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Internet of Health: Applying IoT and Big Data to Manage Healthcare Systems

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Abstract— *This paper investigates the role of Internet of Things(IoT) in alleviating the challenges in health care domain. The major issues encountered by the authors are in case of healthcare systems are interoperability and security. All the health data are considered to be the personal private data and those data should need security. Like confidentiality, integrity, authority should be preserved in the case of medical data. IoT interoperability issues are still not being considered a problem to develop a data transfer system connecting health care providers with patients. Some middleware proposals use SOA (Service Oriented Architectures) in embedded Networks middleware is in need for standards to improve interoperability of devices especially in the case of healthcare devices. Ubiquitous health model is also in existence. In this model, the individual medical data was measured by ubiquitous personal health device (UHD) and the information is sent to the health service will provide feedback to the medical experts and patients. It is clear that, the analysis and processing function of medical data were done in the server only. We provide a description of how the internet of things can be the main enables for distributed health care applications. This paper would promote a lot of research in the area of application of IoT in healthcare.*

Keywords- Internet of Things, Cloud Computing, Big Data, Service Oriented Architecture, Health care systems.

I. INTRODUCTION

This paper investigates the role of Internet of Things (IoT) in alleviating the challenges in health care domain. The major issues encountered by the authors are in case of healthcare systems are interoperability and security. All the health data are considered to be the personal private data and those data should need security. Like confidentiality, integrity, authority should be preserved in the case of medical data. IoT interoperability issues are still not being considered a problem to develop a data transfer system connecting health care providers with patients. Some middleware proposals use SOA (Service Oriented Architectures) in embedded Networks middleware is in need for standards to improve interoperability of devices especially in the case of healthcare devices. Ubiquitous health model is also in existence. In this model, the individual medical data was measured by ubiquitous personal health device (UHD) and the information is sent to the health service will provide feedback to the medical experts and patients.

The rest of the paper is organized as follows: section 2 describes a cloud-based 3D Healthcare Data Management. Section 3 gives a broad overview of Cloud-Based Mobile Health Information Recommendation System On Wireless Sensor Networks. Section 4 gives a detailed view on Medical Treatments Carried Out Based On PHRs In Cloud. Section 5 portrays Medical Treatments based on HDFS in Cloud. Cloud Enabled Health Shocks Prediction is depicted in Section 6. Section 7 speaks about Signcryption of PHRs in Cloud. Section 8 concludes the paper giving the future research direction.

II. CLOUD-BASED 3D HEALTHCARE DATA MANAGEMENT

ArcangeloCasHglione, RaffacloPizzolante, Alfredo De Santis, Bruno Carpentative, Aniello Castiglione, Francesco Palmeri (2016) [1] in their paper on Cloud –based adaptive computer and secure management service for 3D healthcare data described that 3D-Medical Imaging plays a vital role in healthcare management. Dealing with this type of images with low configuration require complex network protocols and advanced security techniques for compression. A 3D Medical image should be completely transparent to the end user and it should not depend on the computers or network he/she uses. This can be ensured by providing two entities namely,

1)An engine which produce lossless and adaptive dynamic 3-D images, which also allows embedding security watermarks.
2)The architectures of SaaS cloud system.

The architecture with this combination can give a lossless, interactive transparent system to the end user. For compression, least significant technique relating to digital water marking can be used. The idea is the watermark string is hidden as the embedded pixels using Least Significant Bit (LSB). Once the subset which are capable of hiding the bits of watermark is generated, we can elaborate the pixels of the image by processing them together. The security between the transaction of images are guaranteed by these security properties of Public-Key cryptography, Key exchange and Private-

key cryptography. For communication facility by using HTTP(ubiquitous) in particularly SOAP over HTTP, we can pave way for the mobile phones and other devices to actively participate in it, though, the memory space required for the compression is nearly equal. Finally the proposed system can be used to manage other types of biomedical and genomic data. This system can rely of fully public transport facility because the integrity and security is guaranteed by the encryption facilities between the involved parties provide both at storage layers and communication.

III. CLOUD-BASED MOBILE HEALTH INFORMATION RECOMMENDATION SYSTEM ON WIRELESS SENSOR NETWORKS

Shu-Lin Wang,Young Long chen,Alex Mu-HsingKuo,Hung Ming Chen,YishiangShiu (2016) [2] in their paper on Design And Implementation Of A Cloud-Based Mobile Health Information Recommendation System On Wireless Sensor Networks dealt with capabilities of mobile web. A mobile web for personalized information on health can be developed by cloud computing environment, mobile communication technology, context awards technology and wireless sensor networks[3]-[6]. This system includes two recommendation services:

1)A collaborative recommender and

2)A physiological indicator-based recommender.

To protect the moving objects path, a hybrid model can be developed by combining the Grey Theory and Markov Chain. This will increase the lifetime of the Markov and reduces the cost for tracking the errors. The system installed in VMware Workstation to improve the effectiveness of searching information. The database used are MySQL, Javascript, CSS, PHP, jQuery as the main programming languages.

The collaborative recommender works on FRSA(Fusion of Rough set and Average Category rating)algorithm to calculate and recommended health information to the respective users. On the other hand, physiological indicator measures blood pressure monitors, weight meters etc and transmit signal to the cloud database through wireless sensor network. To increase the prediction of sensor nodes Fuemmeler's scheme is used. This will predict more accurate position of the targets which appears in each sensor nodes. Thus by following these techniques a web application can be developed which helps the user to get detailed information of their health at the right time.

IV. MEDICAL TREATMENTS CARRIED OUT BASED ON PHRs IN CLOUD

Dhivya.P,Roobini.S.Sindhiya.A (2015) [7] in their paper " Systems Based Treatment Based On Personal Health Record Using Cloud Computing", postulated that Cloud architecture can be used to store the health rewards of the patients and provide suitable instructions based on the records. The information are stored in a database with proxy-re-encryption method. Cloud computing facilitates businessmen, students, professional institution etc to store information online. The existing system portrayed by the author is capable to do this. But the disadvantages is that the general encryption of data is quiet confidential but it restricts some features of the storage system. Data robustness is essential, but it is with no central authority, secure storage system that supports multiple functions is challenging storing information of the patients in a third party system causes serious concern on confidentiality of data. To provide confidentiality, a user can encrypt message before applying an erasure code to encode and store message. Attribute based encryption can be done for ensuring user to the viewers. The cloud storage contains only encrypted data of the data owners. A key will be sent to the user's private devices and each the data can be decrypted only when that particular key is used. A key will be valid only for one time. The next it will generate a new key. For re-encryption also the user should give a key provided by the system. By using this technique, we can ensure a reliable health information to the patients through cloud storage.

V. MEDICAL TREATMENTS BASED ON HDFS IN CLOUD

Chao-Tung Yang,Wen-Chung shih,Lung-TengChen,Cheng-Tai Kuo,Fuu-Cheng Jaing,Fang-Yie Lau (2015) [2] in their paper dealing about Accessing Medical Image File With Co-Allocation HDFS In Cloud, identified a problem in World Health Organisation(WHO) where the patients privacy in storing and sharing a medical records in hospital. This paper presented Medical Image File Access System(MIFAS) working on Hadoop Platform for solving problem of exchanging, storing and sharing medical images. This also includes a co-allocation mechanism for inspecting medical images on Cloud computing. Co-allocation architecture is efficient for parallel downloading from data nodes. It works by specifying the characters of desired data and pass attributes description to a broker. Then, it will search for resources available and obtain the Information Service Location. In this paper, authors suggested eight co-allocation schemes such as Brute force, History-based, Conservative Load Balancing, Aggressive Load Balancing, Recursively-Adjusting Mechanism, Dynamic co-allocation with duplicate Assignment, Dynamic Adjustment Strategy and Anticipate Recursively-Adjusting Mechanism. The MIFAS systems has three HDFS groups .They are THU1,THU2 hosted at Tunghai University and the third group hosted at Chung Shan Medical University(CSMU) Hospital. They are connected with 100Mbps network bandwidth in TANET(Taiwan Academic Network)environment. Middleware mechanism can be used to handle transmission issues. By using these technique medical image files can be accessed more efficiently than PACS system.

VI. CLOUD ENABLED HEALTH-SHOCKS PREDICTION

ShahidMahmud, RahatIqhal, Faiyaz (2016) [5] in their paper on Cloud Enabled Data Analytics And Visualization Framework For Health-Shocks Prediction, said that health shocks on single individual person, his family and society may occur due to some critical illness in the family history. The aim is to reveal the relationship between socio-economic, demographic and geographical conditions and their impacts on health. To study the health shocks in one particular area, authors conducted a user study to gain a dataset of 1000 households. Questionnaries were given to the people and is divided into 12 sections with an aim to obtain geographic, demographic and socio economic data. For this purpose a cloud system based on Amazon Web Service(AWS) synchronized with Geographical information System(GIS) will be developed to capture to index, storage and visualize the data through smart devices. For prediction, Fuzzy logic systems can be used due to their ability to handle and manipulate uncertainty, imprecision, complexity and incompleteness of information. It is flexible and transparent with a methodology for predictive modeling and classification by approximate reasoning of uncertain information. It will be useful for healthcare professionals to conduct surveys with less human efforts and financial resources. It will also help Government to form policies and health reforms [9]-[12].

K.Ashokkumar,Baronsam,R.Arshadprabhu,Britto (2015) [8] in their paper on Cloud Based Intelligent Transport System, focuses on solving challenges in transportation issues. Authors employed a multi-layered vehicular data cloud platform by cloud computing and IoT technologies to deal with significant traffic, vehicle safety and congestion. Vehicular AdhocNETwork(VANET) is used to communicate between two different vehicles and its applications targeted on up drivers safety and traffic watching, emergency warning and road help. By using varied devices like sensors, actuators, GPS devices, mobile phones, controllers, networking technologies, cloud computing, IoT, middleware and platforms supporting V2V and V2I communication mechanism, information can be transferred among the drivers. Working modules include intelligent parking cloud and vehicular Data Mining Cloud service. Intelligent Parking Cloud Service gives information about parking spaces and whether the space is occupied or vacant. IoT helps to integrate varies devices offered inside vehicle and the devices within road structure. Thus IoT and Cloud Computing pave way for tremendous opportunities for technology innovations.

VII. SIGNCRYPTION OF PHRs IN CLOUD

Jianghua Liu, Xinyi Herang AND Joseph X Liu (2015) [4] in their paper on, " Cloud Computing-Secure Sharing Of Personal Health Records By CP-ABSC(Cipher Text-Policy Attribute -Based Signcryption" addressed dual problems on preserving E-PHRs(Electronic-Personal Healthcare Records) namely,

1)An enemy can access the Personal Health Record which is stored in cloud ,the data is transmitted through the internet and

2)The unknown person can change the personal health records before the authorized person reads it.

The author proposed solutions as: Personal health records are shared securely by viper texts policy attribute based signcryption. In this paper, an already existing access control is secured by using CP-ABSC that can protect the PHR and the access control is restricted only for authorized user can read and only or modify the already existing PHR.

Assad Abhas, Kashif Bilal, Liminzhang, Samea U-Khan (2016) [3]in their paper on, " Cloud Based Health Insurance Plan Recommendation System" says that now-a-days, the use of Information and Communication Technologies has brought a rapid growth in the volumes of digital data through Internet. Multi-Source data Organization and management that are huge in nature and rely on the concept of 'Bigdata' which contain huge volume of data.The cloud computing ensuring the quality of service through internet. Authors focus on the information that has been given to researchers. Electronic health records used some bigdata innovative tools to achieve highly effective outcome [13]-[15].

VIII. CONCLUSION

This paper investigates the role of Internet of Things(IoT) in alleviating the challenges in health care domain. The major issues encountered by the authors are in case of healthcare systems are interoperability and security. All the health data are considered to be the personal private data and those data should need security. Like confidentiality, integrity, authority should be preserved in the case of medical data. IoT interoperability issues are still not being considered a problem to develop a data transfer system connecting health care providers with patients. Some middleware proposals use SOA (Service Oriented Architectures) in embedded Networks middleware is in need for standards to improve interoperability of devices especially in the case of healthcare devices. We provide a description of how the internet of things can be the main enables for distributed health care applications. This paper would promote a lot of research in the area of application of IoT in healthcare.

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