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OPES:An on-line Practice and Examination System Based on Web

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***Abstract*—On-line practice and examination is a new trend of interactive remote teaching and learning. By providing practice and examination content, OPES realizes another distributed and asynchronous learning atmosphere for students. OPES is carried out under the B/S design model with student, teacher, system administrator three functional roles. During the practice procedure, the practice content is focused on the users' weakness of knowledge by dynamic adjusting questions. After each time of practicing, OPES will summarize and export the weakness and blind spots of user as guidelines. Students can capture detailed knowledge under the instruction of guidelines. The exam questions are generated randomly under the testing thematic with scientific counting distribution. To reduce the burden of clients, all the operations are executed on the server side and the clients only received execution results by JSP technique.**

Keywords- remote teaching; B/S; design model; JSP.

I. INTRODUCTION

With the development of WWW technology, on-line practice and examination system based on Web (OPES) has been fully developed as one of the network quality evaluation systems of remote learning network. The network practice and examination system has become a hot research field, because a consummate and strengthen on-line practice and examination system can timely and objectively feedback on learning outcomes. In order to provide more meaningful guidance to the teaching strategy, this paper presents the core functions of a B/S mode OPES framework based on JSP technology and combining with the actual teaching.

II. FONTS FRAMEWORK OF OPES

OPES is composed of three kinds of roles, which are teachers, students and system administrators. The major components of OPES can be classified as authorized function model, login model, questions management model, exercises model, test model, exercises feedback model and tests feedback model according to the detailed functional needs. The authorized function model can directly authorize the new user when creating different users. The user can get access to the system according to the system administrator's authorization, while teachers can operate on the detailed items. Students can only use the system to do exercises and tests. In the questions management model, the teachers can complete the initialization of the questions, such as sample questions, answers, knowledge points, preparatory knowledge points, follow-up knowledge points. The practice model organizes questions according to the knowledge point which the students choose, and the results will feedback to the students in the form of quantitative indicators [1]. The test model based on the knowledge point that teachers set and the scores for each knowledge point randomly selected sample questions, examination results of students will feedback to teachers in the form of quantitative indicators, the core functional of OPES framework is shown in Figure 1.

The system is designed under the B/S design model, which is shorted for Browser/Server and is a improving model of C/S with series of application features. The B/S structure has simplified the work of the client, and the client only need to configure the Web browser. The Server would take more works, such as accession to the database and the application implementation which is completed by kinds of dynamic web page technology. The technology offers a simple and fast way to create a Web page with dynamical content. The JSP page is constructed by adding Java program fragment and tags in the HTML file of traditional web pages[2].All program operations are executed on the server and the results are conveyed to the client by network, by doing which the requirements of the client browser are lowered. The process can be achieved without Plug-in, ActiveX, and Java Applet and even without Frame. The JSP pages are programmed in scripting language which is based on the Java programming language and complied into Java Servlet, so JSP pages have all the benefits of Java technology, including automatically storage management and security and the feature of Java programming language "write once, run everywhere"[3].

JDBC has been part of the Java Standard Edition since the release of JDK 1.1. The JDBC classes are contained in the Java package java.sql. JDBC allows multiple implementations to exist and be used by the same application. The API provides a mechanism for dynamically loading the correct Java packages and registering them with the JDBC Driver Manager. The Driver Manager is used as a connection factory for creating JDBC connections. JDBC connections support creating and executing statements. These may be update statements such as SQL's CREATE, INSERT, UPDATE and DELETE, or they may be query statements such as SELECT. Additionally, stored procedures may be invoked through a JDBC connection. Query statements return a JDBC row result set. The row result set is used to walk over the result set. Individual columns in a row are retrieved either by name or by column number. There may be any number of rows in the result set. The row result set

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has metadata that describes the names of the columns and their types. JDBC provides a standard API for database developers, so that they can use a pure Java API to write database applications. The programmers will only need to write the program once and could make it run on any platform with the combination of Java and JDBC.

III. INTRODUCTION OF THE KEY ISSUES

A. The Definition of Question

The operation of OPES system is started with the initialized questions by teachers and followed by random selections of questions, students' exercises and examinations, quantitative feedback given by the completion of examination questions, so examination questions is the core of the system[4]. Under normal circumstances have the relationship that exists between knowledge points, the new knowledge points need to have prior knowledge points, and a new knowledge point will become prior knowledge of another knowledge point.

Definition 1 (Examination question): Question $Q = \{d, c, k, priorik, posteriori\, k\}$ is a five-tuple, where d stands for the description of examination questions, c stands for the score of the examination questions, k stands for the knowledge points of questions, *priorik* is the prior knowledge point of k, *posteriorik* is the follow-up knowledge point of k.

Suppose a practice $P = \{K_1, K_2, ..., K_n\}$, K_i stands for the knowledge points included in the exercises, $K = \{q_1, q_2, ..., q_m\}$ is the questions related to each knowledge point. Quantitative feedback from practice $G = \{g_1, g_2, ..., g_m\}$ is the proportion of error questions for each knowledge point. That is $g_i = \sum_{i=1}^{m} c_i / \sum_{i=1}^{m} c_i$ If g_i is greater than the threshold value λ ($0 < \lambda < 1$) , then you need to strengthen all the examination questions in K_i in the next exercise, and introducing the relevant examination questions which are prior knowledge of K_i and do not reflect the follow-up examination questions related to knowledge point. The feedback generation process of test is similar with that of practice and the only difference is that quantitative information will be feedback to teachers for teaching in response to the shortcomings [5].

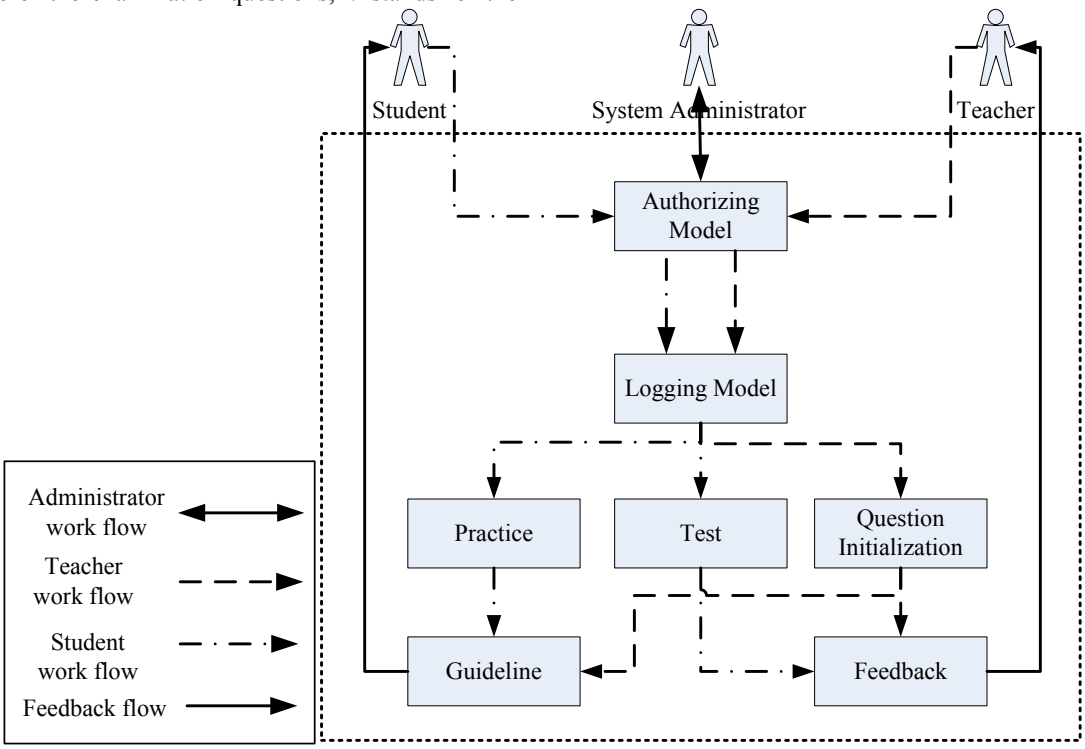

Figure 1. The framework of OPES

B. Chinese characters conversion

For Windows and JRE (JAVA RUN ENVIROMENT virtual environment) encoding mechanism is different, and text transmit from Windows to JRE, use the Windows default encoding to translate code to Unicode and text from JRE output to Windows, then Windows default encoding to use Unicode to decode.

If the input is Chinese character, in order to avoid garbled situation, we need to add the following statement in the JSP page: <% @ page contentType = "text / html; charset = gb2312"%> to display the resources in Chinese.

When transmit from JSP to Action, deal with request and response in the Servlet[6]. Call the conversion function for Chinese convert. The main code is as follows:

```
import java.io.UnsupportedEncodingException;
public class Code {
public String codeToString( String str )
{
try
{
str=newString(str.getBytes("iso-8859-1"),"gb2312");
}
catch (UnsupportedEncodingException e)
{
e.printStackTrace();
}
return str;
}
}
```

C. Database Connection

The main function of JDBC technology is to establish a connection with a database and send SQL statements to the database and process the database to return results. The system obtains a database connection object from a data resource, thus through the connection object we can establish a state object, and from this state object, execute SQL statements of operations, if it is a query operation, then returns a result set, if it is the other operations, then return true or false. Specific code is as follows:

```
DataSource db=getDataSource(request);
//Get a data source object from the data source
try {
Connection con=db.getConnection();
//Create a connection object
Statement stm=con.createStatement();
//Create a state object from the connection object
ResultSet rs=stm.executeUpdate(sql);
 //By this state of an object,do SQL operations,to return a result set
con.commit();  //Submit the connection
stm.close();  //Close the connection object
con.close(); //Close the connection object to return the data source
}
catch (SQLException e)
{
e.printStackTrace();
}
```

D. Struts configuration file

Database connection is an important expensive and limited resource. To manage the database connection, we can significantly affect the entire application's scalability and robustness, and the program performance. In the framework of Struts, Database Connection Pool (connection pool) technology can significantly improve the performance of database operations [7].

This system is benefit from the Struts by using Database Connection Pool technology. When the server starts, the server will create a number of connections. The user will directly obtain a connection to the database in the connection pool after user logging on the system. After finishing operation, the release of resources is automatically carried out and the connection will come back to connection pool waiting for the next user access [7]. If the user operation is idle longer than the prescribed maximum idle time, the system will disconnect this connection, then the connection will re-back to the connection pool waiting for the next user access. Using this technique, it not only significant saves in the user's waiting time, but also save system resources by preventing a user logs caused by an excess of the server system crashes from happening at the same time. If an excessive number of simultaneous logons and more than the number of connections inside the connection pool, the system will re-establish the number of connections to meet the user's requirements [8]. The following code shows how to configure in the struts configuration file data source:

```
<data-sources >
<data-source
type="org.apache.commons.dbcp.BasicDataSource">
<set-propertyproperty="driverClassName"
value="com.microsoft.jdbc.sqlserver.SQLServerDriver"/>
<set-propertyproperty="url" value="jdbc:microsoft:sqlserver:
//127.0.0.1:1433;DatabaseName=exam"/>
<set-property property="username" value="sa"/>
<set-property property="password" value="sa"/>
<set-property property="maxActive" value="10"/>
<set-property property="maxWait" value="5000"/>
<set-property property="defaultAutoCommit"
value="false"/>
</data-source >
</data-sources>
```

Through the above code, we found that using the Connection Pool technology, not only can save the system response time and save resources, but also, the user only need to reset the parameters of the database in struts-cinfig Xml file when the user changes the database parameters without modifying other files. In this way, the system can save time, prevent errors and facilitate the procedures for modular management.

IV. SYSTEM SECURITY

Web-based examination system security issues include the examination candidates to confirm the legitimacy of the server, candidates can only be provided within the specified time access to information, test database of data security, information and other candidates to answer the security of information.

A. The security of test environment

OPES is run on Windows platform, so it is easy for users to put copies of his papers and answers to the illegal development of disk and file folder, by doing which users are able to tune out his answers reference. In addition, candidates can use the "Network Neighborhood" view other computers, so that some candidates can make their own test directory to be shared possible [8]. In this regard, the client should be banned candidates sharing directory and using

"My Network Places" to view the computer. During designing the system, we can limit the scope of running program for candidates to improve the examination system security. This problem can be overcome by modifying the registry, in order to prevent students from modifying the registry, to restrict the candidates to use the "Run" command and “REGEIT.EXE” command.

B. The identity confirmation and examination process security

The identity confirmation step of user’s require users to enter the correct number and password of admission form, which is the mainly operation taken into account as first time logging on system.When the users enter the examination to test, the whole procedure is ended by the normal time or the timer of examination. When finishing a practice or test, the data that users generated will be automatically sent to the server for automatically marking or teacher marking by the system. In order to ensure a fair test, the system designs a timer. After the users successfully log in, the screen appears the first question and the timer began to time at the same time. During the examination the users should be reminded of the remaining time, when the examination time is 0:00, the candidates can not continue the examination papers. Examination system will automatically upload the data of all examinations candidates to the servers and shut down the system when test is ended. The timer will not get the client time, because users can modify the machine time to extend the examination time. The server's time is not considered, because of addressing the issue of multi-user simultaneous access When the examination time remains 5 minutes, the system gives a warning message. When the examination end time is up, it will lock the computer's keyboard and mouse and forced users to end the examination and submit the examination results without retaining any data on the user machine. During the examination process, "Log Management" real-time monitors the accession, in order to ensure the user's legitimate access.

C. The security of question database

The security of question database includes data security, operation identification, and operation access control. When users enter the item bank system, identification step is the first process of operating privileges for different users by sending a different key, which is stored on a floppy disk or flash drive on the management by hand. At the same time, the system design a security log file, if there is an unauthorized user getting access to the database and modifying the database files, security log files will record the specific content to prepare for system administration to repair the damaged data.

The examination questions and answers is stored in the form of cipher text data and people who do not have the key will see just some garbled codes. During operation, the information is transmitted in the form of cipher text. After arriving at the client, the information is decrypted by the client program and become explicit for users to use[8]. After the end of xamination, the test or practices information generated by users is encrypted by encrypted program before passing back to the server.

V. CONCLUSION

The test paper chosen, answer sheet and scoring of an on-line practice/examination system are entirely carried by computer. It makes sure that the examination content and test scores with less interference by human factors and effectively improve the fair and scientific of the exam, making examination management more standardized and scientific.

This system uses JSP technology and the latest Struts framework to achieve cross-platform application, so the realization of the examination system is not bound by the operating system making sure that anytime and anywhere examination can execute. The system has realized the basic functions of the online exam, with a certain degree of practicality, basically reached the expected results which can effectively solve the drawbacks of traditional test and achieve paperless examination.

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