



Research on Constructing Regional Telemedicine Imaging Diagnosis Center Based on Citrix Technology

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Abstract. Medical informatization is an important direction of medical development, and regional medical information sharing is the overall trend of medical development. Content Establish the integration of information in the radiology department of the community health center and the imaging department of the secondary hospital in the medical union. Solve the problem of ineffective sharing of clinical imaging information data caused by different systems and servers in the region. It can optimize the rapid viewing of clinical data and historical case data of referral patients in the region to achieve an efficient and fast tracking of the entire treatment process of patients And the image information of the disease development. It mainly adopts CITRIX virtualization technology, which has the advantages of small occupied bandwidth, high security, convenient deployment, remote management, convenient maintenance, stable connection, and high reliability. Through Citrix technology, the clinical data sets of the branch hospitals are effectively centralized, and a relatively unified data system is established, which is stored, managed and transferred to a standardized data model to form a data set, and integrates internal data in the region to effectively serve clinical images.

Keywords: Citrix technology · Virtualized storage · Regional imaging

1 Introduction

Medical informatization is an important direction of my country's medical reform, and it is a key step to promote the vertical integration of medical care and form a medical consortium. Regional medical information sharing is the overall trend of medical development [1]. Establish information integration between the radiology department of the community health center and the imaging department of the secondary hospital in the medical union [2, 3]. In order to adapt to the social and economic development of the city, in 1999, the Changshu Municipal People's Government approved the adjustment of the existing layout of the health centers in the three towns along the river, and cancelled the "Changshu Zhenmen Health Center" and "Changshu Zhao City Health Center" and merged them into "Changshu Meili Central Health Center" was renamed "Changshu Meili Central Health Center Zhenmen Branch" and "Changshu Meili Central Health

Center Zhaoshi Branch". After the merger of Meili People's Hospital and Meili Town Community Health Service Center, Meili People's Hospital, as a regional medical center of the Municipal Second Hospital Medical Community, will organize and implement various tasks in accordance with the spirit of the Changshu Medical Reform Office document to achieve medical and Pay equal attention to public health and develop together [4]. Among them, the General Hospital has paid close attention to the improvement of medical service technology and capacity, and advanced to the second-class general hospital in management and technology to drive the comprehensive development of the second branch and public health; Zhaoshi branch focuses on exploring the integration of medical care; Zhenmen branch focuses on Do a good job in the exploration of medical rehabilitation business; it will take three years to build a basic-level Grade 2 A general hospital with powerful functions, complete services and guaranteed quality.

2 Research Status

Image storage and transmission system (PACS) is an important part of hospital informatization, which mainly solves related problems such as digital acquisition of medical images, high-quality storage of image files, and unified management of text materials [5–7]. In order to solve the problems of difficult and expensive medical treatment for patients and the construction of personal medical files, the sharing of medical information and the regionalization of medical treatment will be a major trend in the future [8, 9]. Realize information sharing between regions, improve the efficiency of daily diagnosis of medical institutions in the region, and provide a strong guarantee for scientific analysis and comprehensive diagnosis [10–12].

Some application problems of current medical image storage and transmission systems are affected by the network, security and stability. Hospitals have generally established image storage and transmission systems to archive, store and communicate hospital image data. However, with the continuous improvement of the accuracy of digital diagnostic equipment and the increasing number of patients, there are obviously many problems and deficiencies in the use of traditional image storage and transmission systems [13]. The operating systems, databases and storage devices used by the major image storage and transmission system software vendors are not the same, which makes each image storage and transmission system not only completely heterogeneous in software and hardware, but also lack of interoperability [14–16]. Because the image storage and transmission system storage platforms of hospitals and communities are inconsistent, and the storage interface is also chaotic, it is difficult to realize the sharing of image storage and transmission system information between hospitals. Moreover, the funds of township hospitals and community health centers are relatively limited. It is very difficult to purchase expensive PACS independently. It is often the report writing software provided by the manufacturer when the equipment is purchased. It cannot be integrated with other systems [17]. It is often caused by incorrect input of patient information. Misdiagnosed. In addition, the platforms of township hospitals and community health centers are limited, unable to recruit experienced imaging doctors, and often can only perform routine examinations. Patients then go to secondary and tertiary hospitals for diagnosis, and the quality of printed film is relatively low [18, 19]. If the image storage

and transmission system area is to be shared, data must be shared from the medical digital imaging and communication interface. This will lead to a large number of changes in the application of the image storage and transmission system. With the development of regional health informatization, image storage and communication and interoperability have gradually expanded to between medical and health institutions in the entire region, interconnecting the PACS of multiple medical institutions in the region, and making the image information generated by each medical institution be The image information platform system that shares and exchanges medical needs and resource optimization principles in the region is called regional PACS [20].

By building a regional PACS, patients can be examined at any medical institution in the region, and networked hospitals can share image information, apply for online consultations, analyze and discuss the condition, so as to further clarify the diagnosis and guide the determination of treatment plans. Realize the sharing of information such as imaging resources, expert diagnosis resources, equipment resources, and medical research results, and reduce the number of repeated examinations for patients, and reduce the cost of diagnosis and treatment for patients.

3 Status Analysis and Research Purpose

3.1 Status Analysis

Citrix technology to support the realization of unified clinical information applications, improve the security and disaster recovery capabilities of the information system, establish an imaging information and clinical communication system between the branch and the Meili People's Hospital, to ensure the practicability and operability of the combined system To respond to the development plan of Meili People's Hospital, and to solve the current situation of basic-level branch hospitals that are difficult to recruit or quickly train suitable imaging talents due to factors such as their location and medical technology level. In order to solve the shortcomings of technical talents in branch hospitals, remote consultation medical services have been brought into people's vision and become a breakthrough in the grassroots service of superior radiotherapy talents. This research combines the practice of community medical treatment to study the PACS system of the medical consortium.

3.2 Research Purpose

- (1) Solve the problem that clinical imaging information data cannot be effectively shared due to different system servers in multiple branches and community service stations in the region; It can optimize the rapid viewing of clinical data and historical case data of referred patients in the region to facilitate efficiently and quickly trace the patient's entire treatment process and disease development; Integrate basic clinical data in the Meili area, so as to more efficiently and conveniently trace the patient's entire treatment process and disease changes in the future.
- (2) Using the existing hardware equipment of Meili People's Hospital, combining the actual situation of the imaging system of each branch in the region, using Citrix virtualization technology, the imaging servers of the three hospitals are effectively integrated, effectively reducing the hospital's operating costs.

- (3) Use information technology to further strengthen the telemedicine image service capabilities in the region, solve the limitations of the metropolitan area network in different regions, effectively solve the shortage of branch resources and talents, and provide better and more professional treatment for the treatment of primary patients Program.

4 Technical Architecture

4.1 Model Design of Regional Imaging System

- (1) The regional PACS architecture diagram is shown in Fig. 1. Patient information can be directly called by all parties from the main PACS database after being entered by the system. After the patient completes the imaging examination, the community radiologist can quickly access, browse and process the imaging data through the computer. Community doctors follow the unified diagnostic template of the radiology department of the upper-level hospital of the medical consortium, and carry out standardized editing of diagnostic reports, which can reduce the input workload, shorten the report generation cycle, and improve work efficiency. Set up different permissions, community radiologists write initial diagnosis reports, which are reviewed by radiologists from higher-level hospitals (associate chief physicians and above), and the system retains traces of the modified content. The reviewed report can be submitted and uploaded after being signed and confirmed by the physician The main server stores the backup, which is then printed and distributed by the community radiology department. The printed report can no longer be modified, and it can be accessed as a read-only reference.

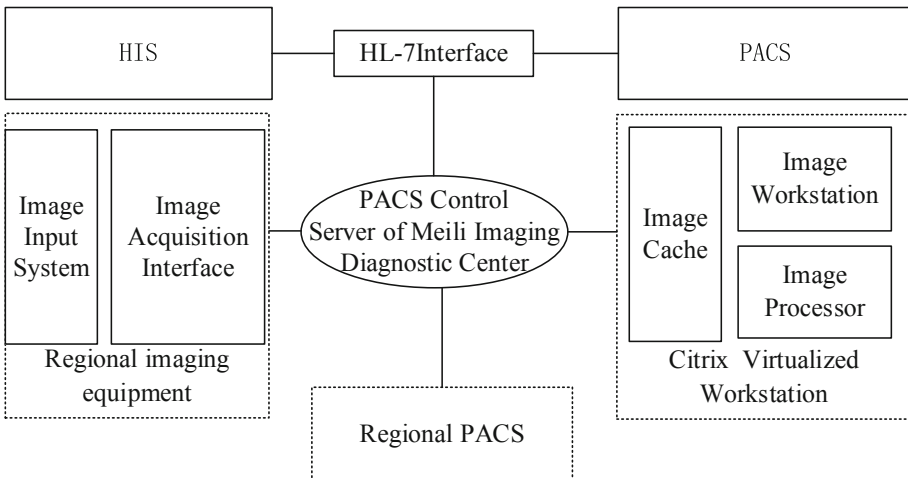


Fig. 1. PACS architecture diagram based on Citrix virtualization area

- (2) Citrix virtualization construction. Take advantage of the existing server resources of Meili People's Hospital, build Citrix related servers and establish efficient links and business relationships between the branches and run data through the health metropolitan area network to realize hospitals such as patients, departments, equipment, and hospital images Unified management of operations. Citrix technology installs and publishes various applications centrally by setting up application servers (groups). The client maintains communication with the server by installing simple ICA software, so that the required applications are completely executed on the server, and then The client obtains the interface results locally, so that the user can efficiently access the upper-level Windows, UNIX or Internet programs and data through various network connection methods (WAN, LAN, Internet, etc.) no matter where they are or what equipment they use.

The application server software (MetaFrame™) separates the execution and operation logic of the application from the display interface, so that the application can be executed 100% on the server, and the interface is displayed on the client.

The ICA (Independent Computing Architecture) protocol greatly reduces the amount of network transmission. Normally, it only occupies a width of about 10K per second, which can save more than 40% to 60% of the frequency band.

ICA client software Through this software, any form of client can log in to the application server, access the required applications and data, and seamlessly integrate server resources and local resources.

- (3) Data storage technology, with Meili People's Hospital in Changshu as the center and secondary hospitals in the region as branch points. The clinical data sets of the two branches are effectively centralized through Citrix technology to establish a relatively unified data system. Centralized storage, management and transfer to a standardized data model to form a data set, effectively integrating regional internal data to serve clinical images. See Fig. 2.

Data storage The storage of image data is also in DICOM format, and the international standard DICOM3.0 interface is used between components. In view of the large data of medical imaging information, massive data storage and management are required, and a single centralized storage has certain risks. In this case, PACS image data adopts a combination of distributed and centralized management to establish PACS1 and PACS2 storage paths. PACS1 is transmitted to the local data storage, and PACS2 is transmitted to the database of the second-level hospital in the medical association, managed with Oracle 11 g software, and set up based on the mainstream J2EE technology platform. The community radiology image data is regularly stored in CDR in DICOM mode. Therefore, this system has the following advantages: prevent data loss; avoid unilateral database failure and affect the work of the community radiology department; multiple stored data can be interchanged.

- (4) Network architecture construction, using the existing hardware equipment of Meili People's Hospital and combining the actual situation of the imaging system of each branch in the area, PACS is an open system based on network communication and transmission. The network of this center adopts the VPN network connection established by the Health Commission. The network transmission protocol standard is TCP/IP.DICOM. The backbone adopts Gigabit switched fast Ethernet, which is directly transmitted to each work terminal through 100Mb Ethernet. The image

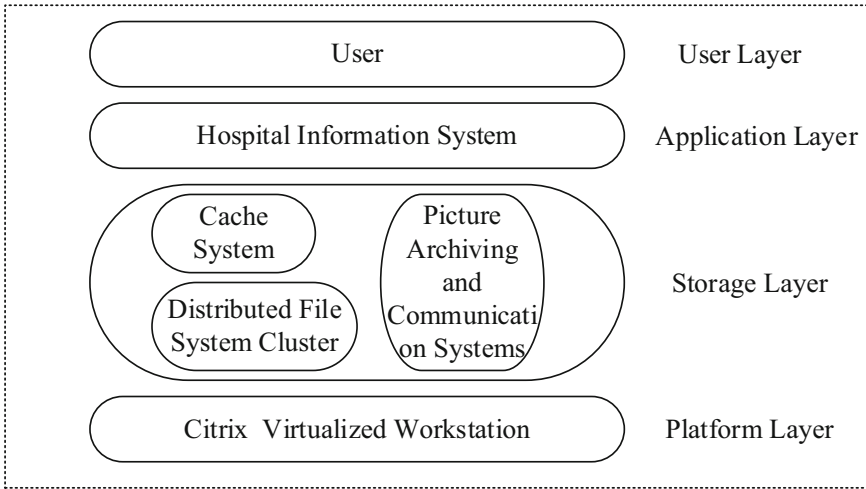


Fig. 2. Medical image storage architecture based on Citrix

retrieval time is controlled in Within 10 s. Radiologists can access the images within ≤ 3.5 s.

4.2 Citrix Virtualization Technology

CITRIX virtualization is composed of many core components, mainly including: virtual controller, virtual agent CITRIX online plug-in, scheduler component, etc. With the cooperation of these components, virtualization can operate normally. First, the user requests to obtain the desktop. The client can be any thin client equipped with a virtual connection protocol. When the terminal is started, an authentication message will pop up. At this time, as long as the user enters the correct authentication information, it will be obtained on the server. Virtual system consistent with office system. After the user is authenticated, the system delivery controller will dynamically configure the virtual system, use the built-in scheduler (Provisioning), deliver on-demand according to the network, combine user-customized applications, OS, and settings together, and use files Stream delivery to the hosting environment, waiting for users to connect. The following are the advantages of CITRIX virtualization:

- 1 Reduce bandwidth occupation In K/3 applications, the effective bandwidth of the client terminal and the middle layer connection needs to be above 20 KB. The bandwidth occupation is much smaller than that of direct registration, which greatly saves the cost of leased lines for enterprises.
- 2 The security is high. Citrix itself provides encrypted transmission, combined with VPN and other technologies, it can provide a higher level of security technology guarantee.

- 3 Reduce maintenance work. The client no longer needs to install the client, just install the Citrix client. The client upgrade, patching and other maintenance are concentrated on the Citrix server, which greatly reduces the workload and maintenance, and shortens The maintenance cycle.
- 4 Realize remote management. Through remote management, remote maintenance and management of Citrix servers or further internal servers can solve many problems that do not require on-site support, greatly reducing service costs and greatly reducing response time.
- 5 The connection is stable. The Citrix connection is very stable. Even if it is disconnected, the information of the disconnection point will be retained, and the disconnection point will be returned directly after the next successful connection.
- 6 High reliability. In high-end multi-user applications, multiple Citrix servers can be used. Through network load balancing, instead of polling, resources such as CPU, memory, and applications are dynamically allocated on demand to achieve high performance and high performance reliability.

5 Function Introduction

- (1) Centralized reporting function of regional radiological imaging examinations Community residents can perform imaging examinations at the community health service center. The image diagnosis is submitted to the imaging diagnosis center of this hospital, which provides diagnosis services. The image diagnosis report is printed by the community center and delivered to the patient. This measure not only realizes the integration of the resources of the imaging department and the imaging diagnosis center of the community health service center, but also improves the imaging diagnosis level of the community health service center, thereby eliminating the suffering of patients. See Fig. 3.

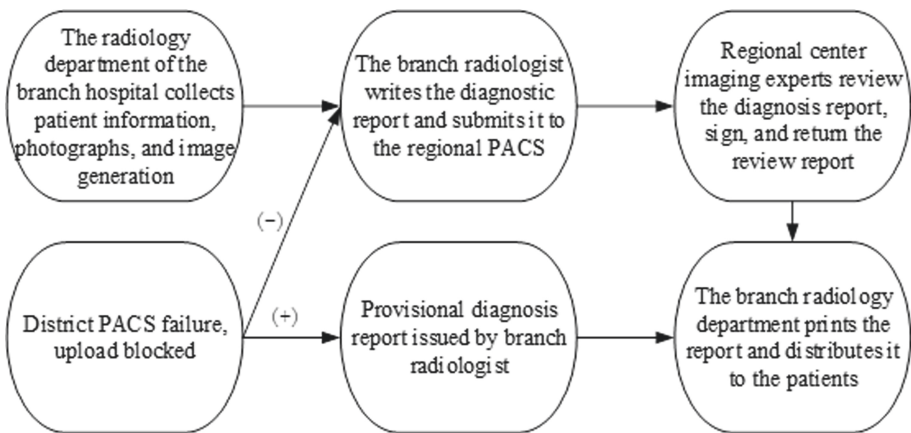


Fig. 3. PACS workflow in the medical consortium area

- (2) **Homogeneous service process** The regional PACS system was established, and the imaging diagnosis report work in the area was coordinated in the report and diagnosis workstation of the hospital, and the reports and images to be processed by the hospital and each community were displayed on the same interface. The business unity of the community health service center provides the same quality service process in the joint body at the level of diagnosis and treatment and quality control.
- (3) **Remote reservation through the construction of the imaging center system**, the community can make reservations for equipment in the central hospital. That is, when a patient is in a community medical institution, the community medical equipment cannot complete the examination. The community doctor can directly call the registration appointment system or examination appointment system interface of the diagnosis center in the local doctor station system to complete the corresponding appointment, that is, make an appointment for registration or examination. If the equipment is occupied in advance, patients will see the doctor on time according to the appointment arrangement. Remote appointment not only improves business efficiency, but also facilitates patient visits.
- (4) **The construction of a regional medical consortium for quality control and reading** will realize centralized storage and centralized diagnosis of examination images in each community. In order to standardize the business operations of community filming technicians, improve image quality, obtain better diagnostic results, and complete radiation quality control management for community hospitals. At the same time, the quality control and reading function in the medical complex can on the one hand find out the work quality and equipment performance of the photographer, typesetting person and equipment through the evaluation; Control level management.
- (5) **The regional PACS project makes full use of the advantages of centralized storage of digital image information**, and implements a regional electronic film process, thereby reducing the investment of medical institutions at all levels in film printing, storage, and verification.

6 Summary

With Changshu Meili People's Hospital as the center and the secondary hospitals in the region as branch points, the clinical data sets of the two branch hospitals are effectively centralized through Citrix technology, and a relatively unified data system is established to centrally store, manage and transfer. A data set is formed in a standardized data model to effectively integrate regional internal data to serve clinical images.

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