Security Improvised Privacy Preserving Medical Network Using Cellular Automata Scheme

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Abstract: Cloud storage is a model of computer data storage in which the digital data is stored in logical pools. The cloud storage providers are responsible for keeping the data available and accessible, and the physical environment protected and running. Cloud storage services may be accessed through a collocated cloud computing service, a web service application programming interface (API). Recently, with the rapid development in wearable medical sensors and wireless communication, Wireless Body Area Networks (WBANs) have emerged as a promising technique that will revolutionize the way of seeking healthcare, which is often termed e-healthcare. In WBAN, bio-sensors are implanted within the patient's body to sense the information of a patient's body which later on transmitted to remote medical sensors through the internet. In existing system, they present the research challenges in developing practical privacy-preserving analytics in healthcare information systems. They analyze the data and analytic requirements for the involved parties, identify the privacy assets, analyze existing privacy substrates, and discuss the potential tradeoff among privacy, efficiency, and model quality. In proposed system, the security and privacy issues of patient's data in Wireless Body Area Network are improved using our new enhanced algorithm. The patients' historical data is secured in cloud and can be used to without discharging any individual patient medical data.

Keywords: Cloud computing, Cloudservices, Health care, Healthcare as a Service, Image Processing

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I. INTRODUCTION

With the advances in information and communication technologies, the amount of digital data captured by health care systems had an exponential growth in the last decade. It is found that Picture Archiving and Communication System (PACS) storage requirements are increasing by 20-40 percent each year and cumulative PACS storage requirements may triple in every four to five years [1]. The number of images ordered by physicians has exploded in the past 15 years. The number of MRI units has doubled between 1995 and 2004, while the number of CT units grew more than 50 percent. [2] Though richer health care and patient data helps to ensure improved and informed patient care, catering to this growing data is not a prosaic job. The data generated must not only be stored but must also be archived for several years based on the medical regulations of the country, e.g. Health Insurance Portability and Accountability Act (HIPAA) requires healthcare providers to keep medical records archived for six years after discharge. The limited infrastructure setup available in a hospital will not be able to manage this growing volume of data in the long run. Moreover the medical data security regulations specify regular data backup, recovery and access plans as a contingency measure in case of disasters. [3] These stringent requirements can add to the burden of hospital IT departments. Health care organizations are struggling to manage the wealth of information produced.

Another challenge the health care industry is facing is the sharing of medical data and its accessibility from anywhere anytime. Legislative initiatives like The Health Information Technology for Economic and Clinical Health Act (HITECH) as part of the American Recovery and Reinvestment Act are promoting the evolution of health information exchange (HIE) to facilitate collaboration between healthcare entities. [4][5]These collaborations can help reduce the duplication of medical data, improve efficiency and quality of care through information sharing capabilities and coordination among fragmented provider systems and can improve the operational excellence of hospital systems that have undergone merging. However, the existing PACS systems produces siloed data and sharing of data is possible only between similar PACS systems. Each modality in a hospital system might have its own PACS system and there is no assurance that these systems might be compatible with each other. This makes sharing of information difficult even within a single organization or department if multiple PACS were purchased from different vendors. Since traditional hospital IT systems is highly fragmented sharing data across hospital systems is even more challenging due to lack of

fast and secure mechanism of data access from outside organizational firewalls.[6] Yet another challenge is the anytime anywhere accessibility of medical data. With a traditional hospital IT system enabling seamless access of medical data across a variety of devices like personal computers, tablets and mobile phones will require significant effort from the IT administrators.

All of the challenges mentioned in this section can easily be overcome by adopting cloud computing offerings in a health care system. Cloud computing is a model for enablingubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. [7] This paper describes an attempt to build a healthcare system, Health Cloud, capable of harnessing the power of the cloud, the various healthcare operations made available as services in the system and how this service utilizes the benefits of a cloud infrastructure are described. The implementation of an offered service (image processing service) is detailed.

II. RELATED WORK

Cloud computing in healthcare bad weather or sunny forecast[8] explains about the importance of cloud computing. It also explains on how technology giants such as Google and Microsoft are driving the cloud computing technology for storage of patient data such as Google health [9], Microsoft Health Vault [9].It also emphasizes on the benefits of moving healthcare services to cloud. The paper limits itself to only access to healthcare services on cloud that are specific patient data, electronic health records and insurance services.

Design and Implementation of cloud based Rural Health information systems [10]explains the problem of maintainingpaper based health records in rural areas of India. It proposes the design of an application which maintains the health records of the patient on the cloud. It also explains the security implementation used to protect the patient data on the cloud. It further explains how healthcare workflows are easily managed using the cloud based solution. However the paper is again only limited using the cloud for storage of patient data. It does not cover other aspects such as analysis patient data, the business aspect such as pay per use, on demand provisioning of resources, re use of services across rural areas are not explored in detail. The paper however gives us clear picture of how cloud can securely store and manage patient data efficiently. The paper also limits the clouds capabilities to storage of health records. It does not cover harnessing the cloud capabilities for processing the data and it's on demand resource scaling capabilities.

III. EXPLANATION

Health Cloud is built on service oriented architecture [11] and consists of a number of services for performing various healthcare operations. The services offered may be made available on premise i.e. within a corporate network or on a cloud infrastructure. Irrespective of the whether the services are hosted [12] on-premise or on cloud, these services will be capable of utilizing the cloud infrastructure. The services offered include storage and indexing of medical data, image processing services, report generation, charting and trend analysis of healthcare data. All of these services are secured with identity and access control features which is capable of utilizing a hospital's existing identity and authentication system like LDAP, Active Directory, or another system.

A. Storage Archival and Indexing Services

Currently the healthcare data is stored in specialized storage systems known as PACS. Standalone PACS systems have limited storage space. With the improvements in medical imaging technology, new and evolving modalities create complex images that have massive storage requirements, which legacy systems will fall short to meet in the long run. Also as the size of data increases the efficiency of data retrieval from a standalone PACS may deteriorate. PACS on cloud provides an opportunity to overcome the limitation of storage space by providing scalable storage solution based on demand. The retrieval of data could be optimized by indexing the healthcare data on the cloud.

Health Cloud is capable of storing data into popular cloud vendor storage options like Windows Azure's blob storage [13]; Amazon Web Service's Simple Storage Service [14] and can be readily extensible to support any cloud vendor. Relational data can also be stored into SQL Azure [15] or Amazon RDS [16]. The data stored is indexed so that retrieval is optimized. The configuring of the data backup and archival can be done easily and can be carried out during the configured intervals. As a contingency plan in case of disasters the service also provides option for geo-replication of the medical data. The service indexes the data that is stored in cloud and this helps in a faster retrieval of data.

The service addresses healthcare regulatory compliance requirements such as Health Insurance Portability and Accountability Act (HIPAA), Health Information Technology for Economic and Clinical Health Act (HITECH) and Federal Information Security Management Act (FISMA) using a combination of security measures. Privacy of the medical data is ensured by using third-party security products and services to

anonymize the medical data [17].The security of medical data at rest when stored in cloud is achieved by utilizing the cloud provider security features. Many cloud vendors are eagerly embracing various health care standards for their services. The service has access control features like authentication and authorization so that an administrative control of data is in place. The service also enables easy sharing of data between various entities within a hospital and with different hospital parties. The service utilizes various encryption and tokenization mechanisms like OpenSSL [18], SAML [19] etc. to ensure secure sharing of data.

B. Image processing services

Currently stand alone healthcare applications are used to process images. These images are acquired from a modality and processed systematically using different algorithms to diagnose the medical condition of a patient. These algorithms are compute intensive and are expected to return the results of processing in a very short time. Many health care providers have their own proprietary algorithms and the hospitals are charged heavily for the licenses, increasing the operational costs significantly. An essential solution is to have these compute intensive algorithms run on cloud as services. These services can then be used by any health care application and hospital on a pay per use basis. This also reduces the cost of procuring high-end healthcare hardware with good computational power and the needed infrastructure. The details of the implementation of this service are presented in the section 'An example use case'.
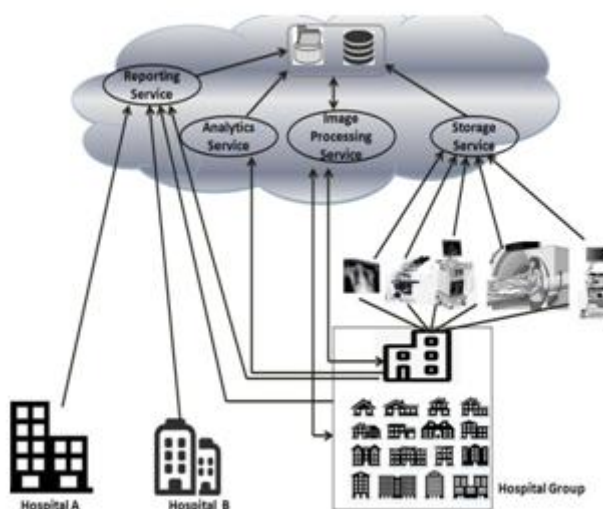
Fig.1. Overview of Health cloud

C. Reporting services

Reporting services provide an easy mechanism of sharing medical reports within different entities in a hospital/hospital group and between different health care providers. This helps to improve patient care immensely, reduce replication of medical data, reduce medical expenses and improve collaboration between health care providers. The reporting service may be used on pay per use basis.

D. Charting and trend analysis of healthcare data

The data collected in a hospital in a day is enormous and is disparate. The charting and analysis services help to aggregate this data and perform various kind of analysis on it. These services helps to monitor the health of a patient, improve treatment efficiency, take necessary guided decisions on patient treatment under critical situations. The analysis service produce a wealth of information which can be very useful for various purposes like medical research, preventive health care, promoting better standards in public health etc. This kind of analysis will require intensive computing and the cloud infrastructure provides on-demand, scalable compute resources.

IV. AN EXAMPLE OF USE CASE

Health Cloud 's image processing service facilitate performing various image processing operations on any kind of medical images stored in cloud. This service is hosted in a cloud infrastructure. The image processing service is built using C++.The service is hosted on a Microsoft Windows Server 2008 R2 virtual machine instance on cloud. The service is capable of retrieving images from Azure Storage blob storage services. The service also maintains a store for various image processing algorithms. The service indexes and caches the processed images for a faster response. The service ensuressecure transfer of data to its clients using

TCP/HTTPS communication protocol and has encryption mechanisms like SSL in place. The service also supports various identity management techniques like username/password, X.509 certificates and SAML tokens. Hosting the image processing service on cloud ensures its availability and the service can utilize the cloud infrastructure to scale based on demand spikes.
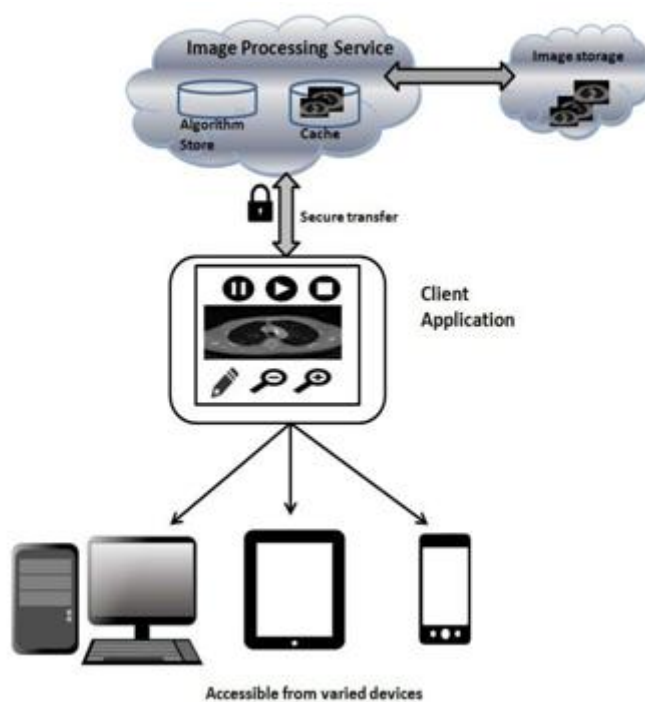
Fig.2. Overview of Image Processing Service

The image processing client application is built using C++, however the programming language or technology is not a constraint for the client as long the client is capable of sending commands to the server in form of simple text or JSON. The client applications for this service can be accessed from various devices like a personal computer, tablets, mobile devices etc.

V. CONCLUSION

Health Cloud provides various services that can be used to manage and process medical data using a cloud infrastructure in a secure, reliable and economical way. The services utilize the benefits offered by cloud computing like on demand services, scaling, access control, pay as you go. Adopting cloud computing can help solve many of the medical data challenges that health care sector is facing currently. Cloud computing can help easily manage the growing volume of medical data, efficiently share information between health care systems and optimize the organization's operational cost. Cloud computing can help the health care industry align its IT needs based on a real time requirement, rather than on a calculated guess. Health Cloud is an innovative way to bring down operational, management costs and provide affordable healthcare services in developing economies. The security of healthcare data however is concern as certain regulatory bodies do not prefer patient data to be stored on public cloud storage solutions.

VI. FUTURE DIRECTIONS

The future of Health Cloud aims offering metering services to determine cost of utilization of different types of health care services. The analysis services also need to evolve to meet the industry's requirements. A step further would be to deal with challenges of getting certified with compliance and legal regulations such as HIPAA.

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