Design of Hospital Remote Consultation and Teaching System Based on Deep Learning

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Abstract. The application of deep learning technology makes the hospital's remote consultation and teaching system more humane. Therefore, this research designed a hospital remote consultation and teaching system based on deep learning technology. First of all, through the analysis of the problems of system construction, clear system design objectives. With the support of the system hardware, the deep learning process is used to realize the functions of case collection, remote consultation, doctor recommendation, remote education and training, and case sharing. Using experiments to analyze the actual application performance of the hospital remote consultation and teaching system based on deep learning, and comparing it with the traditional system, it verifies that the system in this paper is more effective.

Keywords: Deep learning · Hospital · Remote consultation · Teaching system

1 Introduction

In order to meet the growing health needs of the people and the new requirements of economic and social development for the development of health services, the State Council issued the "Twelfth Five-Year Plan for the Development of Health Services". By 2015, a basic medical and health system covering urban and rural residents will be initially established, So that all residents can enjoy basic medical insurance and basic public health services. The accessibility, service quality, service efficiency and public satisfaction of medical and health services have been significantly improved, the burden of individual medical expenses has been significantly reduced, and the allocation of health resources between regions The difference in health status between the population and the population continues to shrink, and basically realize that all people have medical treatment [1].

Therefore, it is necessary to strengthen the construction of medical and health personnel team. We should give full play to the backbone role of urban hospitals in the diagnosis and treatment of critical emergency and difficult diseases, medical education and scientific research, guidance and training of grass-roots health personnel. The training of primary health personnel usually adopts on-the-spot learning. Due to the limitation of

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operating room space and the strict requirements of clean operating room, a large number of interns, interns and medical students are kept out of the operating room [2]. In order to better meet the needs of clinical teaching, improve the quantity and quality of surgical teaching, at the same time, ensure the high cleanliness of operating room and reduce the pollution of aseptic area by surgical observers, many hospitals need to build operation teaching and remote consultation system to provide students, medical experts and medical personnel with medical image quality details, discussion and analysis of operation process, Postoperative treatment, teaching observation, case study and other functions [3].

Under the above background, this study designed a hospital remote consultation and teaching system based on deep learning. Firstly, through the analysis of the problems of system construction, the system design goal was made clear. Then, with the support of system hardware, the functions of case collection, remote consultation, consultation doctor recommendation, remote education training and case sharing were realized, so as to make the hospital remote Cheng consultation and teaching system is more humanized and more timely.

2 Current Situation Analysis and Problems

2.1 Traditional Model

The traditional mode of medical operation observation and teaching is mainly to organize personnel to study in the operating room, or to video the operation situation as teaching. This model has many shortcomings.

(1) Due to the space limitations of the operating room, the number of visitors and observations that can be accommodated is small, and the efficiency of teaching and research is low.
(2) Due to the messy personnel, it will cause air pollution in the operating room and even affect the attention of the operating physician.
(3) Cannot connect with modern minimally invasive equipment.
(4) For the operation records of major operations and special operations, because the on-site video crews do not understand the key points that researchers or students want to pay attention to, some parts of the field of view and the depth of the field of view will be insufficient.
(5) Due to the poor shielding of the camera, when the radiographic equipment, chainsaw and other equipment are turned on during the operation, they will be severely disturbed, resulting in poor recording effect or inability to record.

2.2 Understanding of Operation Teaching in Hospital

Some hospitals recognized the value of surgical teaching, but because the equipment was not advanced enough and the companies that implemented the surgical teaching did not know enough about the surgical teaching, they replaced the surgical teaching system with a security system, but they couldn't meet the requirements of the surgical

teaching system. Video clarity and software features. Up to now, some companies are still using security monitoring and video conferencing equipment to make surgical teaching systems for hospitals in order to make huge profits [4].

3 Construction Objectives

As an important task of many hospitals, clinical teaching is responsible for training medical staff. The training method is usually on-site observation. However, due to the limitations of on-site conditions or surgical equipment, the space for on-site surgical observation is narrow and the participants are limited. At the same time, it also brings unnecessary trouble to the normal treatment of patients, and the effect is not ideal [5]. In order to improve the quality of the operation and reduce the infection rate of the operation, the operating room of the hospital has formulated the control index for the number of observations in the operating room to strictly control the number of people entering the operating room. This has resulted in a greatly reduced opportunity for interns to learn and observe operations, which is not conducive to improving interns Quality of learning.

The rapid development of video communication technology brings new opportunities for the realization of remote visual teaching in hospitals. The hospital can build a high-quality hospital clinical network teaching system, thus the operation teaching and remote consultation system was born. Through the system, the video and audio digital coding and broadcasting teaching system can observe the operation process through the large screen outside the operating room for real-time teaching and consultation, which not only reduces the cross infection in the operating room, but also ensures the aseptic requirements in the operating room, and also expands the scope of surgical teaching, so as to get rid of the limitations of traditional teaching mode in time, space and number of people [6]. The hospital remote consultation and teaching system also realizes that one instructor can guide the teaching of multiple operating rooms, avoid the waste of teaching resources, and realize the sharing of teaching. Each teaching system can observe the video images of one or more operations at the same time. In the application of telemedicine consultation, doctors can complete the medical diagnosis directly through the video communication system without spending too much time on the road, and can also carry out remote multi-party consultation according to the patient's condition.

Construct the hospital's surgical teaching and remote consultation system to achieve the following goals:

(1) The operating room is equipped with video and audio pickup equipment to pick up the surgical field video signal and the voice signal of the instructor during the operation and transmit it to the surgical video demonstration classroom. The video quality is high and the voice is clear and clear.
(2) The operating room is equipped with a camera control system, which is used to remotely adjust the camera position and parameters, so as to avoid the phenomenon of white and distorted image produced by the camera under the high intensity light of shadowless lamp, and ensure high image quality, high definition and high color restoration.

(3) The operating room realizes panoramic monitoring, with good image quality, and adjustable pan-tilt angle and lens focal length. Multi-screen monitoring, full-screen monitoring and control can be carried out through the network in the office of the chief nurse and the sub-head nurses.
(4) In the central control room or in the classroom, the operating room camera can be remotely controlled in all directions to achieve video shooting without blind spots.
(5) It can realize two-way voice intercom in operating room, demonstration room and central control room, realize multi screen preview and any full screen preview, and monitor any audio signal.
(6) The functions of operation teaching, academic exchange and video storage are realized through the network. All video images (endoscope, microscope, endoscope, monitor, field camera, panoramic camera, etc.) can be transmitted and stored through the network, and any video image can be transmitted and stored at the same time to achieve audio and video synchronization.
(7) The most advanced H.264 compression algorithm is used for network transmission, storage and playback. The definition reaches Fullhd level and HD DVD image quality is achieved to meet the requirements of medical operation. For example, pancreas and fat can be clearly distinguished by color. The bitstream transmitted and stored in the network shall not be less than 3mbps or higher than 10Mbps, and can be adjusted within this range to save bandwidth under the condition of ensuring picture quality.
(8) The data after the operation storage video can be carved into HD DVD discs, which is convenient for storage and carrying.
(9) Two-way audio and video intercom can be carried out during surgical teaching and academic exchanges to achieve clear voice, low delay, no echo, and clear and smooth video.
(10) Realize surgical teaching and academic exchange through the network in demonstration classrooms, operating rooms, conference rooms, leadership offices, medical offices, academic lecture halls, and multi-function halls. The video playback resolution is required to reach the FULLHD level and the effect to reach HD. DVD picture quality, high color reproduction. Each demand site can broadcast live, on-demand, intercom, and manage video and audio according to access rights. The two-way intercom communication function can be carried out everywhere, and the intercom equipment must support the video function, so that audio and video two-way intercom can be carried out when possible.
(11) In any network access point in the hospital, the authority can be assigned to manage the audio and video live broadcast, on-demand, intercom and other aspects of the operation process. In the case of a dedicated network, the remote operation observation, operation guidance, remote teaching, remote consultation and so on can be realized.

4 System Hardware Design

4.1 Development Environment

The development environment of this system is as follows:

1. Development tool: MyEclipse2019;
2. Development language: Java;
3. Database server: sQLServer 2008R2.

Software deployment environment:

1. PC operating system: Windows 10;
2. Server operating system: Windows Server 2008 R2;
3. Database server: sQLServer 2008 R2.

Hardware server environment:

1. Central processing unit: Inter(R) Xeon(R)CPU E5–2620 v3 @2.40 GHz 2.40 GHz;
2. Memory capacity: 32.O GB (31.9 GB Available);
3. Hard disk capacity: ITB.

4.2 Database Installation and Configuration

The database used by this system is Microsoft sQL Server 2008. The database installation file can be downloaded from the official Microsoft website of sQL Server 2008 Standard Edition (32-bit). Due to the huge database content and various functions, including: database engine, Analysis Services, OLAP, Integration Services, Notification Services, it is necessary to install sQL server Management Studio Express to coordinate and manage the database. When installing the database, set the account and password, and set the database remote access port [7].

After the database installation is completed, first open SQL Server 2008 to enter the main interface of the software normally; then create a new database designed by the system, configure the main and foreign keys, and generate the database relationship diagram; finally, add test data in the corresponding table, such as the province of the patient, the city of the patient, the county of the patient, the hospital information, doctor information, test user, etc.

4.3 Operating Environment Configuration

After the database installation, the software development environment needs to be configured. Because the system uses Java language for program development, JDK, JRE and Tomcat need to be installed and configured. JDK can be installed by downloading jdk-8ul ll-windows-i586.exe from the Java official website. Because JDK comes with JRE, you only need to download the JDK installation program. Tomcat can also download apache-tomcat-8.5.8.exe from its official website. After the installation, you need to configure the environment variables in the system computer → properties → advanced system settings → advanced → environment variables.

5 System Software Design

5.1 Medical Record Collection

The collection of medical records includes text data and image data. The text data mainly contains basic personal information, descriptions of main symptoms, disease history, and laboratory test results. The system provides manual entry of medical records. Basic-level doctors enter the patient's medical record and preliminary diagnosis information into the patient's current medical record. The medical record data is stored in the system database.

In the process of image data acquisition, the hospital PACS system is generally limited to the outside world, and even some primary medical institutions do not have PACS system [8]. The consultation center is equipped with medical special film scanner, which can convert the ordinary film of CT examination, B-ultrasound examination and radiology examination into DICOM3.0 standard digital image, and automatically store it in the database. The consultation system accesses the database to obtain the digital image data of patients. The paper materials were processed by conventional scanners and converted into pictures, and saved to the database of consultation system in JPEG format.

5.2 Remote Consultation

Based on the process of deep learning, through multiple input, training, learning, output, feedback and input, this study completed the design of consultation, information consultation, video consultation, consultation doctor recommendation, distance education training and medical record sharing. Among them, the number of iterations of deep learning is 1000.

5.2.1 Consultation

Consultation is one of the non real time consultation. Grassroots doctors send the content of the disease to be consulted to the consultation experts, who will reply after receiving the consultation message. Only consultation experts can be selected for consultation and consultation, not doctors [9]. The operation process of consultation and consultation is as follows:

(1) Basic-level doctors log in to the system and select consultation for specific patients;
(2) Fill in the details of the consultation and choose the consultation expert to consult;
(3) The expert log in to the system, check the questioning task, reply according to the question, and submit the questioning report;
(4) The primary doctors check the consultation report and the consultation is over.

5.2.2 Information Consultation

Information inquiry is also non real-time consultation, not limited by time. After the primary doctors submit the patient's medical records, the consultation type is data inquiry,

and the specific consultation doctor is selected and submitted. After the management end of triage platform is approved, the consultant doctors diagnose the relevant diseases according to the text, data and images provided by the medical records, and finally fill in the consultation report and submit it. The grassroots doctors check the consultation report and give the final consultation conclusion. The process of data consultation is consistent with that of video consultation.

5.2.3 Video Consultation

The video consultation is a real-time consultation, and the basic-level doctors first submit the patient's medical records, and select the type of consultation as video consultation, and then choose the consultation doctor. After receiving the video consultation application, the consultation doctor will be managed by the triage station to review and arrange the consultation doctor and consultation time. The consultation doctor will have a video call with the grassroots doctors within the specified time and communicate with the grassroots doctors and patients in a "face-to-face" manner. In addition, the consultation doctors can view the consultation materials submitted by the primary doctors, which contain the patient's condition information, which is convenient for expert doctors and primary doctors to discuss the disease face-to-face, so as to give a better treatment plan for the patient's condition. After the real-time diagnosis is completed, the consulting doctor fills in the consultation report and submits it to the primary doctors, and finally the primary doctors issue the consultation conclusion [10].

The status of video consultation includes eight states: to be reviewed, to be consulted, to be consulted, to be reported, to be concluded, to be completed, to be approved, and to be closed. The status of data consultation includes six kinds: to be reviewed, to be consulted, to be reported, to be concluded, to be completed, and not to be approved. The operation of triage desk administrator includes the audit and management of consultation status.

The specific process of video consultation is as follows:

(1) Consultation of primary doctors: patients are treated at the primary level doctors, new patients are added to the primary doctors, and personal information is input and saved, including name, gender, age, ID card number, home address and so on. Then the patient's information is kept in the system. Then primary doctors select specific patients, add consultation application, select consultation type and consultation doctor, fill in consultation application information (including patient's symptoms, past medical history, upload medical records and submit consultation application). After consultation application, the consultation management center can see the consultation application form.
(2) Consultation management review: After logging in to the consultation management backstage, you can see all the consultation application forms and detailed information of the application form, check whether the content of the consultation application is complete and in compliance with the specifications, if the consultation application meets the requirements, the review will be passed, if the consultation application If it does not meet the requirements, the review will fail. After the consultation is approved, the consultation administrator sends a message to

the superior doctor selected in the consultation application to confirm whether the superior doctor has time for the consultation. If there is time, the superior doctor will be arranged for consultation; if the superior doctor refuses the consultation, the consultation management center will reject the consultation application and reschedule the doctor.

(3) Consultation of superior doctors: after logging in to the platform with their own account, the superior doctors can view their consultation application on the platform, and then conduct video consultation with primary doctors. In combination with the patient's medical record content and the patient's "meeting" in the video, the superior doctor can diagnose and treat the patient. After the video consultation, the superior doctor will fill in the consultation report and submit it.

(4) Primary doctors fill in the consultation conclusion. After the superior doctor submits the consultation report, the primary doctors can see that the consultation report has been submitted on their own platform. The primary doctors can view the consultation report, and combine the specific discussion of the patient's condition during the consultation process to give the patient's final treatment plan. The doctor finally fills in the consultation conclusion and submits it, and the consultation ends.

5.3 Recommended by Consultant

In the consultation module, after the primary doctors in the lower-level hospital fill in the patient's medical record, the next step is to select the consultation doctor. The system recommends a list of consultation doctors for the primary doctors according to

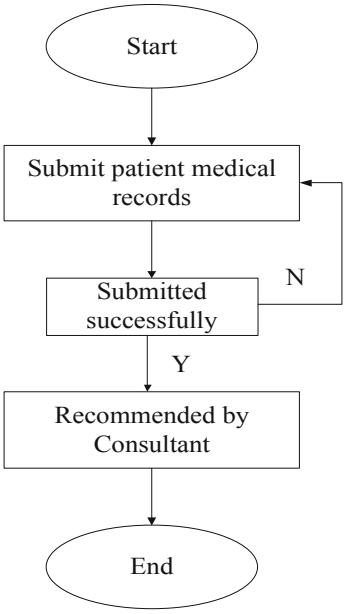

Fig. 1. Consultation doctor recommendation process

the department and the patient's medical record text selected by the primary doctors, and select a consultation doctor from the list, aAnd then submit the consultation application. Figure 1 is a flowchart of the consultation doctor recommendation.

5.4 Distance Education and Training

Distance education training includes knowledge lecture learning, medical history data learning, and knowledge lecture learning. The process is shown in Fig. 2.

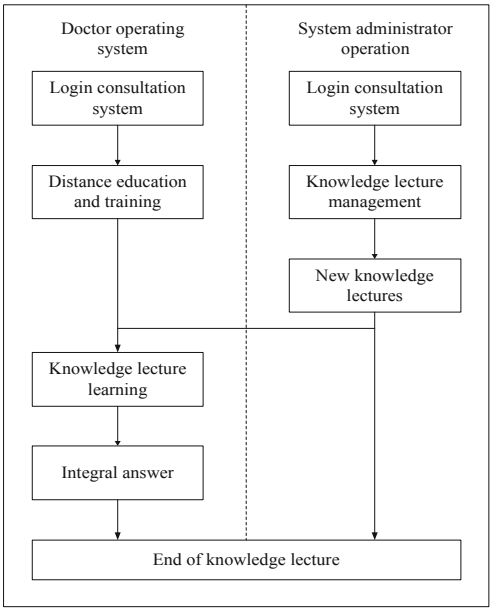

Fig. 2. Business process of knowledge lecture

Figure 2 shows the business operation flow of knowledge lecture. The administrator of the system background management end logs in and adds knowledge lectures. After the doctor logs in to the system, he or she can view the classification of knowledge lectures and learn in the distance education training module. Knowledge lectures are usually equipped with exercises, which can be scored after learning.

The remote consultation system includes three subsystems: system background management, triage table management and organization management. The operation permissions of the three subsystems are as follows: the operation permissions of the background management end of the system are the addition, modification and deletion of special lectures, lecturers and special categories; the permissions of the triage management end are the view of special lectures, lecturers and special categories; the operation permissions of the organization management end do not have the function of special lectures.

5.5 Medical Record Sharing

The business operation process of medical record learning is shown in Fig. 3.

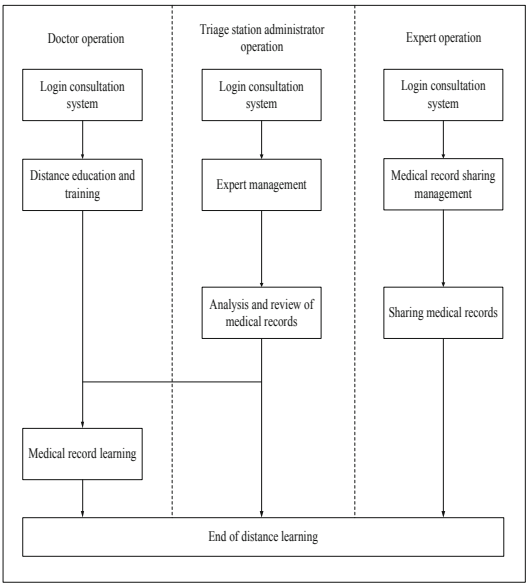

Fig. 3. Case learning business process

After consulting experts log in the system, they can add new medical record sharing in the medical record sharing management module. After the triage terminal administrator approves, the doctor can view the new medical record sharing in the system, so as to learn the medical record.

6 Experiment Analysis

6.1 Experiment Preparation

In order to better reflect the application effectiveness of remote consultation and teaching system, the black box method is used to test the experiment. According to the different functions of each module in the system design, the system as a whole is tested in detail, and the actual situation is simulated during the test to detect whether the modules of the system can meet the requirements of remote consultation. During the test, the system is regarded as a box, ignoring the situation inside the box, only verifying whether the function and interface of the program meet the requirements, and testing whether the remote consultation system can receive and transmit data information correctly.

The main content of the system function test includes the following parts: whether the system can log in normally, whether it can identify illegal accounts and report errors; whether the permissions of the system are normal, whether it can enter different interfaces

according to different identities of users; whether the system is normal Application, arrangement and diagnosis; whether the information can be released normally; whether the overall function realized by the system meets the demand.

Test requirements: after the doctor user logs in to the system and selects view arrangement, the system can enter the view arrangement interface, view the consultation arrangement, click to fill in the diagnosis report to enter the diagnosis report filling interface, which can diagnose the patients.

Test result: After the doctor user logs in to the system, selects to view the schedule, the system can correctly query the consultation schedule of the current user by the consulting doctor; click the scheduled information, the user can correctly query the patient information; click to fill in the diagnosis report, the system can be correct Display the diagnosis report filling interface; when the doctor fills in, click save, the database can store the diagnosis report data normally. The lower-level hospital logs into the system and selects to view the report. The system can correctly query the diagnostic report information and display the diagnostic report.

Test conclusion: the diagnostic function enables doctors to fill in diagnosis reports, save data and share cases as teaching materials.

In order to highlight the performance of this system, it is compared with the remote consultation and teaching system based on neural network.

6.2 Comparison of Experimental Results

The response time of the system is tested. During the test, there are 50 pieces of data in the system. The test results are shown in Table 1.

Table 1. Comparison of experimental results

Test operation	Average response time of neural network system(ms)	Average response time of deep learning system(ms)
User login system	48	45
Lower level hospitals submit applications	54	48
Higher-level hospital inquiry application	66	46
Arrangement submitted by superior hospital	49	42
Doctor check arrangement	67	40
Doctors submit diagnostic reports	62	46
View the diagnosis report in the lower-level hospital	79	48
Hospital releases information	53	41

Through the above test, it can be seen that the system in this paper has a faster response speed when in use, and the system can quickly complete the data interaction of the above functions, which can meet the needs in actual work.

However, due to the limitation of test conditions, this system has not been used on site, and multi-user concurrent testing has not been carried out. In this regard, it needs to be strengthened and improved. And for the data query process of the system, when the amount of data reaches hundreds of thousands or even millions, the time complexity will increase, and the system itself does not have the ability to actively query and can only query passively. Therefore, more effective algorithms are needed to perform database query operations, such as using deep learning technology for data mining in the case of big data, to deal with higher challenges.

7 Conclusion

The hospital's remote consultation and teaching system not only meets the needs of patients to seek medical treatment in different regions, but also promotes the intelligent development of the medical industry, and at the same time solves the problems of limited operating space and the number of visitors, and the risk of cross-infection. The video of the operation process is used as an important data archive, which can be used for medical record archiving, scientific research and teaching, or medical dispute verification data. Therefore, this paper designs a hospital remote consultation and teaching system based on deep learning. On the basis of analyzing the problems of the system construction and clarifying the system design objectives, with the support of the system hardware, the deep learning process is used to realize the functions of case collection, remote consultation, doctor recommendation, remote education and training, and case sharing. In the experimental part, through the comparison with the traditional system, the system is more effective.

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