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Design and Implementation of a Library Management System Based on the Web Service

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***Abstract*—In view of university multi-school district coexisting and many libraries distributed in the different school district, system hardware cost is high, the load of system maintenance is big, the extendibility of system is bad , so we develop library management system's modeling research based on the Web. In the modeling process, we use the UML standard modeling technology to construct system's structure and make the expansion to the UML object's class application. Through the UML model used to map the relational database model, two kind of model's difference can be realized smooth transition, and the relational database modeling with the UML technology has been realized , specially through using class and the class instantiation object to the relational database's modeling, the database integrity and the uniformity have been enhanced greatly, the data redundancy degree has been reduced, software's multiplying function has been increased, the work load of the software development has been reduced, and coordination between software developers' have been promoted.**

Keywords- Web; Library Management System; UML.

I. INTRODUCTION

Along with Internet's high speed development and Web technology day by day mature, the B/S structure has become the current software development pattern mainstream. Many university's management software reform by the traditional C/S structure the B/S structure. Wherever you are, you may use the function in the corresponding jurisdiction by the internet, it brings very big convenient for teachers' work and students' study, for example: On-line choosing course, on- line discussing, score inputting, score inquiry and so on. As the university information resource important component's library, its information management software must cater the current trend. Now information management software of many university libraries uses C/S and the B/S mix pattern, designing system's basic function with the C/S pattern, designing the retrieval website to provide on-line retrieval, on-line appointment, the book information issue and so on with the B/S pattern. The C/S and B/S's mix pattern can be able to satisfy the university current management request, but multi-school district coexisting is the question which the present many universities exist, many libraries distribute in the different school district, such system hardware cost is high, the maintenance work load is big, system extendibility is bad. Now each university is marching toward the digitized campus's goal, translating the C/S pattern of the library management system to the Web pattern, will be provides a platform for the future Digital library. The paper expound library management system's modeling design based on the Web.

The library management system's database design is quite important, it involves to system's efficiency, affects to overall system's quality. The database modeling is the core and foundation of establishing the database and application system, regarding the application environment which assigns, it requests that it can construct the superior database pattern, establish the database application system and enable the system effectively the stored datum to satisfy the user

each kind of application demand. system is a set of management software based on a university library demand development, mainly including the following several stages: The demand analysis , the service modeling stage, the logical modeling stage and physics realizing the stage ,the logical modeling stage is most important.

II. SYSTEM ARCHITECTURE

The selection of software architecture is of vital importance to entire project implementation. This system uses three logic architecture on Web, it is the current most popular model, as shown in Figure 1.

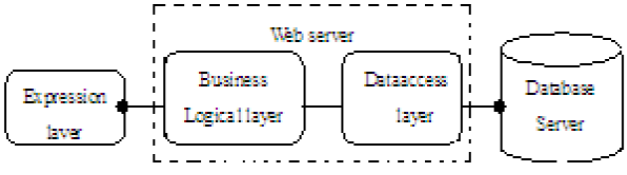

Figure 1. System architecture diagram

The user expression layer is mainly refers to the application procedure interface on web, it is the movement on the client side browser, which is familiar with the homepage, it mainly completes to input the message data the and show the processing result; The service logical layer provides the system logic function to transfer, namely middleware; The data accessing layer realizes with the database correspondence, and will feed back the service logic level finally, the service logic layer and the data accessing layer is located at the Web server; The database server uses for to store the permanent data. Uses this kind of structure the merit to lie in: The function is clear, independent, is advantageous in the project parallel development; The user interface is friendly, simplicity of operator; Exempts the client side installment, only needs the browser to be possible to visit the software system through the Internet, the hardware cost is low, the software and hardware maintenance quantity may reduce greatly.

The demand analysis is the important one step of software design, is foundation which the entire software success realizes, the entire software's implementation is the establishment in demand analysis each function. Based on the university library's service demand, the flow state diagram of library office working is given, as shown in Figure 2, and we obtain major function module of the library management system: The interview catalog management, the book reservation management, the periodical management, the reading room management, the circulation management, the reader management, the literature search and the system configure.

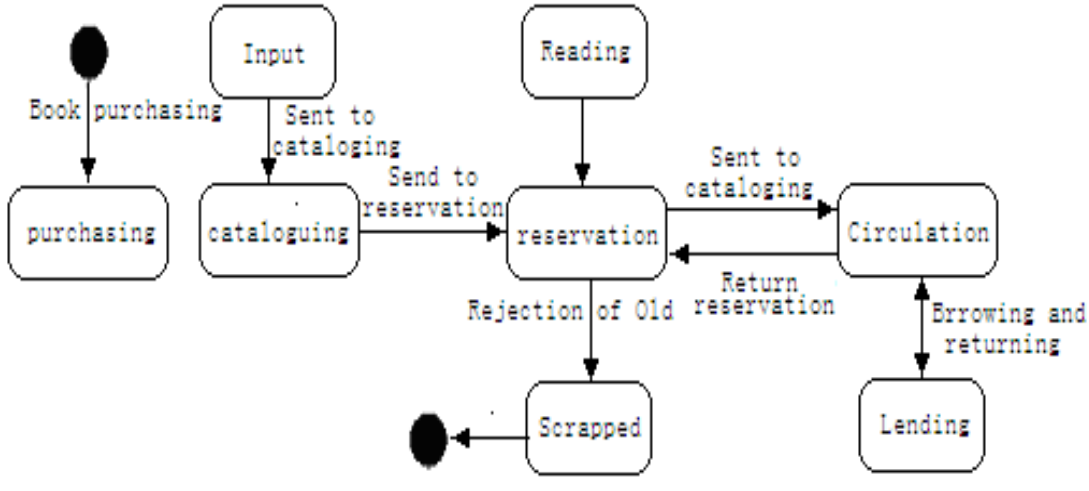

Figure 2. Flowchart of University Library

Handling of traffic aspect: First is the system administration personnel lands the backstage management system management system, then carries on the system maintenance, the verification unit information, operations and so on monthly report data. The library management department may visit in the database through the client side browser the information and can carry on each kind of data statistical analysis, in order to have a comprehensive understanding macroscopically. The teachers and students user may visit own literature material information, the browsing through the customer browser to retrieve oneself need the information and so on.

III. UML SYSTEM MODELING

Along with the database scale's expansion, the simple E- R model structure is unable clearly to analyse and descript the question, causes the system development difficulty coefficient to increase. The database design holds the important position in the software development, it immediate influence entire software system's data access speed, but the database modeling is also the most important.

A. Demand capture modeling

The demand capture is the great importance stage in the software development process, it immediately influence to the user to the final software product's degree of satisfaction, establishing the example view is most important in this stage . The role is a person interacting with the system, which mainly include two kind of participants in the library management system: Reader and library staff. The reader which divided into the books borrower and the traveler (refers to visit system's personnel through the Internet), may carry on the retrieval to literature material of this library. The staff may divide into the system manager and the ordinary manager. Use case is the interaction between the system and user , is function block which the system provides. In the front overall demand analysis's foundation, we may obtain main use case of the system, for example :

- System login use case complete the user to register the system and validating authentication system management use case Data maintenance, system configure, jurisdiction establishment and so on interview catalog management use case

But using the analysis method on UML to design database model, can cause the database model clear easy to understand, can reflect the system structure clearly, easy to develop, reduce the system development cycle, enhance the system development the efficiency.

We Use UML to carry on the system modeling, which uses the object-oriented method to analyze the system, uses the standard visualization's model to display the visual information, so we establish the object-oriented system model. Below, we use the UML view model to carry on the analysis and the design about the system development.

Complete the books reservation, the approval warehousing, the new book looks up the re-recording to enter, the card printing and so on reservation management use case.

Complete the books the collection assignment, the revision and picks out old circulation management use case Provide borrowing and returning manages, the circulation data inquiry and the statistics, urges returning book, the appointment management

 periodical management use case •Provide the periodical the order, to ascend to, urges to lack, to bind with the publication management.

 reading-room management use case •Realizes the reading room reader login, borrowing, the restore function and the borrowing information statistics.

 literature search use case •he reader may visit the library Web server through the Internet, realize the literature search, the borrowing

information inquiry, the books appointment and so on.□

The above use cases are the only macroscopic description about system's major function, next step carries on refine the above use case and obtain use case model in detail. Because the length is limited, below only gives the circulation management with the example model, as shown in Figure 3. From this model, we may understand the system provides the detailed function and the behavior, make the user's needs more precise and completely.

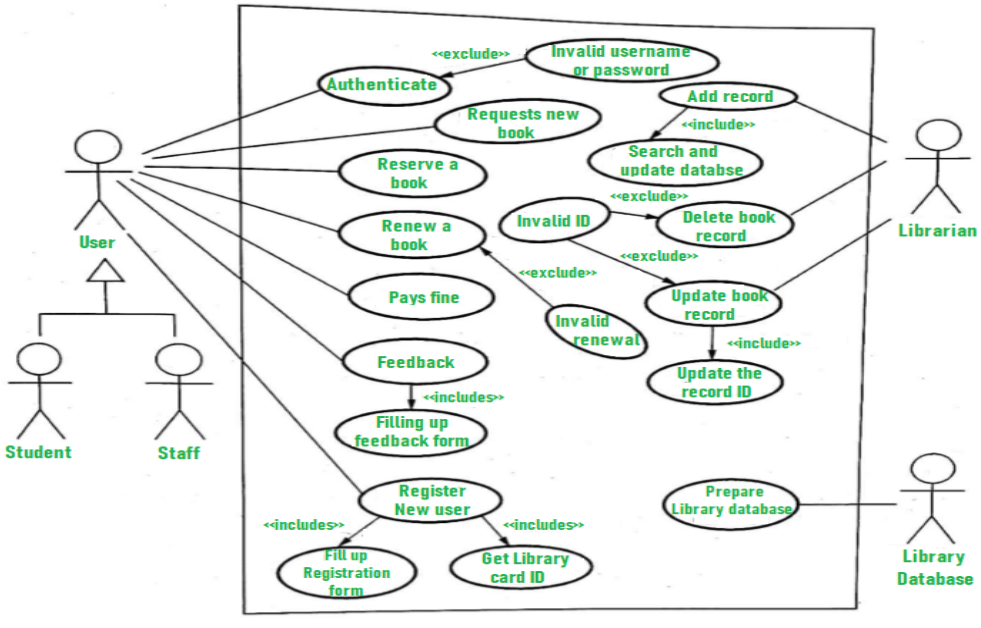

Figure 3. Circulation Management Use Case Model.

B. Demand analysis modeling

The demand analysis stage purifies the capture demand, through class diagram, activity diagram, sequence diagram and so on model, we can describe the detail question which extracts analysis class from each use case, and describes realization of use case corresponding analysis class. The analysis class represents in the question territory simple and direct abstract, maps the real world by the definite way, like books information, borrowing books operation, borrowing books interface. The analysis class corresponds one kind in 3 fundamental construction : Boundary class, control class, entity class. The boundary class uses in establishing the interactive mode between the system and the participant , like borrowing books interface class; The entity class uses to the lasting information modeling, like books information class, reader information class; The control class uses in being coordinated, sorting, business processing and to other object control, like borrowing books operation, but also book operation. We extract analysis class from detail use case obtained in demand capture stage, and obtains the corresponding boundary, the control and the entity class, and establishes the anatomic model, including class diagram, interaction diagram. As shown in Figure 4, it is the retuning book analysis class diagram, Class diagram in the book also gives rough entity class and boundary class involved in the operation of returning book.

C. Design modelling

The design modeling stage primary mission is: At first ,we may carries on the detailed modeling about the analysis class obtained from the previous stage, mainly obtains concrete function of the boundary class and the operation class, the entity class attribute and the method as well as relations between each class ; Secondly, the

interactive diagram which obtained from the analysis stage carried on the supplement, mainly describes realization process of use case in the software system with the sequence diagram harmonious cooperation mapping.

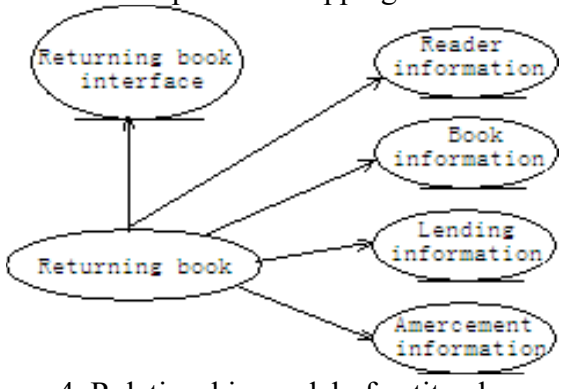

Figure 4. Relationship model of entity class.

D. Database modeling

Now, we give the entity class diagram about the circulation management. From Figure 5, we may understand the attribute method about each entity class and the relations in which very intuitively.

The database design is the process database design method which the database systematic and the real world, the coordination unifies closely, organically are many, what this system uses is the object-oriented relational database design method, it belongs to the entity leadership design, the design stage will obtain the entity class model according to the related translation rule, its transformation doubling should the database table.

IV. UML CLASS MAPPING WITH THE RELATIONAL DATABASE AND REALIZATION

The UML object model is based on software engineering some principles, for example coupling, aggregation and encapsulation, but the relation model based on mathematics principle, specially set theory principle. To combine fully UML class diagrams tools with relational data's advantages, the mapping about relational database and class, object must be created. Class is the core of object-oriented System organization structure, expresses discrete concept about the modeling system. Class has contained the static attribute and the behavior attribute, but the relational database system has mainly contained the two-dimensional table and its related operation. Although class and relational model are from different mathematical model, but there is very strong inner link among themselves.

Through analysing university library management system management system's based on the Web, it discuss mapping plan about UML class model and the relational data model. At the same time, in view of inner link and the characteristic between class model and the relational data model. There are three kind of situations about the table and the operating procedure mapping's class in the library management system: the first is attribute mapping of calss , the second is method mapping of class , the last is connection mapping of class.

A. Class property mapping

Class static attribute is mapped to the field of relational database table. Attribute describe common characteristics of all objects in the same class , mapped to database table fields, there is at least one primary key attribute in the mapping, which is used to be the storage object identifier and be the unique identifier as the primary key object. Not all of the properties about the class are permanent, not a permanent attribute of class does not require mapping, such as the number of attributes for each book can be calculated, so no need to save in the data table, while the attributes of the class is ensured to be a single value, if there are multiple values in the class attribute, put the attribute mapped into multiple fields.

The static attribute type of class is mapped to a relational database field type. Attribute type can be integer, real, char and other types of mapping. when mapping, only the need to define appropriate data types and space, the use of the domain not only improve the database design

consistency but also optimize the application portability.

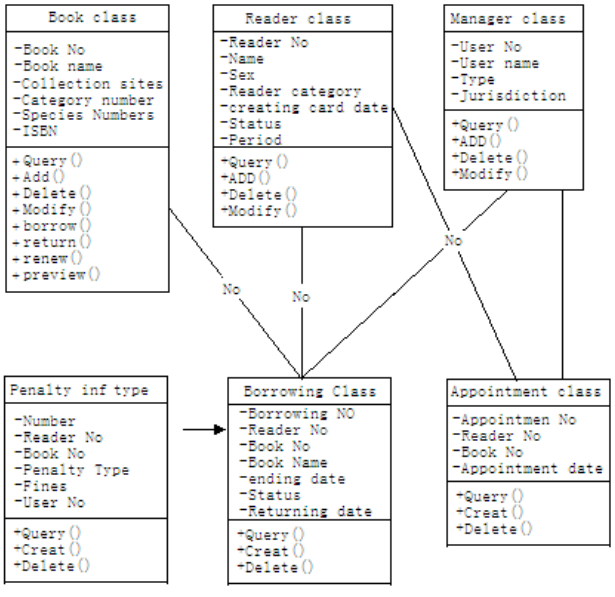

Figure 6. Class property mapping.

Class is mapped for the table. Except very simple applications, in general, the class and the corresponding table are not one to one relationships, we often need to map the class used to store data to the database table, object of class is mapped to each database record in database table. Figure 6 show that the book basis information table (ISBN, title, author, publication date, price) mapped to "static class" of information for the book.

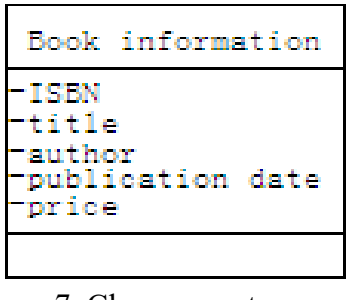

Figure 7. Class property mapping

B. Mapping of class method

Class contain the method property except for static property In UML modeling tool. The static properties can be mapped to a relational database table structure, only static properties, it can not be achieved on the database table insert, update, append, operational control to retrieve records, the methods must make class attributes and operation control of the database map, perfect in function of the access control database table. Database data access control is mainly achieved through the SQL statement, the SQL statement in the DDL statements and DML statements in the Select, Update, Insert, Create, Delete function statement is mapped to UML class methods properties, attributes and class methods in order to achieve relationship between the operation of the database access function mapping. Student's basic information table and mapping method of data operation shown in Figure 7.

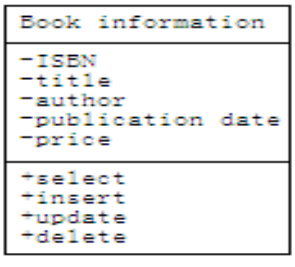

Figure 7a. Mapping of class methods .

C. Class association mapping

In a relational database, the association of class is implemented through the association foreign key, foreign key allows a row in the table associated with other rows in the table. Here in three circumstances:

 One to one relationship. If the association is one option, the other is mandatory, foreign key can be placed in the optional side, the foreign key can not be null; depend on the particular circumstances to other one to one situation, the foreign key may be placed in any side.

 One to Many association. The foreign key is placed in the "many" side. "One" side is optional or mandatory, which decide that the foreign key can be empty or not empty.

 Many to many association. to achieve many to many association through the establishment of an associated table with the relationship ,it established links relation across the table. The

primary key of association table can be used both ends of the table's primary key combination, or use its own primary key, and then primary key of both ends of the table's is used to be foreign key of this table, that is, to many to many relationship into two one to many relations, shown in Figure 8.

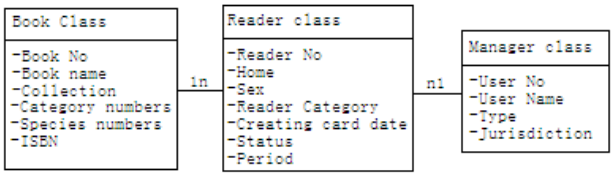

Figure 8. Many to many association mapping program

V. CONCLUSION

Through UML model used to map to the relational database model, the differences between the two models are smooth ,UML modeling technology for relational database has been achieved, particularly the modeling technology through the class and its instance of the object model of the relational database, can greatly improve the database the integrity and consistency, reduce the level of data redundancy, increase reuse of software functions, and reduce the workload of software development, and promote the coordination between software developers.

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