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Telemedicine and the Cloud Computing: A Path to the Future

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Telemedicine and the Cloud Computing: A Path to the Future

By

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Abstract

The medical industry is quickly adapting to keep up with the rapid improvements in technology. The use of the technical developments that had been made in this area resulted in the conception of " telemedicine". Methods that were previously imprecise, time-consuming, and riddled with errors are being phased out in favor of more efficient ones that make use of the internet. These methods make it possible to access data in real time while maintaining a high level of authentication. The concept revolves on the use of cloud computing and the broadcasting of media in real time. The data is uploaded to a website in a manner that is appropriate for viewing by approved medical personnel, and then made publicly accessible on the internet. Cloud computing is having a game-changing impact in the field of telemedicine. There are already a lot of people working in the medical field who use cloud computing's more sophisticated healthcare applications. There is widespread consensus among industry experts and academics that cloud computing has the potential to significantly advance the state of medical care delivery. This paper explores how cloud computing can be used in a manner that is both safe and secure within the context of telehealth.

Telemedicine and the cloud computing: A path to the Future

1. Introduction

Recent WHO reports showed that the ratio of patients to doctors in South Africa is 1:1300 on average, but in certain rural regions, this ratio might reach as high as 1:100,000 patients to one physician (Bryant, 2019). Utilizing information and communication technologies may help enhance the availability of health care services in rural and metropolitan regions, as well as the quality of such services. The World Health Organization has cited health information systems in particular, and notably telemedicine, as examples of potential instruments that may be used in this process (Puustjärvi & Puustjärvi, 2013). Rural communities now have access to more specialized medical treatment because

of the proliferation of telemedicine. This implies that patients do not need to travel far to metropolitan hospitals in order to get care from a specialist; thus, this results in reduced waiting periods as well as reduced expenses associated with transportation. As a result, for the purpose of my research (Zhang & Zhang, 2011), I want to investigate the ways in which cloud-computing platforms might contribute to the provision of healthcare services, with a specific focus on countries that are economically developing.

Although there are a number of benefits that may be gained from using this strategy, the implementation of telemedicine in less developed countries has been gradual. It should also be mentioned that just 34% of the telemedicine sites that already existed in underdeveloped countries were

really functional (Puustjärvi & Puustjärvi, 2013). The unpredictable electrical supply, which in turn leads to the volatility of the system, poor connection, and limited Internet speed are some of the explanations that have been cited for this disappointing outcome. A lack of stable finances to build telemedicine infrastructure and a lack of skills to maintain the technology are two more problems that have been documented in the research. Both of these elements contribute to the problem. The purpose of the current research is to look at the use of cloud - based solutions as a potential answer to some of the technical issues that were discussed before. The process of installing cloud-powered platforms will be broken down in detail by this research project which will offer an overview of the process. In addition to this, it will provide a conceptual framework for handling potential issues in terms of legal and security-related challenges that may arise.

2. *Literature Review*

An increasing doctor-to-patient ratio is a significant cause for worry, particularly for nations still in the process of building their healthcare systems (Bryant, 2019). In addition, the cost of receiving medical treatment has been increasing at a consistent rate throughout the course of the last several years. As the prices continue to grow, it is becoming more difficult to locate qualified medical personnel. As a direct result of this, healthcare organizations have been compelled to implement information systems, which enable them to fully automate the majority of their operations and, as a direct result of this, provide services that are more effective (Matlani & Londhe, 2013). In this case, cloud computing seems to be a workable method for addressing these problems (Ahmed & Abdullah, 2011). Cloud computing is one example of the kind of technology that hospitals and other medical facilities are using in order to advance telemedicine.

A preliminary review of the relevant literature reveals that there are issues connected with the existing systems,

such as excessive costs of implementation and maintenance, ineffective exchange of patient data, inadequate regulations that govern the use of medical data, and the absence of a standard design structure (Cilliers, 2014). The deployment of cloud computing also provides a great deal of difficulty. These issues include the danger of data loss, the possibility of data security breaches, and system unavailability (Jin & Chen, 2015).

Telemedicine & Cloud Computing

Given that the primary emphasis of the research is on the concepts of telemedicine and cloud computing. Therefore, in order to appropriately appraise the issue, the first step is to have a full understanding of these two concepts.

What is Telemedicine

Telemedicine is a means of delivering medical care in which patients observe their treatment through pictures that are broadcast from remote locations. It is the process of providing and receiving clinical treatment as well as information on medical conditions everywhere and at any time in the globe (Bryant, 2019). The provision of clinical and social assistance to a patient via the use of technology is referred to as telecare, which is a related phrase. Telehealth, on the other hand, is a public health service that is provided remotely to people who may not be particularly ill, however such a person's desire to stay healthy and independent. Systems that utilize telecoms systems to enable the interaction of digital documents, such as medical data and real-time videos, for the purposes of monitoring system, virtual diagnosis, telesurgery, as well as other forms of medical services are referred to as telehealth and telemedicine systems (Cilliers, 2014).

Telemedicine has been heralded as rural multiple developing nations' best chance for improved medical treatment and is seen as a revolutionary technology with the potential to revolutionize both the country's health care system and medical practice there. Bringing a physician to a region that does not have any local doctors.

Providing medical assistance to patients in locations where it had not previously been available. Telepathy, teleradiology, and teleophthalmology are examples of techniques that allow for an accurate diagnosis to be made from a remote location (Jin & Chen, 2015).

Obstacles in the Field of Telemedicine

Because telemedicine systems are housed inside hospitals, it might be challenging for medical staff members to manage or address the day-to-day operations of these systems when they are already overburdened with their regular duties. The absence of suitable communication technology has impeded the development of a great deal of potentially beneficial telemedicine programs. To begin, the majority of telemedical applications do not reliably get an appropriate amount of bandwidth via telephone lines. And second, in many countries that are still developing, there are still large swaths of land that do not have the cable wire or other forms of telecommunication's

connection that are necessary in order to make use of telemedicine technologies (Atiyeh, Dibo, & Janom, 2014).

Issues in implementing Telemedicine

It is quite probable that the deployment of such systems will encounter a number of problems. To begin, there are, as was indicated previously, problems with the existing infrastructure. These problems are caused by insufficient bandwidth, since there are certain regions in underdeveloped countries that do not have the necessary bandwidth that is needed to make communication via the internet possible. Additionally, there is no pre-existing infrastructure, thus the cost might potentially be higher. Second, using high-end technology in rural regions, where people are less inclined to adopt it, may prove to be too prohibitive due to the fact that people are less likely to accept it. Nevertheless, if the advantages are realized, it is anticipated that there will be a high adoption rate, similar to what

has been observed with mobile telephone and internet services.

Advantages

Up to 99% of delivery situations are appropriate for the use of telemedicine as a method. Patients regarded telemedicine as a viable form of contact with healthcare providers, which made it a more cost-effective alternative to traditional face-to-face reach or clinic operations. It is possible to provide interdisciplinary care through telemedicine to elderly inhabitants of nursing homes, which has the potential to result in higher levels of productivity as well as considerable cost savings.

Cloud Computing

The Web is such an efficient and rapidly growing phenomenon that it seems hard for regular human information management including libraries, in-person consultations, and print publications that have been peer reviewed to keep pace with it. The number of people turning to the internet for medical knowledge, both professionals and laypeople, is growing at an exponential rate.

The term "cloud computing" may apply to both the programs that are provided as services via the internet as well as the hardware and software that is housed in data centers and is used to offer such services. The term "cloud computing" refers to the practice of storing and managing data via the use of distant servers that are hosted on the Internet. In the event that a physician employs the web and his laptop in order to monitor the patient. The use of cloud computing is being put into action here. In addition to this, it offers patients a cost-effective answer to their problem.

The area of telepsychiatry was one of the first in the medical industry to make use of the opportunities offered by cloud computing. Through the use of videoconferencing, it is possible to achieve everything that would typically be discussed between a psychiatrist and their patient.

The usage of cloud computing may be seen in a variety of settings within the

healthcare industry. To begin, primary care physicians make use of web-based cloud computing in its most fundamental form. Some doctors and hospitals give their patients the ability to view their health records, contact their physician, monitor the prescription, and appointment scheduling from the comfort of their own homes using their personal computers (Thota et al., 2018). The emergency room is an additional important field. The transmission of data to remote locations is accomplished by medical professionals via the use of innovative cloud computing (for example, videoconferencing) together with real-time technologies such as teleEEG. In addition, a number of studies have shown that surgeons are using cloud computing in order to manage robotic surgery.

Last but not least, it also has potential applications in the administrative aspects of the healthcare industry. All aspects of patient care, including admission, scheduling, and monitoring, are managed remotely. The use of telemedicine and cloud technologies has intentionally increased. They work in conjunction with one another to provide healthcare institutions with a telemedicine option at a reduced cost.

Why Healthcare Sector needs cloud computing

Although there have been many efforts made by the government and commercial entities to offer better healthcare for every person, the current state of e-healthcare (telemedicine) in India is not up to the standard, despite the fact that the country has a population of more than 100 million people. According to a study that was distributed by the United Nations, over 78,000 women in India pass away each year as a result of difficulties related to pregnancy or delivery. India is another one of the world's developing nations. The majority of them are brought on by the absence of adequate medical facilities in more remote places. The prompt provision of treatment, on the other hand, may avert the problems that ultimately result in mortality.

Client-server architecture has traditionally been used in the implementation of telemedicine initiatives. The difficulty arises as a result of the vast quantity of health information that, over the course of time, would gather on conventional servers, making it difficult to maintain the data. Computing in the cloud is the most effective option; it is possible to solve problems of this kind.

Advantages of Deploying Cloud Computing

Cloud computing has placed all previous methods and architectures of distributed computing in a distant second place, both in terms of the competition they face and the popularity and success they enjoy. Cloud computing is, in its most basic form, the combination of several already existing technologies that are jointly attempting to bring about a paradigm shift in the process of constructing and maintaining distributed computing systems. These technologies include multiprocessors, network-based distributed data storage and networking (Kuo, 2011). Cloud computing is succeeding in bringing about this shift.

There are a variety of positive outcomes that may result from using cloud computing. To begin, due to the elastic nature of the cloud, there is no upper limit on the number of users who may use the cloud at the same time and are not restricted in any way. Second, when it comes to the execution of apps, mobile devices are no longer required to do all of the laborious tasks. Instead, the network is responsible for managing them (Gavrilov & Trajkovik, 2012. And last, the architecture of the cloud is utilized to store patient health information as well as personal facts about the patients.

Putting it more simply, cloud computing results in lower overall IT expenses. When it comes to investments in information technology infrastructure and ongoing maintenance costs, health care organizations may save costs by only paying for the services that they really use. In addition to this benefit, cloud computing cuts down on implementation risks. Because there is

no need for acquiring hardware, software licensing, or software itself, cloud computing may be quickly implemented. In addition to that, it raised the level of flexibility (Mehraeen et al., 2017). As a result of being able to access data and programs at any time and from any location, cloud computing enables healthcare workers to respond to patients more quickly and with more flexibility.

Because the technology is being maintained and delivered by an outside party, medical personnel are free to concentrate on providing quality treatment to patients. This helps improve operational effectiveness. The last benefit of cloud computing is an increase in scalability. Only the physician and a patient that a given healthcare institution needs will result in a financial outlay. This may refer to the amount of available bandwidth, specifically designed software packages for telemedicine, or storage space (Matlani & Londhe, 2013).

Barriers in implementation of cloud computing

It is important to keep in mind that any modern technology will likely come with a set of challenges and obstacles that must be overcome. The term "barrier" refers to any item or impediment that stands in the way of a person reaching the goal they have set for themselves (Terry, 2009). A user who uses cloud services may have a condition known as vendor lock-in, which occurs when they are unable to readily switch to alternative technologies. One of the primary reasons new users are hesitant to engage third-party cloud providers with the storage or processing of personal and sensitive information is because of worries over the providers' reliability (Matlani & Londhe, 2013). This is of utmost significance in the field of medicine, as information on patients will be exchanged and preserved via the use of telemedicine.

In the case of cloud computing, reliability difficulties are strongly tied to connection issues. This is due to the fact that cloud technology makes use of

the Internet as its primary transportation medium. This was also a problem for healthcare practitioners in the past, but it has since been resolved as a result of the increasing network coverage in emerging countries (Gavrilov & Trajkovik, 2012).

Concerns about performance provide an additional obstacle for the widespread use of cloud computing in healthcare settings. Concerns regarding the performance of cloud technology for telehealth are widespread and include a variety of issues. Some of these issues also include availability of cloud-related services in developing countries, understanding of the cloud and the depth and width of cloud adoption (Terry, 2009). Many people believe cloud computing to be fundamentally unsafe. This is due to the fact that cloud security is often abstract and less apparent than in many other kinds of computing, which adds to the users' perception that they lost control over their data (Mehraeen et al., 2017). In spite of these obstacles, there are instances of effective deployment of

telemedicine in both advanced and poor nations.

Telemedicine systems powered by cloud computing in use

EMS comes first in this particular scenario. It is a mechanism for providing quick medical attention in the event of an emergency that allows access to the patients' individual health data. It is primarily made up of three parts: a platform for personal health records, an application for emergency medical services, and a gateway to access this platform. An interface and a medical repository are the two components that make up this platform. Patients are able to access personal own previous medical data via the user interface, while authorized medical professionals are able to view suitable elements of the patients' medical histories. The emergency medical services application holds both the data and the software necessary to run the application. The application software has a variety of online services, all of which are restricted to authorized workers in the ambulances and the emergency room and may only

be accessed by those individuals (Matlani & Londhe, 2013).

The HCX comes in second. It is a decentralized web-based interactive system that offers a private cloud-based data sharing service. This service enables the dynamic discovery of a variety of health records and other healthcare-related services. HCX makes it possible for various Electronic Health Record (EHR) systems to share patients' medical histories with one another (Ahmed & Abdullah, 2011). It can automatically adjust itself to accommodate any changes made in the cloud.

The third option is walk-up Health ATM kiosks. They are designed to let individuals take control of their personal health information and data. It gives patients more prompt access to their information and increases communication between patients and the care professionals who are treating them. Individuals are able to control their own healthcare by accessing their own account information and doing transactions online (Zhang & Zhang, 2011). Recent years have seen a rise in popularity for the number fourth type

cloud computing. It is a communication system that is based on Electronic Image analysis and Communications in Medicine, and its purpose is to deal with the large quantity of medical images and diagnostic procedures that are currently being performed. Traditional healthcare information systems store picture archives using the inbuilt hospital network. A firewall is in place to provide security for the network.

The player that comes in last in this round is Health Cloud. Cloud computing and Android operating systems are the foundations of this mobile health information management system. Its primary focus is on patient care. Through the use of Amazon Simple Storage Service, it makes it possible to store, update, and retrieve healthcare data (Ahmed & Abdullah, 2011).

Factors to consider while deploying cloud computing powered mechanism

These are the kinds of things that may be looked at as essential elements as well. These are referred to as the

essential domains, in which an institution or a person must be successful in order to attain their goal (Cilliers, 2014). Examining and classifying the effects of the several crucial areas is a part of the critical success factors process. The following factors, which are described in this part, are utilized to address the essential areas that will enable the deployment of telemedicine services by using cloud technology in developing economies.

Nationwide planning

The Ministry of Health of any developing nation should offer a nationwide action plan for the adoption of telemedicine in all of the country's provinces as it is required to solve the issue of vendor lock-in since the entire system must utilize the same technology. Additionally, integration of the telemedicine system throughout the country's several provinces would make it much simpler to coordinate the delivery of healthcare across the nation. It is expected that if the cloud is utilized as the deployment method for telemedicine services in the nation,

costs will be kept to a minimum. This is because the Ministry of Health would only be responsible for paying for the service, and not for the architecture or IT maintenance (Mehraeen et al., 2017). Concerns about safety should also be managed thanks to the utilization of a nationwide integrated plan, and the whole of the system should be given with a set of minimum safety requirements

Preparing legislation framework

The delivery of medical treatment has undergone significant transformations since the introduction of telemedicine. It is now possible to offer medical treatment to patients in other countries without those patients ever having to learn who was responsible for their diagnosis (Gavrilov & Trajkovik, 2012). This creates difficulties with regard to privacy as well as ethics, which need to be managed within one legal framework.

If there is an appropriate legal infrastructure in place, this will make it possible for users to have more control than they have at the moment. This is because users will be aware of the

rights and obligations that pertain to them inside the system. Concerns about cloud computing's lack of physical security must be addressed via legislative action. If a patient's information were stolen while it was being communicated or kept on the cloud, it would raise major privacy issues (Cilliers, 2014). These concerns are particularly pertinent in situations when patient data is disseminated or stored via the cloud.

Active involvement of the end user in planning

In the given case, both the patient and the health care professional are included in the definition of "end user." This element provides some insight into the challenge of change management that was discussed in the prior section. There will be less opposition than there could have been otherwise if the end user is informed of the technology, laws, and best practices around the use of the cloud to deliver telemedicine services (Chauhan & Kumar, 2013). This is of utmost significance in a developing

nation, where both computer literacy and general awareness of technological advancement are low.

Campaigns for awareness

End users, including patients as well as those working in the healthcare industry, need to be informed about the benefits and possible drawbacks of using telehealth and cloud technologies. The user adoption of the technology will rise as a direct result of having this information (Mehraeen et al., 2017).

Focus on the technological infrastructure

The concept of computing on the cloud is still relatively novel, and it faces a number of difficulties. In spite of this, paying attention to the particular technological issues that arise only within the context of medicine will not only lead to an increase in the use of telemedicine in the cloud but will also contribute to the larger field of cloud computing. The dependability, affordability, and accessibility of the technology are all specific technological variables that need to be

incorporated (Puustjärvi & Puustjärvi, 2013). These are essential because the services provided by telemedicine must maintain an elevated level of dependability in order to be of any utility. As additional cloud deployment options become available, the costs associated with installing telehealth services to make use of the cloud will become more manageable. To make this technology commercially feasible, the price of connectivity, which is already prohibitively high in underdeveloped countries, has to be lowered significantly. In developing countries, particularly those with an underdeveloped IT infrastructure, cloud computing allows for the deployment of telemedicine by utilizing already established Internet connections (Cilliers, 2014). This eliminates the need for infrastructure upgrades or financial investments beyond those already in place.

Cloud Models

The public cloud, which also goes by the name external cloud, is the kind of cloud computing that "makes the infrastructure open to the broader public" by way of web browsers. However, this type of cloud computing gives customers limited control over their data. Private cloud systems, on the other hand, are designed to imitate public cloud offerings inside the confines of a single enterprise in order to make such services available to that single organization. Private cloud computing services make use of virtualized environments and place an emphasis on integrating various information technology services, most often within the confines of the company's own data centers. Numerous groups cooperate in order to maintain the community cloud's infrastructure. Due to the fact that the community cloud's operating expenses are distributed across a smaller number of user organizations than those of the public cloud, the cloud environment is a more costly choice than the public cloud (Pino & Di Salvo, 2013). Nevertheless, this particular kind of cloud has the advantages of providing an increased degree of privacy, security, and compliance with regulations.

This is the kind of cloud computing that businesses are obliged to invest more faith in and embrace because of the safety characteristics it has, particularly for businesses that deal with sensitive or vital information. The third and last form of cloud computing is known as the hybrid cloud. It is the combination of at least two clouds, which may be private, communal, or public, each of which maintains its own identity while being connected to the others via the use of a regulated or customized platform that lets the mobility of data and applications. It is possible to make use of a community cloud in order to extend the reach of telemedicine beyond the boundaries of a developing country (Zhang & Zhang, 2011). Alternatively, a privately owned or a government funded platform may be used, depending on the financial constraints and concerns about data safety that are associated with the specific telemedicine project.

3. Research Framework

A literature review and the development of a conceptual framework are going to be the key research methods for this project. In a conceptual framework, one or more formal theories are included (in part or in their whole), in addition to additional ideas and empirical facts gleaned from the relevant body of research. Its purpose is to demonstrate the connections between these concepts and how those connections pertain to the research topic.

4. Methodology

For the goal of data collection, the paper combines qualitative and quantitative methodologies in this study. In addition, it utilizes secondary research approaches to gather information about the topic. It will aid in performing a thorough literature study since there is a wealth of material on the subject of telemedicine services and their significance in today's environment. In terms of data collection, study design, and conclusion derivation, it ensures that

every research adheres to ethical norms (Jin & Chen, 2015).

5. Future Research Agenda

This study primarily relies on literature review and is limited to developing countries only. Future research may be conducted outside of the scope of the current study, particularly in developed nations, with the primary emphasis being on the enhancement of data security. In addition, studies that are special to an area may also be conducted on the subject, with the primary attention being placed on the preexisting healthcare infrastructure and how it might be improved with the assistance of cloud computing.

6. *Conclusion*

The purpose of this study was to investigate how cloud computing may be used successfully in telemedicine to provide a great deal of convenience not only to patients but also to their treating doctors. These most recent developments in information technology and communications might be beneficial to healthcare and medical groups that are geographically isolated from one another. Within the scope of this research project, five crucial success factors were identified with the purpose of putting into practice telemedicine that makes use of the cloud in underdeveloped nations. These factors include having a national integrated plan for telemedicine, promoting best practices within a legislation framework, involving the end user, providing education to improve levels of telemedicine awareness among staff and patients, and addressing technological issues.

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