



Cloud Computing Domain Application in Computational Neuroscience— A Feasible Study

¹Amit Singh, ²Umesh Kumar, ³Shraddha Upadhyay, ⁴Ritesh Srivastava, ⁵Vinay Shukla

^{1,2} Department of Computer Application, Firoz Gandhi Institute of Engineering and Technology,
Raebareli, Uttar Pradesh, India

^{3,4,5} Department of Computer Science & Engineering, Institute of Technology & Management,
Chehari, Maharajganj Uttar Pradesh, India

Abstract: *Over a several years digital & medical technology has played a significant role in defining and reinventing techniques, medical devices, and pharmaceuticals in medical healthcare domain. Advancement in digital technologies as well as information & communication sciences (ICS) creates a wider scope in medical science more particularly in human brain research. We have to admit that human brain is a complex phenomenon to decode nonlinear activity one can use medical imaging devices to scan and understand its functional behavior. The potential & strength of computing power played a fundamental role in medical image processing. As days progresses future of medical technologies are going to be completely decentralized. Cloud computing has been introduced but aspect of application already in discussion research and clinical settings. This is why because easily accessibility and reconfigurable resources such as virtual systems, platforms, and applications with low service cost. Medical practitioners and researchers are moving their efforts to the cloud, because they need adequate resources to process, store, exchange, and use large quantities of medical data. In our study we are focusing on a novel application of Distributed Cloud Computing (DCC) and how it works in medical application in general brain neuroscience & imaging. The ultimate goal is to establish a strong link up with health & medical diagnosis. We are proposing distributed cloud platform together with cloud enabled data grid of human brain scan data of different brain scanners. This data grid is act like a brain consortium which help to do further research and also for medical treatment which widely accessible through web. The distributed cloud framework will spread across different geographic locations and distributed computing gives strong network to process cloud enabled data simultaneously & parallelly from different locations. In this work we are also introducing and establishing computational aspect of neuroscience from system to real brain with different brain disorders and how such data sets are formed in cloud computing. The centrality of our work is based on domain knowledge of bioengineering and how it club with computation based processing for medical healthcare to enhance research as well as speedy medical treatment of particular disorder and we also investigate how distributed cloud computing could benefit computational neuroscience.*

Keywords: *Cloud Computing, Neuroscience, Medical Imaging, Distributed Computing.*

I. INTRODUCTION

Cloud Computing simply means access of computing resources with the help of Internet. The ultimate purposes of data storage, aggregation, synthesis, and retrieval, together with the capacity to act on the data with computational algorithms and software packages [1]. The central dogma behind Cloud computing is used application & its peripherals devices and scalable computing resources from remote locations. Distributed based cloud computing framework will provide enough flexibility to access above computing resources from different geographic locations [2]. Particularly useful in computational based neuroscience research applications and also for medical practitioners. This is why because proposed framework based on human brain scan data sets and widely accessible through cloud based distributed computing network [3]. This paper delineates some of the well-known applications of Cloud Computing like software as service, platform as service and also Infrastructure as a service. The use of core Distributed System network is also highlighted. A comprehensive report of diverse Cloud renderings having different requirements for their system due to varying expectations of the customers is presented [4]. From a user perspective, cloud services are easier to use because they utilize well-known, standardized components [5]. Cloud computing are highly applicable in medical imaging now a days because of easily accessible of data & computing resources [6]. Several authors have tried to provide a succinct definition of what cloud computing is. However, these definitions are still not universally applicable because each is oriented toward specific applications. This is understandable, as cloud computing is quite young and researchers and

engineers from various fields have different points of view. [7, 8]. Medical healthcare domain is directly benefited from cloud services. This is just because information based digital technologies and its application in medical imaging can be greatly enhanced by use of cloud enabled technologies. Distributed based cloud computing network and collaboration of different neuroscience based institutions & data banks are interested to share their medical data and brain scan images. Patient data can be easily stored in virtual archives that are accessible by different healthcare providers, thus facilitating data sharing and significantly reducing local storage requirements. Security & privacy related issues arise from use of distributed based cloud systems for medical confidential personal data. Nevertheless, there are significant advantages in the interpretation of difficult clinical cases when employing distributed based cloud computing networks. Experts from different medical fields can consult on the diagnosis from around the world and applications are widely large in the domain of Computational Neuroscience. Clubbing all medical imaging data from different brain scanners as well as different brain disorder data with the help of distributed based cloud computing network will help us to process these data in very lucid manner [9]

II. RELATED RESEARCH

Kagadis et.al. Discuss about continuing education and teaching efforts can also be facilitated by the cloud. Teaching files can be accessed by several institutions, and training courses can be co-organized to provide shared access to learning tools such as software, presentations, and medical images of clinical interest.

Number of medical imaging studies is increasing approximately 3%–5% annually; this rate is not a significant driver of growth. However, the size of medical imaging studies, especially CT and MRI, is growing considerably faster, increasing storage requirements from 10% to 25% annually. Cloud storage prices have been dropping faster than enterprise storage prices, and this trend will likely lead to faster cloud adoption for medical image storage [10, 11]. An important driver of cloud storage is the observation that as CTs and MRI studies increase in size, longer times are required to transfer them to imaging workstations [12]. Distributed based cloud computing specially for medical imaging neuroscience research needed massive computational based processing and also parallel computation are key prerequisites to club with cloud computing [13]. Medical image reconstruction & image processing is a rapidly evolving domain for different imaging modalities, which over the next few years will require accurate quantitative analysis of reconstructed images [14].

III. PROPOSED FRAMEWORK

Distributed based Cloud computing network is still in very primary stage in computational neuroscience as well as medical imaging domain. Among the potential driving forces for the increased use of cloud computing in medical imaging are raw data management and image processing and sharing demands, all of which require high-capacity data storage and computing, considering the low cost solution for medical imaging modalities. One can bring distributed based cloud computing network in medical image processing domain its field related to domain of computational neuroscience. That can benefit from access to distributed based cloud computing. Research in different areas of medical image processing over the past decade has led to continuous algorithmic improvements. The proposed idea is to bring several institutions located in different geographic locations with the help of cloud based distributed computing network. This central concept also establishing brain related data base which can be shared with the help of cloud based networks. Of course security & privacy of these data sets are one of the important factors which can be considered at highest level. This notion can be extend in public & private brain data bank by this one can access these data sets using request to concern investigators. Simply figure 1 explain and give overview of cloud computing figure 2 gives depth explanation of entire framework which linked with distributed based cloud computing network as well as brain data network. We also proposed brain data network and its management in very large medical image collections is an increasingly demanding important issue in many hospitals and other medical settings. A huge amount of this information is daily generated, which requires robust and agile systems. User authentication and authorization, as well as information ownership, are the main security issues that must be taken into account when considering cloud-based medical services.

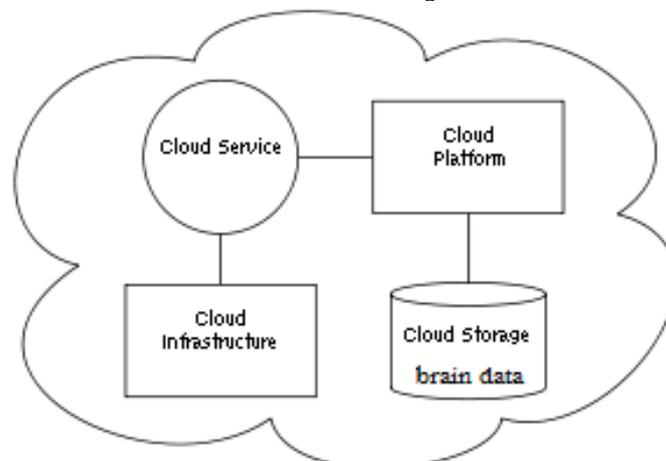


Figure 1. Domain of Cloud Computing [14]

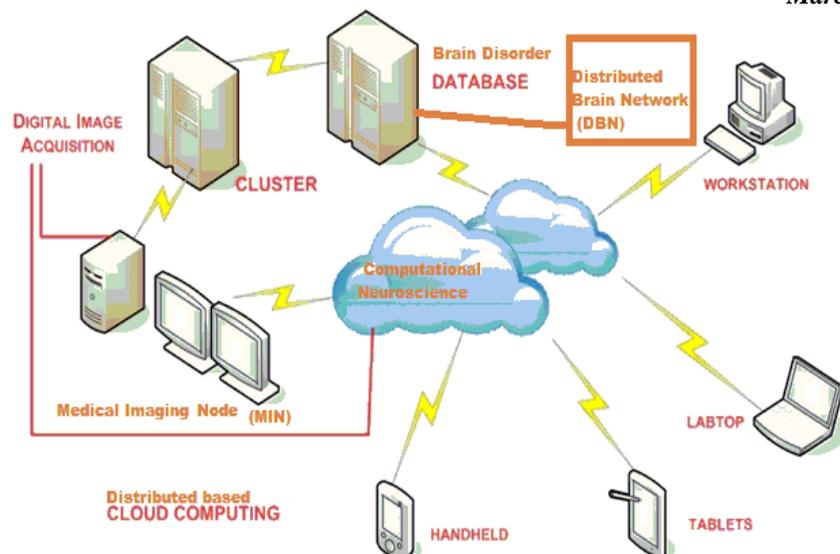


Figure2. Distributed based cloud computing framework

IV. CONCLUSION

Distributed based Cloud computing is transforming ICT services by turning them into a virtual public service. From that perspective alone, use of distributed cloud computing in the healthcare domain as well as medical imaging domain is inevitable, due to the increased functionality and economies of scale that can be achieved. At the same time, distributed cloud computing introduces major advantages for health provision and research that are impossible to ignore, and these will undoubtedly accelerate its adoption. This application can also explore wide platform for computational neuroscience domain. One can think medical enabled distributed cloud computing for social based cloud for medical awareness of particular diseases.

REFERENCES

- [1] P. Mell and T. Grance, "The NIST definition of cloud computing," Special Publication 800-145 (2011).
- [2] Nerkar&Sonali, "Cloud Computing in Distributed System," International Journal of Computer Science and Informatics 2231 -5292, Vol-1, Iss-4, (2012).
- [3] Jeffrey Dean, Sanjay Ghemawat. MapReduce: Simplified Data Processing on Large Clusters. OSDI (2004).
- [4] Liang-Jie Zhang and Qun Zhou. CCOA: Cloud Computing Open Architecture. IEEE International Conference on Web Services, (2009).
- [5] K. P. Andriole and R. Khorasani, "Cloud computing: What is it and could it be useful?," J. Am. Coll. Radiol. 7, 252-254 (2010).
- [6] Kagadis et al, "Cloud computing in medical imaging" Med. Phys. 40 (7), July (2013).
- [7] L. M. Vaquero, L. Rodero-Merino, J. Caceres, and M. Lindner, "A break in the clouds: Towards a cloud definition," ACM SIGCOMM Comput. Commun. Rev. 39, 50-55 (2009).
- [8] L. Wang, G. von Laszewski, A. Younge, and X. He, "Cloud computing: A perspective study," New Gener. Comput. 28, 137-146 (2010).
- [9] P. K. Kijewski, "Radiology IT: Applications integration vs. consolidation," J. Digit. Imaging 24, 814-822 (2011).
- [10] Forrester, A. Reichman, R. Whiteley III, and E. Chi, "File storage costs less in the cloud than in house," <http://www.forrester.com/File+Storage+Costs+Less+In+The+Cloud+Than+InHouse/fulltext/-/E-RES57696?objectid=RES57696>.
- [11] L. A. Silva, C. Costa, and J. L. Oliveira, "A PACS archive architecture supported on cloud services," Int. J. Comput. Assist. Radiol. Surg. 7, 349-358 (2012).
- [12] Informatics in Medical Imaging, edited by G. C. Kagadis and S. G. Langer, 1st ed. (CRC Press, Boca Raton, FL, 2012).
- [13] Daniel Nurmi, Rich Wolski, Chris Grzegorzczak, Graziano Obertelli, Sunil Soman, Lamia Yousef, and Dmitrii Zagorodnov. The Eucalyptus Open-source Cloud computing System. In Proceedings of Cloud Computing and Its Applications [online], October (2008).
- [14] https://en.wikipedia.org/wiki/Cloud_computing