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A Novel Hybrid Technique for Secure and Energy-Efficient Resource Utilization over Green Cloud in Health Services

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ABSTRACT

A regular system of data access is to maintain a selective exchange of composite Personal Health Records (PHR), which is an open-source of research in current information technology (IT) trends from various cloud healthcare providers. Via PHR services, a patient can produce, monitor, and maintain patient records in one location through the internet, which has made it more effective to store, retrieve, and distribute medical information. Each patient can completely access medical records and exchange medical data for a large variety of users like family members, patients, and healthcare service providers. Because of high development costs, and maintenance of dedicated data centers, several PHR service providers may be made open to third parties to provide health care support and services. The emission of Co2 is high in redundant centralized and decentralized data centers and the environmental pollution can be reduced by creating reusable data centers that can share information or data through PHR. By this, we can avoid high Co2 emissions, and as per Moore's law, data centers' compatibility, scalability, flexibility, and availability can be increased. In the existing state of art system practices in health care services, every organization/hospital uses its own data centers for Information and Communication Technology (ICT) services. In fact, these hospitals have been establishing data centers with the underutilization of resources. In addition, several research studies have revealed that the existing resources are heavily power consuming (i.e., lack of consideration of green services) and challenged by multilateral security threats to the highly sensitive and disease critical data of the patients. Energy efficiency, security and privacy of patient's case sensitive data are the most important issues that should be considered with care and sense of accountability. Sharing modern data with e-Health Care and reusable resources from other data centers are of central importance in healthcare services. The major contribution of this paper is to design an environmentally sustainable, energy-efficient, and cost-effective data center model over the cloud for healthcare services. The proposed model seeks to improve the system response time, security, high availability of health services, with low cost of services over-cloud.

Keywords: Green Cloud Computing, PHR, Energy Awareness, Health Care Services, Security, Data center

1. INTRODUCTION

Personal health record (PHR), a patient-centered model for sharing of health-related information, has emerged in recent years. A PHR-service supports patients in creating, maintaining, and managing personal health information through the internet, making it easier to collect and share medical data. In general, every patient is guaranteed full responsibility for clinical records and can share their health records with a wide variety of clients, including medical services suppliers or individuals from the family. Many PHR facilities are provided or operated by third-party service providers due to high construction and maintenance costs. For example, in India, the IT healthcare industry probably spends more than 60% of server & software spending by user population, for example. However, many material fossil fuels and resources, with less than 20% of computer users and less than 25% of India's IT spending, are located in rural areas. Due to recent developments in healthcare and network computing, it may be advantageous to move servers and data centers to rural areas. Developing India's national infrastructure for cloud computing over the next few decades is central to the progress in e-health services. Moving servers and data centers to rural areas may be helpful due to recent developments in health care infrastructure and network computing.

Green cloud computing (GCC) is closely related in wake of the importance of cloud computing in data centers. According to (Koomey, 2011), the energy devoured by server farms was 1.3% of absolute interest. A GeSIreport which is classified "one of Internet's generally extensive and all around perceived energy request previews on a worldwide scale" estimates that the share of total ICTs emissions of CO2 from 1. 3% in 2002 to 2.3% in 2020 will increase from 1.3% in global emissions. The Cloud Energy and Emissions Recovery Model (CLEER) has been developed by Lawrence Berkeley National Laboratory research group and Northern West University. Their model measures save of energy from local network transfers to server farms and computer systems. The cloud consists of these server farms. The results estimate that if all US business users migrate to cloud storage, the essential energy effect of email, client relationship, board programming, and beneficial programming can be diminished by as much as 87%. Even if all variables are not considered, the model can also be used in data centers that belong to internet companies to lead energy efficiency. Increased resource transparency could be assured, allowing consumers to choose the best offer. When data centers are focused on green cloud computing, there are greater environmental benefits from cloud computing (Radu, 2017).

The environmental influence of the healthcare sector has now been a big global consideration and is still attracted to public regulators everywhere. In its totality, including fast development information and communications technology (ICT). Cloud computing, medicine, and 'mobility' are state of the art IT technologies and software used in eHealth, health care, and tele (Health) systems for remote services. To address increasing issues of operational costs, generally, the health sector would benefit from new technology like big data, data science, analysis, cloud computing, and mobile computing (Lamb, 2017). Physicians and researchers encouraged the monitoring of patients by inventing various kinds of wearable health monitoring devices. Provided that patient travel is not automatically monitored or helped by an emergency due to significant disadvantages of existing communication or reporting systems. Cloud-based networking helps to solve problems to some degree, but inventing the wearable computer in IoT (Internet of Things) and Club will solve the big problem of robustness and portability.

The significance of the proposed study is to enhance the uses of green cloud computing in the health care sector, so the work should be minimized. The PHR must be available for access for doctors as well as patients in a very secure manner. The significance of the study is also to provide better performance results in respect to response time, security, availability of health services, and treatment response. Patients who are increasingly used to instant delivery of services are now able to get rid of the same promptness from the health sector. Cloud can also include patients in their health plans by providing them with access to their health records to improve patient outcomes. The democratization of healthcare data and remote accessibility frees both patients and providers and breaks down barriers to the location of health care access. This process helps to reduce the energy consumption of cloud resources by providing security to healthcare services. Cloud technology in healthcare can be used to significantly increase the energy quality of hospitals along with knowledge on the best ways to improve healthcare energy efficiency in an economical way. Cloud infrastructure for energy-efficient resource utilization, Security of data and legal issues related to patient's privacy is not yet clear nowadays. State the units for each quantity that you use in an equation.

2. LITERATURE REVIEW

Healthcare is one of the most common methods to detect and make people aware of adverse physiological events by using sensor devices. Developing and implementing long-term health monitoring to prevent or respond rapidly to diseases and in terms of computing power and energy limits, accidents are an interesting problem. High energy consumption results in higher system operating costs. It means that more heat is produced so that the device needs more power to cool down. Green computing is an increasingly critical approach because of increasing energy costs and environmental problems. Evolutionary green computing should concentrate on energy efficiency, sustainability, scalability, safety, and thermal security.

The physiological signal sensing frequency of various body sections was considered by established green cloud-assisted wireless body area network (WBAN) healthcare service and data transmission between WBAN sensor nodes. Cloud-assisted healthcare controls node sensing frequencies by taking into consideration the global WBAN climate and parts of the body sensing variations. Research showed that the service proposed can transmit sensing data effectively and extend the entire life of WBAN (Chiang et al., 2014).

The healthcare sector's environmental effect has created a significant importance worldwide and continues to draw the regulator's attention. Because of several factors, energy use has increased in the healthcare sector (the largest of

which is 'hospital' segments). These include rapid growth and implementation in the area of healthcare ICT (Information Communication Technology). Latest IT techniques and application technologies in the area of health care include Telehealth services for Remote healthcare service, Medicine (health mobility) and Internet Computing. Health care and Hospitals will take significant green steps by combining large-scale analytics with cloud computing. Substitution of IT equipment and improvements with energy-effective systems such as databases will easily reduce the IT energy consumption of replaced equipment by up to 50%, virtual data storage, virtual servers, and efficient architecture for the consumer. Second, Virtual servers and VDS technology are device management cost and equipment reduction approaches for hospitals. By requiring cloud service device output and test/development programs, healthcare saves even greater on the use of resources for security. There is also a very solid business argument for current green technology without even mentioning electricity cost savings. Examples of how data analytics are of significance to date security are provided in this paper. Broad data and analytical data can be used to increase IT energy quality dramatically in hospitals and also effectively improve reliability and economic efficiency of healthcare energy efficiency.

The major contribution of Anuradha et al (2020) was focused on designing an Internet of Things for cancer prediction system to test whether it's normal or abnormal by extracting details of blood results. Additionally, blood results of cancer patient's data are suggested to be encrypted and stored over Cloud for high Internet reference by physicians or nurses for privacy. This research focused on developing computing and treatment in healthcare. It provides a structure for enhancing the efficiency of the current health system across the world. The conventional medical care drawbacks can be overcome, as all medical data must be stored in the cloud. The authentication and security of patients with cancer are achieved using an AES algorithm decryption and encryption. The emphasis is on managing patient health data efficiently while they are away from home as a requisite cancer therapy is stored in the cloud. The completion time of the task was substantially reduced by Virtual Machines (VMs)from 400 to 160. Clouds gave a versatile framework for simulation to view and reproduce issues. Xu An Wang et al. (2017) paper shows how IBE and IBPRE can be incorporated securely into a cloud system for e-health. They also suggested a new IBE system and demonstrated its protection. Also, a novel Identity based Proxy Re Encryption Scheme (IBPRE) was suggested. Green's paradigm doesn't follow. They introduced an e-health cloud system platform for Identity based encryption (IBE) and IBPRE. Several identity-related encryption techniques were also described for the security of e-health systems. These also demonstrated safety and performance analyses of these schemes and the results show that our IBPRE framework for re-encryption is extremely more efficient for cost-effective cloud use.

The study by J. Miranda et al. (2018),found that the medical services industry today is extremely affected by the definition and vision of "Industry 4.0". Therefore, creative methods and techniques are being employed to provide improved products, services, procedures, and facilities by healthcare companies in the context of new technology, ICTs, Internet of Things (IoTs). This paper uses the concept of 'sensing, sustainable and smart(S3)' to design and develop new technologies which promote healthcare in communities and wellbeing. A research by Sinnapolu & Alawneh(2018) describes that if a system app detects serious heart rate data, the microcontroller of the vehicle allows health locating apps to identify and drive to nearby hospitals for drivers to drive from the proximity sensor on wearables. Thus this prototype's online App can save the patients. This App about heart rate data over wearable devices and its analysis can help to save the life of the patients with critical disease. If a situation is critical and the driver does not respond to in-vehicle intervention, then the CAN message was sent through the microcontroller, to allow the autopilot to assist and rescue the patient.

Ahmed Meri et al. (2019) in their study, proposed a model by recognizing fundamental achievement factors that impact confirmation and checking through the conduct of doctors for utilization of cloud health data frameworks in Iraqi emergency clinics. By utilizing an online survey, the model's factors were measurably researched. A likelihood test of 259 specialists utilized in four high-IT emergency clinics in Iraq has acquired information. The partial least squares structural equation modelling (PLS-SEM) technique has been used to evaluate data obtained as non-parametric second-generation multivariate analysis. The results show that the effects of system compatibility confirmation and behavioral control, security, physician privacy, and system complexity on physicians are statistically significant. Behavioral and confirmation of conduct have also been positive for medical use in Iraqi hospitals of Technology. Such an outcome provides a guide to help encourage existing comprehension of health system data management cloud health systems and give policymakers sufficient recommendations to health practitioners to continue taking account of the use of modern ICT at work.

According to Al-Sharhan et al. (2019), patients and the community will greatly change their healthcare procedures and facilities by implementation at the national level of eHealth systems. To ensure successful implementation of these systems, the introduction of a new paradigm and holistic architecture of eHealth systems is necessary. Contemporary health systems have been severely impacted by the massive and steady development of computers, Internet technology, and communication. However adequate expertise, accessibility, a complex health environment, and failure to create a cohesive e-health system, create real challenges in presenting all these elements with an effective and appealing eHealth model. Also, health record security and secure access to information bring a new level of standardization to the protection of health records. The project has adopted a new model and integrated structure for efficient national integration of eHealth systems. With a new protection model for accessing health records, all success factors in an effective eHealth system are introduced.

T. Benil and J. Jasper (2020) presents different safety problems in sensitive health records, creating major impacts on a person's life due to a lack of confidentiality and honesty factors. To provide medical data protection, the study proposed to secure EHR with approvals of approved blockchain technology to conduct public testing and auditing on Medical Cloud Server, called EC-ACS (Elliptical Curve Certification Aggregate Cryptography Signature Scheme), and Medical Cloud server (MCS). In this Elliptic Curve Cryptography (ECC) the digital signature data for cloud-specifying sharing and data storage is encrypted with medical data and CAS. This proposal would secure protection, confidentiality, and sensitive information from unauthorized cloud healthcare systems. Blockchain technology also guarantees integrity, traceability, and safe storage in the cloud environment of medical records.

Hsueh-Chun Lin et al. (2020) and Amsalu Dinote et al. (2020) proposed the cloud-based IT health informatics transformation model (HITM) and Medical Process Automation Model (MPAM). In pre-processing data analyzing and training, SQL/PL modules were generated in the database. Results are performed in the platform's runtime efficiency and the function forecast is 90 % accurate. Reference to the health risk assessment computing feedback can be expected. In Sharma, M. & Sehrawat R. (2020),the main determinants of adoption decision in CC (cloud computing) in the healthcare sector (criteria and sub criteria) have been investigated. In the present study relevance of established determinants was found in qualitative interviews and Delphi methods (sub-criteria and criteria). To describe the relationship between specifications, subscripted resources critical criteria, and most relevant cloud service providers (CSPs), an integrated hybrid approach for interpretive frameworks, analytical hierarchy, and order-preference technology (ISM-AHP-TOPSIS) was also implemented. Seven criteria and 21 sub-criteria were evaluated for decision-makers to provide the roadmap before implementing the CC- adopting. ISM and AHP research revealed that technology for the human world is the most critical and least critical criterion. Gholipour, N. et al. (2020)in his research he analyzed hybrid container migration strategy and virtual migration in green cloud computing at the same time. This study aims to minimize migration and increase resource energy utilization, lowering energy demand, and generating more residual energy. Also, it targets for reduction in Service Level Agreements Violation (SLA) to increase the quality of service (QoS) of computation performance.

3. PROPOSED SYSTEM

In the previous researches we have explored till now, we found that not much work is done on healthcare in green cloud computing. The main purpose of this research is to secure and protect healthcare services to obtain a quick response along with less energy consumption of the resources. Therefore, for the accomplishment of this task, this paper proposed Joint Virtual Machine and Container Multicriteria Migration Decision Approach (JVCMMD) and AES- 512 bits System for security strengthening. The Proposed migration decision consolidation process is discussed in the next section with calculation of energy /power consumption:

3.1 PHASE 1

First, the overloaded hosts are found using median absolute deviation. Second, the Simple Method (SM) policy (Radu, 2017) is used for under-loaded hosts. Third, the proposed JVCMMD policy applies to assess, through the decision of applicants for migratory VMs, whether overloaded or under loaded hosts will migrate VMs or containers. Fourth, VMs approach is selected using the median average deviation between candidates. Fifth, for selected migrating VMs, a new destination host is specified with the Fuzzy TOPSIS Power and TPSA algorithm (TPSA). The VMs that were chosen for relocation are eliminated from the original competitor VM list and the rundown of residual VMs should have been moved reallocation. Sixth, migrating VMs not found for an appropriate destination host will be treated and

suitable containers chosen with Maximum Usage Migration Mechanism (Benil , T., & Jasper, J. 2020). Seventhly, new destinations for selected containers are defined with LFHS (Least Complete Host Selection Algorithm) as an alternative algorithm for COHRS (Correlation Threshold Host Selection Algorithm). Further energy and power consumption is calculated using the logistic regression technique which is a non-linear relationship unlike the linear relationship used in prior research studies.

Algorithm :To calculate energy and power consumption using migration decision combination process

Input : All Virtual Machines , All Hosts & Containers,
Output : Relocation Map.
1: Identify over-used hosts utilizing median absolute deviation strategy.
2: Identify under-used hosts utilizing Simple Method strategy.
3: Identify turned off hosts.
4: for each OL/UL have do
5: Candidate Virtual Machines for movement utilizing JVCMMD strategy.
6: Select Virtual Machines to be moved from competitor Virtual Machines, utilizing median average deviation strategy.
7: on the off chance that Virtual Machines are chosen, at that point
8: Place Virtual Machines on fitting hosts utilizing fuzzy TOPSIS power and TPSA strategy and put them in the relocation map.
9: else
10: Identify the holders of moving Virtual Machines that no reasonable objective is found for them, utilizing Maximum Usages strategy.
11: Place holders utilizing LFHS/CORHS strategy and put them in the relocation map.
12: end if.
13: end for.
14: return relocation map.

3.2 PHASE 2

Security for a huge volume of information with productivity is required and of necessity as data of the patients are not more confidential in nature. The enhanced AES algorithms are used for encryption and democratization of cancer patients to provide authentication and security. By2001, the National Institute of Standards and Technology (NIST) released Advanced Encryption Standard (AES) (Wang et al., 2017). AES is a symmetric block chip where both single key decryption and encryption processes are used. The AES algorithm's input and output consist of a 128-bit sequence. The 128, 192, or 256-bit key is used in this algorithm. AES is 8-bit bytes operating procedure. The following polynomial representation interprets these bytes as finite field elements:

$$F(x) = bn\text{-}1xn\text{-}1+bn\text{-}2xn\text{-}2+ \ldots\ldots. +b1x+b0 \quad (1)$$

where each is having a value of 0 or 1.

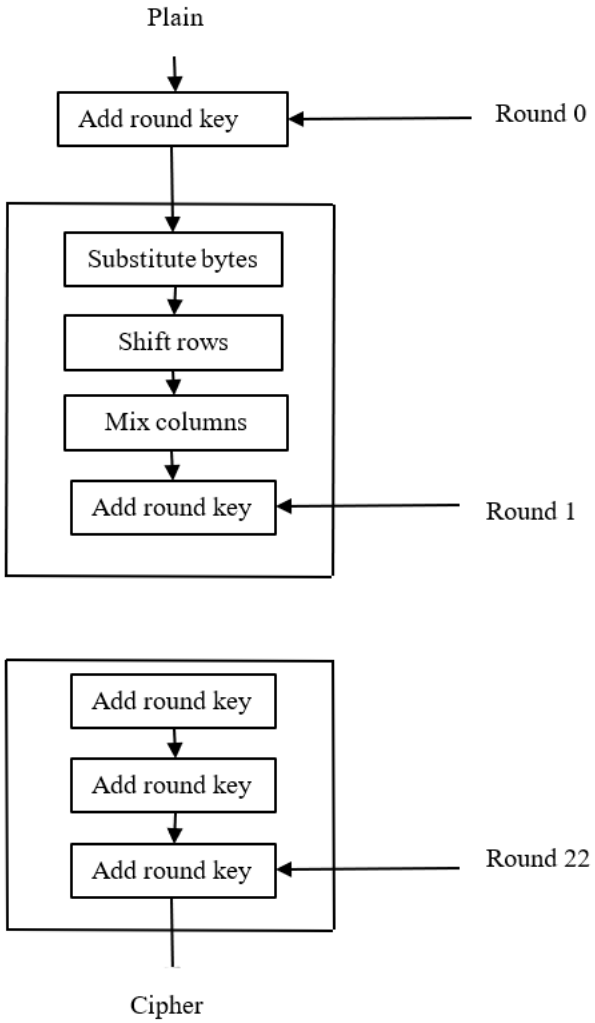

Figure 1: Flow diagram of AES- 512 bits System Architecture

4. RESEARCH CONTRIBUTION

One of the major research contributions is the design of an environmentally friendly, energy-efficient and cost effective model of healthcare systems. Of significance is green development of sustainable raw materials, green material and optimized processes with minimal to no environmental effects on the production of IT and relevant subsystems. The proposed system in this research seeks to improve response time, security, availability of health services, and treatment response on healthcare data in green cloud computing.

5. CONCLUSION

Several IT organizations around the world have initiated green computing, now being the most important part of everyday business. We can create an environmentally sustainable atmosphere through adopting green computing system design, development, and deployment practices. In addition to other benefits, such as cost reduction, conservation of energy, and minimization of energy wastage, the importance of green computing must be recognized and collaboratively work for the future generation systems in general and health care sector's healthier and greener system services for environment sustainability. This can be achieved through reducing energy consumption, using environment friendly computing equipment, and improving data center's cooling. This research focuses primarily on the use of green cloud computing in health care system services for energy-efficient ICTs, computing resources, and strengthening the security of healthcare data and resources. For this purpose, we aim to work on VM migration along with container migration and minimize the SLA violation reduction combined with the enhanced AES technique.

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