Scope of Cloud Computing in Ethiopia Health Care Sector

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Abstract: Cloud computing is the most newly arising technology in this world many organizations that use internet to get different services from cloud. Cloud computing is model that provide on- demand and network access to a shared pool of configurable computing resources like (networks, servers, storage, applications, and services) from cloud provider. Ethiopia is one of the developing countries in East Africa and has millions of population. In health providing sectors use of cloud computing is not highly adopted. The aim of this paper is identifying challenges and limitation cloud computing in Ethiopia health care sector and put best direction for future use of cloud in health care sector.

Index Terms - Telehealth, Cloud computing, Security, Privacy, telemedicine, health care sector

I. INTRODUCTION

Cloud computing is one of the currently emerged technology of this world that gives different services that is based on pay-per-use strategy. Cloud computing can be defined as "a model for enabling ubiquitous, 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" as per definition of National Institution of Standard and Technology (NIST). Cloud computing can be adopted in different organizations in both developed and developing countries based on their own strategies and policies. Cloud Computing has five important characteristics.

These characteristics are:

- **On-demand self-service:** is the service provided by cloud computing vendors that enable the provision of cloud resources on demand whenever they are required. The user can accesses cloud services through an online control panel by their own account.
- **Broad network access**: refers to resources hosted or stored in a private cloud network (operated within a company's firewall) that are available for access from a wide range of electronic devices, such as mobiles, laptops, desktops etc.
- **Resource pooling:** is the way in which providers serve multiple clients, customers or "tenants" with provisional and scalable services.
- **Rapid elasticity:** is ability of providing scalable services to cloud customers.
- **Measured service:** refers to services where the cloud provider measures or monitors the provision of services for various reasons, including billing, effective use of resources, or overall predictive planning.

Cloud computing has several services. These services are categorized into three service models based on the type of models they are providing. These service models are:

- **Software as a service (SaaS):** It is a service model in which a user has to uses applications, but does not control hardware, network infrastructure and operating system on which application is done.
- **Platform as a service (PaaS):** It is a service model in which a user does not manage cloud infrastructures like network, servers, operating system and storage, but has a power to control deployed and hosting application.
- **Infrastructure as a service (IaaS):** A service model user has the ability to rent computing infrastructures like a computer, storage, network and other IT infrastructure.

The cloud computing has three deployment models; private, public, and hybrid model. Sometimes, community model is also included, so cloud computing has four deployment models are there.

- **Public cloud:** It is the model which is accessible and available in everywhere by every public user. It is economical cloud that is stand-alone, proprietary based and off-premises. In house and small businesses use public cloud mostly to meet their requirements.
- **Private cloud:** A cloud infrastructure is operated specially for a single organization. It is not accessible outside the organization. It contains private information that must be secured in that company or organization.
- **Hybrid cloud:** The cloud infrastructure comprises two or more clouds (private, public, or community) based on the type of information in the organizing.
- **Community cloud:** The cloud infrastructure is shared by several organizations with common concerns (eg, mission, security requirements, policy, and compliance considerations).

Cloud computing offers potential benefits to public or private organizations by making information technology (IT) services available online. There are several benefits of cloud computing such as cost efficiency, almost unlimited storage, backup and recovery, automatic software integration, ease of access to information, quick deployment, and easier scale of services and delivery of new services.

Health care is one of the main areas of cloud computing that the health related information such as patient records, disease details, or health center employee and properties management can be stored on cloud as well services provided. In this paper we are studied the scope of cloud computing usage in health care sectors of Ethiopia. The study includes about cloud computing characteristics, services and deployment models, benefits, applications and challenges that are related to health care.

Cloud computing has to be adopted in health care sectors as much as possible. While using cloud computing there are many advantages like service automation, fast and remote availability or/and accessibility that can improve the business of the country also. The following are the advantages of the cloud computing the following features:

- **Cost**: Cloud computing saves the cost to be invested on physical storage hardware and servers, since we can use internet to store or access these resources. It is also very important in case of maintenance when there is a failure (i.e. Backup, recovery).
- **Performance**: cloud computing provides reliable performance though the user maybe at any geographical location. All services and applications are also automated.
- **Security**: Cloud computing plays great role in enhancing security by protecting the resources of the organization from any unauthorized access, modification and loss of information.
- **Flexibility**: cloud computing provides services that are compatible in all platforms, hardware and infrastructures.

II. RELATED WORKS

Health Care has got great consideration in recent scientific and technology researches or studies. Different technologies created in order to enhance health care system by automating it. The following are some basic health related technologies and the literature review studies we used.

A. Personal Health Record

Personal Health Record (PHR) is the record that contains information of patients personal and health record details. The Personal Health Record data is collected, analyzed and stored in Cloud Storage system by categorizing into public, private and secret key for every PHR file [3]. The HPR stored on cloud can be accessed by physicians, nurses, doctors, pharmacists and even patients on authorization basis for privacy and security purpose.

B. Electronic Health Records (EHR)

Electronic Health Record (E-health) is the application of ICT in health care delivery in order to enhance the quality of health care. The scope of E-health is health in general with two major aspects, namely public health which is more concerned about promotion of health and prevention of diseases, and health care which is on individual patient and treatment of disease [6].

C. Telemedicine

Telemedicine is a remote communication of information to facilitate health care. Telemedicine can be classified into Real time (synchronies) Telemedicine where there is no delay between the information being collected, transmitted and displayed, and Store-and-Forward (asynchronies) telemedicine, where   information is acquired and stored in some format, before being sent, for expert interpretation [6].

D. Telecare

Telecare is defined as "the delivery of health and social care to individuals in the home, with the support of devices enabled by information and communication technologies." Therefore it is concerned with the provision of care and community support to a patient at distance. Such provision of care includes: monitoring the daily living of individuals at risk, by connecting telecommunication to other premise that people should be able to participate in the community as much as possible [7].

According to M.Manasa Manjunath [2], since the existing system have many drawbacks there must be the model where we can store the information of a patient, his previous health record. The author developed online health care application with the help of cloud computing concepts will effectively provide enough information. The users of the application can get any required information through broadcast. Patients can communicate with doctors online directly or through email.

Robel Tezera [6], provides studies on E-health solutions can bring changes in current health care system, that there the system planned and deployed is very important. According to this author, there are so many factors for successful implementations of E-health initiatives including government support, collaboration among stakeholders, availability of basic infrastructure, training of skilled human power, financing mechanisms and so on. Therefore, E-health policy, which can serve as a guideline for successful deployment of e-health has to be addressed [6].

III. APPLICATION AREAS OF CLOUD COMPUTING IN HEALTH CARE [4, 5]

There many health care related applications where cloud computing can be highly applied. The most common applications are:

A. Data Management

Data management is very important issue in healthcare system. Data management stores data about human resource, account files and patient medical records including patient history, diagnosis, treatment, dietary information etc. Cloud data storage and maintenance frameworks like HDFS, Hive, HBase etc offer a cost effective solution to the problem with increased security and ease of management. Data management has the following benefits:

- It increases the data availability (4/7)
- Physicians can share the data with other specialists around the world for decision making.
- Hundreds of simultaneous data access can be made using any device having a web browser.
- Cloud data storage is distributed in nature, so there is fast storage and retrieval procedure

B. Telemedicine

Telemedicine is very common application of cloud computing in health care sector where health information is converted to electronic form and transformed over the network. Cloud driven telemedicine services offers the following advantages:

- Participants can interact in live bases even if they are using different site.
- Patient medical data can be stored and shared over the world through internet.
- It is flexible model in which patients can get a medical advice and surgeons.
- Patients can retrieve files at their own time and place.

C. Drug Discovery

Drug discovery is a process of discovering new medicines while ensuring its efficacy and any side effects. This process has to use many computing resources because all possible chemicals need it to identify the potential compounds while producing drugs. Cloud computing provides infrastructures (IaaS) for pharmacists that they can discover drugs in decreased cost and less time.

D. Digital Libraries

Libraries are main sources for knowledge improvement among medical students, researchers and practitioners. Cloud based digital libraries are opportunity to facilitate the acquisition of knowledge. Cloud library can give several advantages for Institutions and individuals that they can read, several information seekers for reading the literature, simultaneously, availability of information for researchers, semantic based query, aware of current medical progress to physicians.

E. Virtual Medical Universities

Cloud computing provides flexible and pay-as-you-go model that can be used as real medical universities. IT companies like Amazon, Google, Microsoft, IBM, and HP have been developing applications for both on-campus and off-campus support . Medical universities can use this model to deliver online lectures, conduct seminars and to increase collaboration among academia around the globe.

F. Management Information systems

Healthcare industry has started using cloud based management information systems to streamline the information flow within and outside the organization. Physicians use the system to provide better patient care; customers use it for querying service; administrators use this to manage the human resource, billing and finance; top management use this system for decision making and forecasting purpose. Cloud Computing provides platforms (PaaS) for this application.

G. Clinical Decision Support System

Cloud service providers (CSP) can develop the expert system in which medical specialist can give the advice upon the analysis of patient record, and Doctors can provide diagnosis and medication for patients. This application includes smart phone technology with built in sensors for heart rate monitoring, blood pressure measurement etc.

H. General Health Education

Cloud computing provide services like PaaS and SaaS that can be used to teach and train in simple way (i.e. self-train). Benefits of cloud computing in education include:

- Patients can get doctor's advice from cloud and can get appropriate treatments
- Health education has great advantages to prevent and control the diseases.
- It increases doctors' accountability that patients can follow the their advices actively etc.

IV. CHALLENGES OF CLOUD COMPUTING IN HEALTH CARE [8]

Though cloud computing has many advantages, there is also several challenges to adopt it on health care sectors and on other applications. The following are some challenges with possible solution suggestions.

- **Privacy and Security Data:** the confidentiality and privacy of healthcare data has to be given a special attention because healthcare data involves the storage and processing of sensitive data about the health status of patients. The challenge of security and privacy as well as confidentiality may occur from lack of control on physical infrastructures, web related issues like hijacking, intrusion and hackers.
- **Data Jurisdiction and Legal Issues:** there are different policies of cloud computing as well as health care deliverance as per different countries. Some cases or issues may be against use of cloud computing.
- **Technical Challenges:** there are many technical challenges especially in case of Ethiopia. The availability of infrastructures like internet and others. This makes the use of cloud computing less.
- **Cultural Resistance:** In different countries culture of using technology is rare even use of industry manufactured drugs is not adopted. But there is many possibilities of creating aware of automated health gradually.
- **Data Ownership**: Data is very important thing in health care sectors. This data must be owned and accessed by an authorized body since there are many risks.
- **Lack of Infrastructures:** Since Ethiopia is developing country there are many lacks of infrastructures that are required for facilitating cloud computing in the country. Most of the countries populations are living in rural areas. This makes the challenging to distribute these infrastructures in short time. These infrastructures include:
  - Network Problems: installation of network over all the country's health care sectors takes much time and is very expensive that the economy of the country could not do it.
  - Electric power problems: distributing the electric power over all the country is also difficult.
  - IT infrastructures: the infrastructures needed for connecting all sectors is so costly. The considerations or budget given to IT infrastructures is very less.
  - Scarcity of Service provider: only one internet service provider is there in Ethiopia (i.e. Ethio Telecom) that it is not enough.
- **Lack of Professionals:** in order to adopt cloud computing many professionals who have computer network, communication, web service and other important skills are mandatory. But only small numbers of professionals are there in the country that it makes great challenging. In addition, rural area populations are almost not educated, or they do not know importance of the technology. The country has to work over these challenges.
- **Lack of aware about Cloud Computing:** Both physicians and patients have less or no knowledge about cloud computing and its advantages.

V. ADVANTAGES AND DISADVANTAGES of Cloud Computing in Health care

Using cloud computing in health care sector has many advantages. These advantages are as listed below:

- Easy to use by decreasing the work complexity.
- The services can address everywhere in the country or internationally
- Patient can get physicians advice and treatment remotely
- Cost for transportation for health treatment is not needed.

Even though there are many advantages of using cloud computing in health care sectors has also some advantages or limitations. The following are disadvantages:

- Interoperability challenges
- Privacy and security of electronic health record is very risky

- It needs high first time cost

VI. CONCLUSION

The Cloud Computing is newly emerging technology that provides services for health care record systems in storing data should be adopted in Ethiopia health care sectors in wide scope. In this paper, we discussed the needs of cloud computing in enhancing health care services, available applications and challenges to apply the technology. So it has to be done on eliminating these challenges and adopting use of cloud computing technology.

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