Personal Health Record System and Integration Techniques with Various Electronic Medical Record Systems

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Abstract - **This paper discusses the importance of a Patient Centric Health Record system. Such systems can empower patients to participate in improving health care quality. It would also provide an economically viable solution to the need for better healthcare without escalating costs by avoiding duplication. The proposed system is Web-based so patients and healthcare providers can access it from any location. Moreover the architecture is cloud-based so large amount of data can be stored without any restrictions. Also the use of cloud computing architecture will allow consumers to address the challenge of sharing medical data that is overly complex and highly expensive to address with traditional technologies.**

*Keywords-**Personal Health Record System, EHR (Electronic health records), EMR (Electronic medical records), CDO (care delivery organizations)***

I. INTRODUCTION

Generally health information is scattered across many different providers and facilities. A visit to a new doctor or any member of a CDO often results in lengthy process of filling all the information in a new system from where which such information is not ported to any other system. A new hospital encounter often results in repeated tests and all previous conversations are ignored due to the absence of any central repository of all data. This naturally results in higher cost to the patients, health insurance companies and government. Most of the times this health information is stored in paper files, which are difficult to organize and share with others. Moreover, the information is not stored in standardized formats.

Allowing patients to access their own medical records will encourage patients to be involved in their own healthcare and that will further strengthen the patient–provider relationship. Such an effort will enhance and increase the effectiveness of healthcare management. Healthcare institutions around the world are encouraged to develop the electronic health record (EHR) systems. Personal health record (PHR) systems that would track all such EHRs from various encounters with a variety of health professionals over years can be seen as one of the means that can empower patients in their own healthcare

We can define the PHR as an electronic application through which individuals can access, manage and share their health information in a secure and confidential environment [2]. It allows people to access and coordinate their lifelong health information and make appropriate parts of it available to those who need it. Thus, it differs from the EHR [3], which is "an electronic version of the patient medical record" kept by physicians and hospitals. The data in the EHR are controlled by and intended for use by medical providers.

To overcome the challenges we have developed a web-based personal health record system (PHR) that can be used by patients to collect and manage their health information (e.g., medical history, past surgeries, medications, and allergies), to request self-referrals, and to store a record of their consultations. In the reminder of the paper, Section 2 presents the brief background of Personal Health Record systems, its need and current state of art. Section 3 and 4 present the functionality and workflows for the proposed system and finally section 5 concludes the paper.

II. BACKGROUND

The Personal health record is a concept that has been developing over several years. The effective use of information technology is a key focal point for improving healthcare in terms of patient safety, quality outcomes, and economic efficiency.

The electronic PHR systems have many forms. In addition to Web-based systems, information in electronic PHRs may be stored on portable computer drives (such as USB "flash drives"), "smart cards," or other electronic storage devices.

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Functionally, PHRs are diverse.

System Integration has been always the most critical issue for the development of information systems in healthcare industry. Medical Information Systems (MIS) are heterogeneous in nature and therefore pose a severe challenge in their interoperability [5] [6]. A large number of healthcare applications are isolated and do not communicate with each other. Therefore, the integration of existing information systems represents one of the most urgent priorities of healthcare information systems.

Many efforts have been made on integrating the heterogeneous systems in hospitals. Healthcare industry has developed several standards through which relevant data can be transferred among different information systems. These standards are Health Language Seven (HL7), Electronic Data Interchange (EDI) X12 Version 4010, Health Insurance Portability and Accountability (HIPAA), Digital Image Communication in Medicine (DICOM), Integrating Healthcare Enterprise (IHE) among others. All these standards are currently being widely used in healthcare industry. The proposed solution will be able to integrate all medical information systems that are in compliance with HL7 standard.

Standardized interfaces are available to many healthcare "Object Oriented Services" such as CORBAmed (Common Object Request Broker Architecture in Medicine), which realizes the share of common functionalities like access control among different systems. Others, like DICOM, HL7 and the initiative of Integrating the Healthcare Enterprise (IHE), specify the guidelines or standards for exchanging messages among different systems, which make the different systems work in harmony and implement the workflow integration [6]. With appropriate access controls, patients can allow portions of the PHR to be made available to family members, various care providers, and others.

II. System Design

The proposed cloud computing based PHR System can allow various authorized users to securely access patient records from various CDO from any location. The system will seamlessly integrate all patient records including images such as CT-SCANS and MRI'S which can easily be accessed from any location and reviewed by any authorized user. Figure 1 shows the overall view of such a PHR.

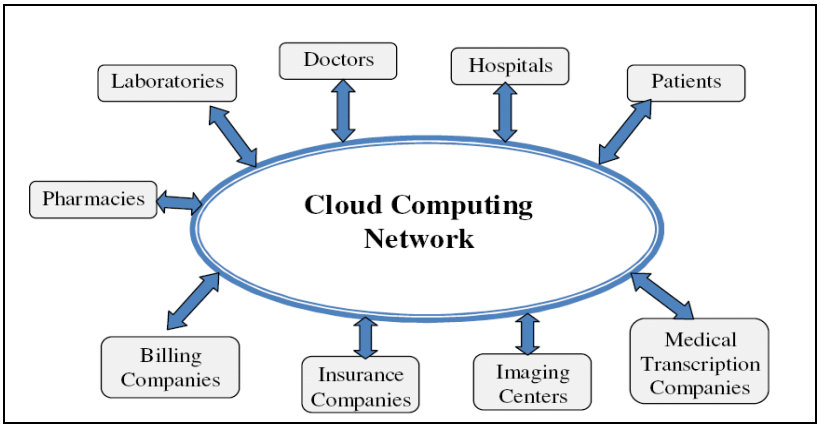

Figure 1. Interaction of various CDO's and Patient with the cloud comuping network

The architecture of the proposed system is shown in Fig. 2. It is a web application that runs on J2EE platform and could be deployed on cloud computing network such as Amazon EC2 and uses Microsoft SQL Server 2005. The J2EE platform is chosen for its platform independent features and availability of rich web application framework library.

The user interface layer for PHRS is based on J2EE, a platform for web applications hosted by the JBOSS Application server. The user interface is divided into role-specific pages (system administrator, patient, CDO, researchers and insurance providers) and common pages (messaging and account maintenance).

The database layer of the system consists of two components; The First component is DCM4CHE server, which is a collection

of open source applications and utilities for the healthcare enterprise. Also contained within the dcm4che project is dcm4chee. Dcm4chee is an Image Manager/Image Archive (according to IHE). The application contains the DICOM, HL7 services and interfaces that are required to provide storage, retrieval, and workflow to a healthcare environment. DCM4CHEE is pre-packaged and deployed within the JBoss application server. The basic work of the DCM4CHE server is to handle the implementation of the DICOM standard images uploaded by the patient.

The second component, which is a SQL server, is needed to store the general demographic information of the patient along with other patient health related data, such as, Insurance provider details, frequent CDO visit logs and prescription, lab reports etc.

The Web viewer interface used is open source Image J which is a Java based image processing program. Image J is chosen because it can work as an online application and can read a variety of image formats including TIFF, GIF, JPEG, and DICOM.

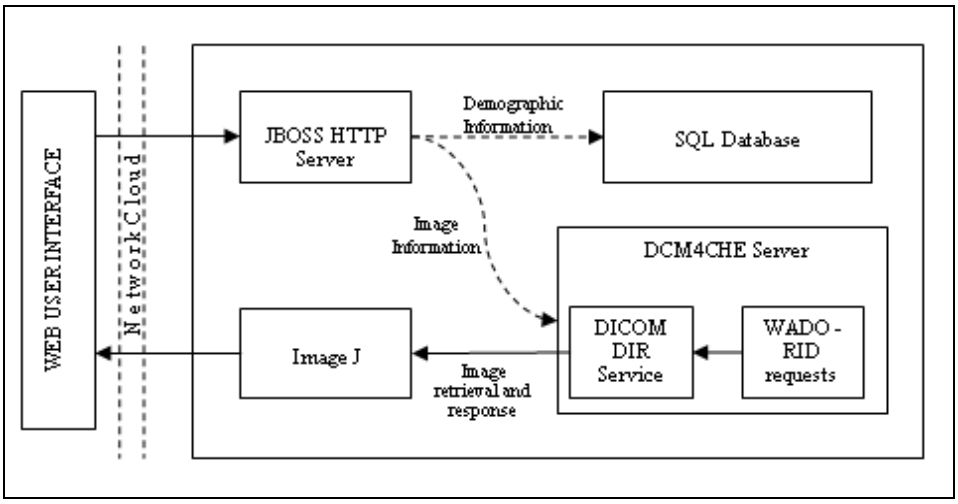

Figure 2. Proposed Personal Health Record System Architecture

The users can also share the information including medical imaging (DICOM images) with the various care providers.

To ensure the security of the data we plan to implement password protected access to the system and only registered patients, CDO's and specialists can log in to the system. Patients are restricted to viewing and modifying and sharing only their own records and CDO's and other care units can only access those records, which are shared with them. Patients can edit the access privileges on their records at the granularity of the categories.

III. USE CASE: PERSONAL HEALTH RECORD SYSTEM

One approach to establishing a foundation for evaluating information design in PHRS is "use cases" that categorize and describe discrete functional scenarios and how computer interactions are carried out. Figure 4 and 5 outline the use of the proposed PHRS.

The user first logs into the web based personal health record system. If the user is a first time customer then he/she will have to create a user account in system before storing/accessing the medical information. Once the account is created, user can select the desired user type and can login into the system.

As soon as users logs into the system with user type as Patient, they will be first asked to first create their profile. The data in the profile comprises of demographic information of the patient and the past laboratory results including images, MRI and other scanned documents. All the demographic information entered by the patient will be stored in the SQL database and all the imaging data will be processed and stored by the Dcm4che server. The patients can also share the medical records and their laboratory test results (including imaging information) with various CDO's and insurance providers by giving access to them. The patients can control the data sharing mechanism and can either share the complete profile or only the selected information with the care provider or insurance providers.

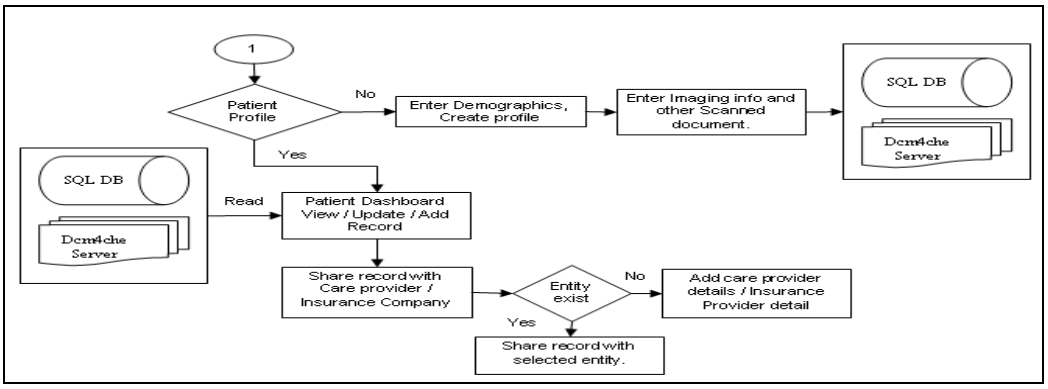

Figure 3. Patient Centric use case for proposed PHRS system.

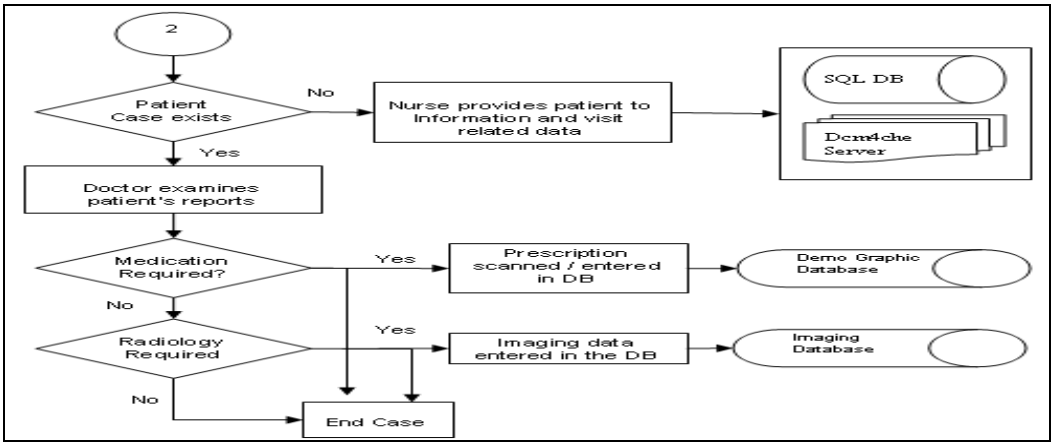

Figure 4. CDO use case for proposed system.

When user shares any information to any of the registered CDO it will be displayed on that particular CDO's dashboard. Any information to the CDO can be shared either in read only mode or with the read/write mode. The patients control the access levels.

Once any patient case is displayed in the dashboard, they can then examine the patient data and can suggests if any medication or radiology is required. Later the details can be stored into the database.

IV. Conclusion

We have proposed a Web-based PHRS that can store data in a cloud-based architecture. The proposed system provides an avenue to store images such as MRI, CAT, X-Ray and Medical personnel can view images with Image J viewer. A user case is discussed to show the functionality of the system. Future updates will focus on security and privacy aspects.

References

[1] Eysenbach G, "Consumer health informatics: Recent advances", Br. Med. J, 320:1713–1716, 2000

[2] Marion J. Ball, Jonathan Gold, "Banking on Health: Personal Records and Information Exchange", Journal of Healthcare Information Management, Vol. 20, No. 2

[3] Thomas Handler, Rick Holtmeier, Jane Metzger, Marc Overhage, Sheryl Taylor, Charlene Underwood, "HIMSS Electronic Health Record Definitional Model Version 1.0", 2003

[4] Tang PC, Ash JS, Bates DW, Overhage JM, Sands DZ, "Personal health records: definitions, benefits and strategies for overcoming barriers to adoption", J Am Med Inform Assoc. 2006; 13 (2):121 –126

[5] William R. Hersh, "Medical Informatics Improving Health Care through Information", Journal of American Medical Association, Vol. 288 No. 16, pp. 1955-1958, 2002

[6] Xudong Lu, Huilong Duan, Haomin Li, Chenhui Zhao and Jiye An, "The Architecture of Enterprise Hospital Information System", 27th Annual Conference Proceedings of IEEE Engineering in Medicine and Biology, Vol. 7, pp. 6957-6960, 2005