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Design and Analysis of a Novel Clinical Data Analysis for Information Exchange on a Cloud Server

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ABSTRACT

In current days health care organizations are increasing day by day from one location to other location with a wide variety of features and new techniques. As the health care organizations are increasing more and more in different locations, each and every individual health organization maintains an individual UI model for storing and accessing their patient's information. Also we know that in some times, information exchange between different hospitals need to be done, so there is a need to share some common database for information exchange in online or offline, such a database is known as Clinical Document Architecture (CDA).The term CDA was developed by HL7 as a core document standard to ensure such interoperability for the patient information. As we discussed above different hospitals or health organizations maintain different user interfaces based on their own technology. So once if any hospital needs any information from other at some urgent situation they both may not match in UI structure, which leads to wrong information extraction. Hence in our proposed thesis we proposed a common format designed in XML for storing the records of CDA from various health care organizations. Also in our proposed thesis we designed CDA document generation and integration of Open API services based on cloud computing which is mainly used to store all the information on a live cloud server. Here we take DRIVEHQ as a cloud service for storing all the CDA information in an encrypted manner rather than in a plain manner. By conducting various experiments on our proposed model, our simulation results clearly show that our proposed system of CDA document generation and integration is based on cloud computing can able to provide developers of different platforms to enhance their ability to interoperability.

Key Words:

Cloud Computing, Data Encryption, Cciphertext-Policy Attribute-Based Encryption, Clinical Document Architecture.

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1. INTRODUCTION

Now a day's there was a lot of user's attention towards the cloud data storage as well as retrieving of data from the cloud server. As the data is been increasing day by day almost all the companies are unable to store their valuable data on their own individual devices, so in this situation they opt for a new data storage area known as Cloud Data Storage [1], [2]. Generally cloud service providers allow the users to access their services for a low economical and ascendable marginal cost compared with primitive data storage services. Generally the data which is stored in the cloud server is mainly used for sharing within the users of same group or between the users of different group with a valid authentication. Some of the best cloud data storage services are as follows: Google Drive, DriveHq Server, DropBox and ICloud. As these all are the best among various types of cloud service providers in which the data can be stored either in public cloud or private cloud, sometimes can be stored in both combine known as Hybrid Cloud.

From the below figure 1, we can clearly find out that there are various cloud service providers that are available in the real time environment that are used for storing various applications like word documents,pdf,excel and many more files. If you look at the above figure you can find out the various cloud service providers like Zip Cloud, Just Cloud, BOX, Google Drive, DROP BOX and a lot more. Of all these we are using DRIVEHQ.COM as the storage medium for storing the uploaded files in this proposed application.

Now a day's Electronic Health Record (EHR) However, most of the HIS in service have different characteristics and are mutually incompatible [5], [6]. Hence, effective health information exchange needs to be standardized for interoperable health information exchange between hospitals.

Figure.1. Represents the Architecture of Several Cloud Service Providers and Their Applications

Especially, clinical document standardization lies at the core of guaranteeing interoperability. Health Level Seven has established CDA as a major standard for clinical documents. CDA is a document mark-up standard that specifies the structure and semantics of 'clinical documents' for the purpose of exchange. The first version of CDA was developed in 2001 and Release 2 came out in 2005 [7]. Many projects adopting CDA have been successfully completed in many countries

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[8], [8], [9]. Active works are being done on improving semantic interoperability based on open EHR and CEN13606 [12], [13].

In-order establish a secure confidence in hospital information support systems for exchange of information between each other interpersonally, more number of hospital information support systems need to support the novel CDA. As we look into the exact structure of CDA, it is very complex and the production of correct CDA document is hard to achieve without deep understanding of the CDA standard and sufficient experience with it. In addition, the HIS development platforms for hospitals vary so greatly that generation of CDA documents in each hospital invariably requires a separate CDA generation system. Also, hospitals are very reluctant to adopt a new systemunless it is absolutely necessary for provision of care. As a result, the adoption rate of EHR is very low except for in a few handful countries such as New Zealand or Australia [14]. In the USA, the government implemented an incentive program called the Meaningful Use Program to promote EHR adoption among hospitals [15]. When a patient is diagnosed at a clinic, a CDA document recording the diagnosis is generated. The CDA document can be shared with other clinics if the patient agrees. The concept of family doctor does not exist in Korea, hence it is common for a patient to visit a number of different clinics.The exchange of CDA document is triggered in the following cases: when a physician needs to study a patient's medical history; when referral and reply letters are drafted for a patient cared by multiple clinics; when a patient is in emergency and the medical history needs to be reviewed.

2. RELATED WORK

In this section we will find the related background work that was analyzed and studied in order to implement this current thesis. This section will describe the work that is related to the various types of cloud servers and also the traditional approach of data sharing in the cloud. This is mainly discussed because the idea of CDA implementation is adopted in cloud server storage for easy and fast access by all the HIS which are located in and around the country. For this reason we mainly discuss about the primitive ways of data hosting in cloud computing. Now let us look about that in detail in this below section:

A) MAIN MOTIVATION

Now let us look about the some of the various types of cloud data storage in detail:

I) PERSONAL CLOUD STORAGE

It is also known as mobile cloud storage, personal cloud storage is a subset of public cloud storage that applies to storing an individual's data in the cloud and providing the individual with access to the data from anywhere. It also provides data syncing and sharing capabilities across multiple devices. Apple's iCloud is an example of personal cloud storage. This personal cloud storage is mainly dealt in various mobile operators which

provide easy access for data storage inside the cloud.

II) PUBLIC CLOUD STORAGE

Public cloud storage is where the enterprise and storage service provider are separate and there aren't any cloud resources stored in the enterprise's data center. The cloud storage provider fully manages the enterprise's public cloud storage. Normally in the current days all the cloud storage providers provide public cloud as storage medium with min 2GB and Max 10 GB for data storage with free data access and usage. If that space exceeds then we need to pay the excess storage cost more than 10 GB, which acts as a private cloud.

III) PRIVATE CLOUD STORAGE

It is a form of cloud storage where the enterprise and cloud storage provider are integrated in the enterprise's data center. In private cloud storage, the storage provider has infrastructure in the enterprise's data center that is typically managed by the storage provider. Private cloud storage helps resolve the potential for security and performance concerns while still offering the advantages of cloud storage.

IV) HYBRID CLOUD STORAGE

Hybrid cloud storage is a combination of public and private cloud storage where some critical data resides in the enterprise's private cloud while other data is stored and accessible from a public cloud storage provider. A Hybrid Cloud Storage is the combination of public and private cloud storage, till less than 10 GB it is treated as public cloud and more than 10 GB treats as a private cloud storage. Hence an account which contains both these combine is known as hybrid cloud data storage.

3. A NOVEL PROPOSED CDA GENERATION SYSTEM BASED ON CLOUD COMPUTING

In this section, we mainly describe the proposed novel **CDA GENERATION SYSTEM BASED ON CLOUD COMPUTING** for secure communication and information exchange between various E-Health care Organizations to process their tasks easily. The main contribution for proposing this CDA Generation is explained in detail in this section.

THE CDA DOCUMENT

The HL7 Clinical Document Architecture Release 2 (CDA R2) was approved by American Nation Standards Institute in May 2005. It is an XML-based document markup standard that specifies the structure and semantics of clinical documents, and its primary purpose is facilitating clinical document exchanges between heterogeneous software systems. Each and every CDA document is mainly divided into two parts

1) CDA Header Part
2) CDA Body Part

The header part clearly define the structure of the patient record, it mainly contains the information about the patient, hospital information and the physician who is visited for the patients etc.

The body part is the main part in this CDA, where it contains a more flexible data than the header which contains only basic information. In the body part we mainly contains all the various clinical data and clinical history about the patient, where each and every piece of clinical data is allocated a separate section and it is marked individually in an XML page. Also the separate section is also represented with an separate name like Logical Observation Identifiers Names and Codes (LOINC) [15].Now let us look about the most notable data which is included in CCD are listed in Table 1.

When we want to look for the integrated CDA document, we chose the Korean Standard for CDA Referral and Reply Letters (Preliminary Version) format as the number of clinical documents generated when patients are referred and replies made, is large [15]. It has the identical structure as the CCD and the types of data contained in the body are listed in Table 2.

As we all know that we are integrating this novel CDA into the cloud server, we need to know about the cloud computing. Cloud computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the data centers that provide those services. The user pays fee depending on the amount of resources allocated, such as network, server, storage, applications and services. Currently, three major types of cloud computing service exist:

TABLE 1
Data Items in CDA Header and Sections in the CDA Body

CDA location	Data items
CDA Header	Document Information (creation time, template ID, language code, purpose) Patient's information (ID, name, gender, birth date) Author's information (ID, name, represented organization) Organization's information (name, address, phone number)
CDA Body	Payers Advance Directives Support Functional Status Problems Family History Social History Allergies Medications Medical Equipment Vital Signs Results Procedures Encounters Plan of Care

TABLE 2
Sections in the Korean Standard for CDA Referral and Reply Letters Body (Preliminary Version)

Sections in CDA body	CDA Referral letter	CDA Reply letter
Diagnosis	Yes	Yes
History of past illness	Yes	No
History of Medication Use	Yes	Yes
Laboratory studies	Yes	Yes
Radiology studies	Yes	Yes
Pathology studies	Yes	Yes
Function Status Assessment	Yes	Yes
Surgical Operation Note	Yes	Yes
Relevant Diagnostic Tests	Yes	Yes
Reason for referral	Yes	No
Special Treatments and Procedures	Yes	No
Subsequent Evaluation Note	No	Yes
Plan of Treatment	No	Yes

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THE CDA GENERATION SYSTEM BASED ON CLOUD COMPUTING

This is mainly explained in the below figure 2,where in that we can show the overall architecture of how CDA documents can be generated on the health information systems of different hospitals by using our cloud computing-based CDA generation system. Hospital A and Hospital B are demonstrated to show that it is easy to generate CDA documents on a variety of platforms if done via cloud. The purpose of each of the components is as follows:

1) CDA Generation API generates CDA documents on cloud.

2) CDA Generation Interface uses the API provided by the cloud and relays the input data and receives all the CDA documents generated in the cloud.

3) Template Manager is responsible for managing the CDA documents generated in the cloud server. Our system uses CCD document templates.

4) CDA Generator collects patient data from hospitals and generates CDA documents in the template formats as suggested by the Template Manager.

5) CDA Validator inspects whether the generated CDA document complies with the CDA schema standard.

The DBMS at each hospital and the HIS are linked as follows.

Hospital A, which uses a .Net-based system is connected via ODBC to connect to the DBMS while Hospital B, which uses a JAVA-based system, is linked with Hibernate. At a hospital, the clinical information of patient, hospital, and physician is entered via CDA Generation Interface and sent to the cloud server via CDA Generation API. We utilize SOAP (Simple Object Access Protocol) as transmission protocol for the purpose of enhancing interoperability among different HIS when a hospital sends data to the cloud. CDA Generation API relays the data in the CDA Header/Body in the list type. The items included in CDA Header are:

1)Patient ID

2)Birth Date

3)Gender

4) Name

5)Family

Figure2. Represents The Architecture Of Our CDA Generation System Based On Cloud Computing.

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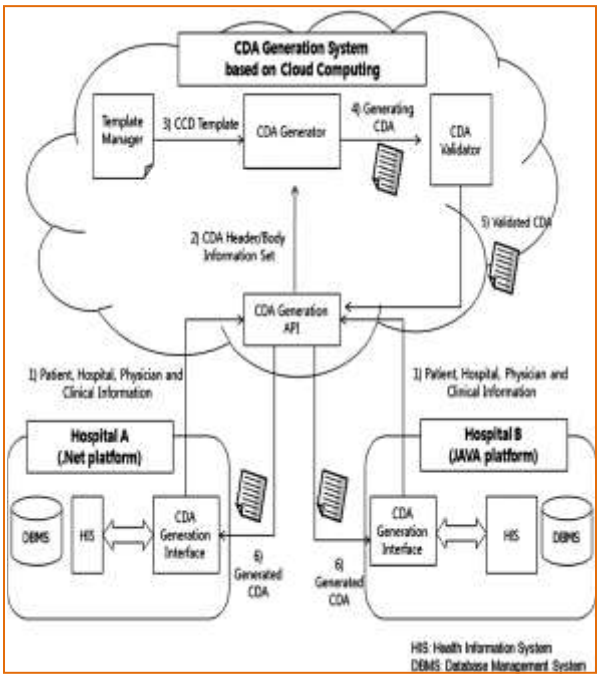

In CDA Body, the following items are included:

1. Problem,
2. Medication,
3. Laboratory,
4. Immunization and so on.

The data sent to the CDA Generation API are packaged in CDA Header Set and CDA Body Set and relayed to CDA Generator.A Generator retrieves a CCD template from Template Manager and fills in the appropriate fields of the CCD template with the data from the CDA Header/Body Sets. The generated CDA document is inspected by the CDA Validator whether the CDA standards are being satisfied. It is inspected whether there is any missing element or the format is adequately followed. If no error is found, a CDA document is returned to the recipient hospital. Hospitals A and B are presented to demonstrate that it is possible for different development platforms to extend to generate CDA documents via a cloud server.

In this proposed application we try to use the novel authorized privacy accessible model for providing security for the patients related information to be stored in the cloud server with timing enabled .Now let us discuss about that in detail as follows:

4. IMPLEMENTATION MODULES

Implementation is the stage where the theoretical design is converted into programmatically manner. In this stage we will divide the application into a number of modules and then coded for deployment. We have implemented the proposed concept on Java programming language with JEE as the chosen language in order to show the performance this proposed CDA generation and integration into the cloud server .The front end of the application takes JSP, HTML and Java Beans and as a Back-End Data base we took My SQL data base along with a Real Cloud Service provider called as DRIVEHQ.com as the Cloud Service provider. This cloud service provider will provide a space up to 1 GB for storing the files which is used by the application. The

application is divided mainly into following 5 modules. They are as follows:

1) HEALTHCARE SERVICE PROVIDER

In this module, Provider has to register to cloud and View all the CDA received and request to the cloud to access the generated CDA from hospital - A & hospital - B. once the access request is granted by the cloud the provider will write the reply letter for corresponding CDA reports and sends.

2) PATIENT/END USER

In this module, the user/patient Registers to cloud and is authorized by the cloud and Logs in. the user/ patient has to request the search key to search the patient CDA. And also request for the view permission from the cloud. If the permission is provided by the cloud the corresponding user/patient can view the CDA generated and the corresponding reply from the doctor.

3)HOSPITAL - A

In this module, CDA is generated, encrypted as hospital-A document and then uploaded to cloud. And also can view the CDA replies from Healthcare service provider. And can view all the generated CDA's.

4)HOSPITAL - B

In this module, CDA is generated, encrypted as hospital-B document and then uploaded to cloud. And also can view the CDA replies from Healthcare service provider. And can view all the generated CDA's.

5) CLOUD SERVER

In this module the cloud will authorize both the doctor and the patient/user .Receive all CDA generated from the hospitals and store, Select the doctor and Sends the CDA report for corresponding doctor. Provide permission for the CDA requests requested by the provider and also generates the search key requested by the user. This module shows the charts/Results based on the CDA allergies.

5. CONCLUSION

In this paper, we for the first time designed and developed a novel Clinical Document Architecture (CDA) and integrating of various CDA for Health care information systems into the cloud server. As the health care organizations are increasing more and more in different locations, each and every individual health organization maintains an individual UI model for storing and accessing their patient's information. Also we know that in some times, information exchange between different hospitals need to be done, so there is a need to share some common database for information exchange in online or offline, such a database is known as Clinical Document Architecture (CDA).Also in our proposed thesis we designed CDA document generation and integration of Open API services based on cloud computing which is mainly used to store all the information on a live cloud server. Here

we take DRIVEHQ as a cloud service for storing all the CDA information in an encrypted manner rather than in a plain manner.In future we want to enhance a concrete estimation of the reduction in cost when the EHR system becomes cloud-based

6. REFERENCES

[1] J. Xu, E.-C. Chang, and J. Zhou. Weak leakage-resilient client-side deduplication of encrypted data in cloud storage. In *ASIACCS*, pages 195–206, 2013.

[2] S. Quinlan and S. Dorward. Venti: a new approach to archival storage. In *Proc. USENIX FAST*, Jan 2002.

[3] K. Huang, S. Hsieh, Y. Chang, F. Lai, S. Hsieh, and H. Lee,"Application of portable cda for secure clinical-document exchange," J. Med. Syst., vol. 34, no. 4, pp. 531–539, 2010.

[4] Y. Kwak, "International standards for building electronic health record (ehr)," in Proc. Enterprise Netw. Comput. Healthcare Ind.,pp. 18–23, Jun. 2005.

[5] M. Eichelberg, T. Aden, J. Riesmeier, A. Dogac, and Laleci, "A survey and analysis of electronic healthcare record standards," ACM Comput. Surv., vol. 37, no. 4, pp. 277–315, 2005.

[6] T. Benson, Principles of Health Interoperability HL7 and SNOMED.New York, NY, USA: Spinger, 2009.

[7] J. D. D'Amore, D. F. Sittig, A. Wright, M. S. Iyengar, and R. B. Ness, "The promise of the CCD: Challenges and opportunity for quality improvement and population health," in Proc. AMIA Annu. Symp. Proc., pp. 285–294, 2011.

[8] KS X 7504 Korean Standard for CDA Referral Letters (Preliminary Version)

[9] J. L€ahteenm€aki, J. Lepp€anen, and H. Kaijanranta, "Interoperability of personal health records," in Proc. IEEE 31st Annu. Int. Conf.Eng. Med. Biol. Soc., pp. 1726–1729, 2009.

[10] R. H. Dolin, L. Alschuler, C. Beebe, P. V. Biron, S. L. Boyer,D. Essin, E. Kimber, T. Lincoln, and J. E. Mattison, "The HL7 ClinicalDocument Architecture," J. Am. Med. Inform. Assoc., vol. 8,pp. 552–569, 2001.

[11] R. H. Dolin, L. Alschuler, S. Boyer, C. Beebe, F. M. Behlen, P. V. Biron, and A. Shabo, "The HL7 Clinical Document Architecture,"J. Am. Med. Inform. Assoc., vol. 13, no. 1, pp. 30–39, 2006.

[12] M. L. M€uller, F. Ückert, and T. B€urkle, "Cross-institutional data exchange using the clinical document architecture (CDA)," Int. J.Med. Inform., vol. 74, pp. 245–256, 2005.

[13] H. Yong, G. Jinqiu, and Y. Ohta, "A prototype model using clinical document architecture (cda) with a japanese local standard: designing and implementing a

referral letter system," Acta Med Okayama, vol. 62, pp. 15–20, 2008.

[14] C. Mart_ınez-Costa, M. Men_arguez-Tortosa, and J. Tom_as Fern_andez- Breis, "An approach for the semantic interoperability of ISO EN 13606 and OpenEHR archetypes," J. Biomed. Inform., vol. 43,no. 5, pp. 736–746, Oct. 2010.

[15] MR. Santos, MP. Bax, and D. Kalra, "Building a logical HER architecture based on ISO 13606 standard and semantic web technologies," Studies Health Technol. Informat., vol. 150, pp. 151–155, 2010.

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