

Design and Implementation of J2EE-based Online Examination System

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Abstract.The paper presents the design and implementation of Online-test System Based on J2EE, the application of B/S and C/S model to a combination of design, and divides the system based on module. Then the paper provides the design of data program, followed by a discussion of the approach of automatically producing test paper.

Introduction

A. J2EE

J2EE is an architecture which utilizes Java platform simplification and enterprise solution to develop, deploy and manage related complex problems. By providing a unified development platform, J2EE reduces the cost and complexity of the development in multi-layer application and strongly supports the integration of existing applications. It completely supports the Enterprise JavaBeans, Servlet and JSP. With the good guidance, it also supports the package and deployment of applications and adds the directory support in order to enhance the security system and improve the performance.

B. Struts

Struts is a comparatively mature framework in Web development. Struts also is a reusable MVC design which is made up of a set of mutual-cooperate classes and the mark of Servlet and JSP. Struts has some advantages like component modularity, flexibility and reusability and it greatly simplifies the development of Web applications. It reasonably separates the user presentation logic, business logic, and control logic to make the development process simple and clear, and improve maintainability and reusability of software. Figure 1 shows the architecture of Struts framework.

C. JavaBean

JavaBean is a model of software component. By the interaction with other software components, it determines how to establish and reuse the software components which are called Bean. Bean uses the existing Bean to develop new programs and establish the relationship between them in next step. In the definition of JavaBean specification which was given by Sun Enterprise, the official statement of Bean is: "Bean is a reusable software component which is based on Java Bean specification of Sun Enterprise. It can be visualized by programming tools." Therefore, JavaBean has four basic characteristics: independence, reusability, utilization in visual development tools, and state which can be saved.

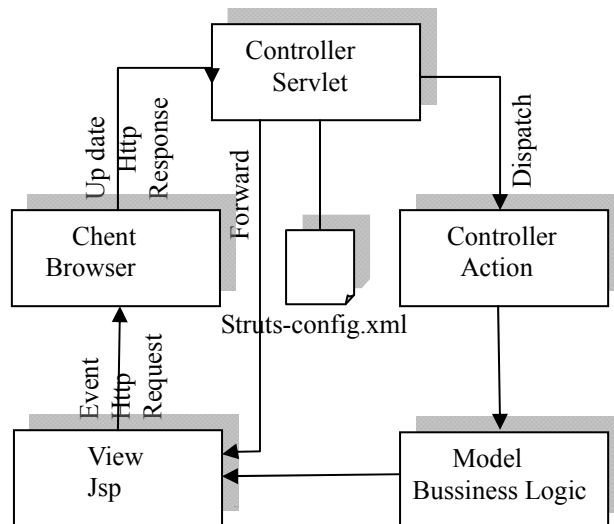


Figure 1. The architecture of Struts framework

System Architecture

The J2EE-based online examination system uses B/ S model to establish a layer structure which divides the system into the application layer, business layer and data layer. The layer structure not only improves the computing speed of data, but also reduces the difficulty of system maintenance. Figure 2 shows J2EE-based online examination system.

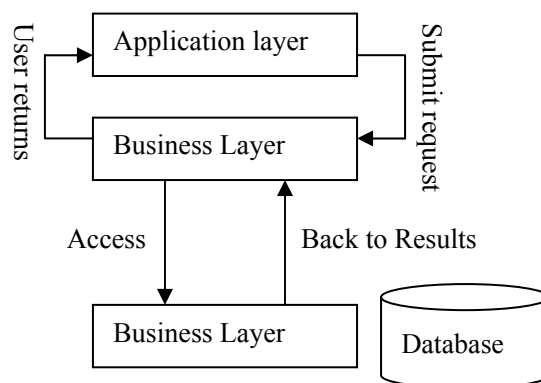


Figure 2. J2EE-based online examination system.

System Design

The J2EE-based online examination system can be divided into three modules. They are student-online-examination module, teacher-management module and system-management module. Figure 3 is the system module structure.

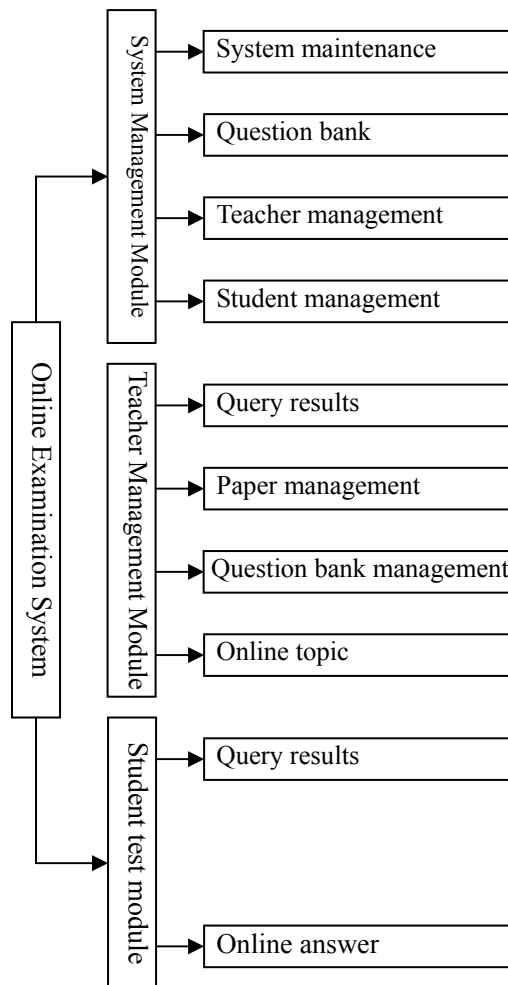


Figure 3. The system module structure.

D. Manager Subsystem

Due to the function of user management, managers can add or delete users, and modify the information and permission of users (managers, teachers, and students). The department management which works on the whole information of department involves the operation of adding, deletion and modification of department information.

E. Teacher Subsystem

The function of question bank management is used to implement the operation of adding, deletion and modification of subjects and the questions of exams. These questions include single choice questions, multiple choice questions, true or false questions, fill-in-the-blank questions and other objective questions, as well as brief answer questions, essay questions and other subjective questions. It uses the same interface to log in every type of questions and normalizes the question-added interface. The managing function of test paper formation means that teachers adopt a specific test paper strategy to set the name, time, degree of difficulty, question types and other related information, and then the test paper will be automatically generated and stored into the question bank. Online test paper-marking mainly refers to the phenomena that teachers only mark the subjective questions. Teachers use the score inquiry system to check students' test scores and make an analysis and comparison of them.

F. Student Subsystem

Online-examination is the main functional interface of student subsystem. Students should choose the test subjects. After that the system randomly selects a set of test paper from the question bank. The paper will be automatically submitted by the system when the time comes. Students can also click on the submit button before the time limit. Then the objective questions are marked by the

automatic scoring system while subjective questions are by teachers. The score inquiry system can't be used by students until teachers finish the job of marking.

Implementation of main functional modules

G. User Login Module

Users of the system can be split into three categories: system managers, teachers and students. They have different permissions to different interfaces. The users must be authenticated firstly, then allowed to enter the system and visit the appropriate page.

The traditional J2EE Web design method was applied to the realization of user login module. The module was divided into five layers, which from the bottom up are: the database layer -> the ORM layer ->the business logic layer -> the control layer -> presentation of view layer.

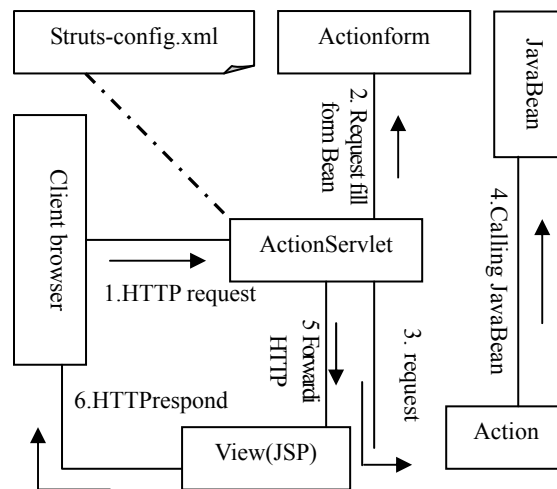


Figure 4. The architecture of Struts

Figure 4 shows the architecture of Struts. The four core components of Struts are:

- ◆ **ActionServlet:** It is mainly responsible to organize the information of HTTP clients' requests and forward it to the appropriate processor according to the specified description of configuration files.
- ◆ **Action Classes:** It is an adapter between clients' requests and business logic processing. Its function is separating the request and business logic.
- ◆ **Action Mapping:** It is responsible to forward the information of clients' requests to the relevant Action class.
- ◆ **ActionForm Bean:** It is responsible for the non-persistent data storage of the information shift in an application system; it can also be applied to store the intermediate model state which will be used by a view.

H. The Algorithm Analysis of Test Paper Formation

The test paper formation is an important part of the online test system. Automatic test paper formation means that the system select the questions automatically from the question bank so as to form a test paper according to the requirement raised by teachers, like question-types and degree of difficulty. Common methods of test paper formation involve the randomly-selected algorithm, the backtracking heuristic algorithm, genetic algorithm. This system adopted the randomly-selected algorithm.

Required parameters: degree of difficulty, coverage, number of questions of each type.

Processing:

- ① Obtain the parameters: degree of difficulty, coverage, total scores, number of questions of each type;
- ② Calculate the coverage of each type of questions and the number of questions that meet the

requirement of difficulty;

③ If the number of a certain type questions is insufficient, the formation fails;

④ Calculate the total scores of inputted questions;

⑤ If the total scores of each type of questions doesn't match with the users' requirement, the formation fails;

⑥ Take out all the questions of a certain type that meet the requirement;

⑦ Randomly register to a record according to the random function and store it into the corresponding question form (guaranteed that the same question won't be selected again), repeat, until you obtain this type of questions.

⑧ Repeat ⑥ and ⑦ until you obtain all the required types of questions

Part of the code of the automatic test paper formation:

```
Vector vector = new Vector();
```

```
for (i = 0; i < m; i++) // Obtain various types of questions
```

```
{
```

```
// Obtain all the questions of this type and put them into vector
```

```
st = con
```

```
prepareStatement("select * from shiti where type=? and chapter>=? and chapter<=?");
```

```
st.setInt(1, typeid[i]);
```

```
st.setInt(2, chapter_start);
```

```
st.setInt(3, chapter_end);
```

```
rs = st.executeQuery();
```

```
n = 0;
```

```
while (rs.next()) {
```

```
n++;
```

```
vector.add(new Integer(rs.getInt("stid")));
```

```
}
```

```
int random[] = new int[typenum[i]];
```

```
int j, k;
```

```
int stid;
```

```
boolean another;
```

```
for (j = 0; j < typenum[i]; j++) {
```

```
another = true;
```

```
random[j] = (int) (Math.random() * n);
```

```
for (k = 0; k < j; k++)
```

```
if (random[j] == random[k]) {
```

```
another = false;
```

```
j--;
```

```
break;
```

```
}
```

```
if (another) {stid = ((Integer) vector.get(random[j])).intValue();
```

```
st = con
```

```
.prepareStatement("insert into sjst (sjid,stid,sttype) values (?,?,?)");
```

```
st.setInt(1, sjid);
```

```
st.setInt(2, stid);
```

```
st.setString(3, typename[i]);
```

```
st.executeUpdate();
```

```
}
```

```
}
```

```
vector.removeAllElements();}
```

Entry algorithm is as follows:

```
Protected void btnSave_Click(object sender, EventArgs e)
```

```
{
```

```

.....
Int count=0;
String ID="";
If (Action=="add")
{
ID=TQuestionBLL.GetMaxId().ToString();
}
else if (Action=="edit")
{
ID=Request.QueryString["ID"].ToString();
If (ID.IndexOf(",")==0)
{
ID=ID.Substring(1);
}
}
.....
Count=TQuestingBLL.ExecuteSql(SqlArr);
If (count==0){
PU.Alert("Failed to save!",this);
Return;
}
Else
{PU.Alert("Saved successfully!,this)
Return;
}
.....

```

Conclusions

The J2EE-based online examination system realizes the management of test question bank, the automatic and manual test paper formation, online examination, automatic marking, score inquiry, score analysis and some other functions. The system's functional design almost meets all the requirement of tests of the whole subjects. It has a positive practical significance in reforming the traditional method of examination and improving the efficiency and quality of teaching.

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