Advance Cloud Computing Health Management System (ACCHMS) for Heterogeneous Distributed Systems

Javed Ali

*College of Computing and Informatics, Saudi Electronic University, Riyadh, Saudi Arabia.
Email: j.ali@seu.edu.sa*

Abstract

I proposed an advance health management technique which is based on recent cloud computing technologies. The proposed technique will be able to assist automated health management based on cloud computing. This technique will enhance the processing of patient files in various health departments for the extraction of accumulated complete health records. It will integrate centralized repository for securing, archiving, retrieving and managing data remotely. Moreover, our proposed model supports all advanced file formats of attachments, and it is also featured with a competent search engine and retrieval tools that can fetch exact information within few seconds with document integrity and corporate control. The system also allows communications through multiple channels. The proposed model may be deployed over recent advanced cloud computing technologies where different users will access the health management system remotely.

Keywords: Cloud Computing, Health Management, Hospital, Patient

I. INTRODUCTION

Cloud computing play an important role for distributed computing systems in which large storage capacity and important software can be used efficiently in optimum costs. Cloud based techniques are capable to provide online services without worrying about the hardware devices and physical structures. Multiple service providers are capable to control the databases with high quality security management. In this Era, we can use high quality services without purchasing high cost servers. We can use subscription based services, on the bases of the requirement of cloud based health management infrastructure.

Advance Cloud Computing Health Management System (ACCHMS) is capable to provide easy and secure access to the technical staff, doctors and as well as patients. It's highly complex to maintain physical attendance records of the employees as well as technical staff also. With the help of Electronic Medical Record mechanism, all medical testing equipment performance and maintenance records can be stored easily and permanently. Online access of all records may be explored with the help of mobile applications also. This record maintaining facility reduces manpower as well as physical space requirements. Strong database data access capabilities play an important role for reducing retrieval time of the queries for medically serious patients quickly and accurately. In paper based records, history based records of the patients may be lost at the time of serious health conditions. Data Base Administrator (DBA), is responsible to assign the privilege of database access. Most important feature of the proposed model is that, no one can access the confidential record of the patients without the permission of concern patients and hospital management authorities. So, in cloud computing based environment large amount of data can be stored remotely with high security capabilities. As data stored in cloud computing based environment, so cloud service providers are responsible to assigned data access privileges to ACCHMS. Personal Health Record maintain all records of

individual patients that can be access by the assigned doctors as well as technical staff of the hospitals.

Proposed solution is web-based solution and it's capable to attach files of medical test records, invoice records and other employees records as an attachment. ACCHMS goes beyond standard functionality by providing the additional dimensions of knowledge management, intelligent search agents, advanced web based notification features, and multi-channel access functionality. Security is one of the most important features of proposed model; it ensures that only authorized users log on to the system and activates the system's pages that conform to their privileges.

II. LITERATURE REVIEW

Koufi et al., proposed "Cloud Emergency Medical Services". They depicted their system components, infrastructure, platform and Software as a Services. They shows performance of prototype implementation system on data centers in cloud computing environment [1]. Fujita et al., implemented "Cloud Cardiology" which they enabled smooth communications amongst multiple departments of the hospitals. Unfortunately, the proposed solution couldn't provide Cloud based secure infrastructure for cardiac failure system [2]. Rao et al., proposed a model that can't facilitated tele-medicine services for rural areas [3]. "Noncontact ECG monitoring" is also a web based system which was proposed by Fong and Chung [4].

Wang et al., explained a system which was able to capture the ECG records for the analysis of the individual patients during critical conditions of the patients[5].

Hiden et al. proposed "a platform as a service which itself was built on an infrastructure as a service environment". The article illustrated extensively how to use cloud computing services for maintaining the secure records of the patients remotely [6].

Kakadis presented further investigations about the image based analysis of internal medical reports in cloud computing environment. How

to manage information communications amongst different types of the departments. He proposed only theoretical and implementation details not covered in the proposed model [7].

Doukas explained analyses of the image processing by using Amazon services in advance computing environment with the help of Wide Area Network. In addition, he discussed only internet based services in client server architectures and cloud computing concept not covered [8].

Botts et al: "Health ATM" was a pilot study by using cloud architecture which offered instant access to personal health information for under-served population groups such as the people who doesn't have a health insurance. They depicted that how individual data in the population can be stored but implementation details not discussed briefly [9, 10].

Takeuchi et al. demonstrated practical techniques to save individual lifestyle and health records with the help of smartphones Applications. They implemented data-mining technologies in a cloud infrastructure for the analysis of human behavior patterns but they didn't demonstrate that how to manage this data on the cloud [11].

Telecare Medical Information System (TMIS) proposed by Siddiqui et al. They discovered virtual helpline for the patient who was not able to reach the OPD (Out Patient Department) due to old age factors and physically handicapped. With the help of telephonic devices, they authenticated the patients remotely and suggested their medicines based on the health conditions and diagnosis [13].

Health record frauds detection Model proposed by B. Rao. He enlightens the concept of financial recovery in cloud base services. He also expressed that how financial fiscal can be detected and resolved in the hospitals by using health management system [12].

Comuzzi and Van Gorp argue the model of MyPHR (Personal Health Record) Machines in which health information may be stored remotely. In this model, there is no data

transformation and health analysis carried out on the basis of inserted data. Patient can access their data with help of MyPHR Machine individually and remotely. So health software may be used to share the information as well as health prescriptions [14].

Xu et al. suggested a computerized machine which was capable to monitor the activities of Trauma patient. Health progress of the patients may be access remotely with the help of switched Telephone Network [15].

Chiang and Su described in house facility for old age patients. They used Artificial Intelligent algorithms to design an electronic platform which known as Home Care Web Service. They used cloud based architecture also but this model couldn't be successful due to unclear demonstration of cloud based technologies [16].

Jalali et al. defined parallel processing based techniques for huge number of inhabitants by forming a conceptual cloud computing base model in which flow of information can be shared remotely by using individual cloud infrastructure [17].

Moreover, Ahn et al. suggested hypothetical article in which he explained mobile based cloud computing techniques for concentrating energy productivity [18].

Yoo et al. designated cautious tactic by building an individual computing infrastructure inside Seoul National University Bundang Hospital (Korea). They proposed virtual desktop cloud amongst four hundred virtual machines. This infrastructure supported highly user friendly environment amongst all departments of the hospital and found that marginal benefit can be achieved in short period of time [19].

According to Ratnam and Ramayah, Malaysian government launched a pioneer alteration in the installation of hospital information and management systems (HIMS). They used cloud based Azure infrastructure as a pattern model [20].

A public based Cloud Medical Service Delivery Framework (CMSDF) model launched by Yao et al. in which they collected information of the patients those who are belongs to the small area general hospitals. This model is referred as Grassroots aid establishments in China. Shortcoming of this model was that they were not able to share the code amongst all service centers situated in remote areas. This code used as a medical code but couldn't be implemented successfully Software as a Service [21].

Patient health records encryption problem demonstrated by Rodrigues et al. with the help of some important articles submitted by potential scholars. They explained that data can't be shared confidentially amongst the hospitals by using encryption in physical devices [22].

Individual infrastructure and private virtual network can be encrypted successfully by using proprietary access. Regola and Chawla used HIPAA (Health Insurance movability and responsibility Act) to solve the criticism of the users [23].

Christoph et al. proposed Neuro-Linguistic Programming (NLP) cloud based service in which they suggested that Nebula-Based implementation can be carried out publically and privately amongst small departments [24].

Shen et al. reveals mystery that generic standards-based services may be implemented to share important data by using web based services amongst geographically distributed hospitals [25].

III. PROPOSED MODEL

Proposed Model provides Web based solution in which Integrated Layer play an important role for sharing data efficiently with high security concerns. In security layer, multiple encryption algorithms implemented according to the importance of shared information amongst multiple hospitals located at different locations globally.

Health Management System consists EMR (Electronic Medical Record), Personal Health Record(PHR), Electronic Health Record(ELR), Reporting Management, Notification Service and Archiving Modules. These all modules are responsible for secure and fast communications amongst distributed hospitals by using cloud

computing services. Modern software can be used for fast and reliable communications. Highly advanced network based software may be used for fast and reliable communications amongst different networks.

EMR (Electronic Medical Record) Module: This module is responsible for maintaining all health records of the patients, employees and management team also. Details of the equipped electronic devices in the hospitals may be recorded in EMR efficiently. This module is flexible to enhance the processing capabilities of the medical test reports as well as executing the biological test inside the hospitals. Attendance record of the employees and salary records of all staff members is also managed by EMR system. All promotion records of the individual employees will also be managed according to the services and experience of the registered employees.

Personal Health Record(PHR) Module: This module is responsible for maintaining the records of all registered patients. Confidentiality of the personal records of individual patients will also be maintained efficiently by applying important encryption algorithms. Sharing of the data amongst multiple hospitals can also be achieved by using Cloud base services in highly cost effective manner. Sharing of information flow can be enhanced by using good communication channels and software in network management system.

Electronic Health Record Module: This module is designed to maintain all health records including biological test results analysis of the patients. Medical history of the individual patient can also be maintained for the better prescriptions of the medicines.
Reporting Management is responsible for all types of the feedback given by the patients as well as their guardians. Daily transection report can be generated by using advanced Payroll based software.

Notification services are used to notify about the schedule of the concern doctors and timings of hospital OPDs. Sometime if there is no available space in the hospital for particular patient then it can be notified virtually by using Cloud Based Service as a Software.
Archiving Module is responsible to record all type of data and transections daily monthly and yearly. By using this module, data of the employees and patients can be retrieved very easily on the basis of their IDs.

Enterprise Data Layer: This layer is responsible for managing operational and transection data in real time manner. Collection of the data and retrieving the records of the data can be achieved by using advance database techniques. Statistical data can be analyzed for the formation of important reports based on advance statistical tools.
These all modules collectively provide a flexible and scalable mechanism in which security concern can be applied for secure Data Management by using advance Cloud Computing Services in health management system.
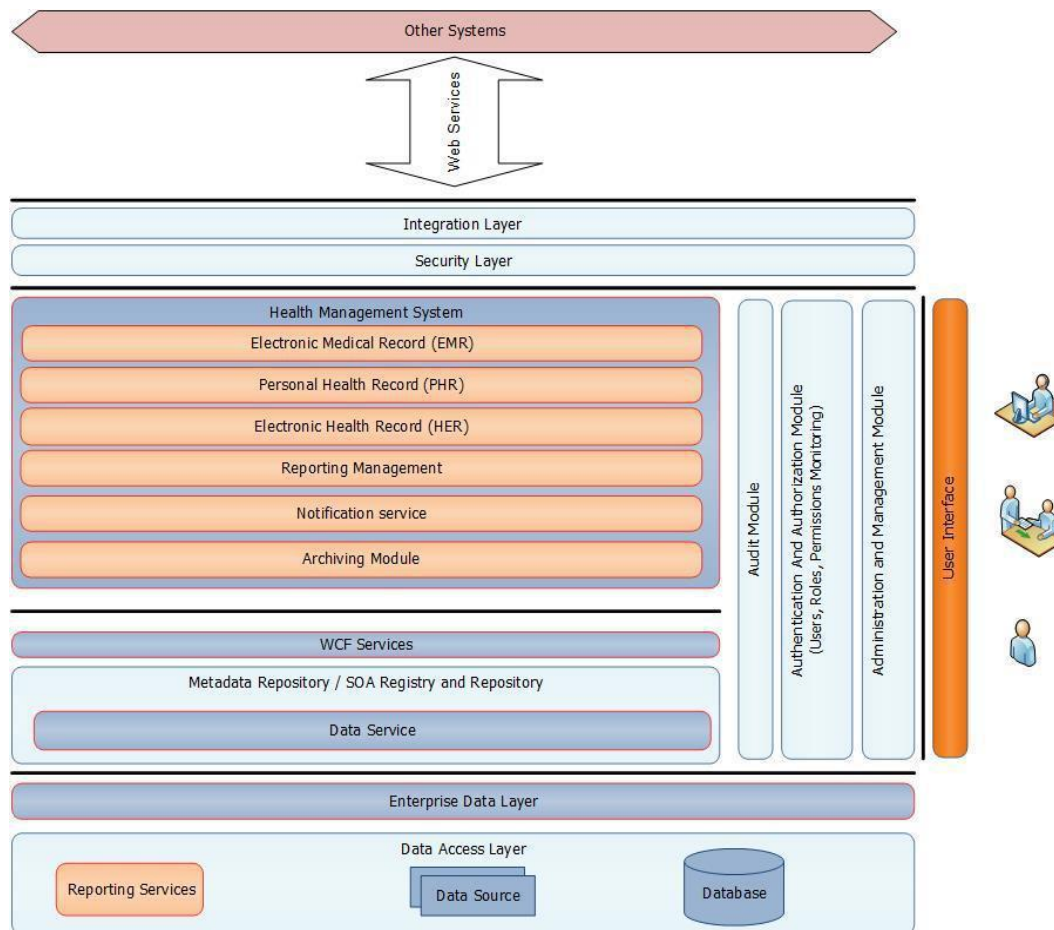
Figure 1: ACCHMS proposed Model

The ACCHMS provides flexible and reliable advance technology services to manage the work remotely. It eliminates errors resulting from poor communications. Maximum level of security and protection of information and data can be achieved by authorized users. It also provides remote access to information to the authorized users. Multiple real time reports can be created for better treatment of the patients.

The proposed model intends to protect from viruses that may cause a serious negative impact on the functioning of cloud computing based infrastructure, therefore threat detection and prevention mechanism is mandatory to avoid this impact. Network and data security may be achieved by authorizing only subscribers to connect to the intended network.

In addition to the above features the proposed model is capable to achieve the below listed services also:

Real-time analysis. To handle the emergency situations, real time analysis of the medical records can be achieved by using highly equipped laboratories based on the cloud computing technologies. Remarkable factor of the proposed model is that if we don't have facility of analyzing the biological test of newly diagnosed health issues of the patients those who are in critical conditions then by using virtual services of cloud computing we can analyze the data in Real Time Manner. Data can be shared Globally without wasting the time due to Virtual installation of the infrastructure of Software and hardware devices.

Unified linking to Cloud Computing Infrastructure: ACCHMS provides flexible and secure access of the data. Upgradation of the records can be maintained by using advance software in Cloud Computing Environment. All records of the data available 24/7 remotely

by using virtual space facility in Cloud Computing Infrastructures.

IV. CONCLUSION:

The proposed technique shows remarkable performance for secure communications by using advance services in cloud computing environment for health management systems. Flow of information amongst different departments like OPDs, laboratories, pharmacy and emergency wards can be shared quickly. Security concerns and confidential data of the patients managed successfully in user friendly manner. Advance reporting system and notification services used for better care of the patients in the concern hospitals.

REFERENCES

1. Koufi V, Malamateniou F, Vassilacopoulos G. Ubiquitous access to cloud emergency medical services. In: Proceedings of the 2010 10th IEEE International Conference on Information Technology and Applications in Biomedicine (ITAB); The 10th IEEE International Conference on Information Technology and Applications in Biomedicine (ITAB); November 3-5, 2010; Corfu, Greece. New York, NY: IEEE; 2010.

2. Fujita H, Uchimura Y, Waki K, Omae K, Takeuchi I, Ohe K. Development and clinical study of mobile 12-lead electrocardiography based on cloud computing for cardiac emergency. Studies in health technology and informatics. 2013;192:1077.

3. Rao GSVRK, Sundararaman K, Parthasarathi J. Proceedings of the 2010 14th International Conference on Intelligence in Next Generation Networks (ICIN) Berlin, Germany: IEEE; 2021. Dhatri-A Pervasive Cloud initiative for primary healthcare services.

4. Fong EM, Chung WY. Mobile cloud-computing-based healthcare service by noncontact ECG monitoring. Sensors (Basel, Switzerland) 2013;13(12): 16451–73. doi: 10.3390/s131216451.

5. Wang X, Gui Q, Liu B, Jin Z, Chen Y. Enabling smart personalized healthcare: a hybrid mobile -cloud approach for ECG telemonitoring. IEEE J Biomed Health Inform. 2014;18(3):739–45. doi: 10.1109/JBHI.2013.2286157.

6. Hiden H, Woodman S, Watson P, Cala J. Developing cloud applications using the e-Science Central platform. Philos Trans A Math Phys Eng Sci. 2021;371(1983):20120085. doi: 10.1098/rsta.2012.0085.

7. Almashaqbeh G, Hayajneh T, Vasilakos AV, Mohd BJ. QoS-aware health monitoring system using cloud-based WBANs. J Med Syst. 2022;38(10):121. doi: 10.1007/s10916-014-0121-2

8. Kagadis GC, Kloukinas C, Moore K, Philbin J, Papadimitroulas P, Alexakos C, et al. Cloud computing in medical imaging. Med Phys. 2021;40(7): 070901. doi: 10.1118/1.4811272.

9. Doukas C, Pliakas T, Maglogiannis I. Mobile healthcare information management utilizing Cloud Computing and Android OS. Conf Proc IEEE Eng Med Biol Soc. 2010;2010:1037–40.

10. Botts NE, Horan TA, Thoms BP. HealthATM: personal health cyberinfrastructure for underserved populations. Am J Prev Med. 2011;40(5 Suppl 2):115–22. doi: 10.1016/j.amepre.2011.01.016

11. Takeuchi H, Mayuzumi Y, Kodama N, Sato K. Personal healthcare system using cloud computing. Stud Health Technol Inform. 2013;192:936

12. B. Rao, "The role of medical data analytics in reducing health fraud and improving clinical and financial outcomes," in Computer-Based Medical Systems (CBMS), 2013 IEEE 26th International Symposium on, June 2018, pp. 3–3.

13. Siddiqui Z, Abdullah AH, Khan MK, Alghamdi AS. Smart environment as a service: three factor cloud based user

authentication for telecare medical information system. J Med Syst. 2014;38(1):9997. doi: 10.1007/s10916-013-9997-5

14. Van Gorp P, Comuzzi M. Lifelong personal health data and application software via virtual machines in the cloud. IEEE J Biomed Health Inform. 2014;18(1):36–45. doi: 10.1109/JBHI.2013.2257821

15. Xu R, Mei G, Zhang G, Gao P, Pepe A, Li J. TPM: cloud-based tele-PTSD monitor using multi-dimensional information. Stud Health Technol Inform. 2013;184:471–7

16. Su CJ, Chiang CY. IAServ: an intelligent home care web services platform in a cloud for aging-in-place.Int J Environ Res Public Health. 2013;10(11):6106–30. doi: 10.3390/ijerph10116106

17. Jalali A, Olabode OA, Bell CM. Leveraging Cloud Computing to Address Public Health Disparities: An Analysis of the SPHPS. Online J Public Health Inform. 2017;4(3) doi:10.5210/ojphi.v4i3.4325.

18. Ahnn JH, Potkonjak M. mHealthMon: Toward Energy-Efficient and Distributed Mobile Health

19. Monitoring Using Parallel Offloading. J Med Syst. 2013;37(5):9957. doi: 10.1007/s10916-013-9957-0.

20. Yoo S, Kim S, Kim T, Baek RM, Suh CS, Chung CY, et al. Economic analysis of cloud-based virtualization implementation at a hospital. BMC Med Inform DecisMak.2012;12:119. doi: 10.1186/1472-6947-12-119

21. Ratnam KA, Dominic PD, Ramayah T. A structural equation modeling approach for the adoption of cloud computing to enhance the Malaysian healthcare sector. J Medicine.

22. Yao Q, Han X, Ma XK, Xue YF, Chen YJ, Li JS. Cloud-based hospital information system as a service for grassroots healthcare institutions. TheScientificWorldJOURNAL. 2018;38(9):104

23. Rodrigues JJ, de la Torre I, Fernández G, López-Coronado M. Analysis of the Security and Privacy Requirements of Cloud-Based Electronic Health Records Systems. J Med Internet Res. 2013;15(8):e186. doi: 10.2196/jmir.2494.

24. Regola N, Chawla NV. Storing and using health data in a virtual private cloud. J Med Internet Res.2013 ;15(3):e63. doi: 10.2196/jmir.2076.

25. Christoph J, Griebel L, Leb I, Engel I, Kopcke F, Toddenroth D, et al. Secure Secondary Use of Clinical Data with Cloud-based NLP Services. Towards a Highly Scalable Research Infrastructure. Methods Inf Med. 2021;53(6)

26. Shen CP, Jigjidsuren C, Dorjgochoo S, Chen CH, Chen WH, Hsu CK, et al. A data-mining framework for transnational healthcare system. J Med Syst. 2012;36(4):2565–75. doi: 10.1007/s10916-011-972

Javed Ali is presently working as Assistant Professor in the College of Computing Informatics at Saudi Electronic University, Madinah Munawarah, Kingdom of Saudi Arabia. He received B. Sc.(Hons), M.C.A. and Ph.D. from Aligarh Muslim University, Aligarh. He has 5 years of teaching experience of reputed International and National Universities viz Glocal University, Uttar Pradesh, India, ACN College of Engineering and Technology. His research interest includes parallel and distributed computing, expert systems, cloud computing and Internet of Things. He has published about 14 research papers including ISI (Elsevier/Springer) in Journals/Conferences of International repute. He received state-level scientist award by the government of India