

A J2EE based Management Information System for Higher Vocational Colleges

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Abstract

Informatization has always been one core competency for effective daily management. Although there are various types of management information systems available, few of them could take into account ever changing management requirements of higher vocational colleges. In this paper, we develop a J2EE based management information system for higher vocational colleges. Firstly, we perform an overview of the entire background and situation of the management informatization for higher vocational colleges. Secondly, according to requirement analysis and use case analysis, we divide the system, which requires three roles, i.e., college administrator, enterprise and graduate, into four functional modules, i.e., user login module, college administrator module, graduate module and enterprise module. Thirdly, for architecture design, we adopt a J2EE four-tier architecture, which are user presentation tier, control treatment tier, business logic tier and data persistence tier. Then, we introduce five entities, which are user information table, enterprise information table, graduate information table, recruitment information table and dynamic news table, for the database design. Furthermore, we also illustrate how we implement the final system.

Keywords: J2EE, management information system, higher vocational colleges

1. Introduction

Being already an indispensable part of Chinese modernization, the higher education plays an important role in its economic development and witnesses a fast popularization during recent years, resulting in a much faster growth of graduates than that of total social requirement. Taking up almost half of total annual graduates, the higher vocational graduates would probably choose to pursue advanced studies when they are exposed to an increasingly competitive employment environment. However, this is prejudicial to healthy development of labor market. Hence, the issue that how to adjust themselves to both complex employment environment and fierce employment market needs to be solved urgently.

Under this situation, most of higher vocational colleges would like to increase the employment rate by formulating employment policies and developing management information systems. However, their informatization progresses can't keep up with ever changing management requirements of higher vocational colleges. Besides, there is no such a versatile management information system that could be suitable for each higher vocational college.

In this paper, we design and implement a management information system for higher vocational colleges. Based on the J2EE four-tier architecture, the system is composed of

three roles, four functional modules and five entities. Following the software engineering principle, we describe our system from four processes, which are system analysis, system design, system implementation and system application.

2. System Analysis

2.1. Requirement Analysis

Requirement analysis, as the first step the software lifecycle, could establish proper models by bridging the gap between project problems and their solutions. In software engineering, the requirement analysis involves those tasks that analyze the needs for a new product, consider possibly conflicting requirements from various stakeholders, document, validate and manage system requirements [1]. As one of the most important components in the requirement analysis, the functional requirement describes user requirements by many system functions that composed of inputs, behaviors and outputs. For the required management information system, major functions include a convenient management of higher vocational student information, an effective reduction of the management cost and an efficient modernized bridge among graduates, college administrators and enterprises.

Accordingly, we divide the required management information system into four functional modules, which are the user login module, the college administrator module, the graduate module, and the enterprise module. Specifically, for the user login module, the system should provide functions for selecting user roles, considering whether to adopt the IP login restrictions, and identifying the verification code. For the college administrator module, the system should provide functions for the acquisition of graduate information, the management of information distribution, the management of graduate archives, the statistic of information inquiry, and the system management. For the graduate module, the system should provide functions for the statistic of information inquiry, the management of personal information, and the featured alumni. For the enterprise module, the system should provide functions for the maintenance of enterprise information, the management of information distribution, the management of graduate archives, and the statistic of information inquiry.

2.2. Use Case Analysis

As a dynamic representation of system functions, the use case diagram involves actor, use case, and relationship between the actor and the use case. We can understand external functions of the system without implementation details from the use case diagram. The actor, which could play the role of persons, things, or systems, is an entity outside the system and participates in the process of several user cases. The use case is a set of scenes for describing how the actor achieves their goals by the system. There are mainly three roles in the management information system, which are the college administrator, the enterprise, and the graduate. Figure 1 shows intuitively the use case diagram of three roles based on functional requirements of the system.

3. System Design

Once we are familiar with system requirements and system use cases, we can then proceed to conduct detailed system design, which are the architecture design and the database design in this paper.

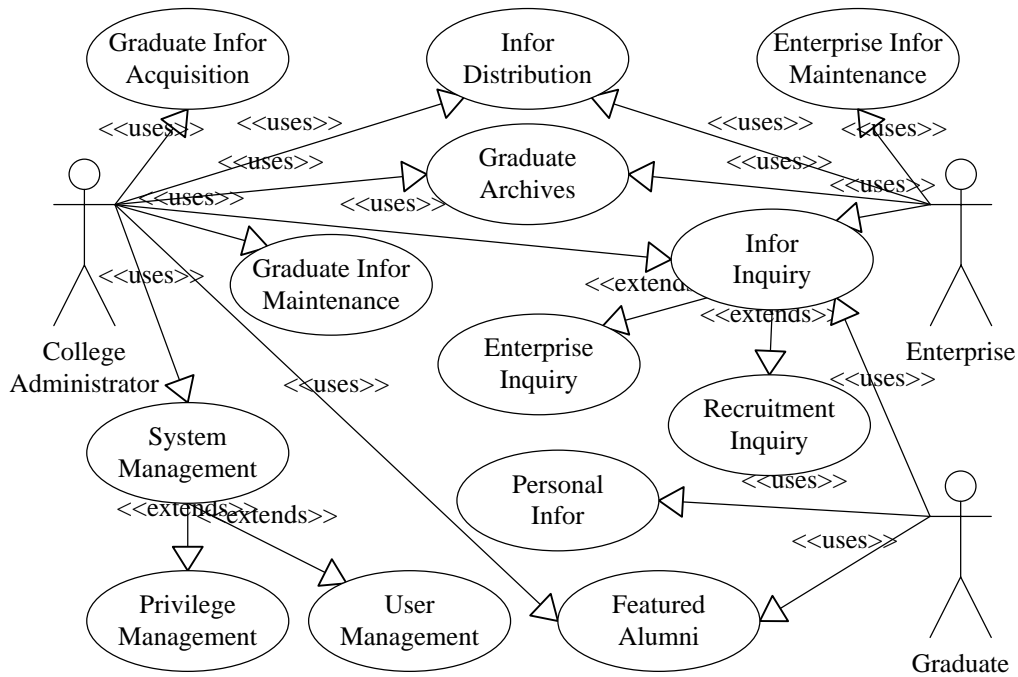


Figure 1. Use Case Diagram for the College Administrator, the Enterprise and the Graduate

3.1. Architecture Design

For architecture design, the J2EE provides a well known four-tier architecture, i.e. the client tier, the web tier, the enterprise JavaBean tier and the enterprise information system tier, which could integrates easily applications with other systems in a loosely coupled manner. In this paper, we adopt an improved J2EE four-tier architecture, as shown in Figure 2, which are the user presentation tier, the control treatment tier, the business logic tier and the data persistence tier, where upper tiers rely on lower tiers. Furthermore, we combine several technologies, such as JSP, Servlet, Struts and Apache, to implement the improved architecture.

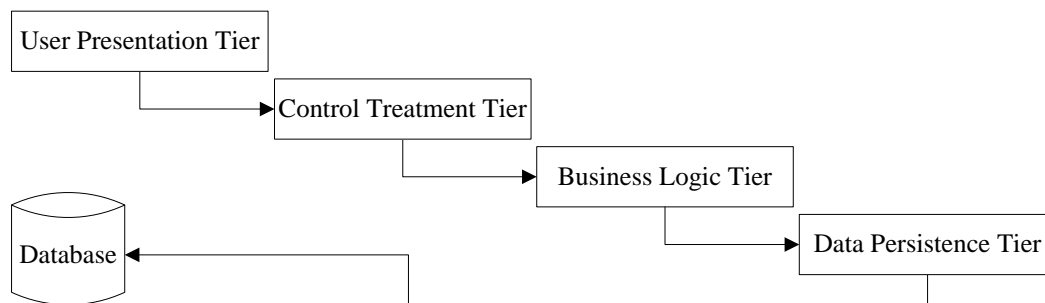


Figure 2. Four-tier Improved J2EE Architecture

3.2. Database Design

We can observe from the Figure 2 that the database is the fundament of the system. In this paper, we adopt the entity-relationship (ER) model based relational database. The ER model provides methods of entity types, properties and relationships to describe the real world based on the conceptual model, which is the initial stage of the database design.

The ER relational database shows many advantages, such as high structured data, minimum redundancy, independence of procedures from data and easy expandability.

Accordingly, by using the Powerdesigner which is one kind of database design tools, we design an ER diagram, as shown in Figure 3, of the management information system based on the previous requirement analysis. We can perceive from this figure that there are five entities, which are the user information table USER_MIS4HVC, the enterprise information table ENTERPRISE_MIS4HVC, the graduate information table GRADUATE_MIS4HVC, the recruitment information table RECRUITMENT_MIS4HVC, and the dynamic news table DYNAMIC_NEWS_MIS4HVC.

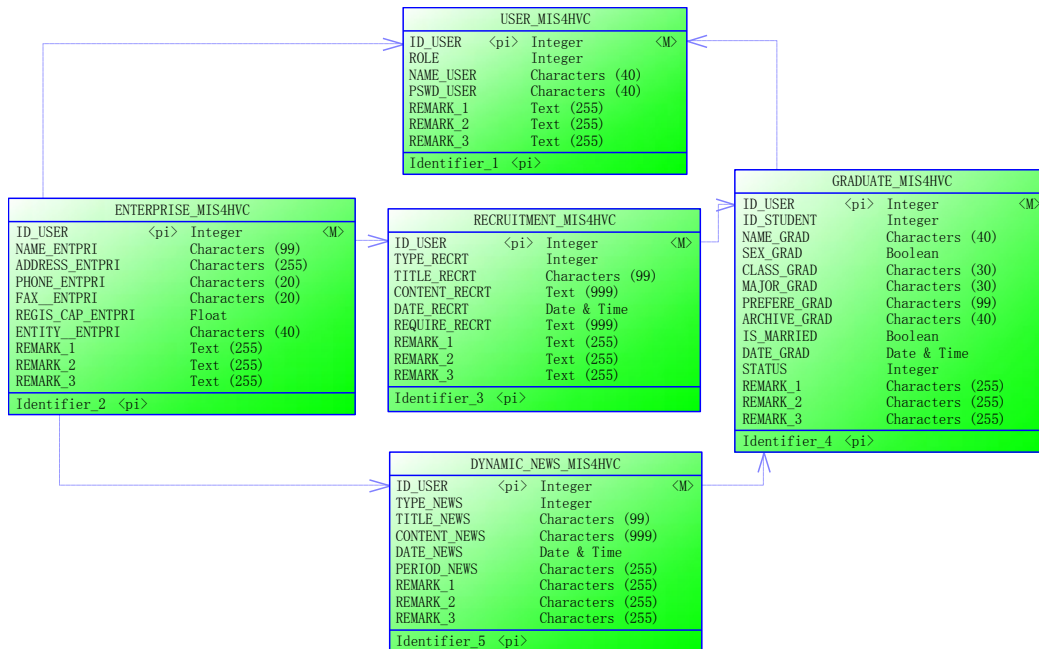


Figure 3. Entity-relationship (ER) Model

Once we fix the structure and the relationship of required entities by the ER model, we can then create these tables in SQL Server 2000 which is a relational database by using SQL script, as shown in Table 1.

4. System Implementation

We implement the management information system based on the improved J2EE four-tier architecture, which are the user presentation tier, the control treatment tier, the business logic tier and the data persistence tier. In this section, we illustrate how we implement each tier of the system.

Table 1. SQL Script for Creating ER Tables

```

create table USER_MIS4HVC (
    ID_USER Integer primary key, ROLE Integer not null,
    NAME_USER Characters (40) not null, PSWD_USER Characters (40) not null,
    REMARK_1 Text (255), REMARK_2 Text (255), REMARK_3 Text (255),
);

create table ENTERPRISE_MIS4HVC (

```

```
ID_USER Integer primary key, NAME_ENTPRI Characters (99) not null,  
ADDRESS_ENTPRI Characters (255), PHONE_ENTPRI Characters (20) not null,  
FAX_ENTPRI Characters (20), REGIS_CAP_ENTPRI Float,  
ENTITY_ENTPRI Characters (40),  
REMARK_1 Text (255), REMARK_2 Text (255), REMARK_3 Text (255),  
);  
  
create table RECRUITMENT_MIS4HVC (  
  ID_USER Integer primary key, TYPE_RECRT Integer not null,  
  TITLE_RECRT Characters (99) not null, CONTENT_RECRT Text (999) not null,  
  DATE_RECRT Date & Time not null, REQUIRE_RECRT Text (999),  
  REMARK_1 Text (255), REMARK_2 Text (255), REMARK_3 Text (255),  
);  
  
create table GRADUATE_MIS4HVC(  
  ID_USER Integer primary key, ID_STUDENT Integer not null,  
  NAME_GRAD Characters (40) not null, SEX_GRAD Boolean not null,  
  CLASS_GRAD Characters (30), MAJOR_GRAD Characters (30),  
  PREFERE_GRAD Characters (99), ARCHIVE_GRAD Characters (40),  
  IS_MARRIED Boolean, DATE_GRAD Date & Time not null, STATUS Integer,  
  REMARK_1 Text (255), REMARK_2 Text (255), REMARK_3 Text (255),  
);  
  
create table DYNAMIC_NEWS_MIS4HVC(  
  ID_USER Integer primary key, TYPE_NEWS Integer not null,  
  TITLE_NEWS Characters (99) not null, CONTENT_NEWS Characters (999) not null,  
  DATE_NEWS Date & Time not null, PERIOD_NEWS Characters (255),  
  REMARK_1 Text (255), REMARK_2 Text (255), REMARK_3 Text (255),  
);
```

4.1. The User Presentation Tier

In order to separate the user presentation tier from the business logic tier, we substitute JSP page, JSP standard tag library (JSTL) and Strut 2 tag library for script codes of the page. Besides, we also show some implementation details about the Strut 2 tag library, the JSTL tag library and the JSP page.

Firstly, the Strut 2 tag library could provide abundant tags for the user presentation tier and the visual HTML editor for the JSP page, which could reduce heavily the amount of coding work for the application developer. From functional aspect, the Strut 2 tag library can be divided into two major categories, which are the non-UI tag library and the UI tag library, as shown in Figure 4. The non-UI tag library involves mainly the process control tag and the data access tag, whereas the UI tag library contains the form tag, the non-form tag and the Ajax tag.

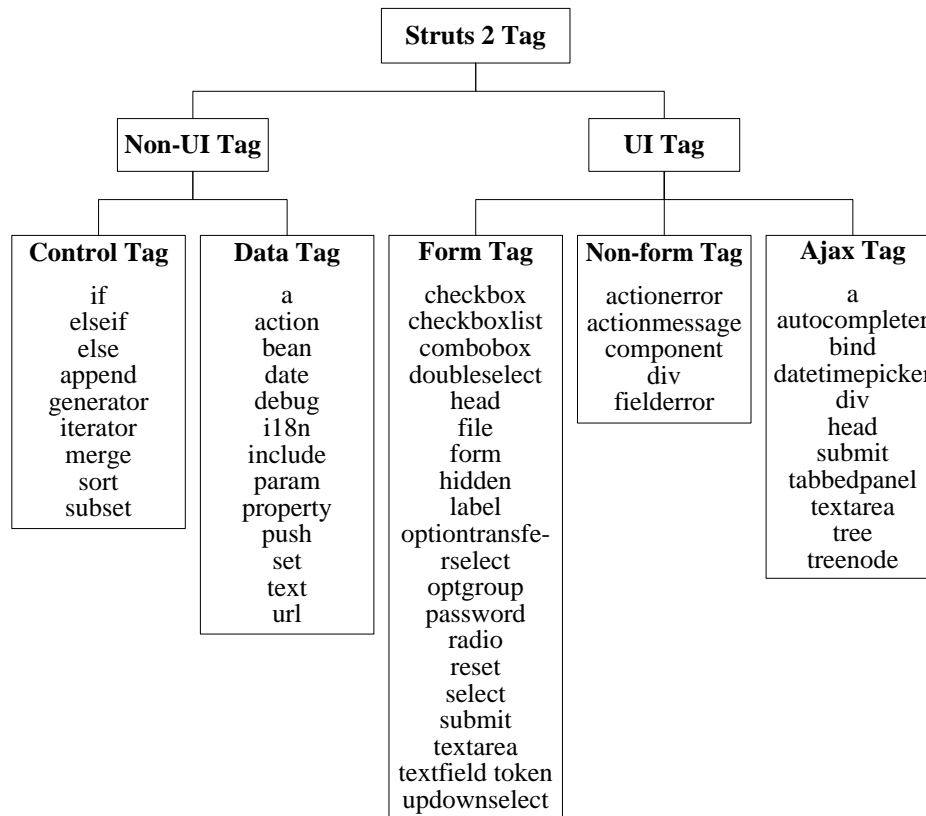


Figure 4. The Struts 2 Tag Library

Secondly, the JSTL is a customized tag library for common functions of the web applications, which include conditional judgment, data format management, XML operation and database access. Consisting of one tag library and one expression language (EL), the JSTL does not need to create the web page for reading XML and accessing database. At present, there are five subcategories of the JSTL, which are Core tag library, i18n tag library, SQL tag library, XML tag library, and functional tag library, as shown in Table 2.

Table 2. The JSTL Tag Library

Sub Tag Libraries	URL	Prefixes	Examples
Core tag library	http://java.sun.com/jstl/core	c	<c:tagname...>
i18n tag library	http://java.sun.com/jstl/fmt	fmt	<fmt:tagname...>
SQL tag library	http://java.sun.com/jstl/sql	sql	<sql:tagname...>
XML tag library	http://java.sun.com/jstl/xml	x	<x:tagname...>
Functional tag library	http://java.sun.com/jstl/functions	fn	<fn:tagname...>

Thirdly, the JSP page, which could decouple views from the business logic tier, is used to display user interfaces, send client requests and receive server responses. There are mainly two types of JSP pages in the system, i.e. the system welcome page index.jsp and the user login page login.jsp. Firstly, defined in the Web.xml, as shown in Table 3, the index.jsp contains only one JSTL line <c:redirect url="u!login.z"/> for jumping to the login page login.jsp, where u!login.z is equivalent to LoginAction.login(). The main purpose of the index.jsp is to use the role based access control model to verify the logged users based on their user names and user passwords. There are mainly three roles in the management information system, which are the college administrator, the enterprise,

and the graduate. Once one user is verified, the system would jump to /jsp/school/index.jsp by executing `sc_u!login.z` if the role is the college administrator, to /jsp/company/index.jsp by executing `cmp_c!login.z` if the role is the enterprise, and to /jsp/student/index.jsp by executing `std_s!login.z` if the role is the graduate.

Table 3. The Mapping Relationship for Action u in struts.xml

```

.....
<global-results> <result name="login">/jsp/login.jsp</result> </global-results>
<action name="u" class="lins.school.action.LoginAction">
    <result name="sc_lgsuccess" type="redirect">sc_u!login.z</result>
    <result name="cmp_lgsuccess" type="redirect">cmp_c!login.z</result>
    <result name="std_lgsuccess" type="redirect">std_s!login.z</result>
    <result name="lgfail" type="redirect">u!login.z?tips=${tips}</result>
</action>
.....

```

4.2. The Control Treatment Tier

The Struts 2 controller is comprised of one key controller and several business controllers, i.e. Action. As a bridge between user requests and the business logics, the Action could locate Java classes of required business logics according to mapping relationships between received page data and Java classes that specified in the struts.xml file. For the key controller, we should configure both the web.xml file and the struts.xml file. For the business controllers, we should implement corresponding Action classes.

Firstly, as a general configuration file for Web applications, the web.xml can be used to set related filters, default home page and filter mapping relationship. Specifically, the setting of related filters is achieved by `<filter> <filter-name> f_name </filter-name> <filter-class> f_class </filter-class> </filter>`, where `f_name` ∈ {struts-cleanup, sitemesh, struts2} and `f_class` ∈ {ActionContextCleanUp, PageFilter, FilterDispatcher}. The setting of default home page is implemented by `<welcome-file-list> <welcome-file>index.jsp</welcome-file> </welcome-file-list>`, where the index.jsp is the home page of the management information system. The setting of filter mapping relationship is realized by `<filter-mapping> <filter-name> f_name </filter-name> <url-pattern> p_name </url-pattern> </filter-mapping>`, where `p_name` is the filter mode, such as /*.

Secondly, as another general configuration file for Web applications, the struts.xml is the key component in the struts 2 architecture for forwarding all HTTP requests of the system. Both the global forwarding setting and the Action mapping relationship setting can be supported by the struts.xml file. For the global forwarding setting, we can use `<global-results> <result name=login*/jsp/login.jsp</result> </global-results>` to jump to the /jsp/login.jsp for any Actions with a return value of `login`. For the Action mapping relationship setting, Figure 5 shows four major Actions and their relationships of the management information system, which are `u`, `sc_u`, `cmp_c` and `std_s`, where the identifier before the `>>` denotes return value of the Action, the identifier after the `>>` signify to jump to corresponding JSP page, `>>` is the jumping operation. `lins.school.action.LoginAction` is the java class for the Login Action, `lins.school.action.UserAction`, `lins.company.action.CompanyAction` is the java class for the Company Action, `lins.student.action.StudentAction` is the java class for the Student Action, and S1-S5 are the implementation orders corresponding to different return values.

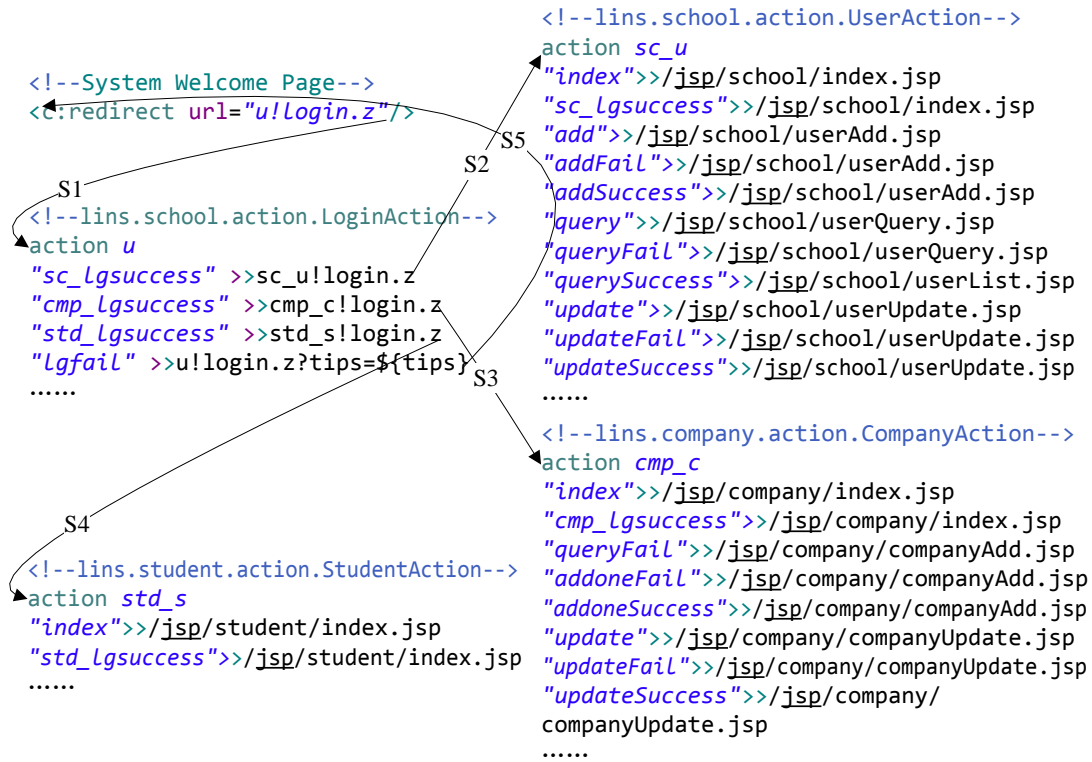


Figure 5. Four Major Actions and their Relationships

Thirdly, as business controller, the Action could call methods of its Java class and return the results to another Action or web page. To implement an Action, two types of definitions are required. Specifically, one of them is the definition of method execute() for responding user requests. The execute() is a method without any parameters and five return values, i.e. ERROR, INPUT, LOGIN, NONE and SUCCESS. The other is the definition of attributes and methods of set...() or get...() for receiving submitted parameters from users, where ... should be substituted by the corresponding attribute name. For example, if the submitted parameters involve Username and Password, then the Action should contain methods of setUsername(), setPassword(), getUsername() and getPassword().

4.3. The Business Logic Tier

Providing functions for processing actual user requests, the business logic tier involves two types of classes, which are the business entity, i.e. the Entity of the ER model or the tables of the database, and the business Service. There are 11 such classes to be implemented in the business logic tier of the management information system, which are User, UserService, Company, CompanyService, Student, StudentService, JobInfo, JobInfoService, NewsInfo, NewsService, and ExcelService. Due to the limited space, we show only source java codes of the Student class in Table 4. Member variables of the Student class correspond to fields of the graduate information table GRADUATE_MIS4HVC. There are both a set...() method and a get...() method for setting and getting value of each field.

4.4. The Data Persistence Tier

The data persistence tier applies the Data Access Object (DAO), one standard J2EE design mode, to access the database. Data interfaces, i.e. methods to be used by system users, are defined in the DAO mode, which could separate low level data access

operations from upper level business logic operations. Accessing mechanisms of various data sources, such as DBMS, LDAP and File, are provided in the DAO mode. One of the other advantages of the DAO mode is that developers are not need to understand details about how to operate the data source. In this paper, there are five java DAO classes, corresponding to five database tables, which are CompanyDao, JobDao, NewsDao, StudentDao and UserDao. Besides, final database operations, including database connection, create, read, update and delete (CRUD), of all DAO classes, are achieved by calling the fundamental java DB class.

Table 4. Source Java Codes for the Student Class

```
public class Student implements Serializable {  
    private Integer ID_Stu, Status; private Boolean Sex_Grad, Is_Married;  
    private String Name_Grad, Class_Grad, Major_Grad, Prefer_Grad, Archieve_Grad,  
        Date_Grad, Remark_1, Remark_2, Remark_3;  
    public Integer getID_Stu() {return ID_Stu;}  
    public void setID_Stu(Integer ID_Stu) {this.ID_Stu = ID_Stu;}  
    public String getName_Grad() {return Name_Grad;}  
    .....  
}
```

5. System Application

In this section, we use web pages of four functional modules in the management information system to display system applications.

5.1. User Login Web Page

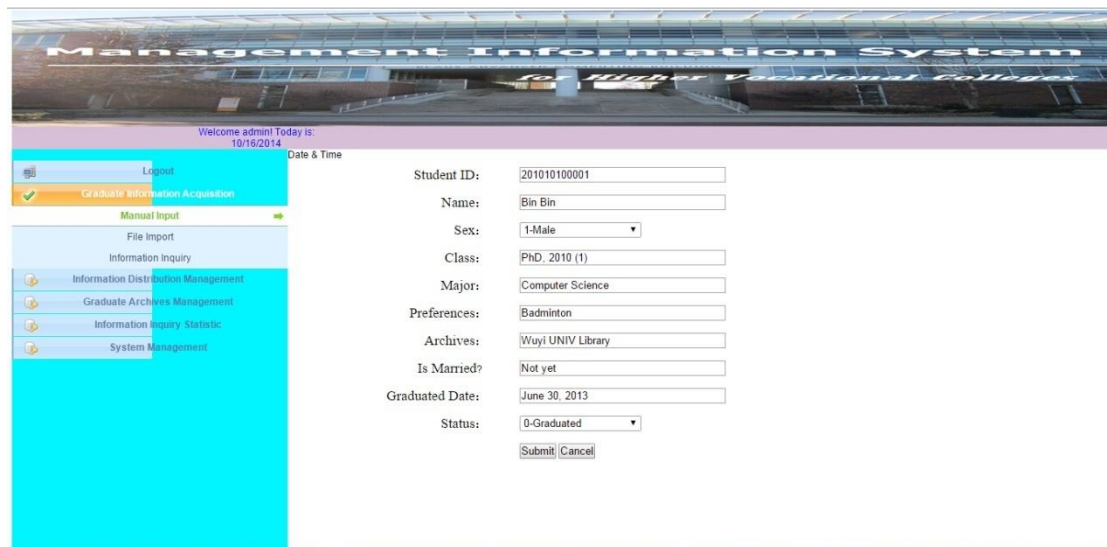
There are three roles in the system, i.e., college administrator, graduate and enterprise. For all roles, the system provides a uniform login web page, where users could select their roles, input their user names, and input their passwords. Figure 6 shows the user login web page.



Figure 6. The User Login Web Page

5.2. College Administrator Web Page

Once verified by the login web page, the college administrator could enter its own homepage. The acquisition of graduate information is one of primary functions provided by the web page. Furthermore, there are three acquisition ways, i.e., manual input, file import and information inquiry. Figure 7 shows the college administrator web page.



The screenshot displays the 'Management Information System' interface for a college administrator. The page features a sidebar menu on the left with options: Logout, Graduate Information Acquisition (highlighted), Manual Input, File Import, Information Inquiry, Information Distribution Management, Graduate Archives Management, Information Inquiry Statistic, and System Management. The main content area shows a form for entering graduate information. The form includes fields for Student ID (201010100001), Name (Bin Bin), Sex (1-Male), Class (PhD, 2010 (1)), Major (Computer Science), Preferences (Badminton), Archives (Wuyi UNIV Library), Is Married? (Not yet), Graduated Date (June 30, 2013), and Status (0-Graduated). A 'Date & Time' section shows 'Welcome admin! Today is: 10/16/2014'. At the bottom of the form are 'Submit' and 'Cancel' buttons.

Figure 7. The College Administrator Web Page

6. Conclusion

Graduate of higher vocational colleges is one of the most important components in the entire employment structure. A reasonable management of graduate information is crucial to the economic development, the social stability and people essential benefits. In this paper, we describe how we develop a J2EE based management information system for higher vocational colleges from four aspects, which are system analysis, system design, system implementation and system application. At present, existing system applications have already demonstrated that the system could not only improve the employment rate and the management efficiency, but also bridge the gap among graduates, college administrators and enterprises, from technical aspects. In the future, we want to combine the SSH (Struts + Spring + Hibernate) framework with the current used J2EE four-tier architecture and strengthen system security by workflow or service oriented access control model.

Acknowledgments

This paper was supported by the Doctor Startup Foundation of Wuyi University under Grant No. 2014BS07, the Basic Theory and Scientific Research Project of Jiangmen City under title "Research on complex network evolution model and link prediction", and the National Natural Science Foundation of China under Grant No. 71202165. We would like to thank anonymous reviewers for helpful comments.

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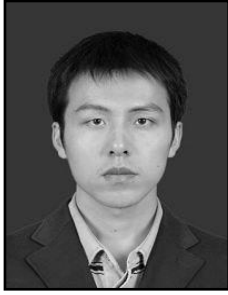
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