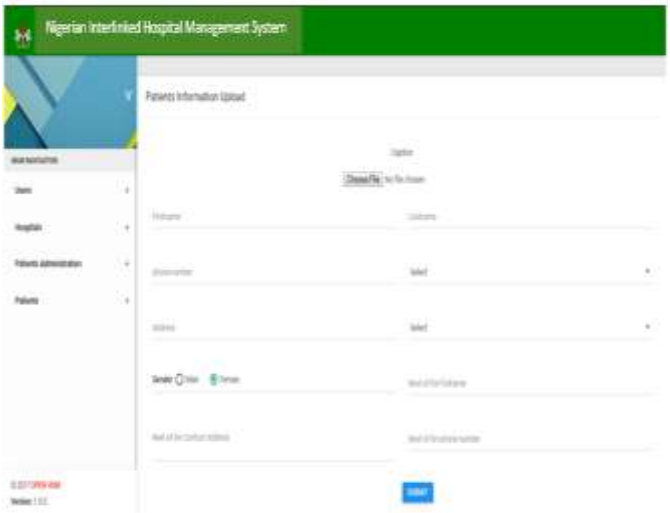

Figure 4.0(b): IHMS for Patients Registration

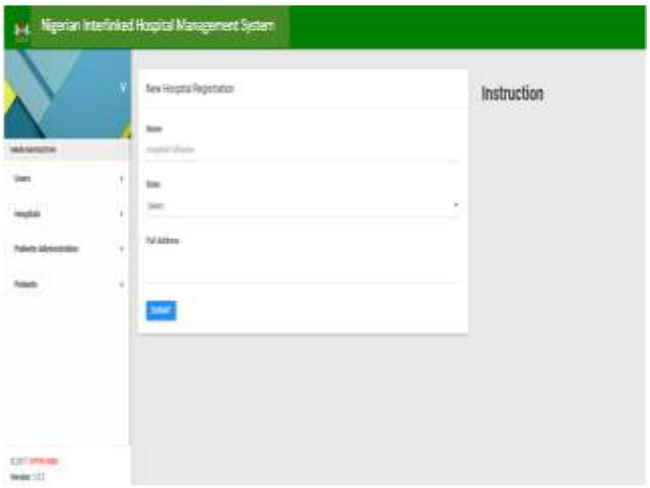

Figure 4.0(c): IHMS for New Hospital Registration

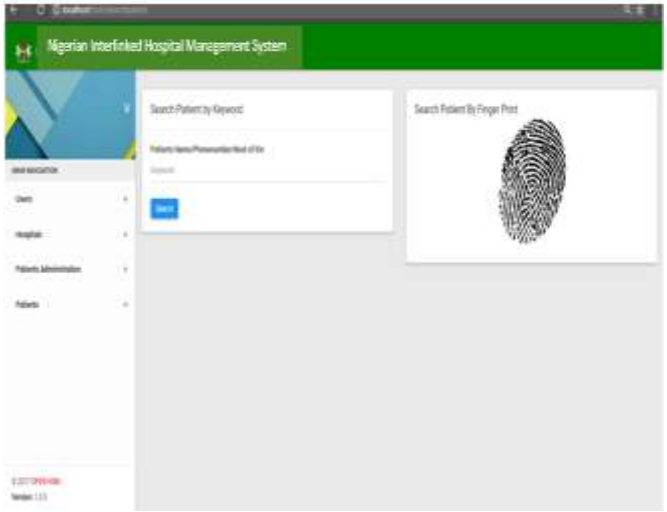

Figure 4.0 (d): Search for Patient Details (for Emergency case).

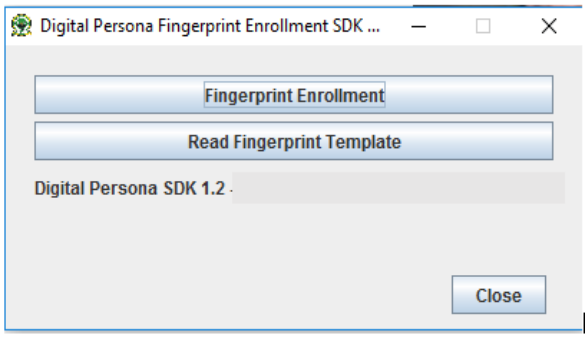

Figure 4.0 (e): Search for Patient Details (call fingerprint device).

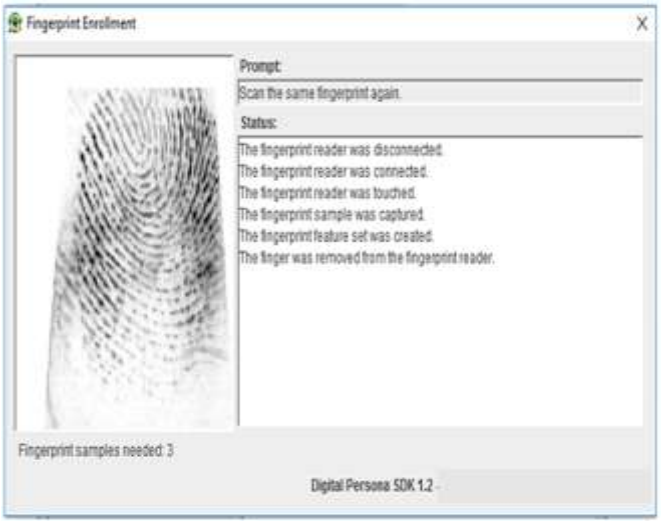

Figure 4.0 (f): Search for Patient Details (capture fingerprint).

5. Conclusion

As the numbers of patients keep rising, managing a health facility can become increasingly difficult, but it can be made easy using an effective and efficient system. Proper information management system are the mainstays for a patient's health care and thus good for handling emergency cases. The reviewed papers within concentrate on works done on hospital management systems but pay little or no attention of employing modern technology like biometric fingerprint into hospital information management system for handling emergency cases of patients. Therefore, this work seeks to analyze, design and implement a system that will permit medical professionals in their work to improved patient care, patient safety, efficiency (to access patient historical medical records, reduce the stress in tracking records, reducing patients waiting time and increasing the number of patients served)and reduced costs. It provides easy access to critical information, thereby enabling management to make better decisions on time while attending to patients. This work will be of great importance to the Ministry of Health staff at national and state or Local Government Area levels to explore medication information quickly within the country.

References

[1] J. K. Arthur, M. S. Jang, "The Analysis and Design of an Integrated Hospital Management System," The Case of Motherlove Hospital, International Journal of Computer Science Issues, ISSN (Print): 1694-0814 | ISSN (Online): 1694-0784, Volume 12, Issue 5, 2015.
[2] J. Bisbal, D. Berry, "An Analysis framework for Electronic Health Record System," 2009. Available: http://www.tecn.upf.es/~jbisbal/publications/me09-01-0002_Bisbal.pdf, Accessed: July 23, 2015.
[3] Z. Chaczko, C. Chiu, A. K. Singh, "Smart Hospital Management System: An Integration of Enterprise Level Solutions Utilising Open Group Architecture Framework (TOGAF)," ISBN: 978-1-4244-5539-3/10/, 2010
[4] F. K. S. Gihan, A. M. Haneef, "Database and Flat File Validation Tool," International Journal of Engineering Science Invention, ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726, www.ijesi.org, Volume 2 Issue 4, PP.38-42, 2013.
[5] J. Hasan, "Integrated Hospital Information System (HIS) Special focus on BIRDEM Hospital (600 Beds)," *E-Health Telecommunication Systems and Networks* 2, 29-35, 2013.
[6] H. D. Lieu, V. T. Dung, "Health Management," Vietnam: Ministry of Health Medical Publisher, 2008.
[7] H. N. Phuong, M. N. Anh, H. H. Anh, "*Electronic Medical Record*. Vietnam," Ministry of Health Medical Publisher, 2008.
[8] B. Premkumar, K. Kalpana, "E –Hospital Management & Hospital Information Systems – Changing Trends," I.J. Information Engineering and Electronic Business, 1, 50-58, 2013.
[9] R. Ranjan, How to secure your cloud database in an insecure world, 2014. Available: https://www.ibm.com/blogs/cloud-computing/2014/10/secure-cloud-database-insecure-world/, Accessed: November 12, 2017.

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