Research Article
A Review of Cloud Computing Technology Solution for Healthcare System

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Abstract: Previously the traditional healthcare information system that used in the healthcare sector was the paper-based and then later it was replaced by the Healthcare Information System (HIS). However the HIS was found not perform effectively because of several issues such as storage capacity, system integration, high operating cost and system maintenance. Cloud computing is a new technology that deliver the software, infrastructure and computational platform as a service over the Internet in any place and any time. This technology has been said can solve many problems of the healthcare system such as increase the storage capacity and add new capability on the existing healthcare system. Cloud computing offers cost effective, increase interoperability and accessibility, optimize resources and integrate the healthcare information systems. It becomes a solution for solving the current issues, which lead to enhance functionality and features of the healthcare information systems. Therefore, the aim of this study is to explore the cloud computing technology as solution for healthcare information system issues. Issues such as data transmission, data storage, cost and maintenance issues are presented and described. The implications of this study then discussed.

Keywords: Cloud computing, healthcare information system, healthcare system issues

INTRODUCTION

In the last years, one of the technology that has been appeared and developed is a cloud computing. Cloud computing is a new technology that delivers the services over the Internet with using the computing resources and nowadays many applications are based on it. Cloud computing can be one of the best solutions for healthcare information systems issues and with the benefits of cloud computing can develop the healthcare information system. Cloud computing offer many advantages to healthcare system and also patients. With this economic condition, reducing the cost is one of the benefit that the healthcare system with using the cloud computing can achieve it. For patients, the quality of service is very important that cloud computing lead to increase the collaboration between the doctors, patients and hospital.

This study presents the issues of existing healthcare information system and describe how the cloud computing can be current solution for healthcare information system.

HEALTHCARE INFORMATION SYSTEM ISSUES

Healthcare system mainly contains public and personal healthcare services, research activity and teaching. Public healthcare service includes guideline for patients in consume the drugs and foods. Research and teaching activities are necessary for disease treatment. Technology helps to provide high quality medical services to the patients in the hospital (Kuziemsky *et al*., 2011).

A healthcare information system is defined as a computer system that designed to manage the hospital's administrative and medical information to reach effectively and efficiency performance in this job (Bamiah *et al*., 2012). HIS controls and manages all activities that related to information processing in the hospital to achieve high quality patients' services (Winter and Haux, 1995). HIS has several benefits to the hospital (Mohd and Mohamad, 2005), but in the same time they have many the challenges and issues in implementation stage (Boonstra and Broekhuis, 2010).

Software and hardware cost, complexity and inflexibility issues of the healthcare system have raised and need the low cost technology, cloud computing help to develop and solve the healthcare issues. It brings significant benefits to healthcare information system (Fern'ndez *et al*., 2012). By using the cloud computing in the healthcare information system, various healthcare issues can be solve such as: cost, integration system, storage and optimizing resources (Ahuja *et al*., 2012; Bamiah *et al*., 2012).

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The existing healthcare issues are as below (Boonstra and Broekhuis, 2010; Chowdhary *et al*., 2011).

Data storage: With growing in the number of the electronic file that related to patient health record that stored in the healthcare system, this system face with storage problem and need to improve their storage of the system all the time and this study lead to increase Information Technology (IT) expenditure for healthcare information system.

Data transmission: Different hospitals have different healthcare system, so the formats of the data that store in healthcare systems in the various hospitals are not same and uniform. In some cases, when the patients need to transfer the data from one hospital to other hospitals face with incompatibility issue because these hospitals lack of the integration system and universal format for data that store. So with this existing healthcare system cannot share the patient's data effectively between the other hospitals and lead to duplication and resource waste.

High setup cost: The set up cost for hospital infrastructure system that integrates all type of software and hardware is very expensive. Even for medium and large-scale hospital are also high. As a result of the high cost, hospital is like to keep the traditional system.

Maintenance issue: Healthcare information system includes two departments: one department is a management another is a maintenance department. In some cases, if occur issues such as storage of technical then personnel of the maintenance part can't solve this issues, the management department must use outsource to solve this issue and support the system that incur additional cost to the hospital. Although, this process lead to temporary interrupt in the hospital system.

CLOUD COMPUTING TECHNOLOGY

Cloud computing is a technology to add capability and also increase capacity without investigating on the new infrastructure. Cloud computing offer unlimited capacity and power. Cloud computing develop as a solution for issues that relevant to traditional computing ways (Mell and Grance, 2009).

Cloud computing structure has an architecture layer that each layer provides and offers the services. The cloud computing layers as below (De la Torre-Díez *et al*., 2012).

SaaS: The upper layer is software as a service that let to user to run different applications from the cloud.

PaaS: Platform as a Service provides the operative system for application that implement on the cloud.

IaaS: This layer offers the storage and computing resource as a service. The goal of this layer is similar to PaaS while this layer refers to hardware.

Virtualization: Actually it's not layer, but data virtualization is very important on order that other layers work properly.

dSaaS: Data Storage as a Service is a lower layer, it provides storage for the users and also bandwidth need for storage.

Cloud computing system divided to the three type of cloud that includes: Public Cloud, Private Cloud and Hybrid Cloud (Furht, 2010).

Public cloud: Cloud service providers make resources available to the public over the Internet and payment base on usage.

Private cloud: Cloud infrastructure operates for signal organization. Data center or network supply hosted service to the specific group or user.

Hybrid cloud: The cloud infrastructure contains two or more cloud. Organization provides and also manages some resources within its own data center and has others provided externally.

Cloud computing is very useful for healthcare information system because it offer the practical advantages as below (Guo *et al*., 2010; Bamiah *et al*., 2012; Chowdhary *et al*., 2011).

Quality of services: Cloud computing increase the collaboration among the doctor, hospital and patients and make it easier that lead to increase the quality of services.

Reduce the cost: By adopting the cloud computing, healthcare system can use the advantages of various virtual services in the cloud and also pay base on consumption. With adopting the cloud computing do not need to pay for purchasing the server and also implementing the service based on the cloud is very cost-effective. In addition with using the cloud computing doesn't require to employ the IT staff to maintain critical infrastructure and application. So, one of the important benefits of adopting cloud computing is ability to minimize the hardware and software expenditure and also pay based on consuming the service resources, with this condition organization can more focus on the core function.

Reliability of the server operation: In the existing healthcare system, all data of the hospital kept on the primary server and also copy of them kept on the secondary server but in some case that maybe occur problem and primary and secondary service be fail so the hospital will not able to access to important data,

while in the cloud computing, data migrate quickly into the new instance of virtual server that will be created automatically and all server can be resumed normally.

Improve data transmission and sharing: With the cloud computing, hospital has integrated system and all data that store in the cloud have universal and same format, so hospitals in this condition can work closely and data can be easily transfer between them.

Reduce the maintenance expenses: When using the cloud computing in the healthcare system doesn't need to have IT Stuff to support the system because all transaction (processing) control by cloud provider.

Healthcare system needs innovation to remain timely, cost effective and also efficient. Cloud computing has ability to improve the healthcare system. With using the cloud computing, patient, doctor and nurse can access to different data for different purpose from any location with simple Internet connection. Easy accessing to the patient health record, help to doctors to make vital decision about patient diagnosis (Bamiah *et al*., 2012).

CLOUD COMPUTING SOLUTION FOR HEALTHCARE INFORMATION SYSTEM

In this section, mention initial projects that conducted in the healthcare sector with using the cloud computing technology.

DACAR (Data Capture and Auto identification Reference project): This project was invested by TSB (Technology Strategy Board). The goal of this project makes highly secure in the cloud computing infrastructure for healthcare data and also storage (Winter and Haux, 1995). For guaranteeing the data privacy, DACAR use the private cloud for storage of data and also use a hybrid cloud for hosting service. DACAR include five steps, fist of all, the patients should enter the user name and password and after that patients username and password send to Single Point of Contact (SPOC) for identification that patient allow to request the service or no, if user allow to using the service then SPOC makes a Service Ticket; however, if user don't permitted then system send massage that include reason of error. In the final step, user can use the service. This project issues was a smart devices secure integration that related to the healthcare. DACAR for data capture using the RFID (Radio Frequency Identification). RFID is not just for data storage but also using for gathering data from the environment (Fan *et al*., 2011).

Practice fusion: Practice fusion provides web-based Electronic Health Records for primary care physician. Here is a place that we discover the first thing that surprises to us. A health features that has no cost at all, it consists some advertisement in the program that not related to the workflow. However, if it's required, a paid advertisement free version is an available. Second, for using it don't need special system, by using computer with Internet connect can use it because it's web-base. The connection security is ensured via 500 level infrastructures guaranteeing stable availability. The data privacy of user is a serious issue. The organization data center has biometric security, redundant power suppliers, continuous surveillance systems, data backups and so on (Guo *et al*., 2010).

Athenahealth: Athenahealth is a one company that is trying to develop the cloud computing to the healthcare service, so it have developed four platform that include: Athena Clinical, Athena Collector, Athena Comunicator and Athena Coordinator. Firstly, we are going to interduce athena Clinical. It's web-base EHR that designed to overcome the restrictions of the traditional EHR. It uses pay for performance program, the cost is based on using and also less than the traditional system that were used. It based on PCMH (Patient Centered Medical Home) model to decrease the time to focus on patients care without decreasing the assistant quality. Athena Collector is a tool that make administrative easy and help to the doctors via the billing operations, athenahealth has extended a tool named Athena Communicator; it will announce to you if you have an appointment scheduled. Finally, athen Coordinator is a cloud-based care coordinator. It's very useful and important not just for big hospitals, because they have to manage a many workers involving many doctors and people working for the hospital, but just for medical practices in sending patient to several hospitals depending on their necessities (Guo *et al*., 2010).

CONCLUSION AND RECOMMENDATIONS

Cloud computing has benefits for healthcare information system, not just solve the issues such as: storage and bandwidth, but also lead to reduce the cost and optimizing the resource. With cloud computing, hospital has more interaction with patient, patient can reach to better result in their treatment and increase the quality of service to the patients. With the cloud computing solution, it's easier for healthcare organizations to managing information and also for provider to manage the patients' health.

It's important to know when healthcare system want to adopting the cloud computing confront with barriers that the top barriers in adopting cloud computing is security. So need to perform various researches in this area to reach sufficient information about security issues in the cloud computing in the healthcare system until cloud provider can design

suitable security strategy and after that healthcare sector can trust and adopt cloud computing.

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