Research on Network Database Laboratory Instrument Management Information System Based on Content Query

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Abstract. With the requirement of further opening of laboratories, it is increasingly important to carry out open management of laboratories on the basis of traditional laboratory management. In this paper, Windows operating system is used as the operating platform, ASP technology and databases such as Microsoft Access 2013 and Microsoft SQL Server 2000 are used as development tools. This paper mainly discusses how to build an object-oriented image database based on content query based on the existing database management system, proposes a hierarchical model of the system, and presents a data structure model of the image database. A laboratory instrument management information system with B/S mode based on content query network database is developed. In the specific teaching, the laboratory should be fully open in the experiment content, experiment equipment, experiment time and experiment management, so as to make the laboratory open management scientific and improve the utilization rate of instruments and equipment.

1. Introduction
After years of development, the laboratory equipment management system has gradually realized paperless and modern management from manual management to C/S mode and function-oriented B/S mode. However, with the gradual increase in the requirements of openness in laboratory construction, the original laboratory management methods are no longer suitable for the current teaching practice in colleges and universities [1]. With the increase of the number and size of image files, retrieving images, managing files and confirming the correct extraction of image data are all time-consuming and error-prone. Therefore, the use of database management systems to manage image data is attracting more and more attention [2]. At present, the scale of laboratories in institutions of higher learning is getting larger and larger, the number of laboratories to be established and the number of equipment in laboratories are also getting larger and larger, and it is increasingly impossible to effectively manage laboratories by using the previous manual management methods [3]. The form of the database may also be distributed, so that it can cross the limitations of the local machine, which is a great development and progress in both the amount of data used and the means of access. On the other hand, content-based image queries are also receiving increasing attention [4]. The database database based on content query has the B/S structure mode laboratory management information system. Compared with the traditional C/S structure system, it has many advantages and can better meet the use requirements.

2. System Function

2.1 Instrument Management
Instrumental management includes laboratory bench, large-scale instruments and common instruments, which have common features as well as their own characteristics. The test bench and large instruments and equipment with high volume, weight and price can only be placed in fixed positions, while small expensive instruments with high price can be borrowed just like ordinary instruments, thus lending instruments in different ways. To establish and improve the management procedures of instruments and equipment and laboratory rules and regulations, and organize all laboratory personnel to study, pay attention to laboratory instruments and equipment in thought, be familiar with equipment management procedures in methods, operate correctly, and carry out maintenance on time [5]. Using the modern network technology, we can realize the network of laboratory information management. From difficult to easy, traditional laboratory management “difficult to manage” becomes “easy to manage” [6]. However, there are unified standards for all kinds of data of these instruments and equipment or stands, such as instrument name, instrument unified number, price, manufacturer, main performance indexes, etc. The information is input into the database by the school laboratory and equipment management office to ensure that each equipment has a unique number. The laboratory shall be equipped with instruments and equipment according to the project, and the main equipment and auxiliary equipment shall be equipped to meet the needs of the project.

2.2 User Management
Ordinary users don't need to register to query the information about the instrument, but they can't modify anything. Advanced users should first fill in their basic information in the laboratory information management system, apply for registration, and be confirmed by the laboratory management personnel before using the registered name and password to log in to the system. Unlike the previous ASP programming language, which is a real-time interpretation language program, it is directly compiled into an intermediate language on the server. Customers will not feel the running process of the program at all, only need to read the compiled information in the memory of the heavy computer to browse [7]. In this mode, the client software varies with the server software, and accessing different servers requires different client software, which is not suitable for running in multi-platform environment. With the expansion of functions, clients become more and more complex, making the maintenance and management of the system more and more complex [8]. The whole system can combine the specific situation of the school management mode to carry out function selection and authority allocation, and subdivide it into basic units as much as possible.

2.3 Statistics and Analysis of Experimental Data
The cost of using instruments varies with teaching, scientific research and management. The specific laboratory management personnel of each functional laboratory are mainly responsible for the purchase application, appointment and daily data maintenance of instruments. Equipment used for measurement shall be verified/calibrated as required [9]. Annual verification/calibration plan shall be made at the beginning of each year. Existing equipment shall be verified/calibrated as planned. In addition, in order to collect, count and analyze the utilization rate of laboratory instruments and equipment and the experimental conditions of users, the statistical and analytical functions of experimental data are required. Ideally, one would expect an image database to have an automatic semantic extraction function that allows the user to query the image content without first providing the image content information [10]. Teachers can manage information management such as personal information, experimental projects, student experiment review and scoring, and view device status and borrowing. The administrator mainly conducts laboratory course scheduling, personnel management, and the like. Realize the openness of laboratory management, experimental equipment and content, experimental time and space.

2.4 Error Handling
When the user operation authority is out of bounds or the system is abnormal, the error handling mechanism will automatically capture the error, and access the database according to the GUID (global
unique identification number) corresponding to the error, find the processing method corresponding to the error, and output to the error message prompt interface. At the level, it is far below the semantic meaning represented by the image. Therefore, it is crucial to find a representation that converts the original pixel values into appropriate image characteristics [11]. Teachers can check the experiment schedule arranged at the beginning of the semester, and inquire the free time of the laboratory, so as to apply for other time use, and check the experiment equipment to apply for loan; the point of B / S architecture is to configure the laboratory management system to a remote server, which can access and use the system wherever you can access the Internet, of course, you must have permission.

3. System Architecture and Design Scheme

3.1 System architecture. LIMIS system is constructed by B/S architecture, and ASP3.0 script is used to construct middle-tier business processing components to complete the processing of most transactions. In the traditional database, the best data mode may be designed before the data input system, and the mode will rarely change once it is established [12]. The system introduces students and course information into the system based on the elective course of the student educational system, and adjusts according to the actual situation.

Data storage is realized by enterprise-level database products; it runs on the Windows operating system platform and has excellent data processing capabilities. The system network topology is shown in Figure 1.

![Figure 1 System Network Topology](image)

The client/server (C/S) architecture consists of multiple computers connected in a network. A computer that requests another computer to serve it is called a client. The computer that processes the database is called a server. VBScript and HTML are used to implement interface display and user interaction functions, and mature application server products are used in the middle to support the operating environment of business processing components; Different image feature extraction algorithms often correspond to different feature files. When searching, it is actually searching the entries in the feature file. In this way, the client does not need to install any code of MIS system, which makes the system platform independent and reduces the development and maintenance costs. The B/S structure is scalable. When the network environment allows, browsers and servers can be added as much as possible without being affected by the original network resources.

3.2 System design scheme. In this design scheme, the database support system is organized and maintained by Microsoft Access 2013 and Microsoft SQL Server 2000 relational database management systems, using Microsoft Jet4.0 database engine. It can accept users' connection and use requests, and should be a concurrent service and processed concurrently. The implementation of the specific advancement can be different in different operating systems. The client of the C/S database application must be able to communicate with the database management system of the server. The client of this article uses ODBC for SQL. Server driver and TCP/IP protocol to connect with the server. Access has poor multi-user performance, low operating efficiency, and small data traffic carrying capacity; while SQL server can achieve extraordinary scalability and reliability, with the ability to scale up and expand
outward, and can meet the requirements of demanding e-commerce and enterprise applications. This is because when the new image processing program is applied to the system or the retrieval requirements change, the mode will change. In addition, content-based query belongs to semantic query. It needs the combination of knowledge-based technology and database technology. Moreover, the system is running in the Internet or Intranet environment. Internet / Intranet adopts TCP / IP, HTTP, HTML, CGI and other technologies and standards, and has good data communication and extensive data sharing characteristics.

LIMIS system is divided into two major blocks: the background management system of the database and the functions of browsing, viewing and submitting borrowing applications for foreground users, as shown in Figure 2 and Figure 3.

The main characteristics of Access are easy to use and powerful performance, which can meet the needs of small and medium-sized applications. SQLServer is mainly used for large-scale applications, especially for massive data and very large number of users. Its basic work is to complete all kinds of processing of local on-board images, including image analysis and feature extraction. It can intuitively display image features and other information, while users select different algorithms to generate different feature values of the image. Compared with static sites, dynamic and interactive sites can better reflect the advantages of network environment. With the continuous development of network technology, new technologies are emerging in the development of information systems. In the system design, in order to maximize the convenience of information input and improve work efficiency, human-computer interaction should be fully considered. Therefore, when designing the database, create a specific database for common or common information of some instruments. The database can be modified as needed. From the development cycle and user-oriented considerations, LIMIS has a small application scope. The Access database can meet all requirements and does not require maintenance by later professionals, so it is used in version 1.0. The benefit of this layering is that the problem of creating an image index is independent of the design of the database concept pattern and is easily compatible with building other object-oriented databases.

3.3 Implementation of the System
Implementation of database structure design. In the process of database design and implementation, first of all, different field names, data types, qualification conditions and annotations must be defined according to different information. Then the data structure is designed and coded. The client has a network communication interface. In the process of inquiry, firstly, network login and connection are
carried out, and after success, image inquiry can be carried out through the network. The server side will complete the interpretation and operation of all scripts and commands in ASP and send the dynamically generated WWW page to the client browser. Different from the common technology of realizing dynamic homepage on the client, the client technology is in the development of web application. In the process of using the instrument and equipment, its status will change from time to time, such as the quality of the equipment, the maintenance situation, the laboratory, etc., all need to get timely response in the system. Provide basis for equipment maintenance and decision-making.

Based on the existing relational database management system, an object-oriented image database is established. In this regard, we propose a hierarchical model of object-oriented image database based on content query on RDBMS (Figure 4). Among them, the lowest layer is the existing RDBMS and the image database built on it. The middle layer comprises an insertion module and an extraction module. The insertion module includes an index submodule and a data conversion submodule.

![Figure 4 System Structure](image)

Since most of the business of the whole system is data query, there must be a caching mechanism, and the data persistence layer is responsible for this work. As a view, the presentation layer is the interface that finally interacts with the user. The friendliness of the user experience and the ease of operation of the system are all reflected in this layer. A system with C/S mode has a natural barrier. You have to access my system to have my own dedicated client software. After using Internet technology, there is no such barrier. If you don't have other security measures, anyone can access your system. When the service resources are not sufficient, the number of users is limited and the database expansion is limited. Therefore, the user's request should use the asynchronous party as much as possible, especially after the work is completed, the server immediately releases the resources used by the user.

Implementation of ASP programming. ASP itself contains a DLL file named asp.dll, which is installed by default in the Winnt\System32\inetsrv directory. This DLL file is responsible for getting an ASP page, then parsing it and looking for server-side script content. The quality of the database structure design will have a direct impact on the efficiency and effectiveness of the system. Reasonable database structure design can improve the efficiency of data storage, ensure the integrity and consistency of data, and is also conducive to the realization of the program. According to the management method of large-scale instruments and equipment in schools, in order to strengthen the management of large-scale instruments and equipment, give full play to the role of large-scale instruments and equipment, carry out the cooperation and sharing of large-scale instruments and equipment, manage and use the teaching scientific and technological resources, improve the utilization rate of instruments, enhance the ability of teaching and scientific research, give full play to the advantages of large-scale scientific research instruments and equipment, and realize the optimal allocation and sharing of teaching and scientific and technological resources.
The data flow of the equipment borrowing and returning management subsystem is shown in Figure 5. The system can real-time statistics and display the cost, start use time, end use time, experiment use status of the instrument borrowing as the statistical basis for accountability and instrument use.

![Diagram of Equipment Borrowing and Returning Management Subsystem](image)

Figure 5 Data Flow Chart of Equipment Borrowing and Returning Management Subsystem

Since the image features have been extracted in advance, there is no need to extract features from the images in the library, which can reduce the cost of server resources. The complete page will be sent to the Web server, from where it will be sent to the original requesting client. The design of ASP web page uses frame technology to realize the frame structure of web page, in which the left side is the expandable / foldable menu, the right side is the information display corresponding to the menu, the top is the title, and the bottom is the copyright information of the system. It is combined with the object-oriented entity relation model of the upper layer as the data model of the system, which provides a good support for content-based query.

The realization of information update system of instrument and equipment. In the process of using the instrument and equipment, its status will change from time to time, such as the quality of the equipment, the maintenance situation, the laboratory, etc., all need to get timely response in the system. Provide basis for equipment maintenance and decision-making. According to the requirements of the system design, the information of the personnel involved in the laboratory experiment and management is designed into the user information table. The user table stores the personal information of all the registered personnel, including their personal data and communication methods. When each user makes a normal connection, the service process is bound to open up a new workspace as the workspace of the newly connected user. This is a memory resource. ASP is actually an environment for developing scripting languages on the server side. It can be used to develop dynamic, interactive, high-performance, Web server-side applications and easily implement complex Web applications. If the user inputs the query statement, the user can search through the high-level semantic structure according to the query statement. In this way, the user can not only query through the examples of the underlying features on the basis of the high-level semantic search, but also fine-tune the query results through relevant feedback. When we want to know some information, the query function helps us find the information we need in the shortest time and improve the efficiency of our work. The system has designed different query functions according to the characteristics of each school equipment management. The back-end database is MySQL, which is a small relational database management system that is small, fast, low total cost of ownership, and open source.

4. Summary
This management platform is mainly for a set of solutions for the management of laboratory equipment in colleges and universities. The goal is to achieve “resource sharing, saving efficiency” in university laboratories. The use of the system realizes the high sharing of laboratory information resources, which can not only achieve the selection and scoring of general experimental tasks, but also consider the
characteristics of the open experiment project involving many students' professional and time inconsistency. It is convenient for teachers and students to arrange experiments, improves the order of experimental teaching, improves the dynamic and open management of experimental courses, and improves the efficiency of experimental teaching and the utilization rate of experimental equipment. Practice has proved that the B/S structure, which combines the front-end and back-end technologies of network database for content query, is a good choice for laboratory instrument management system to realize network application. The system has certain practical value and popularization value.

References
[1] Zhao Xin. Research on the Construction of Agricultural Information Management System Based on Database Technology [J]. Rural Science and Technology, 2017(35):92-94.
[2] Meng Bin. Realization of Information Management System Based on access Database [J]. Automation and Instruments, 2017(4):190-191.
[3] Ma Jun Xi. Research on Application of Distributed Database in Management Information System [J]. Information System Engineering, 2019, 303(03):72.
[4] Wang Bing, Wu Chao. Progress in International Research on Security Management Information System-Typical Literature Analysis Based on Web of Science Database [J]. Social Science Information, 2018, 37(11):135-140.
[5] Huang Jianghong, Yu Minjian. Design of instrument and equipment management information system based on two-dimensional code [J]. Computer Technology and Development, 2018, 28(11):169-173+178.
[6] Tang Wei, Lei Junfang, Lei Jianlan, et al. Design of a Trinity Large Instrument Sharing Management Information System [J]. Experimental Technology and Management, 2019, 36(04):171-173.
[7] Yuan Guangcun, An Tao. Study on the Application of Electric Power Environmental Protection Supervision and Management Information System [J]. Automation and Instruments, 2017(8):53-54.
[8] Qiu penrui, yuan xiping, gan Shu, et al. research on university instrument management system based on Android platform and QR code generation and identification technology [J]. Automation and instrumentation, 2018(4): 67-70.
[9] Zhao Yong. Design and Implementation of Logistics Management Information System for Electric Power Enterprises [J]. Modern Scientific Instruments, 2018(6).
[10] Jiang Yixiang. Analysis of Laboratory Information Management System [J]. Science and Technology Information, 2017(15):29.
[11] Wu Kaidong. Development Direction and Implementation Technology of Management Information System [J]. Successful Marketing, 2018(12):118-119.
[12] Ning Fangjing. Development of Management Information System [J]. Electronic Technology and Software Engineering, 2018(8): 57-57.