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Cloud computing approaches in health care

Farhan Faridi, Huzefa Sarwar, Md Ahtisham, Sarvesh kumar *, Khalid Jamal

Department of CTIS, Integral University, Lucknow, Uttar Pradesh, India

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ABSTRACT

Cloud computing and health monitoring is increasingly being employed together as the healthcare equipment's are giving proper monitoring and collection of patient health record is being transferred and collected using cloud computing services like SaaS which stands for storage as a service. The need of tech equipped. equipment's are increasing day by day as equipment's are highly technical and the software and configuration which need to keep equipment's work progressively can easily be served by cloud services which named under infrastructure as a service and software as a service. Our paper is a literature survey for how the cloud web services are merging with health care and in how many ways it is beneficial for human being for adding the cloud web services in healthcare in terms of facility and industry utilization. The digitalization of everything gives the benefit of availability of each record about a disease or patient, this makes the data available for all and all experts can look and monitor without having limitation of physically present there. Also, there are some challenges in employment of cloud services they are also mentioned in this paper with possible solution.

Selection and peer-review under responsibility of the scientific committee of the 1st International Conference on Computations in Materials and Applied Engineering 2021

1. Introduction

Cloud computing and health monitoring is increasingly being employed together as the healthcare equipment's are giving proper monitoring and collection of patient health record is being transferred and collected using cloud computing services likeSaaS which stands for storage as a service.Table 1.

These days including each zone like stock, education, military, gaming, agriculture and healthcare IT resources and services are used with higher scale every day. IT industry offers the services in proper authenticity and more functional way then the traditional one, it gives a hike on demand on It employed services. Disregarding different conveyances concerning dispersed registering in clinical consideration, there is no exact review on stream research up to this point. The inspiration for this paper was to uncover the state of research and the assessment of future of cloud services in health industry, which is positively increasing, and the benefits are surprisingly visible worldwide. The composing covers the subject of conveyed processing in clinical administrations from an arrangement of perspectives. Despite the way that there are different dispersions in the territory, we found no conscious review on force research up to this point.

1.1. Services which come under cloud computing

SaaS: SaaS abbreviated for software as a service, which intended for providing the configurations and the supportive required software in addition to that it provides variety of services like storage of your data, files, and records on cloud with proper protocol and authorization of client with which a higher secured way of storage of data can be achieved as without appropriate credential no one on web or physically can temper your data. Additional services also include email web-based services and various project management related tool which can be customized according to company to company.[1] The best part comes with leasing of services that means you will have to pay for only those services that you are using.

PaaS: PaaS abbreviated for platform as a service, which intended for providing a highly equipped IT tech environment with which developers need not to look for additional web sources for development as all required resources are available at cloud.[2] All databases processing related requirements means databases and processing tools are available at lease basis, operating system like windows, Linux any platform is provided here without being

* Corresponding author.
E-mail addresses: kumarsarvesh1gr@gmail.com, sarvi899@gmail.com (S. kumar).

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Table 1
Literature survey of various articles.

Characteristics		Categories			
(1)	Focus	Research Outcomes	Research Methods	Theories	Applications
(2)	Goal	Integration	Criticism	Identification of central issues	
(3)	Organization	Historical	Conceptual	Methodological	
(4)	Perspective	Neutral Representation	Espousal of position		
(5)	Audience	Specialized scholars	General scholars	Practitioners	General Public
(6)	Coverage	Exhaustive	Exhaustive and selective	Representative	Central/Pivotal

depended on virtual box which reduces burden on physical system by installation of VM or virtual box in system.[3]

IaaS: IaaS abbreviated for infrastructure as a service, which intended for providing the infrastructure related services which are not fulfilled by SaaSi.e., software as a service.[4] The main objective of IaaS services to eliminate additional dependency of frameworks and resource intensive installation as all these facilities are being provided under cloud's IaaS service which is also on lease basis which gives the user the flexibility that it can increase the use and decrease the usage and will have to pay accordingly.[5]

1.2. Cloud computing platforms applied in healthcare

Distributed computing in medical care is developing quickly to the point that assessments put its worldwide market an incentive at almost $10 billion by 2020 and $45 billion by 2023.[6] A connected measurement, from Black Book Market Research, fixed medical care cloud selection at a vigorous 74 percent. Also, per a new story in Global Health magazine, 2019 is turning out to be the cloud's greatest year ever across the medical care range. [7]

1.3. NetApp services for providing current clinical data

NetApp is a cross breed cloud information administrations organization.[8] Its administration stage conveys information progressively to help make clinical activities quicker and more effective through decreased EHR inertness, snappier reinforcement and reclamation, simpler convenience of information/outstanding burden extension and the smoothing out of information the board. [9]

1.4. Medsphere services for general medical care

Medsphere offers an assortment of cloud-based answers for medical services establishments.[10] It is electronic wellbeing record stage offers types of assistance to numerous areas, including clinical, monetary, bookkeeping, nursing, and numerous others. [11] Utilizing Microsoft's safe Azure® cloud stage, the organization additionally assists suppliers with managing planning, enlistment, clinical records, charging, cases and then some. [12]

1.5. Nintex services for robotized operation

Nintex disposes of paper archives, smooth out manual cycles and hauls significant information out of its storehouses, therefore upgrading the general patient experience.[13] The organization gives its computerization administrations to a variety of medical services industry experts, from specialists and attendants to the producers of drugs and clinical gadgets. [14]

1.6. Medable services for providing collaboration in work with technological advancements

Medable's clinical evaluation stage encourages direct-to-persistent medical services by supporting clinical applications and putting away close to home wellbeing data for clinical suppliers and analysts.[15] Likewise, the stage can be utilized by designers to extend or make applications for portable, tablet and work area. [16]

1.7. Literature survey

In a paper proposed by author, distributed computing-based Service-Oriented Architecture (SOA) to encourage the turn of events and reconciliation of heterogeneous information base and application frameworks.[17]If any examination group needs to get to far off assets (information or applications), it simply demands web administrations through the SOA by applying the normalized programming sentence structure [18]. The cloud calculation was utilized to virtualize the worker with Virtual Machine product (VMware) in the stage. It permits specialists to utilize VMware to open a virtualized worker to direct a similar exploration learn at various areas. Distinctive site specialists can share and change results by means of the virtualized worker while keeping their unique patient information in a neighborhood data set. Additionally, we acquired the procedure considered Ambiguity that was proposed by Wang [19] to ensure both presence security and affiliation protection with uninformed misfortune.[20]

1.8. Use of cloud computing services in digital transformation of healthcare Industry

It has demonstrated to be worthwhile for both medical services suppliers just as the patients. On the business side, Cloud processing has demonstrated advantageous for chopping down operational costs while permitting suppliers to convey high-caliber, customized care. [21] The patients, who are becoming used to quick conveyance of administrations, will profit a similar immediacy from the wellbeing area also. Cloud services likewise amps up patient commitment with their own wellbeing plans by giving them admittance to their own medical care information, consequently bringing about improved patient results. The democratization of medical services information and its far-off availability let loose suppliers just as patients and separates area hindrances confining admittance to medical services. [22]

We have included some points here in which cloud services employees' higher benefits.

1.9. Marginal benefits in terms of expenses

With cloud employed services the setup of emergency clinics and medical setup becomes easy as the basic services like computers and monitors who need to keep for monitoring on patients are available on demand. The need for purchasing everything like

server or tools are eliminated with the lease-oriented model provided by cloud web services. There is no need to pay up front charge, but you will only care about the amount of service you are using, just pay for that and be free from additional burden and concerns thus reduces the expenses in deployment. With high tech wearable the patient monitoring report can be sent and viewed by doctor directly in form of EMR and the need of physical checking and travel cost also reduces by this setup.[23]

1.10. Benefits with its interoperability among various frameworks

Somehow if the data about the increasing concerns which are evident to the world these days the monitoring and action by WHO and other healthcare and wellbeing organization of every country can take quick and strict actions towards that concern. This need can be fulfilled by the cloud setup as all the data which being recorded at various health institution and laboratories are collected and integrated at cloud and directly from there it could be shared among the organization which need to know about it and also, they can look for the experts if available there or set the alarm for other countries for such concern so the necessary precautions and action can be taken before chances serious conditions. Having the patient's information in the cloud likewise advances interoperability among the different portions of the medical care industry-drugs, protection, and installments. This considers a consistent exchange of information between the various partners subsequently quickening medical services conveyance and presenting effectiveness all the while.[24]

1.11. Easily available for analysis

The information or data being generated with the logs and report from cloud services can be in various forms like structured and unstructured, single, or grouped, registered or in various forms, by advanced computing power which is integrated with each cloud services, can be easily analyzed and some valuable and remarkable outcomes can be generated from it directly. It also come with assurance that record about disease, virus or any medical experiment cannot be miss placed or lost anywhere not can be accessed by unauthorized person. The use of big data come in picture here when the organization is too big or the data is too big, there the using big data analytics the data being processed and the outcome or prediction can be generated using analytical algorithms.[25]

1.12. Complete authority over your data

Distributed computing democratizes information and gives patients authority over their own wellbeing. It supports understanding interest in choices relating to their own wellbeing and prompts educated dynamic by going about as an apparatus for persistent schooling and commitment. [26]

Persistent records and clinical pictures can be handily filed and recovered while putting away information on the cloud. While cloud security stays a worry, the unwavering quality of cloud for information stockpiling is certainly higher. Information excess is decreased with an expansion in framework uptime. Since the reinforcements are computerized and there is not a solitary touchpoint where the information is put away, recuperation of information turns out to be a lot less difficult.[27]

1.13. U.S. health cloud computing

The growing of cloud demand in healthcare industry has increased. Rising demand for cloud information expected to increase as shown in graph. Population is increasing that's why we need to focus on cloud computing and hospital will store all records on cloud. Cloud computing market globally expected to reach USD 27.8 billion by 2026, according to the report, Infrastructure, digitalizing and deploying cloud server to improve in healthcare organization. [28]

In Figs. 1 and 2 healthcare area cloud adoption has boosting up so far also, nonstop selection of distributed computing by the medical care experts is expected to development of industry in the forthcoming years.

In year 2018, the value of Healthcare Cloud Computing Market Size was almost USD 20 billion and is expected to witness over 15% CAGR from 2019 to 2025.[29]

1.14. Advantage of cloud computing in health care

- Contactinformation from anywhere by anytime.
- Cost effective.
- Providing a shared infrastructure
- Changing access in emerging markets

Distributed computing assumes the essential part in the field of medical services as it gives the quantity of offices, for example, virtual clinical help, shrewd cloud prepared gadgets, putting away the clinical records, on-request space on pay-more only as costs arise model, and numerous considerably more facilities.[30]

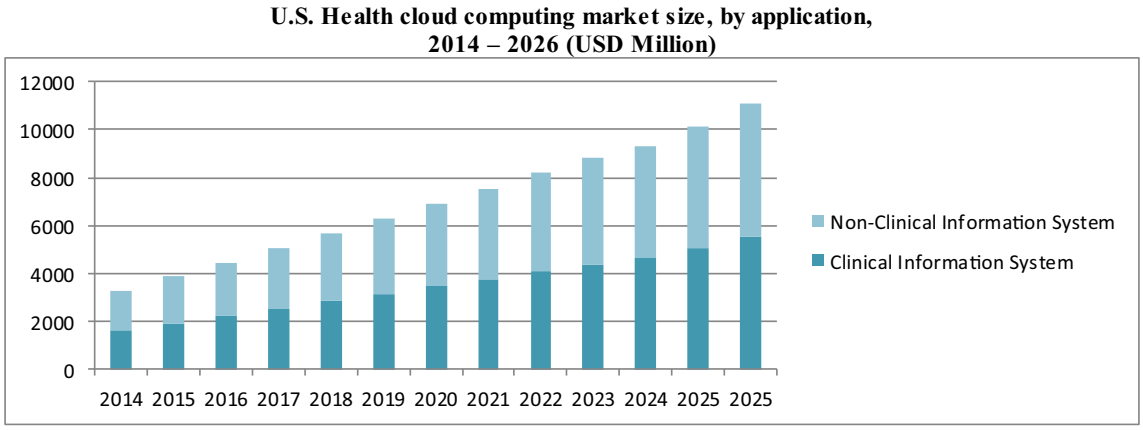

Fig. 1. U.S. Health Cloud Computing Market.

Through distributed computing, there will be ease of collection or transferring of patient's health record very easily, through which one can save not only the money and time but the fuel also.

Keeping the present situation in mind, due to pandemic maximum people are not allowed to gather at the same time at the hospital, which is very risky and infectious, with the help of cloud web one can take advantage.

It will be easy for doctors to keep the data, no matter how long it can stay. [31]

1.15. Proposed framework

The health monitoring system consists of multiple sensors connected to the patient, and they transmit data through the processing unit. In this project, Raspberry Pi is used as a data aggregator and processor. Smartphones/computers of patients and doctors are used as the monitoring system.

As shown in the Fig. 3, the sensor system is used to obtain information or readings from the patient and convert the readings into

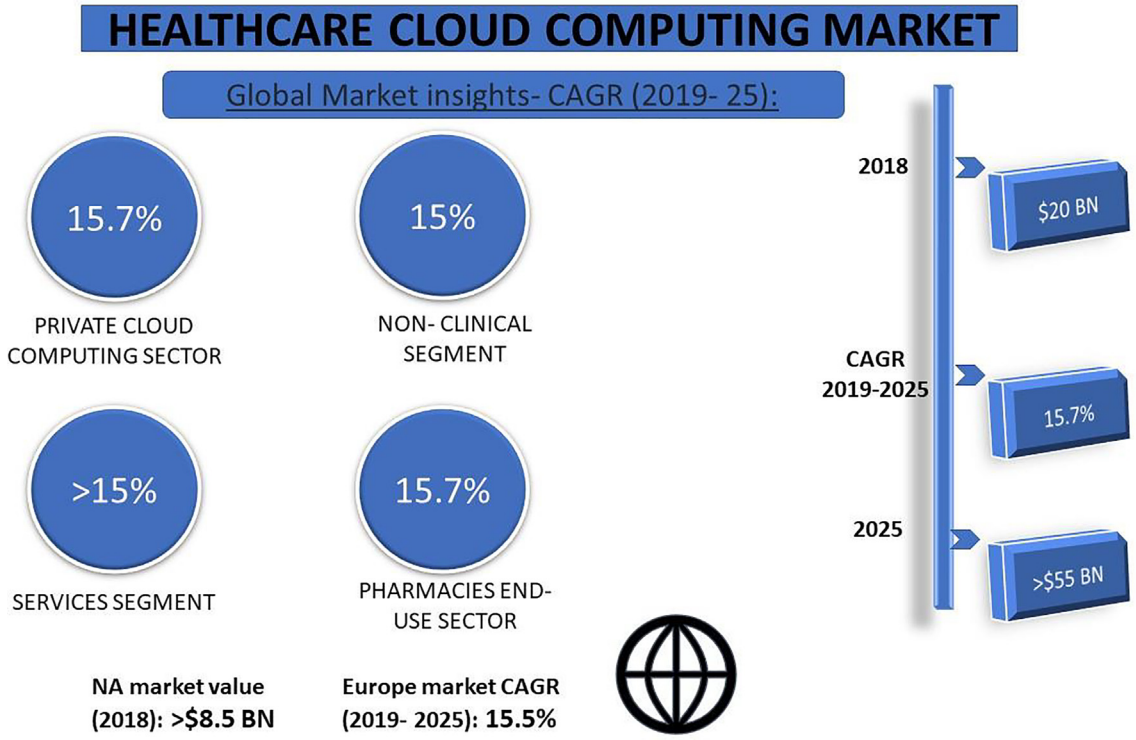

Fig. 2. Healthcare Cloud Computing Market.

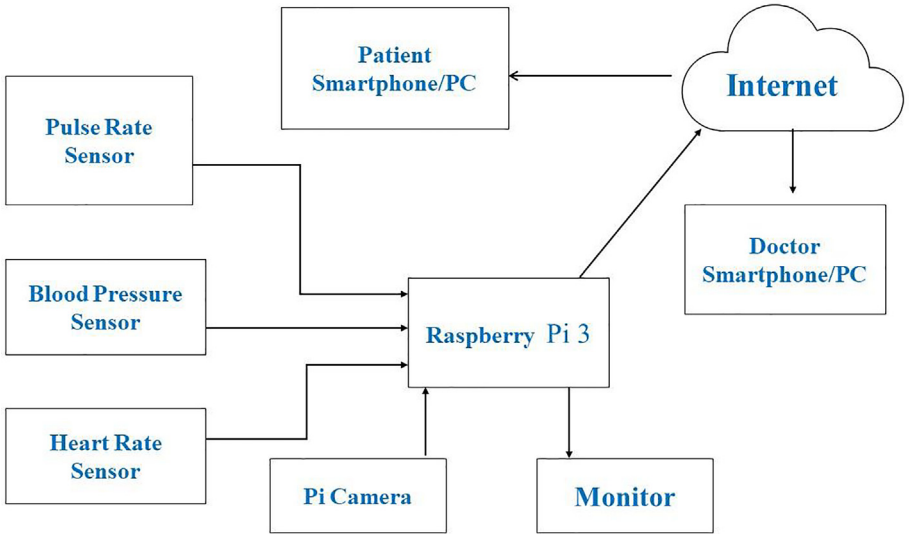

Fig. 3. Health Monitoring System using Raspberry Pi3 & IoT.

signals. These signals are provided to process the Raspberry Pi as an IoT module. Pi then displays the information on the monitor and stores the information in the cloud. The doctor can access this information and get the information on his phone/computer. In the event of an emergency, an alert will be automatically sent to the patient via email to obtain medication.[32]

1.16. Fog computing in healthcare Internet of Things

The Internet of Things technology provides a capable and methodical method to improve human health and comfort. One possible way to provide IoT-based medical services is to use a general health monitoring arrangement to display human health in real time. This arrangement can obtain biological signals from sensor nodes and send the data to the gateway program through specific wireless communication. Then the real-time data is transmitted to the remote cloud server for real-time processing, visualization, and diagnosis. In this research paper, we enhance this health monitoring system by manipulating the concept of fog computing on a smart gateway that provides innovative technologies and services at the edge of the network, such as embedded data deletion, decentralized storage, and notification services.[33]

Electroencephalography (EEG) is used to estimate electrical movement in the brain. Brain cells are connected to each other

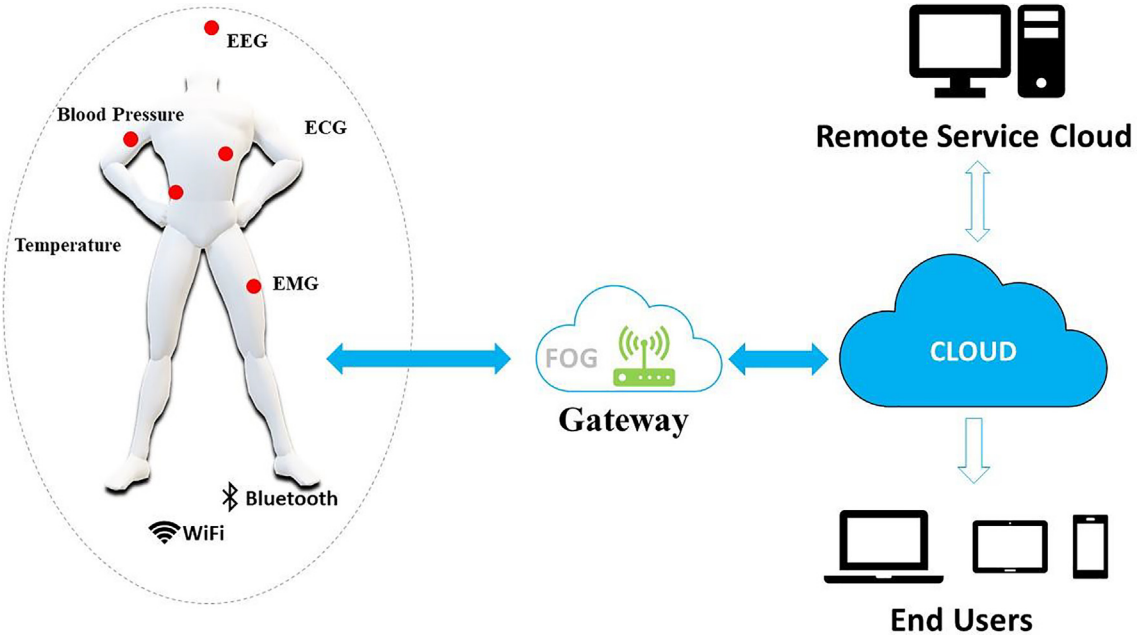

Fig. 4. The IoT-based health monitoring system.

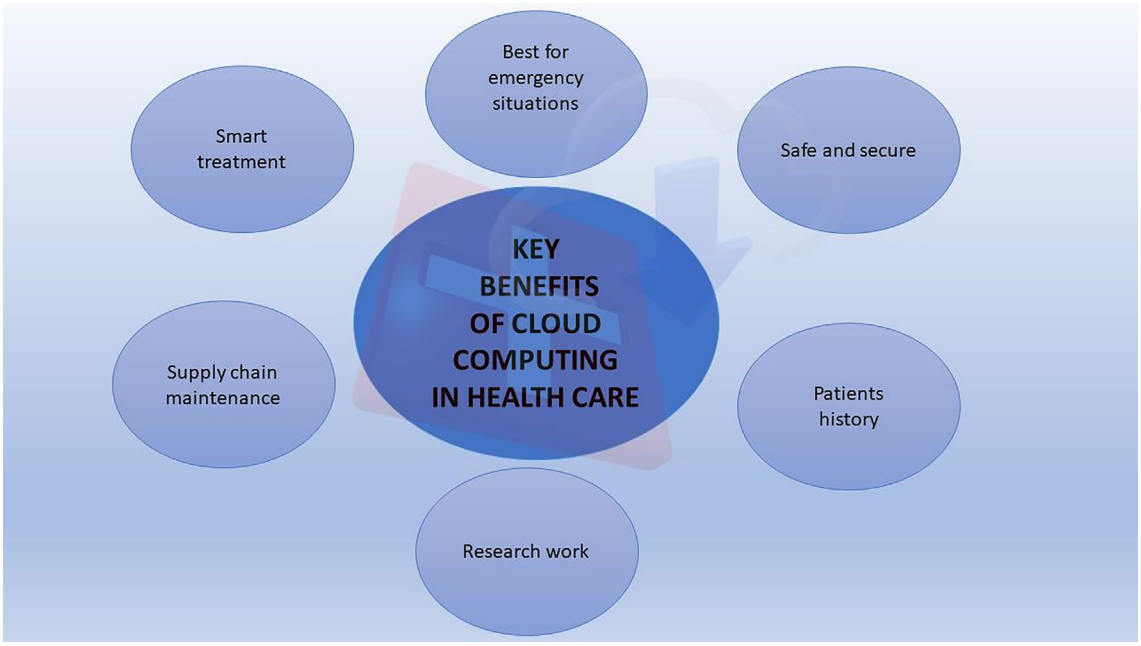

Fig. 5. Key Benefits of Cloud Computing in Health Care.

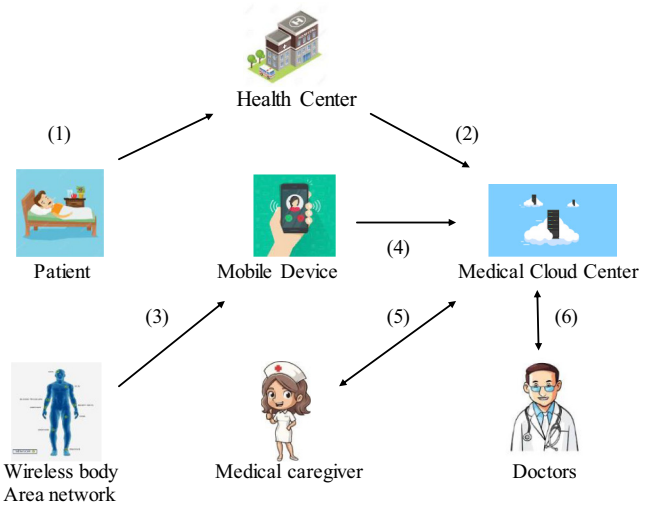

Fig. 6. Medical Record Safe in Cloud.

by electrical impulses. EEG can be used to help detect potential problems related to this activity.[34]

Electrocardiogram (ECG) records the electrical signals from your heart. Check whether the heart condition has changed. Electrodes are located on your chest to record electrical signals from the heart, which causes the heart to beat. The signal is displayed as a waveform on the connected processor screen or printer.[35]

Electromyography (**EMG**) is an electrodiagnostic technique for evaluating and recording the electrical signal produced by skeletal muscles. [36]

In Fig. 4 Fog computing is a grouping of two key components of data processing — Edge and Cloud. In the edge analytics concept, the gateways form a mesh system. The individual mesh system of a selected area creates Fog Nodes.[37]

Cloud computing provides number of facilities to healthcare and healthcare takes benefits from cloud computing as it is safe and secure, keeping the patient's history if you want, offers smart treatment, best for emergency situations, and supply chain maintenance.[38] [Fig. 5]

In Fig. 6 Distributed computing is quite possibly the latest progressive innovation in world. Cloud computing is expanding step by step life.[39] The mix of distributed computing presents openings for changing medical services in more powerful way. All outline of the distributed or cloud computing idea associates with the cloud and offer similar information assets.[40]

2. Conclusion

Our paper presents the submissions of various research papers and application of cloud web services in various medical areas and the use is rapidly increasing day by day despite of challenges faced during employment of service. We have prepared the survey by including 39 articles available in this area and are related to telemedicine, virtual medical assistance, online monitoring on mutation of disease sprint, study of newly occurred viruses and diseases etc.

Most of the employment of cloud web services found in home medical services by employing smart cloud tech equipped devices at home, gym and in offices, distribution, and preparation of various medical assistive databases like recording and virtual operation for physically unavailable case for research purpose. Majority of already employed services as shown better results in wellbeing of clients according to reports and feedback thus it encourages the use and development of many more cloud infrastructure in health care departments specially when this is a time when a deadly disease is destroying the wellbeing in overall world and the infection rate is really high and the gathering and sending things physically is highly risky and could be a medium of spreading the infection, that's where the use and enhance the virtual assistance using cloud web services comes in service where the need of human intervention decreases by the services and it will lead to rapid research in order to revoke from the disease with lesser physical contact and highly equipped infrastructure.

Cloud computing benefit for health care information system. It is not only providing the storage, but it is also reduced the cost. Cloud computing relieves the people to buy the hardware and software to store the data. Hospital has to more interact with the patient with the help of cloud computing. With cloud computing Hospital can access the report and data very fast also consume the time. Electronic medical records, pharmacy records, doctors note and digital medical imaging everything can access in real time. Cloud will lead the better treatment option because we access the real time data. In future, probably there will be best collaboration among these fields which will directly be beneficial for the humanity.

CRediT authorship contribution statement

Farhan Faridi: Investigation, Writing - original draft. **Huzefa Sarwar:** Writing - review & editing, Supervision. **Md Ahtisham:** Conceptualization, Formal analysis, Data curation. **Sarvesh kumar:** Conceptualization. **Khalid Jamal:** Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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