Web-Based Interactive Health Record System (WIHRS)

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Abstract—A Web Based Interactive Health Record System (WIHRS) is a digital web-based record of patients presenting in a hospital. The information so generated on patients can then be accessed by medical personnel to provide treatment for them in any health care delivery setting at any location. analogue ways of record keeping were the traditional way of documenting patients’ information by health information officers. The problems of unavailability of a centralized database system and inability to access patients’ records and provide prompt treatment to patients at any healthcare centre could be solved by WIHRS. The objective of the paper is to design a WIHRS. The methods included cloud computing model, service model, deployment model and cloud hosting. The web technologies languages such as Hypertext Pre-processor (PHP), Hyper Text Ma k-up Language (HTML), Cascading Style Sheet(CSS) and Ajax were deployed to implement the proposed system. The use of WIHRS improves the standard of healthcare to patients with optimal efficiency which guarantees a healthy workforce.

Index Terms—Healthcare, Cloud Model, Service Model, Deployment Model.

I. INTRODUCTION

Healthcare system is a system that takes care of the health of the people in a localized / geographical area. Government and private settings play significant roles in giving timely attention to the health of the people. This healthcare milieu has brought to the front burner the relevance of Web-Based Interactive Health Record System (WIHRS).

WIHRS is the recorded medical information of patients that is readily accessible to healthcare providers. It is a rich store of electronic information as regards an individual lifetime health index that can serve series of legitimate users of the record on line [1].

The information on the health parameters of any patients is scattered across many domains in a given country. The physicians or paramedics in charge are also not permitted to access and keep the patients’ history for future treatment reference [2].

Long before now, records officers used manual methods to store healthcare information about patients. The manual methods were adjudged to be very awkward and slow. Biodata of patients were recorded or stored on papers in registers. Whenever patients visited any healthcare centre or any new hospital, the patients would mandatorily provide personal health information to the hospital to enable retrieval of old case notes or registering for new case notes. It was not uncommon to witness failure of retrieval of old case note due to faulty filing. The lack of standard electronic format to keep patients’ health information was a problem.

The traditional way of health records by health care institutions [3] has some challenges like the unavailability of a centralized database system to control the way records are kept and stored, hence it becomes extremely difficult to grant access to different health care institutions.

Another challenge is the problem of harmonising patients’ records which contain useful information on patient’s management such as past medical history, hypersensitivity/allergies, blood group, genetic conditions and social history. If a patient decides to receive treatment at a different hospital, he or she is expected to request for the release of previous medical information to the new doctor. Such difficult scenario is time-consuming to the detriment of the patient.

Furthermore, the patients’ data/records should be stored in such a manner that different views of the data can be made available to other health institutions on request.

Once a health institution requests for an access to the system using a universal code, it would be possible to read every record on it pertaining to the patients in question. This uninhibited access may in some cases violates privacies of patients.

The WIHRS automates and fine tunes the physician’s workflow in a geographic area. It possesses the ability to generate complete clinical information of a patient as well as backing up other care-centered activities directly or indirectly via an interface encompassing evidence-based decision support, quality care services and outcomes reporting anywhere and at any time.

[4] stated that patients’ data are available in any institution. The cloud service providers can be used to store and manage health records access. Facts are emerging that healthcare service points are being asked to evolve a new computerized system aimed at keeping patients’ medical record history which could easily be used in the future management of the patient within or outside the country.

In this manner, each healthcare institution could still use its application to store patients’ data in public clouds rather than local storage. Public clouds can easily be accessed through the internet. Internet service is the principal communication link between the service provider and the healthcare service points globally. It ensures the maintenance of the network traffic between the physical resources and the cloud. Hence, the objective of this paper is to design an web based electronic health record system (WIHRS) that enables better interactions in sharing patients’ health information among health institutions for easy...
treatment anywhere at any time. Patients’ clinicians or other trained healthcare providers get involved in patients’ treatment seamlessly.

II. LITERATURE REVIEW

This section reviewed some related works.

[5] deployed the centralized based approach where the health care centers use the central database and web server for electronic interaction to store and access the patients’ records remotely via internet. In the design of their work, the healthcare unit accesses the patient’s health information from centralized database which was strategically placed and were accessible through the internet by using a variety of electronic devices. The study was limited by its use of a centralized database instead of a cloud server. The problem that may result from the centralized concept adopted by the study was when the central database was down at any particular time, the entire systems would not be working properly.

[6] employed the simple client server design to implement the Electronic Health Record (HER) systems. They used the simple personal computer as a server, which could store the patients’ biodata and medical history. Any mobile device can then be used to access their record from the server. The system was ideal for limited numbers of healthcare units with small number of patients. Another limitation was that if the server malfunctioned at any particular time, then it would be impossible to access the system. Moreover, limited number of patients’ records can only be stored in the system. Electronic health records systems eliminate the traditional and routine taking down of prescriptions on paper and organize physician workflows. The use of EHR systems has been of immense help to the healthcare providers [7].

A health care system was implemented which promoted a better healthcare system. EHR contains the essential building blocks for healthcare reform and an important component that supports dependable and qualitative exchange of information between providers and health care organizations [8].

Another application that can help in health decision is clinical decision support [9]. Clinical decision support systems assist physicians, and nurses in choosing the correct course of action on a particular patient and his/her condition.

[2] opined that the Electronic Health Record (EHR) systems are easily accessible in many forms despite the web-based systems. The indispensable medical information in the electronic Patient Health Record(PHR) may be stored on portable computer devices such as smart card, USB flash drives, or any other electronic storage device. The author used web-based technology to develop their system based on individual patient healthcare providers and Care Delivery Organization (CDO) which made it possible to access the patient data and update. They adopted the use of an internal restricted cloud computing technology to store patient information on the cloud server. The restriction mechanism placed on the model was the research limitation because the restriction stated that for hospital A to access a patient’s information in Hospital B, internal access must be granted by Hospital B before such patient’s record can be accessed by hospital A. This type of model, of course guaranteed patient’s privacy but will fail in an emergency situation and could result to a severe damage on the part of the patients.

[10] deployed the cloud computing systems where the cloud had a centralized database and data repository to store the EHR and the whole medical information about the patient. In these systems, the information about the patient would store in XML format as a unified standard and could store and retrieve visa query commands from the hospitals or health facilities’ web portal. This data centre would be managed by the cloud provider. The systems were ideal for areas where such types of facilities were available. On the other hand, such type of facilities was not usually available in local or remote settings which created a big problem. Moreover, the data centre is controlled and managed by cloud provider which also created confidentiality pitfalls in patients’ information security.

[11] came up with the design and implementation of a cloud based rural healthcare information system model. The system employed a cloud central server that accepted virtual machines as tenants. The tenants are secure individual state-of-the-art facilities that stored information in different healthcare centres. The connectivity and adaptive design of the cloud rural healthcare information was based on the service provider policy and location of the cloud data centre.

[12] have published an analysis and design of standard EHR. This report analyzed the various aspects of electronic records and their designs to present an approach for a standardized EHR [13]. EHR provided the essential infrastructure required for effective use of new healthcare modalities and IT tools.

[14] Cloud computing brought a new business configuration which enabled several advantages that would benefit the general healthcare community. By adopting the cloud in medical services, both patients and healthcare organizations would obtain a huge benefit in patients’ quality of service, collaboration between healthcare organizations as well as reductions in IT cost burden on healthcare companies. Human life is irreplaceable and medical resources are limited; therefore, healthcare services should key into cloud providers model which guarantees a cost-effective concept. Patients and health organizations should take advantage of this new technology by improving patients’ quality of service through a distributed high integrated platform, coordinating of medical process as well as reducing IT infrastructure investment or maintenance costs with resultant better healthcare environment [15].

III. METHODS

This paper discusses the methodology having the following as its sub-headings: proposed system architecture, cloud computing model, service model, deployment model, cloud hosting, adopted service model and the structure chart of the system.

A. Cloud-Based Architecture

The cloud-based architecture of the web-based health record system consists of a central database (Cloud DB), Unifier Interface Middleware (UIM), Authentication Server and the System Users. The architecture is shown as Fig. 1 below:
B. Central Database Server (Cloud)

This acts as the centralised data bank for all the connected health institutions. The Infrastructure as a Service (IaaS) cloud data centre contains the central database server for storing electronic medical records and retrieving patients’ information. The information is stored in a standard format. The records can be retrieved using some query commands and shared among the hospitals’ Web Portal system via the Unifier Interface Middleware (UIM).

C. Middleware

This part of the cloud provides a common platform for all the health record systems of the sharing hospitals or health institutions. It facilitates the communication between the Central Database in the Data repository and hospitals’ systems. It recognizes any type of health records on the platform that can be communicated seamlessly. This middleware remains in the cloud and communicates health information with the connected hospitals. On this note, each hospital is able to have access to patients’ records, provide treatment and generate reports. At this middleware, patients have access to register in health institution.

D. Authentication Server

This is one of the components of the system that allows authentication and authorization. The unit allows access to the authorised users at the hospital and patient-interaction level for updating, retrieving, transferring, etc) of health information of the patients. This component allows users (medical personnel and patients) to enter their usernames and passwords before they can be allowed. If wrong the username and password are entered which are not matched with those in the local database, access to the user is not granted.

E. WIHRS Web Portal

This is the frontal end of the whole cloud system. It is the top layer of the system where the health institutions are permitted to be integrated and connected to the internet to provide an application - Software as a service (SaaS) for the WIHRS. The proposed health system presents the end users (authorized doctors and clinicians), a web portal to pass through the central database and the whole WIHRS. The web portal can send messages and receive response messages between the middleware and the hospital system.

F. Cloud Computing Model

Cloud computing ensures the sharing of resources to achieve the use of unified interface middleware and the centralized database public utility. It allows the health institution to get and share resources so that the system can be faster.

G. Service Model

These service models provide increasing abstraction which is presented as layers in a stack: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). The layers are closely related. The SaaS is responsible for email, virtual desktop, communication; PaaS presents the execution runtime, database, web server and development tools; and IaaS is capable of virtual machines, servers, storage, load balancers. There are Cloud-computing providers who provide service models. The paper shall adopt the service model as its service model. The general service model is represented as Figure 2 below:

H. Deployment Model

The deployment models could be private, public or hybrid cloud. They are briefly described as follows: Private cloud is cloud infrastructure operated solely for a single organization, whether managed internally or by a third party and hosted either internally or externally. A cloud is called a public cloud when the services or functions are rendered over a network that is open for public use. Public cloud services may be free and hybrid cloud is a combination of two or more cloud (private or public) that is bound together.

I. Cloud Hosting

This is the hosting of all the models on web servers in order to access and share computing resources from networks. With cloud hosting, however, the network of servers that are used is vast and often pulled from different data centres in different locations. To host the servers, a certain cost can be accrued for the service so that patients’ information or records can be hosted, accessed and retrieved at any health institution is much the system is hosted.

IV. ALGORITHM FOR RETRIEVING AND STORING ON WIHRS

Suppose S₁…Sn are WIHRS of h hospitals all having a central location, C, where h ≥ 1.

Suppose for each WIHRS, Sn, there exists, Pi for 1 ≤ i ≤ m for m number of patients.
To retrieve the cloud records of any patient $Pi$;
Step 1: Start
Step 2: Input $X$, which is the identity of the patient $Pi$
Step 3: Check if $X \in S_n$
Step 4: If $X \in S_n$, goto 11
ELSE go to 5
Step 5: Join cloud
Step 6: Check if $X \in S_{n+1}$, where $1 \leq n \leq (k – 1)$
ELSE display “No Record Found”
Step 9: Create patient’s record
Step 10: Add record to the database $S_n$
Step 11: Display patient’s record
Step 12: End

V. DESIGN AND IMPLEMENTATION

In the light of the above language selection, web technologies languages such as PHP, HTML, CSS and Ajax were selected to implement the proposed system.

A. Design Interfaces

The Web based interactive electronic health record system was designed with multiple users. It has administrators from each health institutions that control the inflow and outflow of their patients’ information. It also has cloud user that manage the activities of the head or representative of the health institutions present in the system. Figure 3 represents the patient’s medical records. Figure 4 is the complaint interface which handles the complaint management of the patients. Once complaint has been made, the doctor connects with the cloud server to check if the patient has any cloud data, if any, go through them and if need be, listen to the patient medical history if any and make conclusions based on what he has learnt.

B. Cloud-Server Connect

This module handles server authentication. Cloud key is generated for all registered health institutions which serve as their login detail into the cloud-based system. After being successfully authenticated, the cloud-search engine pops up where the administrator in charge of the health institutions is expected to search using the patient name as the search criteria. The interfaces are shown below as figure 5. Figure 6 is the patient’s cloud data interface which contains the cloud records of the selected patients if any. It allows the doctor to see the number of health institutions the patient has visited, previous complaints, diagnosis and treatments, past medical records, previous physical examination and laboratory records among others. The interface is shown below as Figure 6.

VI. CONCLUSION

The proposed system applies cloud computing technology on WIHRS integration. It provides a ready WIHRS for all kinds of hospitals and health institutions. Irrespective of the number or the size of hospitals that join the cloud; the system is capable of working on the basis of integrity and it will offer healthcare providers the ability to communicate in a controlled, scalable, safe and cost-effective way under the cloud. Cloud Computing can be applied to WIHR system to facilitate health records adoption for all types of healthcare institutions.

WIHRS are expensive, and the risks of privacy and security of patients’ health records are great. However, it is certain that the use of WIHRS would improve quality and efficiency of health care services rendered to the patients. It is required that IT staff at medical facilities use network and data management as best practices. If WIHRS and related...
technologies are implemented effectively especially in developing countries with poor health indices, they can reduce medical errors, improve quality of patient healthcare and make healthcare more efficient. Healthcare guarantees a healthy workforce which improves the economic indices of any nation on the threshold of development.

REFERENCES


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