

Cloud Solutions in Global Health Solutions

Anjana Raut, Anwasha Pattnaik, Rupsa Rani Sahu, Avni Rana



Abstract: Digital innovations and their applications in healthcare have changed the current scenario of delivering healthcare services and storing data. Cloud computing is one such technological adjunct that has the capability of storing volumes of medical data that can be accessed anytime through internet from anywhere. Today all smart devices and health related apps designed for lifestyle changes and monitoring of medical problems use cloud-based programs. These applications result in positive reinforcement for inculcating regular monitoring and counselling. The paper critically discusses and summarizes the cloud-aided performance and applications in health and research. Moreover, it outlines the integration of cloud technology in handling drug theft and counterfeiting. The paper explores misconfigurations and associated risk of current technology to comprehend future scope and applications.

Keywords: Cloud Computing, Electronic Records, Imaging, Nudging, Robotics, Telemedicine.

I. INTRODUCTION

Cloud computing is one of the most beneficial solutions to digital problem. It is an abstracted, virtualised, dynamically scalable network which manages power storage platforms and services for instant delivery through internet [1]. It is a combination of both hardware and software that serves enormous purposes. It offers many applications such as data storage, servers, databases, networking and software. Cloud based applications are developed fundamentally on Internet technologies like Hypertext Preprocessor (PHP) which is basically a scripting language for web applications, AJAX (Asynchronous JavaScript and XML) web browser technologies, HTML, Cascading Style Sheets (CSS) [2]. The main disadvantage of health delivery system is that it is not economical and there is a problem of providing quality health care in remote areas. The cloud computing is a great

opportunity to address the limitations faced by health care system. This system primarily comprises of three services: software-as-a-service (SaaS), infrastructure-as-a-service (IaaS), and platform-as-a-service (PaaS). SaaS is a software which necessitates consumers using provider application services through a web browser without any need for downloads and installation. Moreover, users are not liable to hardware or software updates. Cyber-attacks and network issues influence the performance of SaaS. PaaS enables customized web applications that can be used without any additional tools or skills. Infrastructure as a service (IaaS) where the user rents the working, storage, networks and other computing sources which one can utilize and run software like operating system and applications.

The providers of the IaaS manage the servers, hard drives, networking, virtualization, and storage. The health care system has increasingly become data oriented and a collaborative endeavour. The term- "Cloud Computing" is described by the National Institute of Standards and Technology (NIST) as a model for enabling omnipresent, agreeable instant access to a divided pool of configurable computing sources [1]. As cloud services are using uncomplicated popular systematized components it has become an easy and accessible tool for users. It is an essential collection of information, various functions, applications and infrastructure which can be accessed by any user and health care organization all over the world. Fields of clinical and biomedical research have witnessed an enormous change in healthcare data management systems. The need for huge data analytics and breakthroughs in healthcare field are to be considered in a real time smart health information management system. Cloud facilitates technologies such as electronic medical records, mobile apps, patient portals, devices with IoT, big data analytics that are used in healthcare systems thereby resolving key challenges.

Accessing healthcare is a major issue in inaccessible parts of the country and for patients who are preoccupied. Virtual care solutions are gaining popularity as patients' negligence in following the drug dosage can be easily tracked and monitored avoiding unnecessary hospitalisation. Many medicine suppliers and pharmaceutical apps keep track for automatic order refills making it convenient for patients.

Theft and drug misuse, suspicious and illicit medications require monitoring by the supply chain. With the use of artificial intelligence in the healthcare environment, data can be reinforced by doctors with smart machine-based analytics for evaluation. Each healthcare regulatory has the burden of maintaining their own medical records compliant with Health Insurance Portability and Accountability Act (HIPAA). Cloud-based solutions enable access to security technologies and reduce institutional accountability. Moreover, one electronic health record will reduce fluctuations in decision making and standardize treatment protocol irrespective of care provider.

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The recent advances in cloud computing has transformed healthcare by improving performance and storage at better cost, robust security, hybrid infrastructure and seamless integration [3].

II. APPLICATIONS

Cloud computing has various applications in healthcare: such as telemedicine, medical imaging, hospital management, therapeutics. It's applications include mobile apps, patient portals, electronic medical records etc. as shown in Figure 1 [4]

A. Imaging and Medical Record

Data-Important information can be gathered by image processing, sharing work flows, archiving, PACS (picture archiving and communication system) and thereby forecasting healthcare consequences, predicting epidemics outbreak, real time decision making, discovering trends, interoperability, increased scalability [5]. Cloud based PACS simplifies the exchange of DICOM images between care providers. It comprises of identity and health of the patient based on demographic and personal identity. Treatment plan, lab test and radiograph reports are common necessities of health data management. They provide accurate information and analysis which one can use for one's advantage to diagnose a disease and administer emergency treatment without wasting time on lengthy procedures of lab tests.

B. Data Access in Actual Time

The health data management systems need real time data access for quality patient care. Client server based management enables physicians to access and modify patient record in real time. Any client can access the

required information about the medical records at any place with just one click. Considering time line of events, data correlation can be done. End to end support brings higher patient satisfaction score by defining better care at home.

C. Patient Monitoring

Patient can now track their medical data that is maintained by hospitals or third party cloud service provider. Platforms based on consumers perception shows a convenient system is required. A complete data asset is maintained which can now be approached by patient for monitoring. It creates a transparency and convenient use of the networking system.

D. Telemedicine

It involves the use of electronic communications and software to provide clinical services to patients without an in-person visit. Telemedicine technology is frequently used for follow-up visits, management of chronic conditions, medication management, specialist consultation and a host of other clinical services that can be provided remotely via secure video and audio connections for example cancer monitoring. The easy access to healthcare over mobile applications, is rapid and saves time and energy of both the parties involved. It connects to remote places and one can get easy approach to the treatment needed. The inter connectivity works remarkably towards improving the health situations in remote areas in particular.

E. Efficiency

It increases the efficiency of the health care infrastructure involved while it reduces cost. It can manage a large data and simultaneously provide the service according to the user compliance. Every system involving cloud computing should be efficient enough to provide multiple diversified services related to health care, management and better compliance.

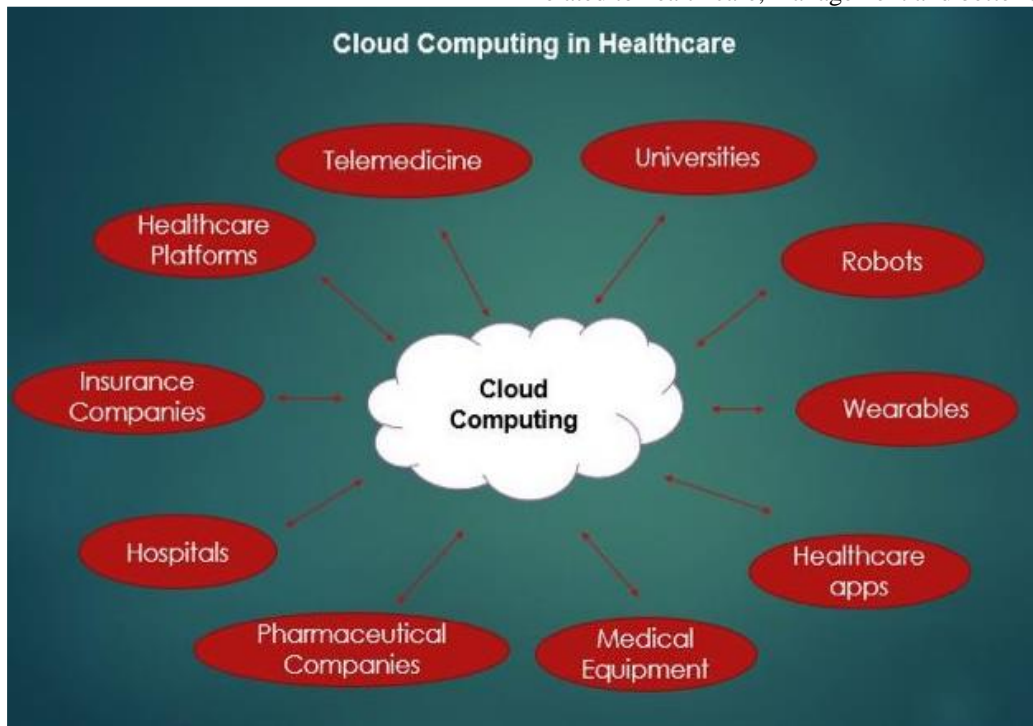


Figure 1: Cloud applications in healthcare [4]

III. KEY BENEFITS

Salient features of cloud computing are many but few important advantages are as the following (shown in figure 2)-

A.Reduced costs

Cloud computing services reduce the financial burden by reducing the hardware cost, therefore further cutting labour and maintenance cost. The vendor takes care of the hardware needs, its repair and replacement. Moreover, cloud software applications are available using internet connection that can be accessed from home or domestic site enabling flexibility at work. Cloud computing will cost less than supercomputers.

B.Security and Privacy

A cloud host is a person who can cautiously keep track of security, which is more dependable than a conventional networking system. Protecting the data requires powerful security laws. According to security standard rules accountability act. - cloud conditions maintain a secured health data using encryption and decryption, unique encryption, public and private key encryption.

C.Flexibility

The pliability that is offered by cloud services to the overall health care system versus hosting on a regional server and the demand of extra band width is met by cloud services at immediate expectancy. The stress free environment which it provides is really beneficial. One can work sitting at any place and can get the required information quickly. The pliancy has enabled the service provider to increase their working capability and give a quality service to the user.

D.Scalability

The most promising feature of the network is that it helps to lower the work pressure. The overall performance increased by working design and complex execution and huge systems such as databases is very important. There is decrease in investment in manpower which in turn saves money and working quality is not hampered.

Rising demand for medical and healthcare IoT devices has resulted in increased amount of data. Large work force is replaced by cloud computing systems. The complex system ensures critical management and storage of data and information regarding health care.

E. Mutual Performance

A large range of cloud providers impart variety of services. For ex- High resolution images that provides storage and analysis. The services are made easy by integrating data among cloud service providers. It reduces the frank chances of duplicate test and prescriptions. The lab reports, the programmed medicine availability, the expenditure of the treatment are all installed in the cloud computing systems to operate in a smooth way.

F. Independency and Program Execution

Different databases such as SQL, ORACL and CASH can be easily installed on a mobile phone. Numerous documents and application will be in one form and have the capacity to

exchange and collaborate. Many networking organizations want independent cloud computing system which only the individual can operate.

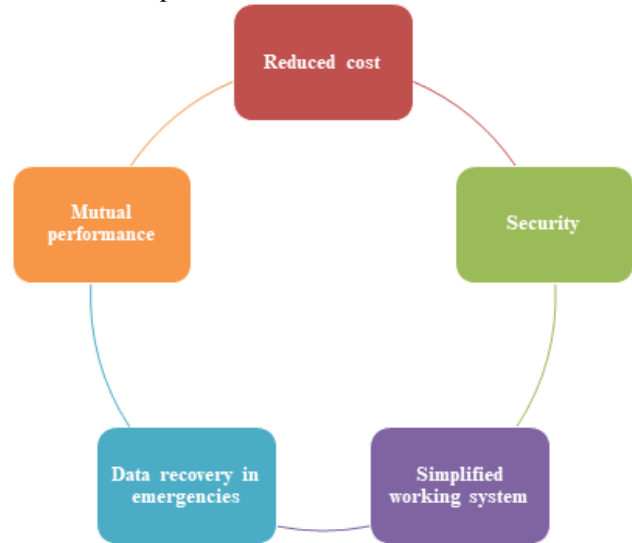


Figure 2: Key benefits of Cloud Technology

G. Exploration

The expertise to search in huge amount of information and data about millions of user database are included in cloud based electronic health record environment, recorded in four categories that is clinical data, insurance and financial data, data about drug, usable researcher, patient behaviour and emotional data. The web browser should include a diversified network to facilitate simplified working system. Health care information fed into the system can be crosschecked for any minor error that can be instantly corrected thereby increasing the dependency on cloud computing.

H. Structure

The cloud infrastructure comprises of task performed at different levels. This makes the work more exclusive and distinct. Hardware malware do not result in data loss as networked backup is always available. In the event of emergencies, such as natural disasters or power outages can result in business disruption but data can still be quickly recovered. The cloud architecture provides high security and faster data recovery.

IV. LIMITATIONS

Despite of the benefits claimed by cloud vendors in optimum medical service and care, there are few demerits in its execution.

A.Internet Connectivity

Consistent network connectivity is a must for computing performance. For hassle-free operations a wider band width can provide the correct amount and speed of the internet required. The internet connection will regulate and monitor the overall working system of cloud service performance. Therefore, organizations should have contingency plan so as to avoid business disruptions. High network band width results in inflated cost.

It requires a lot of costly investment and best technology for smooth operation. One needs to have a good number of investors for the start-up and more over a suitable infrastructure is also required for the build-up of the networking system. The quality and quantity of performance depends on work efficiency which in turn depends on the capital that is invested.

B. Vendor Lock In

Sometimes organizations witness technical incompatibility and additional cost while transferring their resources from one vendor to another [6]. It becomes a difficult task to cope with the diversity of the function of different vendors and expect the same quality of operations from different vendors. The applications are easily transferred from one cloud provider to another. Vendor lock-in challenges data portability. The transportation of networking system can be a real problem that requires to be addressed. Eradication of vendor lock in can be a useful tool, unless otherwise any other applications have been discovered.

C. Limited Control

The cloud system is fully possessed, directed and supervised by the service provider in order to limit the function and execution of services by the cloud user within a cloud framework. This may hamper the work capacity of the user and one may find it really one directional which may jeopardize the relation between the user and provider. Service provider monitors the cloud networking system. Customer as a consumer has minimal control over it and will not have access to key administrative tasks. It will be monotonous and no interconnections between the parties.

D. Security

While acquiring cloud technology one should be well informed that all sensitive information of the organizations will be dispatched to a third party i.e cloud service provider. It is the biggest limitation but can be overcome by implementing encryption and security hardware and applications [7].

E. Interoperability

Developing these complex web services is a real task now. It delays the work process, the handling of every step in systemic manner may take longer time. One may jeopardize the sensitive information in between the transferring. All the platforms should follow similar pattern of technology that may be very difficult to inculcate.

F. Cloud Downtime

Technical problems including reboots network outages and downtime will hamper cloud operations. This in turn will slowdown and hinder the capacity of business operations. Long term power cuts in remote areas, loss to the infrastructure due to any natural calamity, lack of proper platform to incorporate the system. Hacking may cause severe loss of data and require money, time and energy to recover the information.

V. DISCUSSION

Even though Cloud computing is a new technology, all the required patient particulars provided are approachable

throughout the world, it encounters analytical hindrances in meeting one of the health industry's most significant demands [8]. We all are aware that contributing security systems is mandatory due to its basic attributes such as remote data storage, deficiency of networking system, acceleration and gigantic infrastructure sharing. It is trusted that merging the discussed technology can support health care authorities to provide a more precise, sturdy and customised treatment arrangement. According to several survey studies, the major impelling force which motivated organizations in adapting cloud based systems is economic benefits. Administrations will not need expensive infrastructure, but can pay simply for services they receive and pervade in added areas or section. Expansibility of clouds make changes in response to customer expectation and the outcome is sustained progress. The agility of clouds makes health information systems very mobile, because it enables users to ask for required service without any initial action towards service preparation [9]. Undoubtedly, quality has become the main foundation of modern health care organizations.

VI. FUTURE SCOPE OF CLOUD APPLICATION IN HEALTHCARE

Healthcare industry has climbed up with cloud computing technology however newer fields are yet to be explored for further opportunities and prospects. Moreover information technology developers have to monitor the associated risk. IT engineers have to be more vigilant to the various types of misconfigurations that can creep in, since this can result in breach of personal credentials and

hack admin privileges [10]. Although Machine Learning algorithms can be utilized to analyse security challenges in data processing but compromised applications will result in erroneous machine learning. Healthcare-related IoT devices and wearables are becoming popular with technological advancement of healthcare. It is essential for IT and security teams to have the right tools in place to analyse the threat landscape [11]. Sound cognitive and technical skill along with frequent technology update is essential for sustainability of digital transformation. The paradigm shift to digitalization has made patient work more precise and comfortable, but it has incurred to added cost. In order to recoup the investment cost the clinician tends to use more frequently digital aid and technology than otherwise indicated. Federal law plays a vital role to check mismanagement [12].

A. Robotics:

During the unprecedented times of covid-19 pandemic when there was significant crisis of healthcare professionals robotic systems were used for disinfection to stop spread of infection and thereby minimized the exposure of healthcare workers. They can be used 24 hours a day therefore keeping the limited workforce safe. Robots are finding their way into hospitals and elderly care by delivering supplies and assisting in surgeries. Cloud computing providers will process information and security risks associated with designing and building of robots. Since a robot is an Internet of Things (IoT) device, should it malfunction or fail, IT developers would be called in to help troubleshoot and resolve the issue.

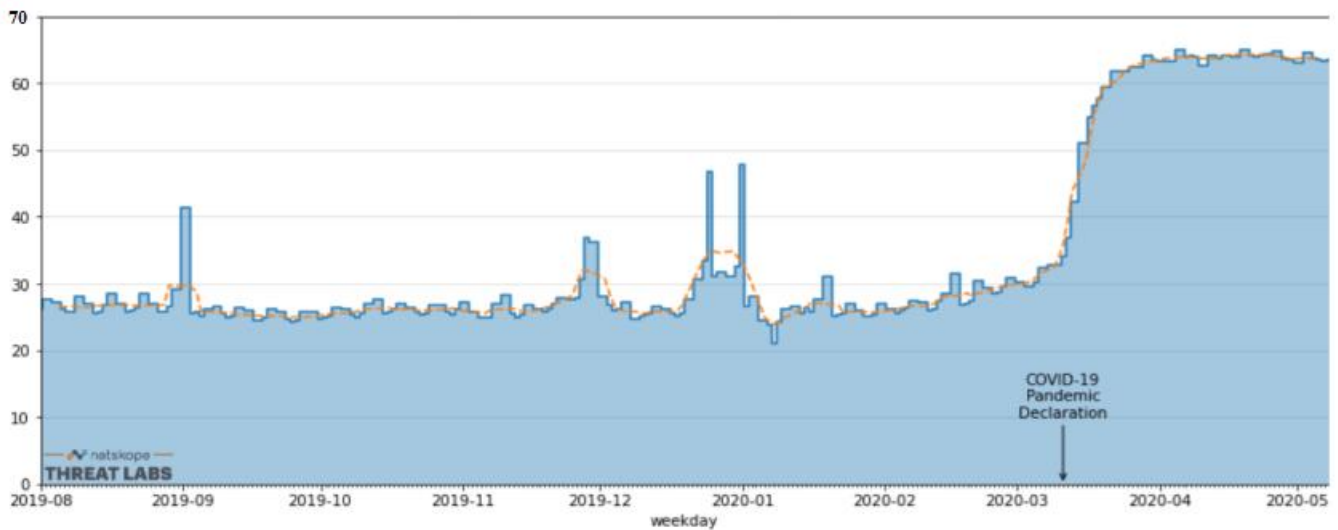


Figure 3: Accelerated Cloud transition during Covid-19 pandemic [13]

B. Nudging

It has been instrumental in digital transformation in the healthcare industry by assisting in decision making. It includes reminding people of doctor’s appointment, helping patients make healthier food choices and many more. The cloud transition in recent years particularly during coronavirus pandemic has been significantly exponential as depicted in Figure 3[13]. That means an AI or a robot could be programmed or reprogrammed to encourage healthy lifestyle choices. On the contrary its misuse can amplify mental health issues. The Information Technology (IT) developers have to understand the risks involved.

C. Telemedicine

Cloud-based telemedicine is a boon for residents of remote areas as they are unable to travel. Virtual care technology allows long distance counselling, advice, reminder setting and intervention. Such services however get disrupted by network noise or bandwidth issues as distribution of information takes place via electronic media and telecommunication technologies. Since the failure is technology-related, IT developers need to troubleshoot and resolve.

VII. CONCLUSION

Cloud computing provides numerous benefits in data entry and depot, specifically in health care organizations and relevant studies. A number of articles and resources have observed the successful application of cloud computing in bioinformatics research. Even though the cloud computing framework is regarded as a potential internet-based computing station, the security concerns that is faced are notable. But the strength and welfare of cloud computing far outstrip peril and threats. Security necessity is increasingly challenging to meet without a significant investment in infrastructure and manpower. The absence of skill, cognition and proficiency of users is another challenge. So cloud

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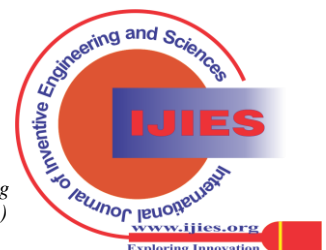
of this paper. The authors are obliged to authors/editors/publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed.

DECLARATION

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