Role of Cloud Computing in the Provision of Healthcare

Ms. Anusha Bamini, Professor Sharmini Enoch

July 2011

Volume 1

Issue 1

Doctors Academy Publications

The World Journal of Medical Education and Research (WJMER) is the online publication of the Doctors Academy Group of Educational Establishments. Published on a quarterly basis, it's aim is to promote academia and research amongst all members of the multi-disciplinary healthcare team including doctors, dentists, scientists, and students of these specialties from all parts of the world. The principal objective of this journal is to encourage the aforementioned from developing countries in particular to publish their work. The journal intends to promote the healthy transfer of knowledge, opinions and expertise between those who have the benefit of cutting edge technology and those who need to innovate within their resource constraints. It is our hope that this will help to develop medical knowledge and to provide optimal clinical care in different settings all over the world. We envisage an incessant stream of information will flow along the channels that WJMER will create and that a surfeit of ideas will be gleaned from this process. We look forward to sharing these experiences with our readers in our subsequent editions. We are honoured to welcome you to WJMER.

DOCTORS ACADEMY

Disseminating Medical Knowledge and Skills Globally

DOCTORS ACADEMY
Disseminating Medical Knowledge and Skills Globally

WJMER

World Journal of Medical Education and Research

An Official Publication of the Education and Research Division of Doctors Academy

In this edition, these topics and more....

The Role of Cell-Based Imaging in Drug Discovery

Antigen Microarrays for Rapid Screening of Rheumatoid Arthritis and Other Autoimmune Diseases

Management of Major Trauma: A Malaysian Perspective

Abstracts from the International Academic & Research Conference 2012

Assessment and Management of Head and Spinal Cord Injuries

Osteoradionecrosis (ORN) of the jaw

Role of Cloud Computing in Global Healthcare Provision

WJMER
World Journal of Medical Education and Research:
An Official Publication of the Education and Research Division of Doctors Academy
Research Article
DAUIN 20120013

Role of Cloud Computing in the Provision of Healthcare

Ms. Anusha Bamini, B.E, M.E
Assistant Professor
Department of Computer Science and Engineering
Noorul Islam University, India

Professor Sharmini Enoch, B.E, M.Sc (Glam, UK), Ph.D (UK)
Department of Electronics Communication Engineering
Noorul Islam University, India

Address for Correspondence:
Professor Sharmini Enoch: sharminienoch@gmail.com

Keywords:

Medical advances, healthcare provision, cloud computing, resource-poor population, health monitoring.

Abstract

Rapid strides in information technology coupled with enhancing interest in hybrid computing environments have resulted in the development of 'cloud computing'. This is an application that can be accessed anytime and anywhere in the world based on the 'pay-per-use' model. The healthcare industry is in a period of accelerating change that requires continued innovation. Cloud computing has got a significant potential in the healthcare system and provision of healthcare in the future. This technological advancement has led to the design of a real-time health monitoring and analysis system that is scalable and economical for people who require frequent monitoring of their health. Peoples' health data is collected and disseminated to a cloud-based information repository that facilitates analysis of the data using software services hosted in the cloud. This article reviews the existing work carried out in the healthcare system using cloud computing. It analyzes the measures, drawbacks and challenges (including security) of cloud computing in the healthcare system.

Introduction

Cloud computing provides high quality and low-cost information services based on the pay-per-use model. It reduces the investment on hardware, software and professional skills[1]. It helps user applications to access various computing resources to any specified location. This technology also allows consumers and businesses to use application without installation and access their personal files at any computer with Internet access.

In the early part of the 20th century, medical care was delivered at home, through visiting family physicians who packed the necessary medical technology into a doctor's bag. Later, advanced medical technology and specialist providers had to be centralized in hospitals to make their utilization effective. In the current century, the lack of sufficient hospitals in rural and resource-poor areas, the exponential complexity of lifestyle (mainly urban) and the increasing of chronic diseases make healthcare a serious issue[2]. Driven by quality and cost metrics, the healthcare systems have to change radically in the near future from current healthcare professional-centric systems to one of distributed network and mobile healthcare systems. In this movement, the leading part is attributed to the cloud computing technologies. Cloud healthcare, in contrast, tries to change the healthcare delivery model: from doctor-centric to patient-centric, from acute reactive to continuous preventive, and from sampling to monitoring. This approach however is to complement and not replace traditional medicine.

Rural residents have higher poverty rates, a larger percentage of elderly tend to be in poorer health, have fewer doctors and hospitals, and face more difficulty getting to health services[3]. Hence, one challenge of a cloud healthcare system is the provision of better healthcare services to people using limited financial and human resources. Many medical errors occur due to lack of correct and complete information necessary at the location at a particular time, resulting in incorrect diagnosis and drug interaction problems[3]. The required medical information can be made available at any place at any time using sophisticated devices and widely deployed wireless networks.

The design and construction of a cloud computing system for healthcare in rural areas appears very effective. It comes as a solution to help patients adjust lifestyle to their health requirements. Apart from that, through patients' behavioral recognition we can detect symptoms of diseases and predict their progression over time.

Existing system

Figure 1 depicts how the process works based on manual notes[4]. The interactions are described below:

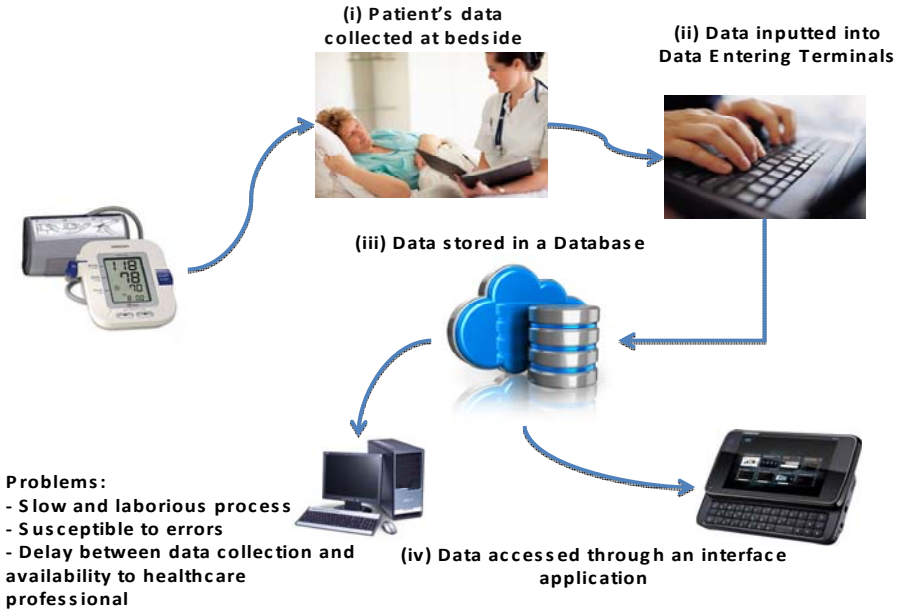

Figure 1: Illustration of existing system that is commonly used in current healthcare

(i) A staff member collects patient's data at bedside, writing it down to a paper spreadsheet;
(ii) The notes are typed in data entering terminals;
(iii) The data is transmitted to a database server that organizes, indexes, and make it accessible through a database interface; and
(iv) At this point, medical staff can access this information through an interface application. It is clear that there is latency between data gathering and information accessibility. This is undesirable and prevents real-time monitoring of vital patients' data, restricting the clinician's monitoring capabilities. Moreover, this process is error prone, as there is a possibility of incorrect input.

Cloud computing in health care

The system of manual notes is replaced by the cloud. **Figure 2** depicts the proposed system structure.

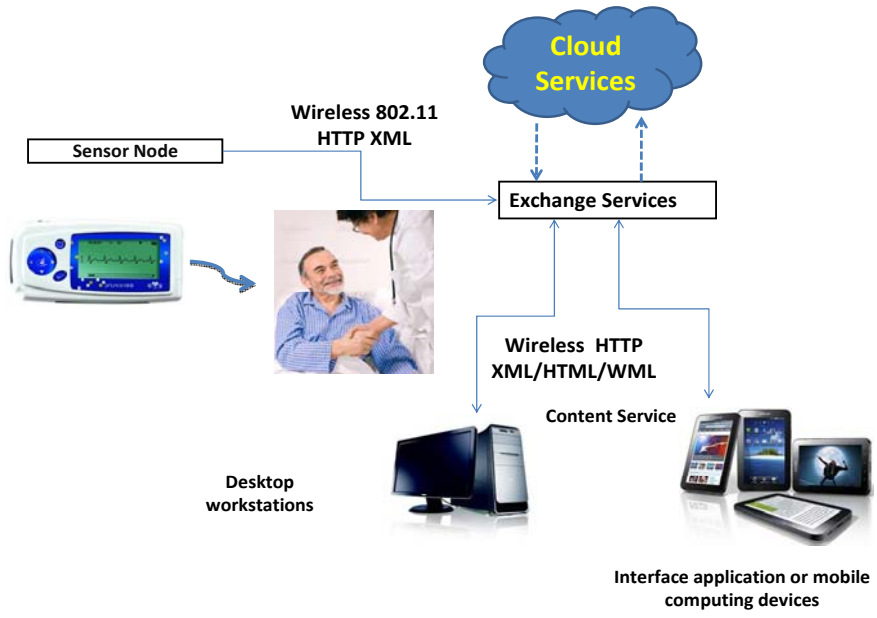

Figure 2: Illustration of cloud computing technology in healthcare

Patient's Data Collection in Health Care Using Cloud Computing

A solution to automate the patient data collection process by using sensors attached to existing medical equipments that are inter-connected to exchange service has been previously explored[4]. This is based on the concepts of utility computing and wireless sensor networks. The information becomes available in the cloud from which it can be processed by expert systems and/or distributed to medical staff. The proof-of-concept design applies commodity computing integrated to legacy medical devices, ensuring cost effectiveness and simple integration. This paper used the cloud based services such as 'Infrastructure' as a Service, 'Platform' as a Service, 'Software' as a service and it was found to be cost-effective. The disadvantages however are the security and management with interaction of third party infrastructure service are not considered.

Cloud Computing Security in Patient Health Care Monitoring

Secure open cloud architecture (OpenCloudCare) for remote patient health monitoring was proposed by Mouleeswaran and colleagues[5]. It defines the front-end and back-end architecture that would integrate healthcare devices into the enterprise cloud. The major components required for securing the cloud infrastructure are also identified. Here the security in electronic health record (EHR) is implemented by using cloud security infrastructure. EHR stores all the data related to human activities. The human activity depicts all the actions and non actions performed by the human. Mouleeswaran and colleagues[5] discusses security in patient health record while the individual security components are not considered.

Hosting ECG Data Analysis Service in Autonomic Cloud Environment

The design aspects of an autonomic cloud environment that collects people's health data and disseminate them to a cloud-based information repository and facilitate analysis on the data using software services hosted in the cloud were discussed by Suraj Pandey and colleagues[6]. To evaluate the software design, a prototype system was developed that uses an experimental test bed on a specific use case, namely, the collection of electrocardiogram (ECG) data obtained at real-time from volunteers to perform basic ECG beat analysis. In this work a heuristic-based method minimizes the cost of using cloud resources while maintaining user quality-of-service satisfaction. This could be done by cloud resource availability, and user allocations based on user priority and varying cloud resource costs. The problem which is not addressed is data security while using distributed cloud storage.

Intelligent Manipulation of Human Activities using Cloud computing

Intelligent manipulation of activities using Context-aware Activity Manipulation Engine (CAME) and the Human Activity Recognition Engine (HARE) has been the focus of discussion in the study by Asad Khattak and colleagues[7]. The human activity is recognized using video-based, wearable sensor-based and location-based activity recognition engines for context analysis. The objective of CAME is to receive real-time low level activity information from Activity Recognition engines and infer higher level activities, make situation analysis, and after intelligent processing of activities with their corresponding information take appropriate decisions. To achieve this objective, two phase filtering technique for intelligent processing of information is used and appropriate decisions based on description logic rules. The experimental results for intelligent processing of activity information showed relatively good accuracy. The security concern is not addressed in this work.

Cloud Computing Framework for New Medical Interface Technologies

Maya Dimitrova *et al.*[8] proposed to formulate a new development framework for cloud computing called User Interface as a Service (UIaaS), which is used to act as an interface between cloud and user. New multimodal interface technologies for medical instrumentation compatible with web platforms have been recently developed. The framework that explicitly aims at supporting seamless and ubiquitous health monitoring based on cloud services for healthcare are presented. The aim of this framework is the implementation of new interface technologies providing the doctors and patients with useful tools to explore conditions and perform monitoring across diagnoses – in an indirect, safe, secure and harmless way - operating as new UIaaS. The device will be integrated in a sophisticated and intelligent backend environment enabling productive end-to-end usage as a step towards modern and ubiquitous healthcare in a cloud computing framework. The security problem is not addressed in this work.

Table 1 compares the related work carried out in health care using cloud computing along with their performance metrics and major drawback.

Related Work	Metrics	Drawback
Patient's Data Collection in Health Care Using Cloud Computing[4]	Time, Cost	Security
Cloud Computing Security in Patient Health Care Monitoring[5]	Time, Cost, Privacy	Security
Hosting ECG Data Analysis Service in Autonomic Cloud Environment[6]	Scalability, Cost	Security in storage
Intelligent Manipulation of Human Activities using Cloud computing[7]	Cost, Accuracy	Security
Cloud Computing Framework for New Medical Interface Technologies[8]	Cost, Time	Security

Table 1: Comparison of Related Work in Cloud Computing

Conclusion and future work

Cloud computing revolutionizes all scientific fields, including healthcare. Health monitoring system monitors human health and shares this information with doctors, healthcare providers, care-takers, clinics, and pharmacies obtained from the cloud to provide low-cost and high-quality service to users. Although security can be provided in healthcare monitoring systems using the encryption method, it continues to remain as a major issue that needs to be addressed and should be the subject of future work.

References:

1. J. Geelan, Twenty one experts define cloud computing virtualization. Electronic Magazine, 2008, http://virtualization.syscon.com.
2. U.Varshney, Pervasive Healthcare and Wireless Health Monitoring, 2007.http://portal.acm.org/citation.
3. R.Suresh, C.R.Rene Robin, An Efficient VOIP Enabled Health Monitoring System using Cloud Computing, International Conference on Emerging Technology Trends, 2011, p.1-9.
4. Carlos Oberdan Rolim, Fernando Luiz Koch, A Cloud Computing Solution for Patient's Data Collection in Health Care Institutions, Second International Conference on eHealth, Telemedicine and Social Medicine, 2010.
5. S.K. Mouleeswaran, Ashok Rangaswamy, Dr. H. Abdul Rauf, Harnessing and Securing Cloud in Patient Health Monitoring, International Conference on Computer Communication and Informatics, Jan 2012, p.10-12.
6. Suraj Pandey, William Voorsluys, Sheng Niua, Ahsan Khandoker, Rajkumar Buyya, An autonomic cloud environment for hosting ECG data analysis services, Future Generation Computer Systems 28, 2012, p.147–154, www.elsevier.com/locate/fgcs.
7. Asad Masood Khattak, Zeeshan Pervez, Intelligent Manipulation of Human Activities using Cloud computing for u-Life Care, 10th Annual International Symposium on Applications and the Internet, 2010.
8. Mayadimitrova, SiyaLozanova, Cloud Computing Framework for New Medical Interface Technologies, 2011, www.sprers.eu.

The World Journal of Medical Education & Research (WJMER) is the online publication of the Doctors Academy Group of Educational Establishments. It aims to promote academia and research amongst all members of the multi-disciplinary healthcare team including doctors, dentists, scientists, and students of these specialties from all parts of the world. The journal intends to encourage the healthy transfer of knowledge, opinions and expertise between those who have the benefit of cutting-edge technology and those who need to innovate within their resource constraints. It is our hope that this interaction will help develop medical knowledge & enhance the possibility of providing optimal clinical care in different settings all over the world.

DOCTORS ACADEMY
Disseminating Medical Knowledge and Skills Globally

978-93-80573-24-3

WJMER

World Journal of Medical Education and Research

An Official Publication of the Education and Research Division of Doctors Academy