Storage and Retrieval of Medical Images using Cloud Computing

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ABSTRACT

Every year health care organizations craft petabytes of data in terms of patient records, medical images and lab results. The dispute for healthcare facilities is maintaining medical images for enduring access while shielding them in a way that meets Health Information portability and accountability ACT requirements for privacy and disaster recovery. This act needs providers to stock up the data for years and decades. The main focus of the health care organization is about the expenditure of an onsite medical image database. Scalability and safeguarding are the most important concern for the domestic network and health care providers while storing huge amount of medical images. Cloud computing is one of the most inspiring technologies because of its cost effectiveness, elasticity, accessibility and scalability which can be an expected way out for the troubles one faced for stock up the images. Microsoft Windows Azure is one of the platforms in cloud computing used to store flexible images. To hold the client queries, Azure includes a server called Digital Imaging and Communications in Medicine Server Windows Azure will supply this sort of service oriented applications.

Key words: DICOM server, cloud computing, windows azure, SQL azure, cloud services

INTRODUCTION

The Windows Azure (Silas et al., 2012) affords core technologies for building affluent Services on top of untrustworthy but scalable hardware (i.e., a cloud operating system) (Teng et al., 2010). Programming tools and interfaces are designed to be well-known to custom desktop programmer. Normally the organizations will use the domestic network (onsite) for holding the request and for storage purpose. Probably, they will use optical disk and tape drives for storage. But the way of storing is not the recoverable one if any disaster occurs. Anything that is offsite means across the internet we can reduce the loss of data. But there exist the issue of security. Cloud computing came to prominence to deal with it.

OVERVIEW OF CLOUD COMPUTING

One of the rising computing technologies is Cloud computing. Cloud computing is the combination of Distributed computing, parallel computing and Utility computing (Yuan et al., 2012). It can be defined in two ways i.e., (1) access by means of the Internet using any Web browser to compute hardware and software that are controlled remotely and are allocated and deallocated dynamically according to the desires of the clients and (2) Pay for real use of the hardware and software (Ding et al., 2012). An association that suggests such a cloud computing service is the Cloud Service Provider. The foremost task of the Service Provider is to preserve outsized volumes
of heterogeneous data and to afford proficient retrieval of the data. Outlay is claimed to be greatly reduced and resources expenditure is switched to operational expenditure. A cloud is a virtual space offered for the customers to install their applications.

**CATEGORIES OF CLOUD SERVICES**

Cloud platform is one among the most significant element of cloud. This sort of platform permits developers to write applications that scuttle in the cloud, or utilize services afford from the cloud. Diverse names are given for this class of platform today, together with platform as a service (PaaS) and on-demand platform. Cloud Services can be clustered into 3 broad categories (Silas et al., 2012; Zhou et al., 2011). Figure 1 shows the categories of cloud services.

**Software as a service:** This application sprints completely on servers at web-accessible service provider. The client is usually a browser or else a simple client. The most renowned instance of a this application is almost certainly yahoo mail, Hotmail, Gmail, Salesforce.com.

**Infrastructure as a service:** This service is occasionally referred to as Hardware as a Service (HaaS). It is a prerequisite model .With this model an organization farm out the tools used to carry operations, together with hardware, storage, servers, networking components. The service provider possesses the equipment and is liable for hosting, running and retaining it. The client in general pays as per the usage of the resources (Ding et al., 2012). Some characteristics of Infrastructure as a service (IaaS) are Internet Connectivity, Dynamic scaling.

**Platform as a service:** In combination with IaaS and SaaS, Cloud has PaaS (Platform as a service) as a service model. The provider’s supplies software to the end user using tools and libraries. The customer also manages configuration settings and software deployment. The

![Fig. 1: Categories of cloud services](image-url)
provider maintains the servers, networks, and storage. Some of the Platforms available for cloud computing are Microsoft Windows Azure, Amazon EC2, Amazon (S3) (Zhou et al., 2010; Silas et al., 2012).

DEPLOYMENT MODELS
There are about four deployment models presented for cloud computing:

- **Private cloud**: The infrastructure and services are preserved on top of a private network, so the name called private cloud (Zissis and Lekkas, 2012). Nowadays private sectors make use of cloud infrastructure for their purpose. The organization will run the infrastructure.

- **Community cloud**: Infrastructure of cloud is distributed to several sectors and supports a precise community which has collective concerns like security requirements, guidelines and agreement considerations. This also managed by the organization.

- **Public cloud**: The infrastructure and services are given off-site over the Internet, named as public cloud. Several IT sector executives are anxious about public cloud security and trustworthiness. These clouds suggest the supreme level of efficiency within shared resources.

- **Hybrid cloud**: Hybrid clouds are expected towards the most common outline of communal cloud computing (Zissis and Lekkas, 2012). If a sector has different requirements based on computational resources and moreover it contains perceptive and non-perceptive applications, those applications can apply a hybrid cloud. For example, the database servers, which normally enclosed with sensitive data, that can reside on private cloud and public cloud is worn for the remaining applications.

DOMAINS THAT CLOUD COMPUTING SUPPORTS
Currently Cloud computing is getting higher in diverse spheres like, business, security, traffic control, education, Mobile, Internet etc. (Mahjoub et al., 2011). Figure 2 predicts the various domains that cloud supports.

Benefits of cloud

**Reduced cost**: Cloud technologies facilitates Organizations to bound the large capital expenditures which was found in the priorly associated costly data centers and make over these costs into operating expenses of resource what the user used (Janssen and Joha, 2010).

**Increased storage**: Organizations can stock up more information than on local machines (Yuan et al., 2012).

**Flexibility**: Cloud computing provides much more flexibility comparing to the traditional computing methods.

**More mobility**: Anyone can access data from any places, rather than having to stay at their desks.

**Scalability**: The term scalability is “When the dimension of the problem increases”, how it deals with the solution (Sabahi, 2011). It should have a capability of sustaining a huge number of service contributor and a great number of users (Silas et al., 2012).
**Security**: Security afford users, the most trustworthy and the most sheltered repository center. Customers need not to worry about the loss in information, viruses and other troubles (Ding *et al.*, 2012).

**PROBLEM STATEMENT**

Conventional healthcare IT system lay up and run image records onsite via domestic network that is guarded with firewall from the outside. On the other hand, the management cost and the growing assets of onsite systems plus the lack of disaster recovery stipulation have stirred other offsite solutions. Storing huge amount of medical images leads to scalability and safeguarding concerns with the network and healthcare association onsite Picture Archiving and Communication System (PACS) (Silva *et al.*, 2011). Security is the main concern for the Healthcare IT sector due to the stock up of images in Optical disk and tape device.

**SYSTEM ARCHITECTURE**

Figure 4 symbolizes the Work of the Architecture. The scope is to build up a Medical Image Archive solution in Windows Azure Cloud and SQL Azure which can be a way in for the Medical Organizations or Hospitals through the remote system (Teng *et al.*, 2010). The application will be made use of by the Radiologist or specialist, Hospital Admin. One of the uniqueness of cloud platform compared with the client-server model is that it does not require central servers. But it still requires a set of devices to preserve records. This crafts the process to be an efficient one (Zhang *et al.*, 2009). The patients in the hospital can make their doorway by registering patient id and password. The patient can send the requests to the DICOM server. The job of administrator is to make registration for the user and upload patient images and he also checks for the valid ID of the user. Figure 3 describes a model of DICOM Image. The radiologist or the specialist can do their registration and they can view the image requests sent by the user and they can save the report in SQL azure (Sahu and Verma, 2011). The SQL Azure consists of hospital data, patient data, patient image data and Radiologist data. Figure 5 represents the radiologist profile. The
deployment of Windows azure is to manage, host and provide services. Separate interface is used for storing and queuing. The cloud environment is deployed so that, not only the patient, outside users can also send query and get the response by the DICOM server (Evangelista et al., 2005).
CONCLUSION AND FUTURE WORK

The objective of this paper is to build up a Medical Image Archive solution in Windows Azure Cloud and SQL Azure. We have designed the system architecture to afford an enduring offsite storage solution. This design reduces the management cost and also protects the data from disaster recovery. Security is the main concern for the Healthcare IT sector which has been achieved by storing the images on the DICOM Server. The service model of cloud computing which we have used in this study is PAAS.

The DICOM server should always be active without any difficulty and thus was a bit problem in some instances which results in data loss. So, we have to maintain a geographically Dispersed server.

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REFERENCES


