Design and Implementation of Secured Electronic Health System Using Pin and Barcode Technology

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Abstract
The healthcare sector increasingly relies on electronic systems to manage patient information, improve service delivery, and enhance operational efficiency. However, the digitization of medical records has introduced significant security and privacy concerns, including unauthorized access, data breaches, and identity misuse. The aim of this study is to design and implement a secured electronic health system using Personal Identification Number (PIN) and barcode technology. This work was motivated on the basis of finding a solution to the security concerns of patients about their Electronic Health Records (EHR). The replacement of paper processes in our hospitals with Electronic Medical Record (EMR) system has neither ended the problem of continued manual and repeated processes in gathering health history of patients, nor the security problem with the patients' health information, hence, the need for the research. The methodology used is the Object-Oriented Analysis and Design Methodology (OOADM). The expected result of this new system is a two-level authentication security technique, as the hybrid model that will solve the bottlenecks identified in this work. Some of the hardware, programming and scripting languages, and application packages that were used for the development of this hybrid software are barcode reader, php, java scripts, CSS, ajax, and Adobe Photoshop - CS6. Also, MySqlLite is used as the database system for the program too, given its robustness. Therefore, with the aid of this research, patient's health data can now move with him through this new system, "Security of Electronic Health Record (Ehr) Using Pin and Barcode Technology", thereby eliminating repeated

antiquated processes and interoperability issues.

Introduction

Taking a closer look at the health sector in the country, it is obvious that computer technology has made a remarkable positive impact on health services provided to the people. Today, computer technology is applied in X-rays, surgeries, and other diagnosis; thereby, generating and contributing to the increasing growth of medical information. Hence, the need for Medical Information Management in keeping records of an individual's entire health history. For instance, as pharmacists have continued to increase their involvement in patients care activities, locating vital pieces of information is critical to developing an appropriate assessment and plan for the individual patient. Additionally, collecting this data in a systematic way will permit the pharmacist to then synthesize it and create a comprehensive list of healthcare needs and considerations for the patient, regardless of the practice setting, (Spooner and Pesaturo, 2014). Information here, may include any documented allergic reactions, surgeries, prescriptions and any medical advice that the patient may have received. However, research has shown that despite the afore mentioned impact of technology in health centers, it is common in Nigeria to notice that during a typical trip to the doctor, you will often see pile of folders and papers that contain medical records of diverse patients. Additionally, EHR systems give patients a way to access some portion of their electronic record through personal health record (PHR) services, which allow patients to view such information as lab results through a secure Web portal, (Holman, 2016). Hence, this dissertation strongly states that the integration of Electronic Health Record (EHR) systems with a two-level authentication/security system - barcode technology and access encryption technique, is a sure bet solution to the problems that set back Nigeria health service delivery.

Statement of the Problem

The problem addressed in this study is the inadequate security and inefficiency in the management of patient health records in healthcare institutions. Many hospitals still rely on manual record-keeping or weak electronic systems that lack proper authentication and reliable patient identification mechanisms. This situation exposes sensitive medical information to unauthorized access, loss, duplication, and manipulation. As a result, patient confidentiality is often compromised, and the integrity of medical records cannot be guaranteed. In addition, the absence of accurate and fast patient identification methods leads to frequent errors such as mismatched records, delayed treatment, and incorrect medical decisions. Healthcare personnel often spend excessive time searching for patient files, which reduces efficiency and negatively affects service delivery. These challenges not only increase operational costs but also pose serious risks to patient safety and trust. Therefore, there is a critical need to design and implement a secured electronic health system that uses PIN authentication and barcode technology to ensure controlled access, accurate patient identification, and effective protection of electronic health records. The aim of this study is to design and implement a secured electronic health system using pin and barcode technology.

Literature Review

Electronic Health Record

The term EHR has always been interchangeably used with the term EMR, although they are quite different. Electronic medical records (EMRs) are a digital version of the paper charts in the clinician's office. An EMR contains the medical and treatment history of the patients in one

practice. But, the information in EMRs doesn't travel easily out of the practice. Electronic health records (EHRs) do all those things and more. EHRs focus on the total health of the patient, going beyond standard clinical data collected in the provider's office and inclusive of a broader view on a patient's care. EHRs are designed to reach out beyond the health organization that originally collects and compiles the information. They are built to share information with other health care providers, such as laboratories and specialists, so they contain information from all the clinicians involved in the patient's care (Garrett and Seidman, 2011).

Electronic Health Record Management System

The spread of automation or computing into almost every aspect of human activities has also permeated into health. The growing health issues and the resultant growing health record of patients have necessitated the need for an electronic health management system. Thus, Rosenthal (2013) opined that "Properly designed EHR systems eliminate the need to take down transcriptions on paper and can well organize physician workflows resulting in increased efficiency and productivity. The use of EHR systems has helped the healthcare providers with the better exchange of laboratory results, scans reports and improved communication method with patients." A computer-based patient-record (EHR) system adds information management tools to provide clinical reminders and alerts, linkages with knowledge sources for health care decision support, and analysis of aggregate data both for care management and for research. To use a paper-based patient record, the reader must manipulate data either mentally or on paper to glean important clinical information. In contrast, an EHR system provides computer-based tools to help the reader organize, interpret, and react to data, (Tang and Mcdonald, 2001). Therefore, electronic health record management system is a computer-based system that is developed to capture, process, store, protect, keep track of-, retrieve, and update all patient's healthcare activities regardless of the hospitals been to, and physicians he has met.

Health Information Technology (HIT)

Our healthcare system is helping to cure diseases, extend our lives, and improve the well-being of our communities. Now, through the use of secure health information technology, health care will benefit from advancements that are making sure health information is confidential, available when and where it is needed, contributing to safer, higher quality, more coordinated, and more efficient and less costly care for everyone, (Office of the State Coordinator for Health Information Technology, nd.). Some evidence suggests that health information technology (HIT) can improve the efficiency, cost effectiveness, quality, and safety of medical care delivery by making best practice guidelines and evidence databases immediately available to clinicians, and by making computerized patient records available throughout a health care network, (Shekelle e'tal, 2006).

The Electronic Medical Record (EMR)

The Electronic Medical Record (EMR) was introduced as a way to facilitate a centralized patient information repository, (Kabiru and Yahya, 2018). An Electronic Medical Record (EMR) is a digital version of the traditional paper-based medical record for an individual. The EMR represents a medical record within a single facility, such as a doctor's office or a clinic (Rouse, 2011). It is a computerized medium that contains clinical information as recorded in a patient's record. This is only restricted to clinical information which refers to patient data which includes, for example, diagnoses, allergies, prescriptions, etc. Some EMRs include an additional module, or component, for registering patients' demographic information, (Berg, 2001). An EMR serves as the primary

source of information for patient care. Information technology permits much more data to be captured, processed and integrated, thereby providing meaningful information and contributing to the knowledge of authorized users for legitimate uses (Computerized Patient Record Institute Work Group, 1996).

Methodology Adopted

In order to move from the manual health service system and the Electronic Medical Record (EMR) system to a secured hybridized and thus, interoperable computer-based health service system with a two-level security authentication – the barcode and encrypted PIN, it becomes imperative to methodically review the old system with a view of getting its general outline and all the operations involved, and analyze their possible constraints. And the methodology adopted for this work is the Structured System Analysis and Design Method (SSADM). The dissertation used the Entity Relationship Modelling as a suitable Logical Data Modelling technique in SSADM for the analysis and collection of objects in this work. Hence, the Entity Relationship Model was used to analyze and collect data from the existing the health centers under study, namely Healthcare International Limited, Port-Harcourt; and three hospitals in Aba, namely, Abia State University Teaching Hospital (ABSUTH), Ekeoma Hospital, and General Hospital, Aba. See Figure 3.1 in the next page.

Analysis of The Proposed System

The proposed system is a secured electronic health system designed to overcome the challenges of poor security, inefficiency, and errors associated with manual and weak electronic health record systems. It provides a computerized platform for storing, managing, and retrieving patient medical records in a secure manner. Access to the system is strictly restricted to authorized healthcare personnel through the use of Personal Identification Number (PIN) authentication, ensuring that sensitive health information is protected from unauthorized access.

Each patient is assigned a unique barcode during registration, which serves as a fast and accurate means of identification within the system. By scanning the barcode, patient records can be retrieved instantly, reducing delays and minimizing the risk of incorrect patient identification. The system supports the creation, updating, and viewing of medical records such as diagnoses, prescriptions, laboratory results, and treatment history, all of which are securely stored in a centralized database. Input data including login credentials, patient details, and medical information are validated to prevent errors and unauthorized entries, while outputs such as patient records and treatment reports are presented clearly for authorized use. The integration of PIN authentication and barcode technology provides a dual layer of security that enhances confidentiality, integrity, and accountability in health information management. The system also improves performance by reducing record retrieval time, eliminating duplication, and supporting efficient healthcare service delivery. Overall, the proposed system is technically feasible, cost-effective, user-friendly, and capable of significantly improving the security and efficiency of electronic health record management in healthcare institutions.

Conclusion

The transition from the present manual system and the Electronic Medical Record (EMR) system to Electronic Health Record (EHR) system using barcode technology and access encryption technique has been presented in this dissertation. A patient's health data can now move with him through this new system, "Security of Electronic Health Record (Ehr) Using Pin and Barcode

Technology", thereby eliminating repeated antiquated processes and interoperability issues. More so, patients and doctors get automatic barcode peculiar to each of them at the point of registration. Hence, the hybrid system at every level of operation request for a person's Personal Identification Number (PIN) and barcode, and authenticates them before it logs them in. Thus, the system ensures that no doctor (or anyone) will have access to a patient's health information unless the patient releases his barcode to the person. Hence, this system also eliminates the health data security concerns of patients; thus, making patients' health information system patient-centric.

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References

Acharya S, Coats B, Saluja A, Fuller D (2013) "Secure Electronic Health Record Exchange: Achieving the Meaningful Use Objectives." Int Conf Sys Sci 46: 1-10.

Agrawal, A. (2002). "Return on investment analysis for a computer-based patient record in the outpatient clinic setting. J. Assoc. Acad. Minor. Phys. 13(3):61–65, 2002."

Alpert, J. (2016). "The electronic medical record in 2016: Advantages and disadvantages. Digit Med; 2:48-51."

Amatayakul, M.K. (2004). *Electronic Health Records: A Practical Guide for Professionals and Organizations.* AHIMA, Chicago.

Aspden, P., et al. (2003). "Patient Safety: Achieving a New Standard for Care, National Academies Press, Washington, DC.".

Ayandale O.S 2018. Electronic Medical Record System as a Central Tool for Quality Healthcare Services, v. 10, p. 147-157

Barlow, S., et al. (2004). "The economic effect of implementing an EMR in an outpatient clinical setting. J. Healthc. Inform. Manage. 18(1):46–51,."

Bates, D., et al. (2003). "Detecting adverse events using information technology. J. Am. Med. Inform. Assoc. 10(2):115–128.".

Bates, D., et al. (1998). "Effect of computerized physician order entry and a team intervention on prevention of serious medication errors. JAMA 280(15):1311–1316, 1998."

Berg, M. (2001). Implementing information systems in health care organizations: Myths and challenges. *International Journal of Medical Informatics*, *64* (2- 3), 143-156

Bodenheimer, T., et al. (2002). "Improving primary care for patients with chronic illness. JAMA 288(14):1775–1779.".

Burton, L., et al. (2004). "Using electronic health records to help coordinate care. Milbank Q. 82(3):457–481.".

Chaiken, B. (2003). "Clinical ROI: not just costs versus benefits. J. Healthc. Inform. Manage.

Clem, A., et al. (2003). Health implications of cyber-terrorism. Prehosp Disaster Med 2003;18:272–275.

Computerized Patient Record Institute Work Group. (1996). Computer-Based Patient Record System Description of Functionality. Retrieved January 14, 2014 from http://www.cpri.org/resorce/docs/ function.html.

Wikipedia. 2019. *Health Information Technology.* Retrieved from https://en.wikipedia.org/wiki/Barcode

Wyld, D. (2006). RFID 101: The Next Big Thing in Management. Management Research News, 29(4), 154-173.https://www.shopify.com/encyclopedia/barcode