The Practical Exploration of the Information Management System of University Laboratory based on the Internet of Things

Huiqiu Liu
Chongqing Youth Vocational & Technical College, Chongqing 400700, China

Abstract

At present, the construction of university laboratory’s information management system has become an important part of modern education and practical teaching with an important role to play. At the same time, during the process of information construction, the laboratory information management system becomes one of the most important things, which can reflect the comprehensive strength and teaching level of a school. But the construction of laboratory information management system in colleges and universities is not optimistic. All the problems have shown such as the utilization rate of laboratory equipment is not high, difficulty in data query, and these problems have become one of the main obstacles of cultivating innovative talents in colleges and universities on the road. Therefore, it is of great importance to study the information management system of university laboratory.

Keywords: Internet of Things, University Laboratory, Information Management System, Practice.

1. BACKGROUND

1.1 Literature review

With the continuous development of economy, Internet technology and computer information has been further utilized in production and human life, and the scale of information management in colleges and universities has been continuously expanded (Hai et al., 2012). As the core and practice site of modern education, the construction of university laboratory’s information management system has always been the important part of in colleges and universities construction. The laboratory information management system of a university has become the embodiment of the comprehensive strength of the school, which is of great significance to the reform of colleges and universities and the cultivation of innovative talents (Wang et al., 2016). At present, the management and maintenance of most university laboratories are backward, with the working efficiency is low and the data query and transmission are more difficult. In the college laboratory management, the click operation mode is still in use, due to a lack of digitalized and intelligent operation system. The laboratories are unable to meet the requirements of information management of modern times, which has become severe constraints for the cultivation of innovative talents and in the education for all-around development in our country (Li and Zhang, 2017). Therefore, college information management system based on the Internet of things can bring brand-new technology and information management method to university laboratory. And it can facilitate rapid exchange of information and data query, making it happen for the intelligent management of university laboratory.

1.2 Purpose

With more and more new majors set up in universities and colleges, the number of laboratory types has increased and the number of experimental equipment becomes varied. Therefore, the management of the laboratory is confronted with new standards and requirements (Ma and Yang, 2015). At the same time, with the development of the Internet of things, the use of Internet of things technology has become the main approach of laboratory management in colleges and universities. Through the Internet of things technology, the staff can achieve real-time management of all laboratory equipment in the office, which further reduced the expenditure of manpower, financial and material resources at colleges and universities, improved the laboratory equipment management level and efficiency. The application of IoT technology has enhanced the laboratory management system and provided new opportunities for laboratory management (Ma and Yang, 2015). In this paper, the research on the Internet of things of college laboratory information management system has completed all kinds of the data collection in college laboratory, and achieve the modernization of laboratory information management; At the same time, it enables the management of colleges and universities to timely understand the situation of laboratory
equipment, so that they can optimize the laboratory configuration and improve the utilization ratio of experimental equipment (Wei and Sha, 2012). In addition, in this paper around the university laboratory management, we try to carry out an information query of laboratory equipment and laboratory information management system of the related equipment information, hoping these data can information can provide a guide for rational use and allocation of the university laboratory equipment, as well as important reference information for hardware procurement department of colleges and universities (Zhang et al., 2014).

2. THE CURRENT SITUATION OF INTERNET OF THINGS’ APPLICATION IN UNIVERSITY LABORATORY INFORMATION MANAGEMENT TECHNOLOGY

At present, the technology of Internet of things is in the initial stage of development in China. There are few of the technology which can be used for the university information management. Among them, RFID technology mainly applies to campus library and campus card. At the same time, the increase of mobile terminal users in colleges and universities also laid a solid foundation for the wide application of iot technology in university campuses (Lu et al., 2013). Moreover, the demand of the teachers and students on network information also creates favorable conditions for the development of Internet of things in colleges. In addition, university Internet technology relies on the existing campus network, and using RFID, database technology and wireless network to cover the iot alliance of the campus. This network has an automatic recognition function and can detect the location and state of the objects in of colleges and universities, with corresponding software processing various items of information, thus to achieve the management and control of all items in colleges and universities (Jiao et al., 2016). Among them, the university laboratory is still managed by the manual labeling due to its miscellaneous and quantity. With the continuous utilization of logistics network technology in universities, the information management of university laboratories equipment has gradually come true, which reduces the workload and improves the work efficiency (Hou et al., 2016).The basic framework of Internet of things technology’s use in college laboratory information management is mainly composed by the campus network and the backstage system, application system, sensor network and user control end, as shown in Figure 1.In addition, the management system mainly relies on the mature campus network technology, including its data and server.

![Figure 1](image)  
Figure 1. Information Management Framework of College Laboratory

3. DESIGN OF NETWORK INFORMATION TECHNOLOGY MANAGEMENT SYSTEM IN COLLEGE

3.1 Design of user login system

In order to ensure the security and convenience of university laboratory management through information technology, the user login system needs to be firstly designed in the design of information technology management system (Han et al., 2015). The first step is to enter the user name and password and select the user type. If the input username and password correspond to each other, the login screen will be displayed successfully. The user
needs to register when using the system for the first time, and the main information, such as sex, name needs to uploaded into the database. The system will determine the user’s authorization according to the identity of the user. The identities of user mainly include the administrators, teachers and students in the laboratory and other users’ four roles. The administrators have the highest authority, who can add and remove the user type, etc., and grant the users with different permissions, or modify the password, etc. The operation flow is different According to the different level of permissions on the system. The specific process is shown in Figure 2.

![Figure 2. Users’ Login Flowchart](image)

### 3.2 Database design

When we try to design database of the laboratory information technology management in colleges and universities, we use browser/server mode to carry out the design. The main function of the database is to achieve the management functions, which will play a decisive role in the whole system. Therefore, the success of database design will directly affect the performance and efficiency of the whole system. Proper design of the database structure can improve the efficiency of management of the whole system, to ensure the integrity and consistency between all the databases, and then to implement all functions of the system, thus to improve the running efficiency of the whole system. When designing a database system, the user's specific needs are analyzed in this paper. Combined with easy operation, simple structure, and safety principle, the design of the database is based on SQL database, which provides the basic prototypes of database for the system. When the database is connected to the user, SQL can provide comprehensive protection technology, which can prevent the system from breaking down. At the same time, the E-R method is adopted in the design the database system model, which mainly describes the entity types, attribute and Internet of things. The E-R diagram mainly consists of the entity, contact, properties, and so on, with the characteristics of simple and easy to understand, intuitively and accurately reflect the information relationship between different subjects in real world. And the rectangular is used to represent the entity, diamond used to represent contact, and elliptic used to represent properties. The relationship of all the users in the IoT information technology management system of college laboratory is shown by E-R diagram, as shown in Figure 3.

![Figure 3. E-R System Diagram](image)

In this system, administrators, teachers, user, experimental device and equipment, maintenance records, and students are all entities. The main responsibility of system administrators in this system is to maintain the
properties and information of teacher, student, laboratory, vendor, and experimental equipment, and manage the maintenance records, scrap records and inventory accounts. At the same time, teachers can use this database to check the use records of the experimental equipment and the laboratory, maintenance and scrap records, etc., Students can check the reservation, make the reservation, and the use of experimental equipment and the laboratory.

3.3 Laboratory equipment management mode design

The management of experimental equipment in university laboratory is achieved by RFID technology. The RFID label is supposed to be tagged on the experimental equipment and red by a handheld read and write device. Then the read and write device after initialization, sends the information of READ SUCCESSFULLY through wireless signal, activating the information on the label, then the information about the equipment with the label on will be set through the wireless signal. When the information is received, the reader starts to process the information.

After the steps mentioned-above, the information read by the read/write device will be compiled, and modified into readable data format. Through the wireless network or campus network, it will be transmitted to the server. And the data then is stored in the database, for the end user to control and manage the experimental equipment. The network structure diagram is shown in Figure 4.

![Network Structure Diagram of Experimental Equipment Management](image)

**Figure 4.** Network Structure Diagram of Experimental Equipment Management

The main hardware used in this diagram includes tags, QR codes, and handheld terminals. Among them, tags are used to store data information of experimental instruments and teachers and students from different departments. After the device information is entered into the tags, each experimental instrument or device will be given a tag that stores its relevant information and data.

The tags in this system are passive ultra HD iron tag, with EPC protocol adopted, because the laboratory equipment is mainly composed of metal materials. QR codes which are mainly combined by a few graphic symbols, distributed in accordance with certain rules on a plane, is mainly used to storage the fixed-message information of experimental equipment including the serial number, device/equipment name and type, etc. A handheld terminal is featured with distance identification, high accuracy of reading, and conflict-prevention ability. It is usually connected with the server through the campus network and wireless network, enabling the resource sharing and system control.

4. IMPLEMENTATION OF THE SYSTEM

4.1 Implementation of login module

Laboratory information management system in colleges and universities is mainly implemented by using the campus network and wireless network. You can input domain name or IP address of the system into the address bar, click the ok button and you see the login interface, users then should choose corresponding user attributes
according to their own identity, and enter your user name and password, if the input information and system information corresponds to each other, user can login successfully and enter the interface of the system. Users will enter the different management interfaces according to their own character, and then use a different search method to read the user's record in the database, and make judgment; if the user’s record does exist in the database, the user can login successfully, and if the record was not found, the system will automatically prompt login error information. If the user logs in successfully, the user will be directed to the lab management page, where the user can modify his or her own information, as well as searching for the lab and experimental equipment he or she desired. The users can also manage the experimental equipment in this interface by clicking on different interfaces to achieve the management of different modules. The system mentioned-above is implemented mainly through the following code:

```java
public String lablist() {
    HttpServletRequest request = ServletContext.getRequest();
    String bianhao = request.getParameter("bianhao");
    String guanliyuan = request.getParameter("guanliyuan");
    if (request.getParameter("page") != null) {
        currentpage = Integer.parseInt(request.getParameter("page"));
    }
    int total = labDao.selectBeanCount(where.replaceAll("order by id desc", ""));
    request.setAttribute("list", labDao.selectBeanList((currentpage - 1) * pagesize, pagesize, where));
    request.setAttribute("pagerinfo", Pager.getPagerNormal(total, pagesize, currentpage, "method! Laboratory list ", "there are" + total + "records"));
    request.setAttribute("url", "method! Laboratory list ");
    request.setAttribute("url2", "method! Lab");
    request.setAttribute("title", "Laboratory information management ");
    this.setUrl("lab/ Laboratory list.jsp");
    return SUCCESS;
}
```

The query function of this system mainly is implemented through the above code. The system administrator can input different information between different fields in the data, to modify and improve the database. Administrators can also click on the student information management interface to add or delete student information.

### 4.2 Operation of the experimental equipment

The operation of experimental equipment in Laboratory information management system is implemented through modules and interfaces:

First of all, if the administrator wants to add new experimental equipment, he or she should first click on the add-equipment button, fill in the blank with relevant information about the new device in the browser and then save the information.

Secondly, if you want to delete the obsolete experimental equipment, you should select the device from the list of existing devices, and select the enter key to remove the device successfully in the prompt interface.

Thirdly, to modify, update, recycle, retrieve and even allocate the existing experimental equipment, the system administrator needs to click on the experimental equipment that to be modified, and make modification according to the pop-up interface. Fourthly, the search in the massive experimental equipment can be achieved through the search of serial number or name of equipment to retrieve the equipment that user needs; just click on the relevant equipment and get into the query interface, then you can use the query function of the equipment. The code for implementing the module mentioned-above is shown as below:

```java
public String shebeilist() {
    HttpServletRequest request = ServletActionContext.getRequest();
    String csname = request.getParameter("csname");
    StringBuffer sb = new StringBuffer(" where ");
    request.setAttribute("url", "method! Laboratory list ");
    request.setAttribute("title", "Laboratory information management ");
    this.setUrl("lab/ Laboratory list.jsp");
    return SUCCESS;
}
```
5. CONCLUSION

With the coming of the information and digital age, the construction of laboratory information management system has become the main indicators to measure the research level and management level of colleges and universities. Therefore, information management of laboratory in colleges and universities tends to be more and more prevailing nowadays. Laboratory information management system in colleges and universities mainly relies on the development of Internet of things, combined with the use of cloud computing in information management system. The laboratory information management system in colleges and universities not only improves the management efficiency of laboratory equipment, but also facilitates good user experience.

REFERENCE