Cloud Computing Base Electronic Health Record System Architecture for Disabled Children

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***Abstract*– This paper discusses the importance of a patient health record system. Such a system enables the health care providers to access and process the patients' medical information on economic cost and in standardized form, by avoiding duplication of patient medical information. The proposed system is cloud base system, which is capable to store a huge amount of data without any hesitation, and most of the resources are managed by the Cloud provider. So the user is not worrying about managing of resources and data storage. Moreover the proposed system is a web-based and the healthcare providers can access the patient record or information from any location and any time. The architecture is Cloud Base to store huge amount of data without any restriction. Using this architecture the chance of system failure is also very low. This architecture allows the healthcare providers to share the patient medical information at a very low cost, which should be very difficult and expensive by using the traditional technologies.**

***Keywords*– EHR (Electronic Health Records), PHR (Personal Health Record), CDO (Care delivery organizations), DB (Database), Middleware and Cloud Computing**

I. INTRODUCTION

Generally the health information of any patient is scattered across many different places and organizations in the country as well as worldwide. In the past, the people used manual methods to store the patient's record in any healthcare centre such a hospital, clinic, dispensary or any other healthcare unit. Those methods were using traditional methods which were very awkward and very slow. In those methods, patients' medical records would be stored on papers in registers. Every time the patient visited to any healthcare centre or any new hospital, he or she provided his/her health information to the hospital. The hospital collected the patient's information and stored on papers in registers. The patient's record would not be stored in any standardized format [1]. Moreover, the information would be lost because the new hospital was not having the patient's past medical history. The health care providers or physicians were also not allowed to access and keep patient medical record history, which could be used in the future and would be helpful for the patient's treatment in the future.

Now the healthcare units around the world are encouraged to develop a new computerized system to keep the patient medical record history, which could be used in the future and could be accessed from any health care's unit across the country. The system which was developed is called Electronic Health Record Systems. In the first phase the healthcare providers develop the EHR system which was used in a single healthcare unit, e.g. in a single hospital etc. But from time to time, the demands and requirements of people or medical providers become changes and they tried to introduce a new version of this EHR system in which the patient's records could be accessed remotely. They called it web-based EHR system. I can define the EHR system as an electronic application through which individual can access, manage and share health information in a secure and confidential environments.[1] I have various EHR standards which differ from country to country and which cover different issues of EHR standardization [10]. The cloud computing based PHR systems can allow various authorized users to securely access patient record from various CDO from any location [1].

To overcome these challenges we have developed a web-based EHR system that can be used by any physician or any hospital to collect a patient's health information (e.g., medical history, past surgeries, medications, allergies, laboratory test, physician's information etc.). Later on this information could be available anywhere to any healthcare unit and could be used by the patient's physicians for patient treatment. In the remainder of the paper section II present the related work section III present the proposal model and finally section IV present the conclusion of this paper.

II. LITERATURE REVIEW

The EHR system is one of the main concepts which have been developing over several years. The EHR system has been used in the healthcare department to improve the patient treatment, lifestyle and provides the efficient medical solution to the patient. The EHR systems are available in many forms despite the web-based systems. The information in the electronic PHR may be stored on portable computer devices such as USB flash drives, smart card or any other electronic storage device [1]. Vishesh Ved & Vivek Tyagi [1] used the

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web-based technology to develop their system due to which everyone patient, healthcare's providers and CDO can access the patient data and update. Moreover, it uses the cloud computing technology to store the patient information on the cloud sever. This model is purely cloud based and all the patients' data is stored on the cloud server. The system is ideal for those healthcare units which have no personal health record system and don't hesitate to share the patient data with anyone but if the health care units have their personal health care unit and don't want to share some patient data with anyone or if the concern healthcare unit is not agreed to give patient data access permission to any other hospitals, then in this case this idea would fail.

Zulqarnain Rashid [2] used the centralized based concept, where the health care centres use the central database and web server for communication to store and access the patient's records remotely via internet. In this proposed work the healthcare unit access the patient data from centralized database which is placed in some common place and are accessible through the internet by using some sort of electronic devices. This system is ideal for some specific application, but for generalized case it could create some problems, e.g., the central DB is shouted down in any particular time because of some DB problems or communication problem then the whole systems would be not working properly.

Ilias Maglogiannis & Nikolaos [11] used the simple client server architecture to implement the EHR systems. He uses the simple personal computer as a server, which could store the patient's record and the client entity would use any mobile device to access their record from the server. The system is ideal for the limited area or the area where the numbers of healthcare units and patients are small but for the large area or where the numbers of patients are large, it creates a big problem, e.g. if the server fails at any particular time, then the whole system would be down and no one could access the systems. Moreover we could store only a limited number of patient's records in that system.

The Health Level 7 [10] used the cloud computing systems where the cloud has a centralized database and data repository to store the EHR and the whole 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 web portal. This datacentre would manage by the Cloud provider. The systems are ideal for areas where such types of facilities are available, but such type facilities are not usually available in most of the area which creates a big problem. Moreover the data centre is controlled and managed by could provider which also creates a problem of information security as well.

III. PROPOSED MODEL

After verifying the problems in the existing systems and looking the advantages of the cloud computing paradigm, I propose a new model for the EHR systems for the solution of these problems. The proposed system allows various healthcare providers to access the patient record from any location securely without any restriction. This system will integrate all the patient records, including the medical data, for example medical history, past surgeries, medications, allergies, laboratory test etc, which can be accessed from any location and reviewed by their physicians. The physicians can update and modify the patient's record from anywhere without any restriction. Moreover, the patient can access his/her record online and can change it anytime from anywhere.

To ensure the security of the patient data, I plan to implement password protected access to the system and only registered patients, CDO and doctors can log into the system. The patients are restricted to viewing, modifying and sharing their own records only and CDO and other health care units can access those records only which are shared with them. Patients can edit the access privileges on their own record only. The proposed Cloud Base system can allow various authorized users to securely access patient record from various health care units. They will integrate all patient records, including CT-Scan and MRT, which can be easily accessed from anywhere and can be reviewed by any authorized users, but any unauthorized user is not allowed to access the patient's record.

In the proposed system, I divided the patient information into two parts. One part of the information is stored in the Cloud server database, while another part of information is stored in the concerned health care's unit databases. But if the local healthcare unit does not have its local EHR system, then that hospital will store the whole patient record in the Cloud database.

The patient information is divided into two categories: i) General information, ii) Private information

i) General information: The general information is the information that the patient and health care unit want to share with anyone (e.g. name, age, contact information, any medical history that the concerned health care unit, patient or physician, want to share with any other hospital).

ii) Private information: The private information is the information that the patient and the health care unit don't want to share with anyone but only upon request and situation (e.g., any past medical history which is private and the patient and healthcare don't want to show it publicly).

The general information would be stored on the Cloud database server while the private information would be stored on the local health care unit database server. The information could change from private to public any time, when it changes from private to public then it shifts to the cloud database server. All the health care units must be registered with the Cloud database server. The Cloud database server would store the general information about the patient and information about all health care units where the patient's information is stored, while the private information about the patient is stored on the local database inside each and every health care unit. The proposed system utilities all cloud computing systems, combining them with the local EHR system. The proposed system will have three main components.

Cloud Database Server: This component is responsible to store the data (patient information) on the cloud and all healthcare units' information where the patient data are stored. The Cloud data centre contains the central database server as a data repository for storing EHRs and retrieving

patient information. This data centre is managed by the Cloud provider.

Middleware Software: This is an intermediate tool between the cloud central Database server and the sharing hospitals systems. This middleware layer is responsible to play an intermediate role between the Cloud sever and local healthcare unit database. This layer facilitates the communication between the cloud server and the local health care unit database. By using this layer, the local healthcare does not worry about the architecture of the cloud database server and platform. Each and every local hospital is using its own architecture and platform, while the clouds sever is using its own architecture and platform. This layer is responsible for facilities and their communication. In simple words, this software puts heterogeneity in the system.

Web Portal: This component provides an application for EHR system. This web portal is responsible to communicate between the middle layer tool and each hospital (user). The end user (doctor, care takers, patient) accesses the Cloud system (Database) through this layer. This component is responsible to send the users message to the Cloud server and receive the response message from the Cloud server for the end user. The end user accesses the patient's information through the GUI. The end user can access the system through web clients, workstations, mobile, and tablets devices.

The proposed system is web-based system which is running on the internet or intranet and is platform independent. We used the J2EE platform at the front end for its cross-platform communication between multiple kinds of device features and have rich libraries to support different kinds of modern technologies and devices and Microsoft SQL Server 2012 at the back end for the local databases because of the powerful database engine and the huge storage capability, while the Cloud database server is using its own database system.

The user interface is designed in such a way to have multiple types of forms (pages) depending upon the role of the user. If the user is the first time user, then his account will be created before entering or accessing. This information and a unique ID will be assigned to this patient but if the user is the old user then the user ID (user name and password) would be used to access his account. The user would be selected depending upon the role of the user because this system would be accessed and used by multiple users (patients, physician, health care unit, CDO etc.).

If the user is the patient then the physician will create his account to enter all his information and give him his patient ID. The patient will use this ID in the future in any healthcare unit for accessing his account. The patient is allowed to give privileges to the concerned user (doctor, CDO etc.) to access his record. He could access his account online and could change the privileges to any user at any time. If the patient is the old user then the physician will get his ID and enter into the computer system to get all his previous information, e.g., past medical history, etc. At the end of the treatment the physician will update the patient record.

The patient record will be stored in the cloud database as well as in the different healthcare units databases, which could be used by any physician from anywhere connected to the system. The patient record would be accessible only by any physician; health care unit, CDO, the patient and all other authorized parties by using the patient ID, and any unauthorized party cannot access or use the patient record.

Working of the system: The end user (patients, physician, healthcare unit, CDO etc.) will access the patient record through the Cloud server computer. There should be no way of direct communication between any two hospitals. When the doctor wants to access the patient information, he will enter the patient ID into the Cloud server computer. The system will display two tabs, one tab for general information and one tab for private information. One tab is used to access the general information from the Cloud server computer while the second tab is used to display the list of hospitals where the patient record is stored along with the information type, e.g., the information x is stored in the health care unit A and information y is stored inside the health care unit B and so on because the patient record would be stored in multiple healthcare units. The next step is to send a request to access

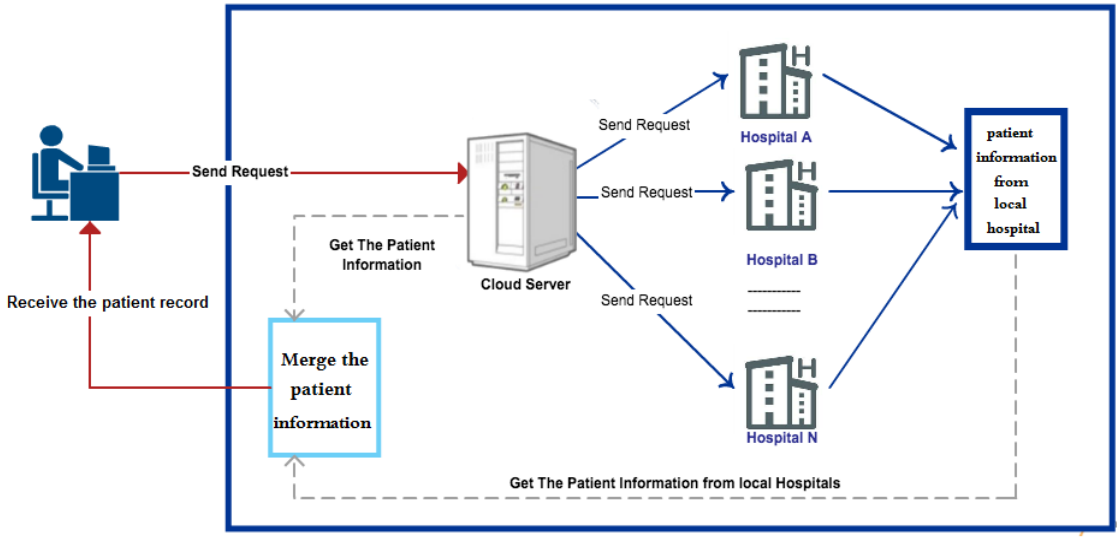

Fig. 1: Getting the patient information from local hospitals

this information from the concerned health care unit. It depends on the access permission, either the concerned healthcare unit agrees to give that information to this doctor or healthcare unit or not.

Case 1: If the health care unit agrees to give that private information to this doctor or healthcare unit, then they will send it to the concerned healthcare unit and after using this information, the doctor will store the general information about the patient into the Cloud database and the private information to their concern healthcare unit and update the patient record accordingly.

Case 2: If the healthcare unit is unwilling to give the patient information to this healthcare unite or doctor then the physician will use the alternative method. In this case the doctor will enforce the patient to get this information from that healthcare unit, or to change the access privilege such that the physician is able to access this information that he needed otherwise they will treat the patient according to the available information.

The patient information is the patient's private information and he has the permission to get and use it according to his own choice moreover, he can change the access privilege remotely. The patient can access the system through the web portal from anywhere and can change the user privilege any time. When the physician wants to access the patient record and puts a request to the system, then one subset of information (general) would be retrieved from the Cloud database server while another subset of information (private) would be retrieved from the concerned hospitals by merging this information which is the record of the patient and this information will be returned to the physician (Fig. 1). Then the physician will use this information for the treatment of the patient.

The proposed system is a web-based system and the patient can access and check his/her record from his/her account by using his/her website. He has the rights to check all his/her medical information either it is general information or private information, the patient can changes the type of information (e.g., from private to general, etc.) when he change the information from private to general then the information will be more to the cloud database and can be accessible by anyone from anywhere. The block diagram of the proposed system is in the Fig. 2.

IV. CONCLUSION

Nowadays, the prospects and medication for health care sector is a difficult job and it is very difficult for healthcare department to give the real time medications to the citizen with a low cost. This paper presents a good and a very cheap solution to health care department to give the real time medication to the citizen with a very low cost. In this paper we propose the cloud base EHR system solution, which could store a huge amount of data and with no worry of control of EHR for local healthcare units.

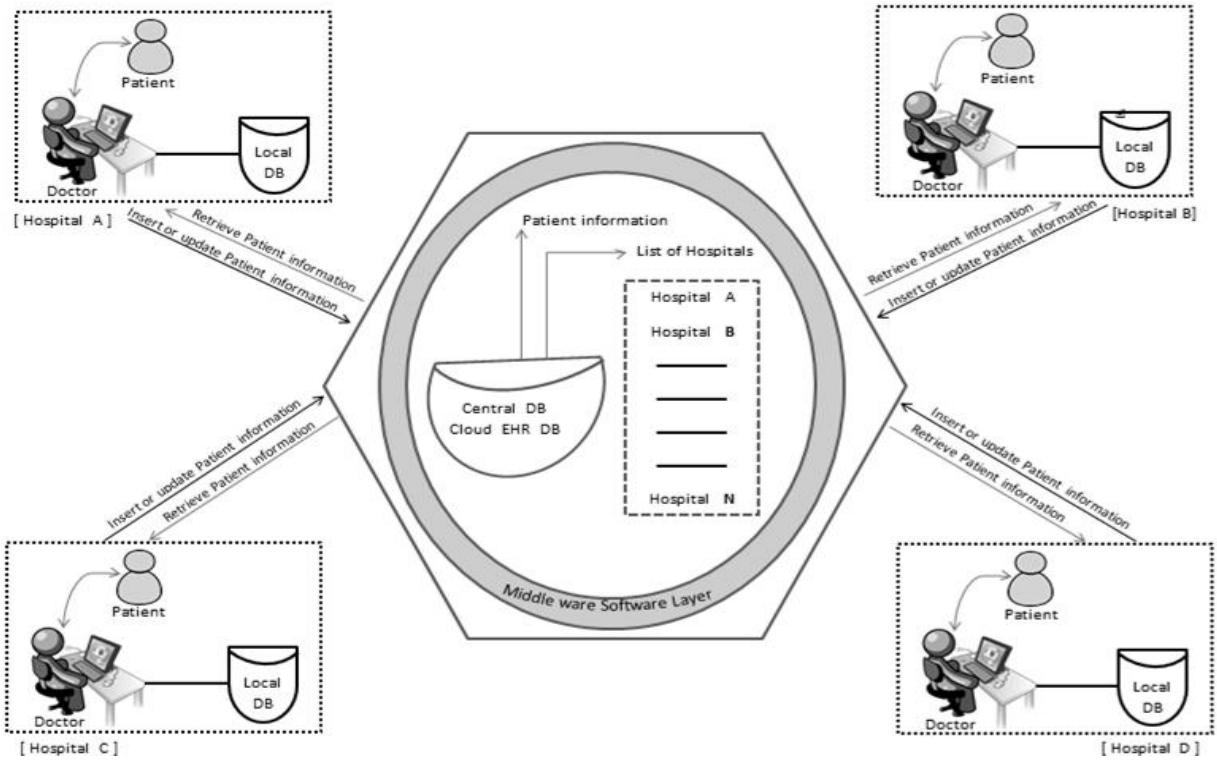

Fig. 2: Proposed Cloud Base Health Record System Architecture

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