Design and Implementation of E-Learning System Based on J2EE

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Abstract Because of the need of college education, some new methods have been adopted. One of them is e-learning system. So how to design a powerful e-learning system is the main concern of the authors. This paper first discusses the EJB component mechanism and the J2EE multi-tiered model, and then applies them to an e-learning system. The J2EE framework makes the e-learning system easier be developed and be of better performance.

Key words e-learning system; J2EE; EJB

With the fast pace development of computer network technology, the information based construction and the URP standard is applied into more and more university. The traditional campus already cannot satisfy the demands of teaching, studying and management. In order to improve the environment of teaching and to enhance the efficiency of college administration, this paper presents an e-learning system project. It establishes a digital space on traditional campus and carries out the college information construction[1].

1 Requests and Characteristics of E-Learning Systems

E-learning systems are a supplement and improvement for traditional teaching. Their requests and characteristics are as follow:

1) Reuse of components. This system includes many parts such as real time teaching/studying, courseware VOD/management, course selection on network, question intercommunication, and teaching evaluation and system management. The business logic of the system is very complicated, and the operation of data query among each module is reused frequently. So the systems demand designing components and providing common service and tools to guarantee code reuse and development efficiency.

2) High performance of security. The users include students, teachers and system administrators. So, it must provide strict jurisdiction control according to different roles, and provide unified status authentication to guarantee the high security.

3) Ability of transplant across platform. The

e-learning system requests fast run on each kind of operation system such as Windows, Unix and so on.

4) Convenient operation for clients. Internet Explore is used as the e-learning system’s operating interface.

5) Ability for extension and upgrade. This system will change unceasingly along with the request of teaching, so it must have strong ability of extension and upgrade.

2 Brief Introduction of J2EE

The J2EE is an industry standard leaded by SUN and produced by many manufacturers such as IBM, BEA, Oracle, etc. It provides runtime environment and computing model for enterprise. The J2EE technically supports EJB, JSP, Servlet and XML. The EJB is the core of J2EE. The EJB technique imports java components idea from client to server. It defines a distributed components standard for object oriented programming and realizes the model of software reuse[2].

The J2EE platform uses a multi-tiered distributed application model. The standard model includes client tier, middle tier and enterprise information system (EIS) tier. The client tier runs on client machine and can be controlled by users. The middle tier is divided into two sub-tiers: web tier and EJB tier[3]. They both run on J2EE server. The former includes JSP and Servlet. The latter mainly deals with complicated business logic. The EIS tier runs on the EIS server. It provides access to different enterprise database.

Some conclusions can be gotten from above analysis:
1) The J2EE introduces B/S mode to develop web applications. Compared with C/S mode, it requests less for client and is good for system upgrade and maintenance.

2) The multi-tiered architecture makes web page designers and dynamic program designers have their definite works. This reduces trouble and workload when repairing the system.

3) The EJB can deal with complicated business logic, realize distributed computing and maximize the reuse of code. What’s more, it can provide high secure authentication.

4) The Servlet and JSP are compiled to java class to execute. In contrast with ASP, which needs interpreting, the Servlet and JSP program have higher performance, and have nothing to do with operating system[4].

Hence, the J2EE framework can absolutely meet all needs of the e-learning system. Its multi-tiered architecture is shown in Fig.1.

![Fig.1 Multi-tiered architecture of J2EE](image)

3 System Design

3.1 Function Design

According to the requests of e-learning system, the following function parts are designed:

1) Real time teaching module: It is in charge of the collection, disposal, sending and storage of video and audio information in class.

2) Study module: It includes real time study, courseware VOD, course selection on network, question intercommunication, homework submitting, etc. This module is mainly used by students.

3) Teach management module: It is used by teaching administrators and consists of course arrangement, courseware editing, attending class checking and teach evaluation.

4) Basic info management module: The basic info includes information of department, specialty, classroom, teacher, student and so on. This module completes their initialization in database and the operation of addition, deletion and update.

5) System and security management module: It involves login, authorization, roles assignment, system log info management, and etc.

3.2 Framework Design

According to the analysis above, it is obvious that the real time teaching module can be developed as an independent module because it mainly refers to stream media technique and it only needs providing an interface to the e-learning system. The rest parts are designed by J2EE framework. From the top to down, they are divided into four tiers as shown in Fig.2.

![Fig.2 Four-tier frame with EJB](image)

The fist tier is client tier. It is made up with DHTML pages and can be seen and controlled by users.

The second tier is web tier. It accepts requests from client and returns the process results from business logic tier to client.

The third tier is business logic tier. It processes requests of client passed by the web tier. It is the core of this system and made up with EJB components. It realizes intercommunication among each module.

The forth tier is resource tier. It deals with storage and management of data. In this system, it involves basic info database and stream media file system.

3.3 EJB Components Design

The EJB is the core of J2EE, so the design of EJB components becomes the most important key of e-learning system.

Then, how to design EJB components? The first important thing is the granularity of EJB components.
As we all know, if the granularity is too big, the reuse performance of bean will reduce. And if the granularity is too small, the number of bean will increase, which results in troubles in maintenance and management of application server. So a compromise is to find a balance between program’s performance and its function to guarantee the system’s whole performance.

Besides, the EJB design patterns are another noticeable problem. During the course of design or implementation, a lot of similar problems will come along. Design pattern is a method that describes the problems and comes up with a strategy to solve all of the problems.

And now it’s turn to design EJB components for e-learning system. In this system two kinds of EJB are considered, entity bean and session bean. Each entity bean is mapped to a table of database. And several related beans are formed an entity bean module. So there are three entity bean modules: MainEJB, which involves department, specialty, course, teacher, student entity and so on; SysEJB, which involves entities such as system log; and OtherEJB, which involves entity of classroom, timetable, roles, etc. The ValueObject pattern is applied to entity bean. Each entity bean is related to a ValueObject whose data is set by the entity bean. The data information in the ValueObject can be locally used through every tier. It helps to reduce the frequency of calling EJB and network flow.

The session bean is divided into five modules based on functions. They are StudyEJB for study, TeachManageEJB for teach, BaseInfoEJB for base info management, SecurityEJB for security management and SysInfoEJB for system management. Each of them includes several session beans, and some of those session beans are stateless session beans, others are state session beans such as CourseSelectBean, which will be discussed later. The SessionFacade pattern is applied to session bean. The SessionFacade provides an abstract tier through which clients access business object or session bean. This pattern makes session bean hide its interface to clients and provides a uniform access strategy.

Fig.2 shows the four-tier frame and EJB components.

4 Realization of System

4.1 System Flow

The e-learning system is shown to users in the form of web site. So before using the system, users must pass the login and authorization entrance. The work flow is that client’s requests are accepted by the JSP and Servlet, they pass the client’s requests to a session bean or an entity bean through the SessionFacade, then these beans process the requests and return the results to client through SessionFacade, Servlet and JSP. Fig.3 shows the work flow.

4.2 Web Realization

When developing a JSP web application, there are some frameworks available. In this system the Apache Struts framework was adopted. Struts is a web application framework based on MVC design model. Struts is constructed with Servlet and JSP API. Struts provides services such as flow control, taglibs, realization of JDBC connection pool, processing mechanism of errors and exceptions, etc. These services make web applications have better performance in reuse and maintenance. The details of web tier realization are not discussed here.

4.3 EJB Realization

The EJB has four essential parts: Home Interface, Remote/Local Interface, realization class and deploy
When a client calls an EJB, the program first gets its reference of Home Interface by looking up the JNDI server, then Home creates a bean class with a Remote/Local Interface, and at this time the client can call methods of bean class through its interface. The call flow is shown in Fig.4.

Now, let’s design an EJB. Take the course selection on network for example, it is named CourseSelectBean as a state session bean. The CourseSelectBean’s Home Interface and the CourseSelectHome, has one method:
/* create bean’s example and return its Interface;*/
CourseSelectInterface create();

The CourseSelectInterface has following methods which are completed by class CourseSelectBean:
/*search for courses*/
Collection searchCourse(String query);
/*select new courses*/
Void addCourse(Hashtable course);
/*delete some courses have been selected*/
Void deleteCourse(Hashtable course);
/*show all courses have been selected*/
Collection showCourse(String id);

All the methods in CourseSelectBean are completed through calling some entity bean. For example, the SearchCourse method calls an entity bean named CourseBean that is related to the course table in database.

All Interfaces of entity bean are designed to be Local Interface. So the CourseLocalHome Interface has following methods:
/*create an entity bean and return its local interface */
CourseLocalInterface create (CourseVO course);
/*find an example of bean by primary key*/
CourseLocalInterface findByPrimaryKey(PrimaryKey key);
/*find a collection examples of bean by department name*/
Collection findByDept(String dept);
/*find a collection examples of bean by specialty name*/
Collection findBySpecialty(String spec);

There can be more different finding methods through different parameter. The first two are essential according to the rule of J2EE. These methods can totally be completed in EJB Container because the container is designed in CMP mode. That is to say, programmer is no need to care about CourseBean class, except for providing some getter() and setter() abstract methods to set data in CourseVO, because the Value Object is related to course entity.

When finished an EJB, the EJB must be deployed to the application server and be described in deploy descriptor.

5 Conclusions

An e-learning system is designed using multi-tiered architecture and EJB components of J2EE. The system has features of stability, security and reliability. It can run on different operating system and is very easy for users. Furthermore, it can be upgraded by teaching requests.

References


Brief Introduction to Author(s)

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