# Research on Co-Construction and Sharing Mode of Multi-Source Hospital Information Resources in Cloud Computing Environment

## --Taking county hospitals in Shandong of China as an example

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*Abstract*—**This paper investigated the status of construction of information resources in 34 county hospitals in Shandong. There are various problems in the integration of medical resources. This paper proposed a cloud service model of multi-source information resources in cloud computing environment. By scheduling and configuring multi-source information resources, the utilization rate of information resources can be improved and the individual needs of users can be met.**

*Keywords—cloud computing; hospital; multi-source information resources; co-construction and sharing*

## I. INTRODUCTION

At present, the main problems facing the medical industry in China are as follows: Firstly, because of the large population base, uneven distribution of medical resources, and the fact that most people's ideas have not changed, it is difficult for the people to see a doctor. No matter serious illness or minor illness, they have to go to the Third-Class Hospital. Under the limited circumstances, the value of doctors can't be fully played, resulting in a waste of resources [1-2]. Secondly, China's late start of development and uneven level of education of the people, which makes the people's medical health, prevention, rehabilitation and other knowledge very scarce, eventually leads to medical information asymmetry. Patients, who are passive, are unable to communicate effectively with doctors, and lack the active participation in the treatment process [3-4]. Finally, because of the huge individual differences between each person, there are many kinds of diseases, which have complex relationship. It is difficult to have a set of standardized countermeasures [5]. Although medical examination, diagnosis and treatment are constantly developing, new diseases are also constantly emerging and changing. The emergence of these problems put forward higher requirements for today's medical industry, so medical and data resources are imperative.

## II. MODE OF CLOUD COMPUTING SERVICE AND CONNOTATION OF RESOURCES CLOUD OF MULTI-SOURCE INFORMATION

Cloud computing is a new IT service mode at present. It brings a large number of Internet computing resources, storage resources, software resources and service resources together, and constitute a huge computing resource pool to meet the needs of users. Cloud computing combines cluster computing, distributed computing, parallel computing and virtualization technology, and transforms all kinds of IT resources from "buy" to "rent". cloud computing has the technical characteristics of elasticity, scalability, on-demand leasing, ubiquitous access, user sharing and so on. There are three cloud service modes: software as a service (SaaS), platform as a service (PaaS) and infrastructure as a service (IaaS) [6-8].

This paper analyzes the connotation of resources cloud of multi-source information from four dimensions: organization, users, information services and service evaluation.

- organization of multi-source information resource. It is a multi-source resource set with high virtualization, high flexibility, high scalability, ubiquitous access to resources and dynamic organization of resources.

- user of multi-source information resource. the resource cloud of multi-source information provides users with multi-resource_as_a service (MRaaS), knowledge as a service (KaaS), and application software as a service (AaaS) and so on.

- resource service. resource cloud of multi-source information is based on user's intent and user behavior, and guided by user decision-making. It is a personalized and specialized resource collection provided to users .

- service evaluation. It combines the management with services of multi-source information resources, forming a new cloud system of quality evaluation for user experience.

## III. RESEARCH ON CO-CONSTRUCTION AND SHARING OF MEDICAL INFORMATION RESOURCES AT HOME AND ABROAD

### A. Research oOn Co-Construction and Sharing of Medical Information Resources in China

At present, China's hospital information system has begun to take shape. Especially with the launch of the National "Jinwei" Project, many hospitals have established hospital-

wide information systems. The main issue of development at this stage is standards. Because data in many hospitals do not have a unified standard, the sharing of data has brought great trouble [9].

### B. Research on Co-Construction and Sharing of Medical Information Resources Abroad

The Office of the National Coordinator for health IT was established in 2004 in the United States, it is leading to build a national network of health information and medical system including electronic health records. In 2016, President Obama put forward the "precision medical plan", which opened the era of precision medical treatment.

Since 2003, the British government has created an information network across the country to implement all service arrangements. Patient can choose which hospital to visit independently by means of this information network, and can also obtain their electronic medical records. On the other hand, doctors can conduct remote medical consultation, provide electronic medical records and prescriptions, and also share image resources with other hospitals. This initiative has had a more obvious effect, and become a model for European hospitals to follow[8-10].

### C. Comparison of Sharing of Medical Information Resources Between Home and Abroad

The co-construction and sharing of medical information resources in foreign countries covers a wider range than in China, and pays more attention to the sharing of multi-institutions. Processing, analysis and application of data are more adequate.

The types of medical information resources abroad are more comprehensive. Many of them are structured and unstructured data, in the following forms: pictures, images, text, documents, video, audio, database and so on. However, there is still a big gap between China and foreign countries. Expanding functions and popularizing them is the inevitable way to expand the sharing of medical information resources. At present, the content shared by most large medical data projects at china is part of electronic health records and medical records.

With the development of cloud computing technology, it can not only reduce the consumption of resources and the cost, but also improve the security level and capacity. Many clinical data platforms based on Hadoop have emerged in foreign countries. By comparison, the practice of sharing medical information resources in China is relatively inadequate. Data sharing technology and facilities are still weak links. The sharing level and scope need to be further strengthened.

### IV. CONSTRUCTION STATUS OF INFORMATION RESOURCES OF COUNTY HOSPITALS IN SHANDONG

This paper investigated the construction of medical information resources in 34 county hospitals of 17 prefecture-level cities of Shandong. Generally speaking, the data which are in the database of their own systems were not integrated together, and have no information resources management platform. So the utilization and sharing rate of resources was low, in some time, only a few relevant departments can be interconnected.

### A. Construction Status of Data Platform of Hospital Medical Information

After more than ten years of construction of the medical information data platform, a basic application software environment has been developed. However, with the development of the scientific and technological information industry and hospital business, hospital informatization is facing the following limitations:

- Application systems provided by many software vendors for hospitals. Data Distributed storage is difficult to truly integrate, thus cross-domain comprehensive analysis has become a major problem. So that managers can't control the overall situation of key issues and analyze the reasons.

- The complex sources of hospital statistics. The existing statistical data of hospitals come from the reports of other business systems, and the processing of some reports by hand delays the decision-making cycle, such as calculation, merger, etc. It is difficult for hospital managers to control the overall operation in time.

- The traditional mode of data analysis. Data analysis is mainly based on traditional reports, lacking simple and reliable tools to support the "automatic" analysis and application of data. At present, the existing hospital application systems can't deal with massive historical data and display the data in an all-round way.

- The lack of monitoring and tracking system for hospital operation efficiency, quality and performance. Due to the less investment in this area, there is no unified information resource management platform. And the data is scattered in various systems, so there is no unified integration and utilization of resources.

### B. Status of Utilization Rate of Medical Information Resources in Hospitals

At present, there is no unified data management platform, which leads to the data sharing and utilization of medical resources low. The basic data were internally called through HIS, LIS, PACS and other software, Report forms which include monthly, quarterly, year-end data for Superior department and other purposes, have not many functions such as guidance, prevention for treatment and so on.

### C. Sharing Mode of Hospital Medical Information Data

The current data storage mode is as follows: the medical information in each department is transmitted to the data center through the exclusive network or public network, and stored in the central database by the data center in the form of a unified data specification. If someone who want to obtain the corresponding medical data, only need to submit an application to the regional data center.

*D. Summary*

Nowadays, most hospitals still use simple search engines and input text information to process daily data records, but few not to deeply analysis and research. Those information systems which stored too much data have many kinds, wide range of sources of data. However, some data resources in each department of a hospital can only flow in the department, which invisibly increases the idleness of data resources and reduces the degree of cooperation between departments. Therefore, sharing mechanism is needed to manage.

## V. Co-construction And Sharing Mode Of Multi-source Medical Information Resources In Cloud Computing Environment

Different from traditional distributed information resources management, multi-source information resources management in cloud computing environment usually adopts virtualization technology, which shields the heterogeneity and complexity of the network's bottom information resources, and integrates all kinds of scattered information resources across different fields. Finally it forms a huge resource cloud pool. Multi-source information resources are reconstructed, added, subtracted and redistributed into a single resource, that ensure the efficient and high-quality use of resources[11-12].

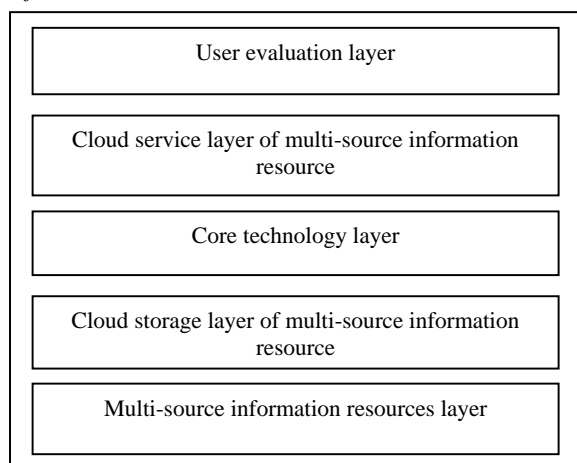*A. Architecture of Cloud Service Model of Multi-Source Information Resource*



FIGURE I. PLATFORM ARCHITECTURE

The cloud service model of multi-source information resources proposed in this paper consists of five layers, namely, infrastructure resource layer, platform layer, core technology layer, application software layer and user evaluation layer. As shown in Figure 1.

*1). Multi-source information resources layer*

This layer includes information resources cloud at the physical level and virtual resources at the logical level. Physical resources are mainly based on open source cloud computing system, which combines resource integration technology and integration technology. It simplifies multi-source information resources into a giant resource pool, and provides open information resource interface for logical layer

resources. The resource set constructed by the physical resource layer has the characteristics of high virtualization, elastic scaling and dynamic change.

Logical resource layer which is mainly user-oriented, further process virtualized information resources, analysis and extraction of user intentions, so as to provide users with knowledge services. The resource layer includes description, classification, extraction, reconstruction and extension of information resources.

The multi-source information resource layer is the bottom layer of this model and the foundation layer of the whole model. On the one hand, the layer directly provides infrastructure resources, and those are directly provided to users as a service. On the other hand, the layer which has a search engine function can search information resources in the cloud.

*2). Cloud storage layer of multi-source information resource*

Because of the huge amount, variety and heterogeneity of information resources, cloud storage layer must have a large-scale, large-capacity distributed server. Cloud storage layer of this model can be regarded as the PaaS (platform as a service) service mode. But this layer must rely on IaaS (infrastructure as a service) to realize the storage ability of information resource cloud. In addition, the cloud storage layer is similar to the resource layer, but also has two purposes.

*3). Core technology layer*

This model uses a variety of cloud services technology to develop service applications in order to meet the needs of all kinds of users. Service applications manage middleware development, including user log management, system construction management, resource management, database and security management, in order to achieve efficient management of information resources cloud. Cloud service technology involves virtualization tools, resource ontology construction technology, data mining technology and resource scheduling technology. This model can improve resource utilization, reduce service application development cost, save the construction cost and operation cost of information resources, and maximize the optimal allocation of information resources.

*4). Cloud service layer of multi-source information resource*

This layer is based on the underlying resource layer, cloud storage layer and core technology layer, which can be regarded as the service product layer. The service objects of this layer include individuals, enterprises, scientific research institutions and other relevant organizations. The cloud service provided by this layer is a personalized knowledge product throughout the whole cycle of user activities. It is a tool that can provide users with feasible solutions and personalized knowledge value-added and decision-making tools.

The content of cloud service of information resource mainly has three kinds.

(1) Application software service. Users put forward requirements to the service platform in the form of key. After a series of processes such as platform retrieval, analysis and matching, users are provided with software resources selected.

(2) Personalized service. According to their actual situation and the rules provided by the platform, users can customize their own information resources.

(3) Recommendation service. The biggest difference between this platform and ordinary ones is that it can realize the accurate matching between users and resources, resources and users according to the discovery mechanism and mining technology in the core technology layer. At the same time, whether the user is online or not, it can actively push information resources related to their needs for users.

This layer can efficiently provide users with high-quality information resources, at the same time bring users knowledge of value-added benefits. The concrete implementation process is shown in Figure 2.
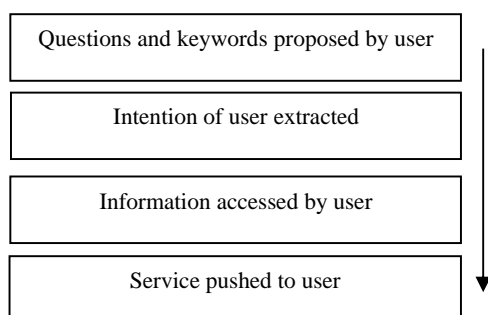
| Questions and keywords proposed by user |
| --- |
| Intention of user extracted |
| Information accessed by user |
| Service pushed to user |

FIGURE II. MODE OF CLOUD SERVICE LAYER OF MULTI-SOURCE INFORMATION RESOURCE

*5).    User evaluation layer*

This layer mainly evaluates the retrieval, mining, matching, scheduling, storage and service realization of cloud information resources. In addition, this model not only provides information resources that meet the needs of users, but also pushes resources based on content and knowledge for users.

## VI.    CONCLUSION

This paper investigated the status of construction of information resources in 34 county hospitals in Shandong. It is found that the management efficiency is low, the allocation of medical resources is unreasonable, and there are various problems in the integration of medical resources. This paper proposed a cloud service model of multi-source information resources in cloud computing environment. By scheduling and configuring multi-source information resources, the utilization rate of information resources can be improved and the individual needs of users can be met. So the future application fields of cloud computing can be expanded to a certain extent.

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