Laboratory Management System Based on Data Visualization Technology

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Abstract: In order to solve the problems of imperfect equipment monitoring in laboratory management, difficult to transmit information reasonably to relevant functional departments, and complex business processes, etc. A laboratory management system based on B/S structure is constructed with the main idea of big data analysis and processing and the combination of Internet of Things and other technical means. After clarifying the needs of laboratory managers, the functions of laboratory timetable management, laboratory equipment management, laboratory access control management and laboratory log management are realized. This system not only meets the needs of laboratory managers, but also realizes the highly informationized management of intelligence, security, data and visualization of the laboratory.

1. Introduction

In recent years, with the rapid development of our university, laboratory management is becoming more and more complex. The information construction and management of laboratories are closely related to the teaching and scientific research activities of colleges and universities. Laboratories play an important role in cultivating high-quality talents.

To promote the construction of laboratory information, the Internet of things sensor control with information technology as the means, the application of Internet plus big data to laboratory management, and the comprehensive improvement of the information management level of university laboratories, and the intellectualization of laboratory management have become the inevitable trend of future laboratory construction.

The innovation research of laboratory management system should take the Internet of things as the core [1], and provide a comprehensive intelligent perception experimental environment and comprehensive information service platform for teachers and students by using the new generation of information technology. Realize the intelligent, safe, data-based, visual management of the laboratory, resource interconnection, personnel interaction and cooperation, and open laboratory equipment resources, teaching resources, scientific research resources, laboratory utilization rate, equipment failure rate and other data high information sharing [2].

Combined with the actual situation of our institute, the independent research and development of intelligent laboratory management system can improve the scientific research level of teachers and students, play the role of laboratory information management demonstration, radiate the whole school, and promote it in an all-round way.

2. System Design

2.1 Overall Framework Design of the System

The overall framework of the system [3] is shown in Figure 1. The system consists of equipment management module, laboratory management module, curriculum management module, laboratory log management module, data collection and processing module, data visualization panel [4].

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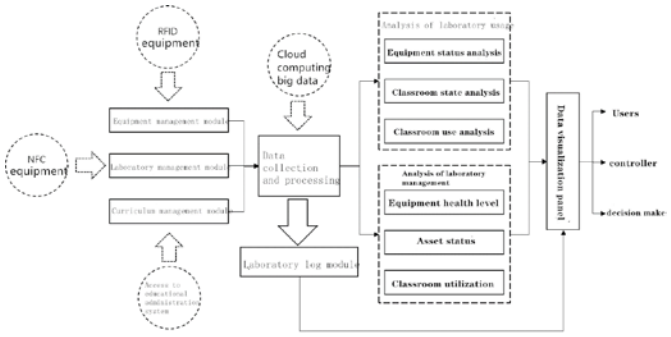

Figure 1 overall framework of the system

2.2 Design of Equipment Management Module

The equipment management module includes equipment management, equipment repair, equipment borrowing and other modules [5]. Preparation work must be done before the experimental equipment enters the laboratory for the first time. The preparation includes attaching the QR code identification label [7] with built-in RFID [6] on the equipment and binding the tag ID with the SN code, type and price of the equipment in the system. RFID function is mainly used for anti-theft and equipment positioning [8], and the function of two-dimensional code is mainly used for equipment repair and equipment borrowing. When the equipment enters the laboratory door, the RFID device can capture the ID of the RFID tag and add it to the corresponding laboratory in the system. Similarly, when the equipment is moved out of the laboratory, the system can also obtain the time when the equipment leaves the laboratory. When the user wants to repair the equipment or borrow the equipment, he can scan the QR code on the label to enter the details interface of the equipment, in which the equipment can be repaired and borrowed [9].

2.3 Design of Laboratory Management Module

Laboratory management module includes laboratory access control module, laboratory appointment module and so on. Before using the access control system, NFC card reader should be added to the system. The door of the laboratory is closed by electromagnetic lock, and the user can swipe the card to open the door within the appointed time. Laboratory reservation system according to the free schedule of the laboratory, in the laboratory free time, teachers can make laboratory appointment. If a teacher teaches in a certain period of time in a laboratory, then this time period in this classroom is the teacher's appointment time.

2.4 Curriculum Management Module Design

The curriculum management module can be bound with the educational administration system. After inputting the correct account number and password of the educational administration system, the timetable of a specific laboratory can be synchronized from the educational administration system, and the synchronized timetable can be added, deleted, modified and queried. The schedule management module mainly provides the basis for the control and management of the laboratory reservation module, and the data collection and processing module generates the laboratory idle schedule according to it.

2.5 Design of Data Collection and Processing Module

The data collection and processing module is the core module of the system and the data processing center of the system [10]. The module collects the information of equipment management module, laboratory management module and curriculum management module, analyzes and processes the information by using cloud computing and big data, generates the analysis data of laboratory usage such as equipment status, classroom status and classroom use, and generates laboratory management analysis data such as equipment health, asset status and classroom utilization. Provide the necessary information for the laboratory log module and the necessary data for the data visualization panel

2.6 Design of Laboratory Log Module

The log module is used to record the laboratory log. The main data include laboratory equipment records, laboratory access control records, laboratory schedule records, laboratory security records and other information, and also provide valuable samples for the system to conduct secondary analysis [11]. In addition to the laboratory safety records, these records are automatically generated according to the data collection and processing module. The laboratory safety records are filled in by the laboratory security administrator after inspection.

2.7 Design of Data Visualization Panel

Data visualization panel is HTML interface, and data is provided by data collection and processing module. The use of graphics, tables and other forms to show the recent use of the laboratory, for classroom users, laboratory administrators, superior decision-makers to provide management data visualization interface.

3. System Implementation and Testing

3.1 System Implementation

In order to facilitate the use of users, the system adopts B / S structure [12]. In order to facilitate the system, it adopts django2.0 framework for secondary development, MySQL for database, pychar for compiler. At the same time, for the safety of the system, the internal and external network isolation is adopted. All the functional components of the whole system are in the internal network, and the server is connected to the external network. The overall network deployment is shown in Figure 2. Because the core of the system is the collection and processing of data, a backup server is deployed for the security of the system data. The data of the system is not only calculated and processed in the main server, but also stored in the backup server to ensure the security of the data resources.

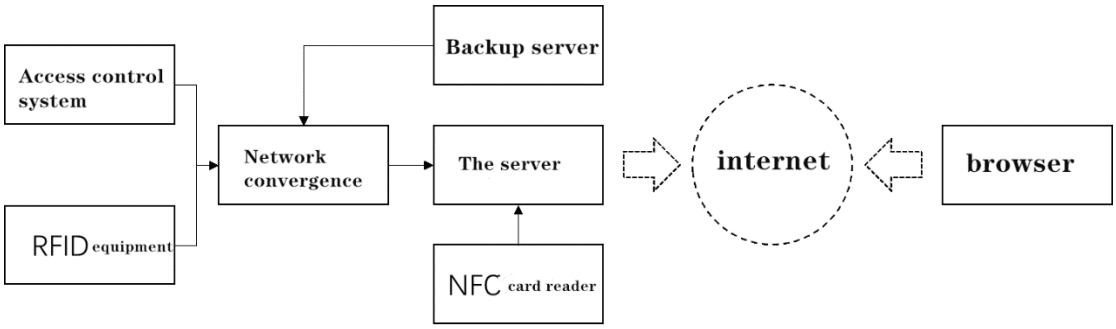

Figure 2 system network structure diagram

3.2 System Testing

After the system test, the testers include but are not limited to laboratory managers, teachers and superior leaders, which fully shows that the system can meet the initial design requirements of the system [13]. The system has passed the pressure test, fully system robustness, the system can meet the daily use of our school. The management interface of the system is beautiful and elegant, which meets the aesthetic requirements.

4. End

Through the research and development of this system, the scientific research strength of our university has been fully demonstrated. Big data is the future development direction, and the Internet of things is also the direction of future development. In the future, big data and the Internet of things are bound to set off a huge wave in the education field [14]. Only by firmly grasping these two can we win more initiative in the future competition. This paper first studies the mainstream

laboratory management systems on the market, and finds out their disadvantages [15]. By using the Internet of things technology and big data thinking, we build a laboratory management system that can look forward to the future. After the system was formally put into use, it received wide praise from teachers and leaders. The effect of laboratory intelligent management was tested, the burden of laboratory managers was reduced, the process of laboratory management was optimized, and the efficiency of experimental teaching was improved.

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