Chapter 1
Service Level Agreements for Smart Healthcare in Cloud

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ABSTRACT

With the advancement of Cloud computing, the adoption of cloud service in various industries is fast increasing. This is evident in the healthcare domain where the adoption is on the rise recently. However, the research contribution in this domain has been limited to certain functions. While cloud can increase availability, reachability of services, it is critical to design the healthcare service before provisioning. Besides, it is important to formulate Service Level Agreements (SLAs) to ensure that consumers can get guaranteed service from the service provider. The objective of this paper is to design the cloud based smart services for patient diagnostics. This research specifically defines service architecture for patients, physicians and diagnostic centers. In order to measure the proposed services, metrics of each SLA parameter is described with its functional and non-functional requirements. This paper also explains a case study implementation of a basic patient service using Google App Engine.

INTRODUCTION

Cloud computing has transformed the way computing infrastructure and services were getting delivered in the past. It comes with practically unlimited computing and storage power, at lower costs and with high availability (Paul & Das, 2017). Cloud computing brought in total shift of infrastructure ownership. With three different service models – *Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service* (SaaS) (Paul & Das, 2015), organizations have flexibility to choose the model based on the needs. Cloud computing has penetrated in almost all domains, including healthcare. However, in this domain, use of cloud computing has been limited to managing healthcare data (Braunstein, 2015). In the US, cloud is leveraged to store and manage Electronic Health Records (EHRs) (Mantas,

2001) and Patient Health Records (PHRs) (Fricton, 2008). Data analytics, using Big data, process huge volumes of patient information (Kuo, Sahama, Kushniruk, Borycki & Grunwell, 2014).

Conventional methods for medical examination are at times cumbersome for patients. Visiting physician or doctor checkup followed by carrying out diagnostic tests are always time consuming. Patients may need to wait for long time and in case any relevant documents are missed out, then treatment gets delayed further. It becomes more inconvenient if the relevant documents are misplaced or lost. These processes can be streamlined with storing all the documents in cloud and using online appointment booking facility. The objective of this paper is to design the cloud based smart services for patient diagnostics and derive functional and non-functional SLAs for those services. The advantages of this proposed services over that of conventional methods are as follows.

1. In conventional methods, the patient has to physically book a physician or a diagnostic center appointment whereas in using cloud services, the patient can do this activity easily.
2. With cloud based services, the patients do not have to carry documents such as prescriptions, test reports, as all these documents can be accessed from anywhere. In conventional methods, patients have to take care of the documents and take full responsibility of those.
3. Physicians have better control and visibility on the patients' diagnostics as they can view necessary documents (such as previous prescription and test reports) before the patient arrives for a checkup. Physicians can also use this data for comparing the various cases.

This paper is organized as follows: Related Work section presents recent research work done in this area and next section presents Service Level Agreements for Healthcare domain. Provisioning of Smart Healthcare Service in Cloud section elaborates the proposed services based on already proposed layered cloud architecture for healthcare (Paul & Das, in press). Data Privacy and Security section details out the privacy requirements of healthcare services for individuals. Next, the Case Study section explains the implementation on Google App Engine for online appointment booking service. The last section, Conclusion summarizes the paper and future scope of work.

RELATED WORK

Doukas, Pliakas, & Maglogiannis (2010) proposed use of cloud computing and mobile application to create a mobile system that can manage patient health records and medical images. The paper detailed out implementation using Amazon S3 storage for storing information while Android application for accessing this information. However, this novel research is limited to accessing of patient records and cannot be extended for any other service such as physician consultation and appointment booking. Besides, the security risks associated with accessing patient health records is also not addressed. A paper by Hussain, Khattak, Khan, Fatima, Amin, Pervez, & Saddiqi (2013) conceived a framework named as Smart Clinical Decision Support System (Smart CDSS) that could manage diabetic patient information from various sources (such as sensors, social media and medical knowledge bases). This framework complied with Health Level 7 (Benson, 2012) standards. Specific diabetic rule base could be applied on the information collected, generating recommendations that could assist physicians in analyzing patients' behavioral patterns and prescribing suitable treatments. The drawback of this framework was that it could be only used for diabetes treatment and hence not extensible for other diagnosis.

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