Health care system based on Cloud Computing

Fernaz Narin Nur, Nazmun Nessa Moon
Department of Computer Science & Engineering,
Daffodil International University,
Dhannodi, Dhaka,
Bangladesh.
fernaz_amin@yahoo.com, moon_ruet@yahoo.com

Abstract—Cloud Computing provides functionality for managing information data in a distributed, ubiquitous and pervasive manner supporting several platforms, systems and applications. This work presents the implementation of a health system that enables electronic healthcare data storage, update and retrieval using Cloud Computing. It is envisioned that, in the near future, cloud computing will have a significant impact on the health care environment, enabling their own users (i.e., doctors, patients) to perform their tasks effectively with less cost by utilizing the available cloud-based applications offered by the cloud service providers. This paper discusses the use of cloud computing in the personal health care arena, to be called “Health Care as a Service” (HCaaS), emphasizing its possible benefits and offerings.

Index Terms—Cloud computing; SaaS, IaaS, PaaS, ElaaS, architecture.

I. INTRODUCTION

When compared to the existed traditional IT services provisioning models, cloud computing has many advantages such as reduced upfront investment (i.e., software, hardware, and professional staff to maintain servers and upgrade software), reduced launching time, where days become hours, expected performance, high availability, infinite scalability, tremendous fault-tolerance capability, and enhanced collaboration, accessibility, and mobility, allowing users to use any device, such as a personal computer (PC), or a mobile phone, etc. Therefore, the use of cloud computing will have a profound positive impact on the cost structure of all the industries using IT resources by lowering the total cost of ownership (TCO), resulting in an indirect crucial impact on business creation and the macroeconomic performance at national levels, extending to a global level. This benefits the private as well as the public sectors, including healthcare (especially for e-healthcare), education, and the activities of government agencies. In both academia and industry, cloud computing has been recently attracting significant momentum and attention as one of those opportunities that could prove to be of immense benefits and empowering in some situations, due to its flexibility and pay-per-use cost structure, for organizations. In the health care arena, this will be called “Health Care as a service” (HCaaS). HCaaS focus towards achieving two specific goals: the availability of e-health applications and medical information anywhere and anytime and the invisibility of computing [1]. Cloud Computing provides the facility to access shared resources and common infrastructure in a ubiquitous and pervasive manner, offering services on demand over the network to perform operations that meet changing needs in electronic healthcare application.

II. CLOUD COMPUTING PLATFORM ARCHITECTURE

Cloud computing is a calculation of provide leasing services to users, the user can use a simple terminal to access powerful computing capabilities, regardless of the complexity of the background. To meet the user’s needs, which the back-end cloud concerns care is the number of machines required to achieve cooperation. Now Google, Amazon and other companies have built the cloud platform to provide services for their clients, include hundreds of back-end machines at least. It is obvious that cloud platform back-end is a large distributed system, rather than a single machine which user interface displayed [2]. Cloud computing turn the hardware resources into virtual resources with virtual machine monitor, and manage hardware resources with virtual hardware.

III. CLOUD COMPUTING SERVICES

A. IaaS

Infrastructure layer corresponds to IaaS infrastructure services, is the lowest layer of the network. Users can household to provide standard services, including computing power and storage resources. It turn the memory, storage and computing power into a virtual whole resource pool for the entire industry to provide the required of computing power and storage resources.

B. PaaS

Platform layer correspond to PaaS (Platform as a service) that made a higher level of abstraction on the base of IaaS layer. To provides a development environment, test environment, server platforms and other services, users can develop applications based on Internet and other servers service providers infrastructure, then share it to other users.

C. SaaS

SaaS(Software as a service) is a software distribution model, designed for web delivery, user can deploy and access through the Internet hosting. SaaS providers need to build information for all network infrastructure, software, hardware, operating platform, and is responsible for the implementation of all post-maintenance and other services. Compared with the traditional method of service, Saas not only reduces the cost of traditional software licensing, and vendors deploy application software on a unified server, eliminating the end-user's server hardware, network security devices and software upgrade and maintenance expenses, the customer does not need other IT investment in addition personal computers and Internet connections to obtain the required software and services [3].

IV. HEALTHCARE SYSTEMS AND CLOUD COMPUTING

Several studies have demonstrated that the limited access to patient-related information during decision-making and the
ineffective communication among patient care team members are proximal causes of medical errors in healthcare ([4], [5]). Thus, the pervasive and ubiquitous access to healthcare data is considered essential for the proper diagnosis and treatment procedure. Cloud Computing is a model for enabling 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. The major characteristics of Cloud Computing can be summarized into the following [6]:

A. On-demand self-service

A consumer can unilaterally obtain access to computing capabilities, such as server computing time and/or network storage, as needed automatically without requiring human interaction with each service’s provider.

B. Broad network access

Resources are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., smart phones).

C. Resource pooling

The provider’s computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. Examples of resources include storage, processing, memory, network bandwidth, and virtual machines.

Given the characteristics of Cloud Computing and the flexibility of the services that can be developed, a major benefit is the agility that improves with users being able to rapidly and inexpensively re-provision technological infrastructure resources. Device and location independence enable users to access systems using a web browser regardless of their location or what device they are using (e.g., mobile phones). Multi-tenancy enables sharing of resources and costs across a large pool of users thus allowing for centralization of infrastructure in locations with lower costs. Reliability improves through the use of multiple redundant sites, which makes Cloud Computing suitable for business continuity and disaster recovery. Security typically improves due to centralization of data and increased security-focused resources. Sustainability comes about through improved resource utilization, more efficient systems.

A number of Cloud Computing platforms are already available for pervasive management of user data, either free (e.g., iCloud [8] and Dropbox [10]) or commercial (e.g., GoGrid [7] and Amazon AWS [9]).

V. APPLICATION OVERVIEW

This section discusses the main features of the HCaaS. The prevalent functionality of the application is to provide medical experts and patients with a interface for managing healthcare information. The latter interprets into storing, querying and retrieving medical images, patient health records and patient-related medical data (e.g., biosignals). The data may reside at a distributed Cloud Storage facility, initially uploaded/stored by medical personnel through a Hospital Information System (HIS). In order to be interoperable with a variety of Cloud Computing infrastructures, the communication and data exchange has to be performed through non-proprietary, open and interoperable communication standards. Figure 1 illustrates the proposed system architecture for developing and deploying the Health care applications that utilize cloud computing. The main components of a cloud computing service are [6]:

A. Seamless connection to Cloud Computing storage

The main application allows users to retrieve, modify and upload medical content (medical images, patient health records and biosignals) utilizing Web Services and the REST API [11]. The content resides remotely into the distributed storage elements but access is presented to the user as the resources are located locally in the device.

B. Patient Health Record Management

Information regarding patient’s status, related biosignals and image content can be displayed and managed through the application’s interface.

C. Image viewing support

The medical image protocol is supported, while the JPEG2000 standard is implemented to support lossy and lossless compression, progressing coding and Region of Interest (ROI) coding. The progressive coding allows the user to decode large image files at different resolution levels optimizing this way network resource and allowing image acquisition even in cases network availability is limited.

D. Proper user authentication and data encryption


With the progress and application of technology, the emergence of cloud computing offers e-health care good opportunity to develop, so we are convinced that it can work perfectly. In e-health care cloud model, data storage is highly distributed, data management is highly centralized and data
service is highly virtualization, all of which offer a much safer data service.

This architecture for the cloud platform provides a variety of user interface forms, such as WebService interfaces, Java interfaces, C interfaces, Shell interfaces etc.

VI. BENEFITS OF HCAAS

There is a lot of conversation on Cloud computing and how it could benefit our healthcare practices. With Cloud computing, hospitals, particularly the large ones, are able to deliver IT as a service without the costly and complex investment in infrastructure and applications, freeing them to focus on strategic business initiatives while delivering better service levels, increased business agility and reduced costs.

The gig gain is hospitals pay only for the services they use, without having to maintain or incur upfront infrastructure costs, giving businesses the technical tools to become more agile. Cloud computing presents an opportunity for healthcare providers to improve patient care, protect their privacy and mitigate the risks associated with implementing expensive technology.

- Even though cloud computing comes across as a complex web of knowledge it provides some crucial long-term benefits including: Increased IT responsiveness and efficiency
- Reduced capital expenditures and operational overhead
- Greater flexibility through an on-demand, pay-as-you-go model that scales with your business.

With the implementation of cloud computing, healthcare professionals across the globe can collaborate in real time and share information without the need to invest in expensive infrastructure. The Cloud provides a centralised platform for healthcare professionals to access reports, scans, electronic medical records (EMRs) and prescriptions and patient information and history such as insurance claims, prescriptions, and lab reports from anywhere in the world. Having a central repository for patient information will mitigate the risks of misdiagnosis or the prescription of the wrong medication, as well as eliminating chances of conflicting treatments where multiple healthcare professionals are involved.

Correctly implementing and utilising information technology will offer healthcare practices enormous benefits, with Cloud computing offering better access to healthcare services and information that would subsequently result in improved outcomes, fewer errors and increased cost savings.

Cloud computing’s pay-per-use model means healthcare providers can leverage the latest software solutions while keeping operating costs to a minimum, covering only the essentials. In addition, with patient data stored in the Cloud, health professionals and hospitals will no longer need to invest in storage systems.

Finally, cloud computing fits very nicely with increasingly mobile healthcare professionals who may need to administer service from remote locations, enabling physicians to provide better patient care at a lower cost without sacrificing their quality of work and productivity.

VII. CONCLUSIONS

Through the research it is believed that, an e-health care application model can be created based on cloud computing by means of cloud computing’s mass data storage, high-speed computing capabilities, as well as its ideal allocation and the sharing mode of resources. The sharing of medical information resources (electronic health data and corresponding processing applications) is a key factor playing an important role towards the successful adoption of pervasive of healthcare systems. The concept of Cloud Computing and applications similar to the one presented in this article will attract the interest of scientists, developers and industrial partners working in the field of biomedical informatics. Some problems such as platform security, technical standards, regulatory and other services are not well resolved yet in practice, pending further research and exploration. As the cloud computing become increasingly widespread, e-health care will certainly usher in a new era of cloud computing.

REFERENCES