Research on University Open Laboratory Management System Based on "Internet +"

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Abstract: The overall scheme designed in this paper includes building a wireless sensor network to realize laboratory environmental information collection, using intelligent terminal equipment to realize intelligent control and asset management of the laboratory, access control card, intelligent lighting adjustment, temperature and humidity monitoring, and equipment information management. Set up a big data platform to achieve the collection of laboratory digital information, mining and analyzing laboratory data, and providing decision support for the intelligent management of laboratories. Through the Android mobile terminal, the visual adjustment of each part of the function is realized, and the remote control provides the system access of the teacher, the manager and the student, realizes the teacher's inspection of the student's attendance, and the manager queries the use of the laboratory and the experimental teaching instrument. Student online appointments and other functions.

1. Introduction

With the rapid development of computer technology, related products have been applied to every corner of life, and various forms of intelligent products have been able to replace people to complete complex work, and work efficiency has been greatly improved. The concept of "Internet +" is an important manifestation of the rapid development of computer technology. The spirit of reform and innovation advocated by "Internet +" is in line with the idea of college education reform at this stage. The "Internet +" education model is being gradually explore.

As an important teaching method of college education, experimental teaching has always been valued by universities. Therefore, the construction of university laboratories as the carrier of teaching experiments is particularly important. The current educational model has changed from a traditional teacher professor and a passively accepted teaching model to a new type of education model that focuses on interaction and fosters students' independent learning ability and innovative consciousness. The content of experimental teaching has also become more practical and comprehensive from a single experimental routine, and cross-platform and interdisciplinary experiments have gradually increased and openness has become stronger. The construction of the laboratory must also be more closely followed by changes in the teaching environment. The laboratory must have the ability to provide interdisciplinary experiments, comprehensive experiments and independent experimental platforms.

At the same time, in order to meet the constant innovation of the educational environment, colleges and universities continue to increase investment in experimental teaching. The procurement of experimental equipment, the addition of integrated instruments, and the management of equipment have become more and more complicated. At present, the management of laboratories adopts the traditional management method with the administrator as the core. The recording of information is still based on labor. The labeling of equipment information is implemented by means of labeling on

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the equipment. Each time the equipment inventory needs manual verification by the administrator against the ledger, which not only greatly increases the workload of the administrator, but also it will inevitably lead to information errors in the records, resulting in management omissions. And now the information exchange speed is getting faster and faster, the management of system software makes the manual management method even more stretched. Under the "Internet +" education model, how to build laboratories in universities, how to carry out innovative teaching, how to intelligentize and manage information in laboratories has become an established challenge.

2. "Internet +" Education Background

“Internet +” Education On March 5, 2015, Premier Li Keqiang’s government work report at the opening ceremony of the Third Session of the 12th National People’s Congress mentioned the use of the “Internet Plus” technology to serve the current manufacturing industry. For a time, the concept of "Internet +" has become a hot topic. The concept of "Internet +" is the expansion and extension of the Internet to a certain stage. Thanks to the promotion of the concept of “Internet +”, in the field of education, first of all, learning resources have become more abundant. With the diversification of means of knowledge acquisition, channels have become more widespread, and different educational models have become more and more. New educational concepts and new methods have emerged, and various software and hardware resources have become more abundant and open source.

Secondly, the way of education changes, the way of education is more humanized, and it begins to become a learner-centered, analyzes the differences between learners, and then uses a variety of teaching models to customize the teaching content. Teaching students in accordance with their aptitude, teaching students, and at the same time, according to the learner's learning feedback, the teaching plan is continuously improved in time, so that the teaching content is more in line with the learner's own, so that the learner's interest in learning and learning efficiency are improved.

3. Open Laboratory Design Related Technology

Internet of Things technology is developed on the basis of Internet technology. The main research content of Internet of Things technology is information exchange and communication between objects. Through the identification technology, the Internet of Things obtains information through the recognition technology, and exchanges and communicates the perceived information through the corresponding network protocol to realize the connection between the physical world and the information world and the detection, identification, and control management of the corresponding objects. Internet of Things technology has been widely used in the field of data fusion, and it has also set off a third wave of development in the information industry.

Android system, Apple system and Windows system are the mainstream three systems of mobile operating systems. Due to the strong dominance of the Windows system on the PC side, Microsoft has a lack of skills in the construction of the mobile terminal. The Apple system has formed a closed-loop ecosystem in order to ensure its security. This is a big limitation for developers. The Android system relies on its open source and the powerful function has aroused the enthusiasm of the developers. In the process of continuous iteration and perfection of the system, the mobile operating system market has been gradually ruled. The Android system has been applied to almost all fields, and a large-scale network structure has been formed. .

4. Network Communication Technology

The IP layer of the network layer and the TCP protocol of the transport layer constitute the network communication protocol of the Internet, and they are also the basic protocols of the Internet. Just as the language of people in different places can't communicate, all kinds of computers all over the world run different operating systems, and the programming language and data format are different. The standard communication protocol is essential. TCP is responsible for communication

between applications, and TCP completes the process of establishing connection, sending data, and disconnecting according to the instructions of the application. TCP can establish a reliable transmission to smoothly send data sent from the application layer to the corresponding endpoint. The TCP header and TCP data transmitted by TCP become the IP data, and the IP further processes the data, plus the IP packet generated by the IP header, and the routing control table determines that the IP packet will be accepted. Route or host address.

The IP protocol corresponds to the network layer, and the TCP protocol corresponds to the transport layer. The transmission principle of the network is that there is no way to directly perform data communication. The emergence of Socket solves this problem. Socket is a protocol package for TC/IP. It is an API for programming calls. Through the deployment of Socket, TCP/IP communication can be performed on the Android system. Socket belongs to the transport layer. The types of Socket use are mainly stream sockets and datagram sockets.

People are increasingly demanding the transmission of information and the requirements for communication equipment are increasing. In the Internet of Things network, we need a small, short-distance wireless network to achieve anywhere, anytime. Both can get information and send information. Short-range wireless communication technology has developed rapidly. Among them, wireless communication technologies such as Bluetooth, WIFI, and ZigBee, which are low-cost and low-power consumption, are becoming the focus of technology research. The ZigBee protocol is designed with a layered design concept and is divided into physical layer, MAC layer, network layer, application layer and security service specification. In the ZigBee protocol, activities between two layers, including function calls and information transfer, can be done with "primitives", so even if the system is divided into different layers, if they are all done with "primitives", then The communication methods between them are very similar. There are four types of primitives: request, indication, response, and confirmation.

The database has emerged in the 1950s, and it organizes and stores data according to a certain data structure. The organization of the data in the database is called the data structure of the database. The data structure is divided into logical structure and physical structure. The logical structure of data refers to the organization of data and the logical relationship of each other. The physical structure is the concrete realization form of logical structure. There are three kinds of data models in the logical structure: level Models, mesh models and relational models.

SQL Server is a typical relational model database management system. It contains many powerful tools, such as integrated business intelligence tools, which can provide business-level data management and make data more reliable and secure in storage. Compared with other databases, SQL Server database has the following characteristics: it supports storage and query XML, language, ADO.NET includes data set operation more flexible, more secure, and provides Analysis Services for data mining and data.

The development of the Internet has also brought us a lot of data, and now the data has become one of the fastest growing resources. While data is growing rapidly, data types are certainly cumbersome, including structured data and unstructured data. The traditional data analysis and data processing technology has not been able to meet the requirements of processing large amounts of data and complex data types, so the concept of big data came into being.

The significance of big data is not the size of the data. The key is to professionalize, search and mine the data to find valuable information. At present, it is widely believed that big data has four basic characteristics: large scale, multiple types, fast data processing speed, and low data value density. The core problem to be solved by big data: how to obtain a large amount of data, how to transform relatively complex data into results through data analysis in a large amount of data with low value density, how to ensure the timeliness of data analysis, how to get the analysis The results are presented in the form of image charts, etc., allowing users to actually use the data.

5. Workflow Technology

Modern laboratory management systems are inseparable from workflow technology. Currently,

the workflow technology based on mail systems is called groupware technology.

1) A process is defined as a description of a series of steps to be completed to achieve a work goal. It contains all the information necessary to enable a business process to be executed by a workflow. This information contains start and end conditions, individual components activities, activity scheduling rules, participation of each business and the work to be done, related application order and data call information. The process consists of activities and related data.

2) The data stream is the intermediate exchange information and mapping of the activity. The Workflow Management System (WFMS) uses this data to determine state transitions for workflow instances, such as process scheduling decision data, transfer data between activities, and so on. Workflow related data can be used by both the workflow engine and the application.

3) The control flow is an execution sequence between activities, including system data managed by the Workflow Execution Service (WES) and the engine, such as status information of the workflow instance, status information of each activity, and the like.

4) Activity is every step in the process. An activity can be a program activity or a process activity, and the activity is performed by assigning to a user who can perform the activity.

5) The workflow engine is responsible for interpreting the process definition, and performing process instantiation and process execution control, task mobilization, log maintenance, calling applications through application programming interfaces (APIs), providing supervision and management functions, and providing workflow participation. The interface between the people.

6) The process definition tool is used to create a description of the business process that the computer can process. It can be a formalized process definition language or object-relational model, or it can be a set of routing commands that simply specify the transfer of information between users.

6. Building a Multi-Dimensional University Laboratory Management Platform

Applying smart campus ideas and key technologies in the "Internet +" era, the department's business integration and student innovation ability training are deeply integrated, and the laboratory management objectives, teacher and student experiment needs and usage habits are investigated for the status quo and problems of laboratory management information. Integrate laboratory business and experimental teaching, student innovation ability training, joint software development company, build a multi-dimensional university laboratory management platform, integrate various business management systems, realize data communication, build experimental personnel, project library, information statistics The subsystems achieve full-scale laboratory management, combined with access control and remote video, appointment and open systems, breaking through the limitations of laboratory resources access and use of time and space, forming a ready-to-use, on-demand experimental environment. Realize multi-dimensional platform management of experimental personnel, instruments and equipment, construction projects and experimental activities.

(1) Interconnection and high speed. The high-speed multi-service internet network supports the real-time transmission of data between people, people and things, people and things on campus, and eliminates the limitation of time and space to the greatest extent.

(2) Comprehensive perception of the environment. A wide range of intelligent sensing technologies, including light, azimuth, image, temperature, and electronic control, are used to obtain various types of monitoring information in real time to provide basic information for services.

(3) Business application integration. Application integration, collaboration, open and intensive information architecture, tracking and monitoring throughout the process, to play a good organization and overall efficiency of resources.

(4) Data mining intelligence. Use cloud computing and big data technology to store, calculate and analyze the massive data collected by smart campuses, and further improve decision-making, management and service support capabilities.

7. System Function and User Needs Analysis

Administrators can query laboratory equipment information and use the relevant laboratory equipment. Administrators can log in to the system based on their username and password. In the information system, the status of back-end database storage is quite important. The design of the database not only affects the speed of data operation, but also directly relates to the quality and life cycle of the software system. The system uses a SQL database, which includes a user login table, a storage device table, an outbound device table, a device basic information table, an inventory device table, and the like. Requires the following functions:

1) All work is done by a specialist, and no one else is allowed to use it arbitrarily;

2) For the complete disposal of the waste, and record the relevant information in detail;

3) For repairs with serious problems (faults), record the repair date, equipment name, repair manufacturer, repair fee, responsible person, etc.

4) For urgently needed but missing equipment, please send it to the superior leader for approval to purchase in the form of “application form.

5) Immediately after the new equipment is purchased, register the equipment (including category, equipment name, model, specification, unit price, quantity, purchase date, manufacturer, purchaser, etc.) and update the contents of the application form;

6) Statistics and inquiries on existing equipment and its repair and scrapping at any time. It is required to be queried by category and time period (before a certain date).

Corresponding to this management system, the specific functional requirements are as follows:

1) System login: After the user runs the lab device management system, the user enters a login interface. The user needs to enter the correct username and password before using the system.

2) System management: including management platform users, account creation, deletion, modification, etc.; password setting, password is an important guarantee for the normal operation of the management system, where passwords can be re-edited, deleted, etc.; system parameters Configuration, configuration of the system operating environment; database management, including database restore, backup, delete, and so on.

3) Device classification settings: You can add, modify, and delete different levels of device categories at this level and lower levels, such as basic equipment, common equipment, equipment, glass equipment, and consumables.

4) Storage management: For some experimental equipment’s in the warehouse, some basic information such as supplier, quantity, unit price, and commodity name are entered into the system database, and can be modified and deleted later.

5) Outbound management: Equipment that is shipped out due to different reasons such as use, scrapping, maintenance, etc., according to the quantity, unit price, commodity name is recorded here, and can be deleted, modified and other operations.

6) Inventory inquiry: Select the goods to be inquired in the product name, and you can display the inventory information of the goods to be inquired, such as the remaining quantity, price and so on.

7) Exit the system: Exit the system and restore the actual state of the system.

8. Multi-Dimensional Laboratory Management Platform Architecture

8.1 Perceptual Layer.

The perception layer provides basic information for each service. Using intelligent environment-aware technology, through the access control, high-definition surveillance camera, power controller, card reader and other sensors and various application systems deployed in laboratories and instruments, the personnel, equipment, workstation resources in the laboratory, The experimental process data, laboratory security status and other information are fully perceived in real time. The monitoring information is transmitted to the server and data center through the network

layer, and the collected monitoring information data is stored, calculated and analyzed by using cloud computing and big data technology.

8.2 Network Layer. The Network Layer is an Important Infrastructure in the Era of "Internet +".

The mobile network, the Internet of Things and the campus network are used to realize the interconnection and interaction between the mobile terminals, instrument equipment, data centers and integrated management platforms of the laboratory, and provide a high-speed, fully-covered network environment for various business applications and data exchanges. Improve information delivery and real-time service capabilities.

8.3 Data Layer. The Data Layer is the Data Center of the Platform.

Complete the storage, mining and analysis of all types of information monitored and delivered. It includes data such as laboratory establishment, equipment, course information, e-learning resources, and various real-time information such as real-time information monitored by the sensory layer. It is used for real-time updating of laboratory information resources and the daily learning habits and learning needs of teachers and students, thereby enhancing the laboratory experience of teachers and students, improving the open and shared service processes of the laboratory, and improving the laboratory service level.

8.4 Application Layer. The Application Layer Completes the Management and Handling of Various Business Operations in the Laboratory.

In the design of the application layer, we fully follow the idea of "service as the core and management as the support", deeply integrate the new service concept and open sharing mechanism of the "Internet +" era, integrate the various management services of the laboratory, and log in to the platform. To achieve seamless connectivity such as laboratory safety training test system, valuable equipment and equipment public platform, warehouse material management system, intelligent access control system, remote video system, open management system and project library management system, etc., each system realizes data intercommunication, Information synchronization, to achieve all-round management of the laboratory.

8.5 Service Layer. The Service Layer is a Comprehensive Information Portal.

Through a unified and friendly portal interface, different authorized and personalized information services are provided for teachers and students of different roles. Realize all-day, full-year appointments, and include experimental teaching centers, innovation laboratories, and general scientific research laboratories. The labs on the platform can be reserved for use, experimental teaching projects, and approved experimental experiments and disciplines. Labs and equipment can be reserved for competitions, graduation projects and more. The mobile client will be developed to facilitate teachers and students to use mobile devices to query, reserve, and use various resources in the lab. Improve the efficiency and management level of laboratories by using the service methods of the "Internet +" era.

9. Laboratory Open Algorithm Data Structure

The data structures involved in the lab open algorithm are as follows:

(1) Use the three-dimensional array store[x][y][z] to store some temporary data in the algorithm execution. Z is the number of nodes in the GPR set, Y is the number of nodes in the GLCT set; x is the total number of ways to store yxz two-dimensional form data. There are 4 kinds of data in the scheduling algorithm to be stored in the array, then store[x][y][z] can be represented as store[4][y][z], where:

1) Store [4][y][z] is used to store the global optimal course scheduling method. The optimal class table searched by the entire algorithm is called up from the end of the iteration.

2) Store[2][y][z] is used to store the weight Cij on each side of the bipartite graph. The heuristic information of the edge can be obtained indirectly: r}ij= 1/Cij;

3) store[1] [y] [z] is used to store the amount of information on each side of the two parts.

4) store[3][y][z] is used to store the results of the lesson table with the lowest value in each iteration. In the algorithm, only the pheromone is updated for the optimal solution path in each iteration;

(2) Use the lessons array to record which course nodes are more than 2 times a week and correspond to the same course;

(3) The pr[x][y] array is used to store the PR allocation table information of all ants, where Y is the number of nodes in the GPR set, and x is the number of ants. Similar to the taboo table in the D-Sp problem, each ant has a PR table.

In the process of optimising the class, the ant should use a <time and one classroom> node, and mark the node in the PR table in time to avoid classroom conflicts in subsequent class scheduling.

(4) In order to make the ants work independently of each other, an AntLessons array is introduced to store the corresponding Lessons information of each ant individual. Ants can modify the corresponding AntLessons array.

(5) the algorithm uses a 3-dimensional array AntCost[xJ [y] [z] to solve the problem of scheduling more than two times in the course scheduling problem, in AntCOst x is used to store the individual weight information of x ants Y is the number of nodes in the GLCT set, and Z is the number of nodes in the GPR set.

(6) The class scheduling algorithm introduces an array marry[x][y][z] for storing the <time one classroom> resource matching situation of each course node in each course of the ant, wherein z represents The number of nodes in the GPR set; Y represents the number of nodes in the GLCT set; x represents the number of ants, that is, each ant has a record for storing the course results it searches for. That is, the many array is used to store the open laboratory method that all ants find in a trip.

10. Summary

Database technology, server technology, network communication technology, Android mobile development technology and wireless sensor network technology are used. Database technology and server technology are the foundations of the system. They provide a powerful guarantee for the storage and processing of data. The network communication technology realizes the data communication between the mobile terminal and the server. The powerful functions of the Android system realize the functions of the mobile terminal. The sensor network technology provides strong technical support for the intelligent construction of the laboratory.

The realization of laboratory intelligent control and laboratory information management has effectively reduced the workload of laboratory managers and made laboratory management more informative and user-friendly. A paperless office has been realized, and the resources of the laboratory have been fully utilized to provide an excellent environment for students' learning.

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