Research on Management and Monitoring of Intelligent Medical Data Platform Construction under Cloud Computing

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Abstract: In order to improve the medical efficiency and the accuracy of disease prediction, this paper studies the construction and management of medical data in cloud computing environment. Mainly from the access expansion model and password protection mechanism, this paper mainly analyzes the platform construction and management of medical data in cloud environment from the access control model and encryption mechanism. These technologies have solved the problems of dynamic data access, fine-grained access control and step-by-step authorization according to patients' preferences in special medical scenarios. Access control can indeed prevent unauthorized users from obtaining data L23 intentionally or unintentionally to a certain extent. However, the current access control technology of medical data is mostly in the research stage, and it is not fully integrated with medical institutions or systems to prevent data leakage or theft. In the past two years, 90% of medical companies have been hacked and leaked patient data.

Keywords: cloud computing; Wisdom; Medical data; Construction management

1 INTRODUCTION

Smart medical care is a medical system that comprehensively applies medical Internet of Things, data fusion, transmission and exchange, cloud computing, metropolitan area network and other technologies, integrates medical infrastructure with IT infrastructure through information technology, takes "medical cloud data center" as the core, crosses the time and space limitations of the original medical system, and makes intelligent decisions on this basis to realize the optimization of medical services. The regional smart medical platform based on cloud computing establishes a cloud data resource pool with the region as the center, and centrally stores personal health data, clinical medical files and other medical data resources in hospitals at all levels within its jurisdiction. Then, after the data format in the resource pool is converted, classified, integrated and summarized, the national health files are established through the regional medical cloud service platform and shared with health supervision departments, individual family users and other demanders [1]. The platform integrates individuals, devices and institutions into a whole, and closely links patients, medical personnel, insurance companies and researchers to achieve business collaboration and increase the triple benefits of society, institutions and individuals. At the same time, medical services such as remote registration, remote consultation, remote monitoring, online consultation and online

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payment are pushed to everyone's hands through technologies such as mobile communication and mobile Internet, thus alleviating the problem of "difficulty in seeing a doctor" [2].

2 MANUSCRIPT PREPARATION

2.1 Key technologies of regional smart medical platform based on cloud computing

Cloud computing technology is based on the network. In a remote data center, many servers are connected together for fast storage and calculation. The user's application platform can be connected to the data center through a data adapter for data utilization, thus improving the utilization rate of resources and reducing repeated investment. In the smart medical platform, the storage technology based on cloud computing is mainly used in the data storage and processing of massive medical information. The management technology of smart medical platform based on cloud computing mainly includes system computing and storage resource management, data management and resource scheduling, virtual machine configuration management, and service quality control and optimization. The cloud computing service model is divided into three layers: SaaS (software as a service) PaaS (platform as a service) IaaS (infrastructure as a service). The smart medical platform based on cloud computing is the systematic application of the above three service models, and the construction is roughly divided into three steps: establishing the laaS data resource center, building the SaaS cloud computing service software, and finally forming the PaaS cloud computing platform. Table 1 shows the research hotspots in the cross fields of cloud computing, privacy and security, and medical data [3].

Table 1: Cross-research hotspots of cloud computing, medical data, privacy and security

cloud computing	Privacy security	Medical data
Legal compliance	PHI data security	individual
Cloud architecture attack	Patient privacy/anonymity	Microsoft health repository
trust	EHR interoperability	ICW lifesensor
Cloud storage CIA features	-	-
data protection	-	-
Cloud health information; Storage safety; Process access; Data publishing/sharing		

2.2 Mobile cloud

Mobile cloud refers to a mode of delivery and use of IT resources or (information) services, which can obtain needed infrastructure, platforms, software (or applications) in an on-demand and easily expandable way through mobile networks. Mobile cloud is the application of cloud computing technology in mobile Internet. Mobile cloud data storage is convenient, which can weaken the limitation of terminal hardware, provide services on demand, and satisfy convenient services anytime and anywhere. Mobile computing based on Internet and mobile communication is developed on the basis of traditional network. As two different design schemes, it has different purposes, protocols and working modes, but it permeates each other, and the network is gradually becoming unified. With the development of mobile communication, mobile computing has been successfully solved [4-5].

2.3 Internet of Things technology

Internet of things technology is one of the main technologies of smart medical platform. The architecture of Internet of Things for smart medical care can be regarded as an "ecosystem" of human body, which is divided into three layers: perception layer, network layer and application layer. The sensing layer of the intelligent medical platform mainly realizes the function of intelligent sensing, and uses a large number of sensors to make the operation status of any medical system or process that people pay attention to be effectively measured, sensed and discovered, and complete automatic identification and intelligent control, and exchange information with the network layer through the communication module [6]. The network layer transmits and processes the information obtained by the perception layer, and is responsible for information transmission, routing and control. The network layer includes the integrated network of communication and Internet, network management center, information center and intelligent processing center. The application layer mainly includes various specific applications of smart medical care, covering public services, industry services and other medical and health activities that run through the whole life cycle of individuals. Smart wearable industry is a well-developed industry in the application of Internet of Things, and will enter a stage of rapid development in the next few years [7]. People record people's health data through smart wearable devices (smart watches, smart bracelets, smart sneakers, smart sphygmomanometers, smart toilets with urine analysis, etc.), and form smart medical care through the "terminal+cloud platform" model. Nowadays, wearable products have developed from bracelets, watches and other products with relatively simple functions in the early days to more intelligent, more practical and more in line with the needs of users. The ideal state of smart medical care is that people are wearing sign-sensing equipment, and medical service providers can automatically and remotely monitor their health, early warning and consultation. If problems are found, they will be prescribed or treated through community hospitals nearby, and the medical model will be changed from post-medical treatment to full-course health management and disease prevention. Create an integrated electronic health service covering the whole life cycle of prevention, treatment, rehabilitation and health management [8].

2.4 Medical data

The medical data includes a wide range, including all kinds of physical data originally detected outside the hospital, personal electronic medical records circulating in the hospital, and laboratory test results. Because other kinds of data (original detection, laboratory data, etc.) can be directly or indirectly imported into personal electronic medical record as part of its content, this paper focuses on personal electronic medical record as the representative and subject of medical data. EMR(ElectronicMedicalRecord) is a digital patient medical record saved, managed, transmitted and reproduced by electronic devices (computers, health cards, etc.), instead of handwritten paper medical records. EMR is designed according to the business process and requirements of hospital treatment, which meets the requirements of hospital business and management. The National Institute of Medicine defines EMR as an electronic patient record based on a specific system, which provides users with the ability to access complete and accurate data, warnings, tips and clinical decision support systems. EHR(ElectronicHealthRecord)- Electronic health record is an electronic personal health record (medical record, electrocardiogram, medical image, etc.). It integrates patients' health information from different sources, including all patients' electronic medical records. It spans

different institutions and systems and is exchanged and shared among different information providers and users. PHR(PersonalHealthRecord) is a personal health record platform, which is a complete and accurate record platform for individual health and summarizing medical history. Anytime, anywhere, online access through the network. It can be stored in non-medical organizations, such as commercial companies or patients themselves. There is a connection among them. EMR is generated and owned by medical institutions. If EMR data is shared with other medical institutions or systems, the interoperable EMR becomes EHR. PHR collects data from EMR, EMR and other aspects. With the help of advanced technologies such as computer or network, it digitally collects personal health-related information, transmits it electronically, and stores it in the health file server. In this paper, in addition to the original data collected, medical data refers to one of them according to the corresponding computing fields.

3 ACCESS CONTROL MODEL

Access control is the process of granting some users access rights and prohibiting other users from accessing data; Its model is a method to describe the security system and establish the security model from the perspective of access control. However, in the cloud computing environment, to ensure the privacy and security of medical data, RBAC (Role-RBAC(rolebaseaccesscontrol) often has limitations. Scholars have gradually turned to the study of a combination of various models or technologies, and achieved certain results [9].

3.1 Extended model of role-based access control

According to the results of statistical literature review, more than two-thirds of EHR access control articles adopt RBAC(Role-BasedAccessControl (RBAC) or a modified change model based on it. Regarding the RBAC model of the medical system, the main concerns are: "Who will define the user role?" , "Who authorizes users to access these medical data?" , and "Can access rules be ignored in an emergency?" . RBAC does contribute to the efficiency of search, but the adoption of universal authorization strategy can not meet the personalized needs of patients for privacy protection, and it is not conducive to fine-grained access and privacy anonymous protection. On this basis, scholars put forward an extended model of role-based access control for the defects of single access model .

(1) Role-controlled access based on decision support

The role control method based on privacy extension, which is based on electronic health situation information, designs a decision support model to interact with the role-based access control model to protect personal health information.

(2) Role-based access control based on hierarchical authorization

In view of the shortcomings of RBAC, and considering that medical data have different weights in protection, if all information is protected by high-level means, it will affect the efficiency of actual operation and waste resources. Zhou Kai and others put forward an EMR storage cloud system, which provides a unified service for patients and hospitals to register and use electronic medical records, and mainly discusses the access control strategy of electronic medical records. The strategy of combining general role access control with user

personalized authorization step by step effectively solves the problems of dynamic authorization and user personalized demand, and meets the needs of patients for information security and privacy protection. A comprehensive access control model combining basic access control strategy and user personalized strategy, and setting sensitivity levels for each part of EMR, can realize fine-grained access and user personalized dynamic authorization step by step.

(3) Access control based on role and behavior

RBAC model is based on the idea of subject-object access control, which adopts static authorization mode and lacks the ability to dynamically adjust role permissions. Wang Qi proposed Rb-NAC (Behavior-based Network Access Control, BB-NAC) mechanism. Its core idea is to define the permission set by role model and dynamically adjust the permissions available to users by using behavior clusters, which overcomes the defects of RBAC-basedNAC in dynamic permission adjustment and allocates or restricts users' permissions by using behavior clusters. By using the changes of users' real-time network behavior characteristics, users are dynamically clustered, which improves the flexibility of the system.

(4) Patient-oriented privacy protection access control

In order to support patients to define personalized access control policies according to their own privacy preferences and meet patients' personalized privacy protection needs, Huo Chengyi and others put forward a patient-oriented privacy protection access control model POP-PAC (Patient-OrientedPrivate Access Control Model for His) on the basis of the RABC model. Through patients' participation in the definition of their own sensitive data access control rules, the functions of reasonable judgment of different user roles and correct granting of access rights are realized. It effectively solves the fine-grained access control problem of passive disclosure of patient sensitive data without permission.

4 RESEARCH ON ENCRYPTION MECHANISM

On the cloud platform, it is unsafe for users to store data on an untrusted semi-trust, and the CIA characteristics of data privacy protection, Confidentiality, Integrity and Availability)CIA not reach a high security level, and there are many unsafe factors in the network transmission process, so it is very necessary to protect data by password in the cloud computing environment. According to the application of encryption mechanism in medical field, there are mainly patient-centered encryption mechanism, smart card-based encryption mechanism and attribute-based encryption mechanism. This section sorts out the relevant literature, and analyzes the research of these three encryption mechanisms on the privacy and security protection technology of medical data on the cloud platform.

4.1 patient-centered encryption mechanism

In Pearson's "Six Practical Privacy Suggestions" about cloud systems, there are two suggestions about users controlling data themselves: "Maximizing user control" and "allowing users to choose". It is a simple access control strategy for patients to directly encrypt health records and assign corresponding keys. When medical data are stored, they are usually arranged in a hierarchical structure (as shown in Table 2). Leaf nodes contain basic medical

data of patients, while intermediate nodes represent different kinds of information. In PCE (PCE(PatientCentricEncryption), patients only need to create and hold a root key, and the keys of sub-records are obtained from the root key and their positions in the medical record directory. Sub-keys are used to encrypt or decrypt data like sub-records. Therefore, patients can grant their doctors, pharmacists, spouses, etc. access to these sub-records. Although the key distribution of PCE is simple, the access right is limited to the records of fixed categories. Some scholars further put forward a set of standard leaf classification that can aggregate any subset. The owner of the data can calculate a concise key for these subsets, thus improving the flexibility of data access.

Table 2: medical data hierarchy

surgery	other	
	urinate	Urine routine
		type-B ultrasonic
	vascular surgery	other
		blood sugar
		blood pressure
personal information	other Medical insurance card number gender (full) name	
internal medicine	Division of Gastroenterology	other
		liver and gall
		appendix
	Department of Cardiovascular Medicine	other
		electrocardiogram
		heart rate

In PCE, the key is sent directly from the patient to the corresponding accessor, and the patient needs to be online when the access request is issued. In order to solve the problem of requiring patients to have always online, there are two methods: using smart cards to replace patients themselves, or entrusting access to the server.

4.2 Attribute-based encryption mechanism ABE(Attribute-basedEncryption)

Attribute-based encryption model ABE usually includes four data providers, trusted third-party authorization center, cloud storage server and users in cloud computing environment. Data is stored in an encrypted form on the cloud server, and the authorization of access depends on the attributes of the data user or file. The authorization method is completed by the data user calculating the private key (Figure 1). Using ABE to obtain electronic medical records on the cloud platform has been adopted more and more because of its controllable fine granularity.

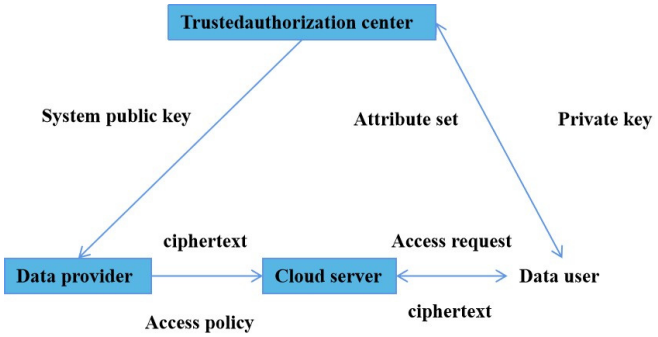

Figure 1: ABE authorization model in cloud computing environment

5 REGIONAL SMART MEDICAL PLATFORM SOLUTION BASED ON CLOUD COMPUTING

The regional smart medical platform solution based on cloud computing is divided into several sub-solutions, mainly including smart medical infrastructure solutions such as medical cloud data center, medical metropolitan area network, medical park network and medical cloud collection point. At the same time, joint medical partners provide comprehensive, rich and efficient medical application solutions such as medical cloud data sharing/exchange platform, medical pre-service and medical post-service for smart medical construction. The medical cloud data center includes data center cloud platform, data center security cloud data center management and other solutions, providing services such as network, computing, storage and security protection for smart medical care, which is the key to high reliability of business, high data security, high service quality and high management convenience in smart medical IT system. This is the core of the regional smart medical platform. We should make full use of "N: 1 virtualization technology" and "1: N virtualization technology" and distributed data centers to improve the overall reliability of the system. Medical MAN includes medical CE MAN, new generation medical Internet, integrated gateway and other solutions, while medical park network includes medical park basic network, wireless medical, BYOD and other solutions, both of which belong to the category of hardware facilities. The medical cloud collection point is based on Internet of Things related technologies, which can effectively collect, distribute, store and calculate medical business data, making medical business more convenient and efficient. At the same time, the medical cloud collection point supports flexible access methods such as wired and wireless, which is convenient for the development of mobile medical services. Qianle business is similar to the business of social platform and OA system, which mainly refers to two aspects of business carried out by medical institutions for patients, the public and their own office. Houle business mainly refers to the supporting business carried out by medical institutions for the management of medical parks, such as some construction projects related to medical platforms and the management of computer rooms [10].

6 CONCLUSIONS

Cloud computing and big data analysis technology are widely used in the medical field, which can improve medical efficiency and the accuracy of disease prediction. But at the same time, it also brings the hidden danger of privacy disclosure of medical data and information insecurity. Access control is one of the core technologies in the privacy and security protection of medical data in cloud storage. This paper studies the construction and management of medical data in cloud computing environment by combing the relevant literature. This paper mainly studies from two aspects: access expansion model and password protection mechanism. Firstly, the content of medical data is divided and expounded. This paper mainly introduces the privacy protection and security of medical data in cloud computing environment in recent years from two aspects: access control extension model and encryption mechanism, which are the most important access control technologies. Therefore, in the future research direction, we should study more feasible access control technology; Not only in terms of technology, but also the laws and regulations on medical data in China need to be improved. Technology and law are jointly used to jointly safeguard the privacy and information security of medical data.

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REFERENCES

[1] Zheng, X. , & Guo, H. . (2021). Research on subway construction monitoring and warning system based on internet of things technology. Journal of Physics Conference Series, 1885(2), 022052.

[2] Chen, C. , Chen, C. , Wang, Y. , Zhao, J. , & Li, Y. . (2021). I 3 city: an interoperated, intelligent, and integrated platform for smart city ecosystem. IT Professional, 23(4), 88-94.

[3] Fan, L. , Xia, M. , Huang, P. , & Hu, J. . (2021). Research on educational information platform based on cloud computing. Security and Communication Networks, 2021(1), 1-11.

[4] Xiao, C. , Zhang, H. , Chang, Y. , Zhai, J. , Yu, P. , & Ning, C. , et al. (2022). In situ construction of black titanium oxide with a multilevel structure on a titanium alloy for photothermal antibacterial therapy. ACS biomaterials science & engineering, 8(6), 2419-2427.

[5] Huang, Z. , Yang, Y. , Gao, J. , & Wang, K. . (2021). Research on intelligent cloud test platform. Journal of Physics: Conference Series, 1756(1), 012003 (9pp).

[6] Qian, Z. , Yang, X. , Xu, Z. , & Cai, W. . (2021). Research on key construction technology of building engineering under the background of big data. Journal of Physics: Conference Series, 1802(3), 032003 (9pp).

[7] Ma, Q. , & Yang, Y. . (2021). Research on the construction of smart cities by the big data platform of the blockchain. Journal of Physics: Conference Series, 1883(1), 012144 (6pp).

[8] Qiao, L. , & Zhang, X. . (2021). Frequency management method based on cloud computing, big data and artificial intelligence. Journal of Physics: Conference Series, 1757(1), 012106 (8pp).

[9] Dong, P. , Zhu, S. , Yan, X. , & Zhang, X. . (2021). Research on fine management of expressway construction schedule, quality and safety based on mobile terminal. IOP Conference Series: Earth and Environmental Science, 768(1), 012174 (7pp).
[10] Wang, H. , & Du, Z. . (2021). Research on application of teaching informatization construction based on cloud computing. International Journal for Innovation Education and Research, 9(5), 288-294.