Research on Key Technologies of Medical Information Integration

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Keywords: Hospital information system, Data integration, Cloud computing, Heterogeneous data.

Abstract. The effective integration of heterogeneous data in medical information systems has always been a hot issue in the information industry and the medical field, and it is also a prerequisite for the digitalization of hospitals. Based on the analysis of the characteristics of the existing medical information system, this paper is supported by cloud computing technology and uses XML technology as a tool to focus on the integration of medical information. The purpose of the research is to eliminate information barriers between medical information systems and achieve effective sharing of medical information resource, thereby further improving the level of hospital information service.

Introduction

Integration of medical information, also known as medical enterprise integration, which began in 1997, jointly sponsored by the RSNA and HIMSS to promote a higher level of imaging and information systems interoperability. It is the new specification of medical information by medical expert and information technology experts, aim to enhance the computer system in the healthcare information sharing on the effective use of the new rules proposed and advocated and promote the existing communication standards such as DICOM and HL7 in clinical care and treatment used in conjunction.

At present, in China there are many software and equipment about medical treatment system, such as HIS, LIS and PACS, which block the share of the information, for they use different standards and different formats of information. Thus, most medical treatment institutions become lonely islands of information. The traditional hospital information construction and management model no longer meets the requirements of digital hospital construction and development, and the introduction of cloud computing technology will become a major opportunity for the digital hospital to realize the transformation of informationization.

As the target and application innovation of information technology development in all countries of the world, cloud computing has its beautiful application prospects and it’s economic and management advantages have promoted the development of the medical and health industry. Reasonably and selectively try to apply cloud computing technology in hospital information construction, give full play to and deeply explore its value in hospital information construction, and then continuously improve the hospital information service level.

This paper studies the cloud-based medical information system architecture and focuses on the integration of heterogeneous medical information. The use of XML technology to achieve bidirectional conversion between data generated in heterogeneous medical information systems and XML data can fundamentally solve the problem of information integration.

Cloud-Based Medical System Architecture

One of the ways to implement a cloud-based medical information data sharing platform is to completely replace all hospitals and medical information systems in the region, and now it is an infrastructure that has the ability to interact with the platform, but this method is obviously very difficult to implement. After investigation and analysis, most of the medical information systems used
in various hospitals are developed by different software companies and run on different system platforms. The technologies and standards used are also different.

Therefore, the existing difficulty is that the original system cannot provide unified standard information. The medical information system architecture given below is designed to maximize the use of existing medical information systems and securely access regional medical information data sharing platforms in a data-integrated manner in accordance with established medical data exchange standards. The architecture is shown in Fig. 1.

![Cloud-based medical information system architecture](image)

The architecture is characterized by the improvement of the original system, so that it can be combined with the cloud platform on the basis of maintaining integrity, thereby realizing information sharing in the region. The system adopts SOA architecture and Web service technology to realize the integration of clinical information data to effectively solve the problem of heterogeneous data sharing and integration. The data integration security gateway device integrates the functions of the business logic layer and the security gateway. The business logic layer uses Web service technology to realize the unification and exchange and sharing of clinical medical data based on the HL7 CDA format. The business modules such as medical information and inspection information are composed of a plurality of related web services in a web service pool to realize formatted sharing of medical information data.

Finally, the calling interface of the Web service is connected to the cloud sharing platform through connection to the cloud sharing platform through the security gateway. The security gateway integrates security measures such as route conversion, firewall, data encryption and decryption, and gateway to ensure the security of personal information and medical data during transmission. The implementation of the sharing function is mainly based on the Web service technology, and XML language is used to uniformly convert the data in the heterogeneous EMR system among the medical institutions into a CDA-compliant file format, and combine with the cloud platform to realize the information sharing function.
Key Technology

From the above analysis, it is not difficult to draw the following conclusions. The bidirectional conversion between data is the key part of medical information integration technology. Next, we will discuss the bidirectional conversion between data based on XML technology.

Medical Data to XML Data

The process of medical data to XML data is shown in Fig.2.

![Figure 2. Procedure of medical data to XML data.](image)

...Data conversion process is mainly used the XML DOM technology. First initialize the DOM tree, and then by adding an element node, which generates a new DOM tree. Thus, the new XML document is constructed. The procedure description as follows:

1. Get the data which needed to convert from medical database or other healthcare information system.
2. By creating a DOM object, an empty DOM tree is created. This tree is the initialized form of XML DOM.
3. According to the definition of XML meta data, data with different meanings in different labels, so then we can form a new DOM node. This node is minimum unit of integrated medical information.
4. Add the newly created XML DOM node to the DOM tree which created by step 2.
5. Repeat this process until all data is inserted into the DOM tree.

And now we create a medical information integration DOM tree in computer memory. In the last, we store this tree into integrated healthcare enterprise bank.

XML Data to Medical Data

The reverse process is shown in Fig.3. This process is a reverse procedure about medical data to XML data. The demonstration of this process in detail are omit in this paper.

![Figure 3. Procedure of XML data to medical data.](image)

Experiment Example

Through running of the experimental system, we can see that medical information in different formats to achieve two-way conversion. Then achieve the aim of integrated the healthcare information. After this paper has been completed, the paper is ready for the experiment. Table 1 lists the registration...
Through running the system, we can acquire the medical data which is transformed into XML format.

Table 1. Structure of registration system’s information.

| Number | Field Name   | Data Type | Length |
|--------|--------------|-----------|--------|
| 1      | Patient id   | Char      | 10     |
| 2      | Patient name | Vchar     | 8      |
| 3      | id           | Char      | 18     |
| 4      | sex          | Char      | 2      |
| 5      | Birthday     | Data time | 8      |
| 6      | Age          | Tiny int  | 2      |
| 7      | Contact name | Vchar     | 8      |
| 8      | Phone        | Vchar     | 18     |
| 9      | Address      | Char      | 30     |

The content of the file which stored transformed data is as follows:

```xml
<?xml version="1.0" encoding="GB2312"?>
<?xml-stylesheet type="text/xsl" href="guahao.xsl"?>
<ClinicalDocument xmlns="urn:hl7-org:v3" xmlns:voc="urn:hl7-org:v3:voc" xmlns:xsi=http://w3.org/2001/XMLSchema-instance>
!--CDA Header-->
<title>registration</title>
effective time>20190503</effective time>
<recordTarget>
  <patientRole>
    <patientid>1234</patientid>
    <patient>
      <name>Chunfei</name>
      <id>123456789</id>
      <sex>male</sex>
      <birthday>19790215</birthday>
      <age>40</age>
    </patient>
  <contact>
    <cname>zhangnan</cname>
    <phone>12345678</phone>
    <address>xian road 5333#</address>
  </contact>
  </patientRole>
</recordTarget>
</ClinicalDocument>
```

**Summary**

In the process of digital construction of hospitals, there are two main problems that are meted. One is the storage problem of massive data, and the other is the exchange of data of heterogeneous systems. Based on the analysis of the current research status of medical information systems, this paper rebuilds the existing medical information platform and proposed medical information system architecture based on cloud computing platform. The purpose is to solve the problem of integration of medical information. The architecture mainly uses SOA and Web technologies. And focus on the XML-based technology to achieve the two-way conversion of information, thus achieving the exchange of data in heterogeneous systems, so that medical data is used that are maximized. This article’s exploration of key technologies for medical information integration can provide some reference for similar research.
Acknowledgement

This paper was supported by Science and Technology Project of Department of Education in Jilin under Grant No. JJKH20170806KJ.

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