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System design and realization based on open computer laboratory teaching management

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ABSTRACT

With the rapid development of computer science technology and network communication technology, there has been an increasing need for computer technology in different industries and different departments. The human management mode has failed to keep pace with the development of the times especially in university computer laboratories. Based on the information requirements of the laboratory management departments and combined with business management process, this article designs an archival management platform of computer laboratory with the.NET frame by discovering the deficiencies in the computer laboratory management.

KEYWORDS

Computer laboratory; Functional module; Archives; .NET technologies.

INTRODUCTION

Since the beginning of the enrollment expansion of colleges, student numbers have been increasing and a large quantity of equipment and funds has been invested in it. Especially in the twenty-first century when computer and network began to prevail, the constantly improving computer technology and cheaper computer hardware have made computer a common and necessary tool. In universities, laboratory is the place to carry out trials or we can say it is the base for scientific research and the cradle of scientific development, therefore the investment in the laboratory is relatively greater, especially those computer laboratories that gained rapid development in the past few years. In order to meet the demands of work and study, all kinds of computer laboratories emerged, having the tendency of clear category. Therefore, the management of the laboratories is at a deeper level. They should not only supervise the equipment, but also carry out classification analysis on the archives and provide a basis for administrators to make long-term strategies based on optimization of computer resources. But at present, most college computer laboratory management methods are lagged behind and present heavy work pressure on the staff members. So there is a need for a computer laboratory management platform which will standardize the lab management, free staff from the heavy work and provide data reference for decision-makers.

In recent years, research and development has been carried out on the similar computer laboratory systems in China, for example the total management system designed by Tsinghua University which realizes automated management on computer labs; the laboratory information management system which rationally utilizes equipment and network resources developed by Central South University of Technology. At present, universities are designing computer laboratory management systems and there has been preliminary philosophy on open laboratory management, some of which are now available to public. But most software is corporate-oriented rather than targeting the universities, therefore often seen as reference. Foreign laboratory management system has an early start and rapid development. After three stages of adaptation, it is focusing on the holistic management on labs.

According to information requirement asserted by most universities, the computer laboratory management platform based on.NET technologies covered in this article focuses on scientific and efficient computer lab management. On the basis of reducing work stress of management personnel, it can efficiently support the process of the management of laboratory and provide guarantee for the normal operation of the equipment and labs.

DEMAND ANALYSIS

Overall demand

The development of software has failed to keep pace with that of hardware with the increasing investment in the laboratory infrastructure and hardware equipment and the rapid development of computer and network technology. In response to this issue, some universities starts to carry out software development on the existing computer laboratory management systems based on the requirements and have achieved some results, but most universities are having trouble updating the management system. Human management system means heavy work for staff, inefficiency and mistakes during archiving and query. Since the process is handled by hand, it is impossible to present archives to decision-makers in data-form thus unable to provide scientific reference for decision-making. Under the circumstances, it is quite meaningful to design an archival platform for computer laboratory management which is easily accessible, able to generate report form and targets the workflow of a computer lab as shown in Figure 1.

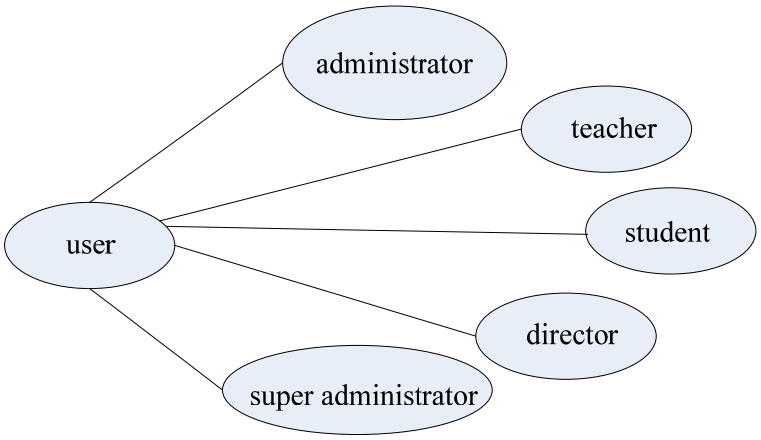

Figure 1 : Chart of user rights

From the point of computer lab management, the platform focuses on the standardized management of the lab archives. The management includes the data record and profile creation, the former refers to real-time tracking and record while the latter means the formation of standardized management profiles.

Informational Requirement Analysis

The goal of this platform is archival lab management which means gathering the standardized management profiles mentioned above. This platform should not only the need of the management but also record the data during management and automatically generate standardized management profiles.

When designing the platform, we have to consider different requirements toward it. From the staff's aspect, they need the platform to track the initial information and equipment use and real time monitoring on the computers in the lab if they are damaged or need to be updated. From the perspective of teaching administrators, they need the teachers' experiment plans and the students' computer class scores and attendance rate. From the perspective of the teachers and students, they need the experiment plans, laboratory analysis report and the final score output. After knowing the requirements of the users, we can have a clear idea about the platform designing. Based on the above information, we can establish an archival platform for computer laboratory management by programming the requirements into the daily management work in archive form. The overall system data flow chart is shown as Figure 2.

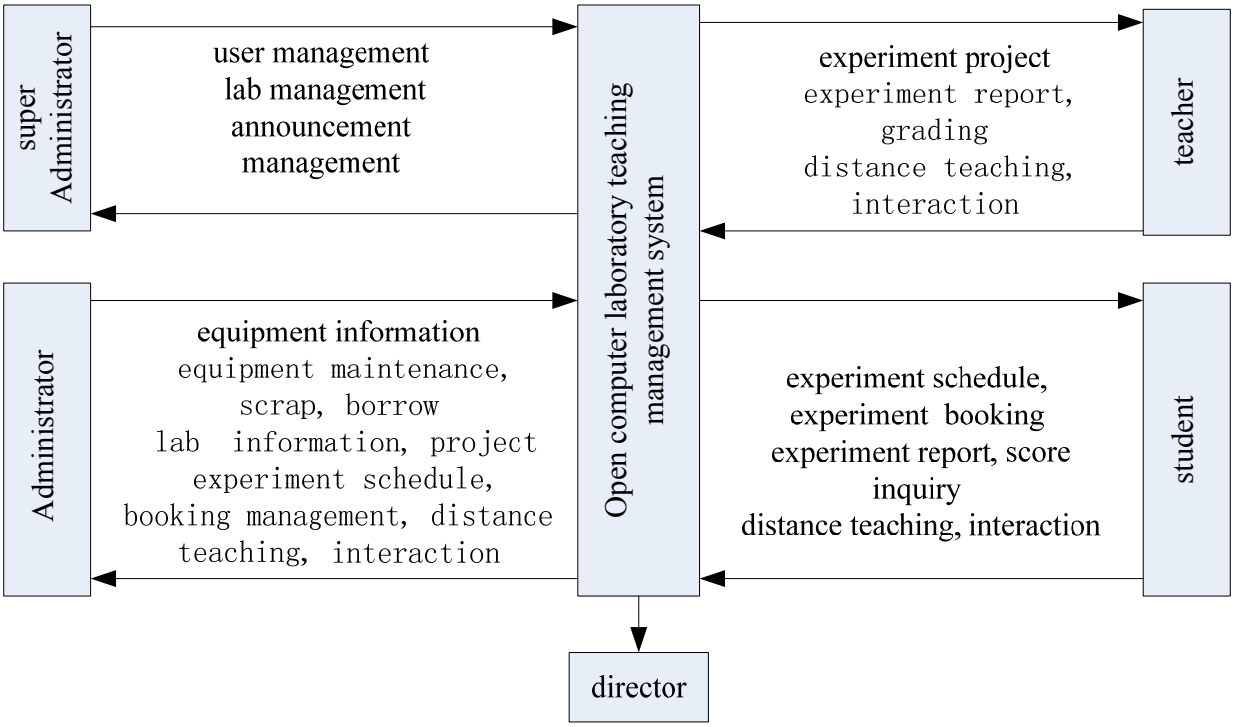

Figure 2 : The overall system data flow chart

Functional requirements

From the above informational requirement analysis, we can learn that the platform is a combination of integrated equipment, teaching and the platform itself. Equipment management not only includes the information on its hardware but also the repair and scrap information of the equipment. Teaching management includes lab information, corresponding experiment of each lab, experiment plans that are accessible to teachers and students, scores and lab analysis report. Platform management includes different levels of limits of authority to ensure the stability of the platform.

This platform can meet the needs of all the above users and also integrate other factors in daily management into itself, forming a standardized business process in archive form. In this way, different electronic records can be shared and the lab information is conveniently and concisely presented which helps the standardized management of the lab information. While those are the archival processing of the lab information, the platform can carry out real-time track on the procedures of the process which will be good for the maintenance of the lab, generating of the historical data and also easy access to inquiry when there is a problem.

Besides the platform should not only fulfill the management functions but also following requirements to keep the stability of the system. First of all, the goal of the platform is to free staff from the human management mode on the basis of high efficiency and more standardized, so the platform must be reliable. Second of all, the platform would be running in the campus, so it should also be open to lay foundation for future management of other professional labs. Third of all, since this platform has a large quantity of users, there should be more people-oriented designs in it so it will be easier to operate. At last, there is a large number of archives information in the platform data base and they are net-accessible, so security measures will be crucial. While inputting the data, there should be authorized personnel to be in charge of modifying the data information.

PLATFORM DESIGN

Based on the analysis of the above information, the archival platform for computer laboratory management mentioned in this article includes two parts: business procedures and supportive procedures from the perspective of teaching administrators. The former, from the perspective of experiment teaching management, processizes the staff and establishes archival information which includes experiment plans, score, attendance and analysis reports. The latter, based on above-mentioned procedures, is the management of electronic archives which include laboratory hardware information, all kinds of users' information and equipment maintenance information.

Module design

Based on the two parts of this platform, there are all together six modules, including experiment plans, attendance, analysis reports, equipment, maintenance and system management. The module function structure is shown in chart 3-1. The first module is designed as attendance management including the functions of register, counting and query which will be convenient for experiment administrators to put in data on a large scale. The information of the attended can be set in the system module. The second module is designed as experiment teaching module which is comprised with submitting of experiment plans, counting and query. After the teacher users have submitted the experiment plans, platform administrators will compare the experiment plans, laboratory and experimenting time. If there were no conflict, the experiment plans do not have to change. If there were any conflict, teacher users will have to revise the plans. The third module is designed as module which is comprised with submitting of the students' experimental report, grading of the report and the query on the reports' final score. In this module, platform administrators will offer different levels of permission to carry out the operation of experimental report module. The three modules mainly focus on the first part of this archival platform for computer laboratory management which is the construction of experiment teaching management business procedures archives from the perspective of teaching administrators

The fourth and fifth modules in this platform are equipment management and maintenance respectively. In the equipment management module, administrators can check the history counting data and the service condition of equipment, while in the maintenance management module, there are not only logs and reports about maintenance but also a maintenance booking function with which teacher users can book a software needed in teaching and student users can report equipment malfunction to make it easier for administrators to maintain and upgrade them. The equipment management and maintenance modules focus on the second part of the platform which is the construction of supportive procedures of experiment teaching management arvhives shown as Figure 3.

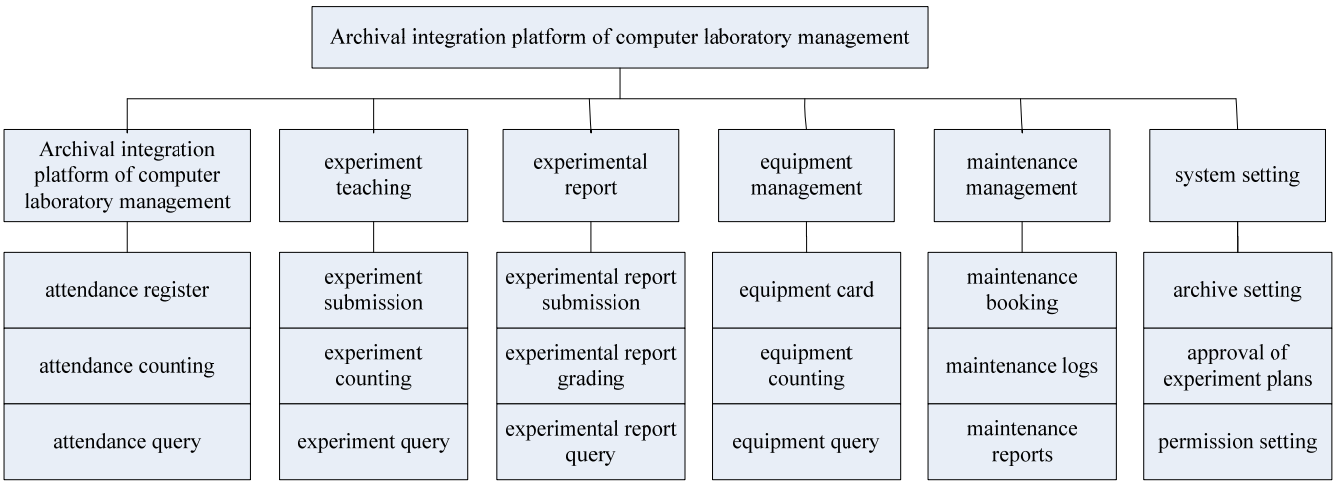

Figure 3 : The Module function structure

The last module: system setting module, is the representation of all the above five modules which includes approval of experiment plans, archive setting and permission setting. This module is largely used by platform administrators. By using the archive setting, the administrators can set the electronic archives of equipment, administrators, teachers, students and other information of the lab. By using approval of experiment plans, they can achieve the connection of experiment plans in the second module. Permission setting provides convenience for platform administrators to categorize the users and offer permission.

Database Design

After the analysis on teaching management and its supportive procedures, it is certain that concept modal of archival platform for computer laboratory management is database E-R. As shown in Figure 4.

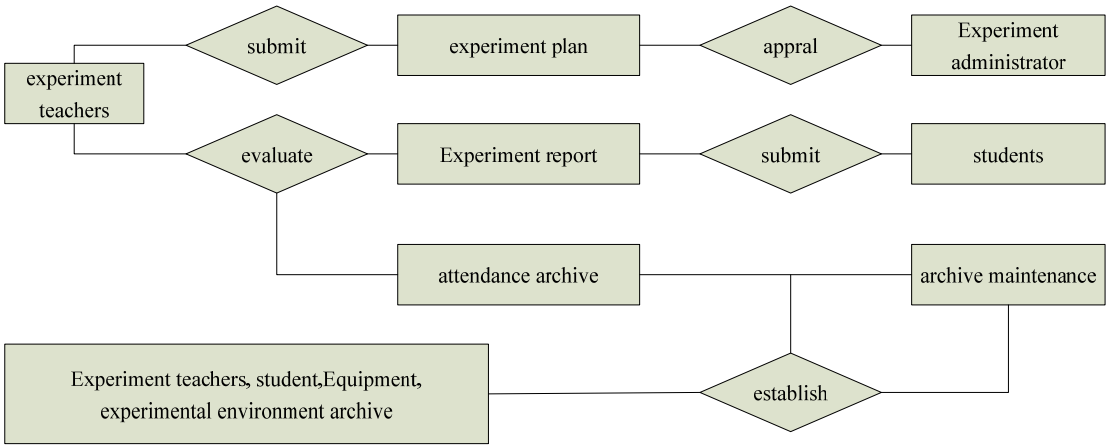

Figure 4 : Database E-R

In the database, Figure 4 involves entities which we will not mention here. But among all the entities, there are two codes that need our attention. First is the code of equipment. Since the equipment is not only for the usage of the lab but also should be registered in equipment department as fixed assets, the equipment code should be the same as fixed assets code to make it more convenient to inquire and register. The second one is the experiment plan code which should take every requirement of the laboratory management, including experimental period, class, course and teachers.

IMPLEMENTATION OF PLATFORM

The platform design in this article constructs the system based on the distributed application architecture of.NET components with C sharp, including two components and six modules. The two components system login and data access components which are shown in ASPX page through C sharp source file.

The realization of key technology

In the design, the realization of public data component is of great importance which includes the function of data validation and data access. This component should include the original four categories and another two added categories. We will not repeat the AssemblyInfo.cs category that comes with the component here.

ShareFunction.cs category includes some common functions and methods and is usually used for encapsulation. The code is shown as bellow; the code is easy to realize on the interface. In the ASPX page, there is an output button which can invoke the category and output the data from the database.

```
Public viod ExporExcel (string FileName,string Title,string Field-NameCh,string FieldNameEN,DataGird Dg,Page page)
{
String[]FieldNameCHs=FieldNameCH.Split(';');
String[]FieldNameENs=FieldNameEN.Split(';');
SpreadsheetClass xlsheet=new SpreadsheetClass();
DataView DV=(Data View)Dg.DataSource;
Xlsheet.ActiveSheet.Cell[1,1]=Title;// fill in headline
For(int i=o;i<FieldNameCHs.Length;++){//I control column location
Xlsheet.ActiveSheet.Cells[2,i+1]=FieldNameCHs[i];
For(int j=1;j<DV.Count;j++){//j control line position
Xlsheet.ActiveSheet.Cells[j+2,i+1]=DV[j][FieldNameENs
[i]].ToString();//fill in the cell
}
}
}
```

Category Validator.cs and ErrMessage.cs are mostly used for data validation. Category ErrMessage.cs is a virtual data chart for saving error messages, which mainly come from the ASPX page. There are three virtual field in the data chart including project name, project value and error messages. The goal is to return to the error messages when going through data. The code is shown as bellow:

```
//function description：return to the error message through this category when inspecting data item
Public class ErrMesage:DataTable{
Public const string MainCaption="MainCaption";// verified project name
Public const string ValidateValue="ValidateValue";// verified project value
Public const string ValidateMessage="ValidateMessage";// error message
```

```
Public ErrMessage()
{
This.TableName="Validate";// form a data table for saving verification results
DataColumnCollection DCC=this.Columns;
DCC.ADD("MainCaption",typeof(System.String));
DCC.ADD("ValidateValue",typeof(System.String));
DCC.ADD("ValidateMessage",typeof(System.String));
}
}
```

The category DataBaseClass.cs that needs to be written by oneself forms database connection string; the category SqlOperationClass.cs is used to encapsulate the database. Those two self-written categories are used to realize database access.

The implementation of module components

The platform in this article consists of six modules. Due to space limitations, only the realization of attendance modules covered in this article. When designing the platform, the modules are separated into four levels and all four of them are displayed in the form of separate folders in resource manager developed by.NET. Every management component in every module consists of four levels. Taking the attendance register in the attendance module as an example, the four levels are manifested as business registration, validation of business registration, building of database data and registration of object, among which business registration is the portal to the data in the database, packaging the other three properties. This category can realize database access and invoke the other three categories; there are also four methods in the validation of registration. There also four methods in the validation of business registration to validate the business rules packaged in the business registration. There are four ways in the database query builder category of business registration to return the database query to business registration in character string. The data object entity category of the business registration will create a virtual sheet of the virtual data. The data is saved their temporarily. The sheet includes the field of the database mapping table and the properties of the sheets can be added as the object entities increase.

The relation of the four levels is shown in Figure 5.

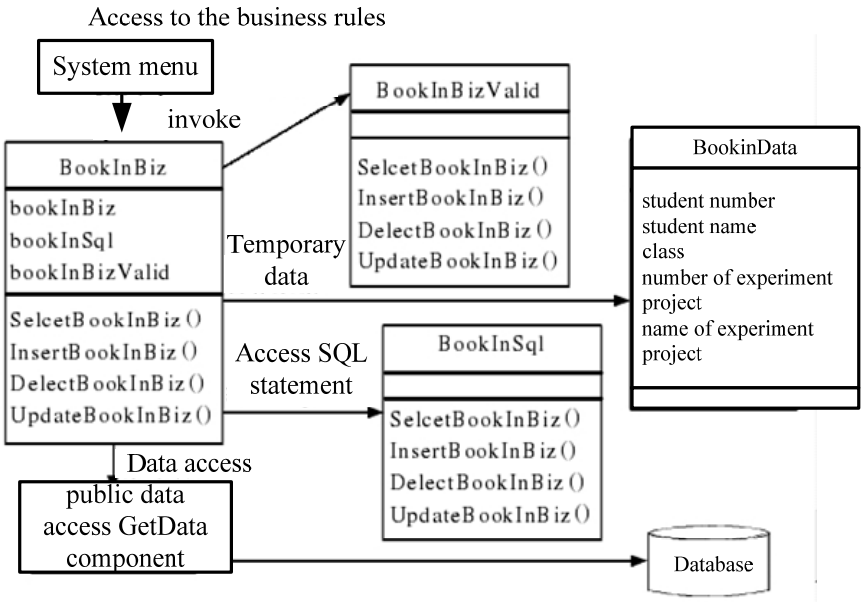

Figure 5 : The diagram of attendance business class

SYSTEM TESTING

After completing the design, we move into the system testing stage which is designed to detect and correct errors. During the testing, every function, component and module of the platform will be debugged have a trial run to see if the outcome is satisfactory. This process can guarantee the usability of the platform and provide technical basis for the running of the platform.

This platform is designed to improve the efficiency of the computer lab management, therefore we choose a small computer lab when testing. The sketch plan is shown in Figure 6.

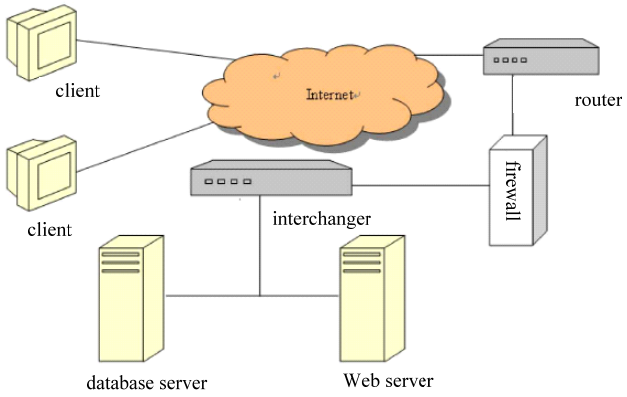

Figure 6 : The overview of test environment

As we can see in the above picture, the laboratory should be equipped with client, server, interchanger, router and firewall, while there is no need for high hardware configuration requirements; software environment is most frequently-adopted Win7 and an explorer above IE8.0; network environment requires the campus network. The next step is system testing on every module. First, the system manager will authorize different levels of permission to different users and use the users' name and original password to see if the modules are complete. After testing, the platform can basically fulfill the information requirements, carry out real-time track on the laboratory archives, invoke archive for reference during historical archives query and is reasonable in module partition. The platform is carries out in ASPX page, so the interface is more direct, the functions are clear and fulfills the basic requirements of easy access. We have also detect some unnoticed problems. In safety and security, only the safety of the information in the database, solved by resetting the system permission, is given consideration, while we did not consider the inability to restore the data if there were a mechanic malfunction. We have to further think about the user permission setting and adding more entities in the module.

CONCLUSION AND PROSPECT

Under the circumstances of rapid development in computer technology and communication technology, in order to change the outdated management mode in most universities, we determine the entities in the platform by carrying out requirement analysis on the management experience of computer lab and combining the requirements and reflect them in the database based on the distributed application architecture of.NET components with C sharp. There are two components and six modules in the platform. It is displayed on ASPX page and is easy to access with a direct interface. This platform completes two most important contents set at first place and realizes the business procedures and supportive procedures from the perspective of teaching administrators, which includes six modules: experiment plans, attendance, analysis reports, equipment, maintenance and system management. Every module consists of three components which will fully fulfill the requirements of daily computer lab management and relieve the laboratory administrators from the tedious work. Bu adopting this platform, all kinds of archive of experiment management can be standardized and **systematize** and shared among different administrators and departments, achieving the target of ensuring the good running of daily computer lab management.

An archival platform for computer laboratory management is constructed in this article and during the process of designing and test-running we have noticed some problems and some need to be modified, such as the data backup solution, users' permission setting and the adding of entities. This platform is not perfect yet, but there is a lot that we can do about its openness and integration in the future. The computer lab management can be expanded to other disciplinary laboratories and a shared data file can be established to carry out a unified management on the laboratories.

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