Research on Management of Digital Library Based on Information Platform

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Abstract: How to improve efficiency and service level of digital library by means of computer technology is becoming an urgent problem in higher education. In this context, this paper is developed a new set of digital library management information system. This paper is studied structure of digital library, and we use case modeling to analysis Web platform module, database module, further build the overall system architecture, design main database table. In the process of implementation, database connection is configured, and we do a lot of tests for Web system platform module and reader-discuss-community module. Since the system is online, the website has maintained a good number of visits, and is welcomed by many teachers and students.

1. Introduction

University library [1] is a place to provide information resources and research papers. With the popularization of computer technology, some daily work, for example, managing electronic resources, subscribing books, subscribing newspapers and book circulation has been changed from pure manual labor to computer operation. Development of library has been transformed into digitalized and informationalized. At the same time, there are many problems in the library information management system [2]. On the one hand, system operation is not smooth[3], interface is rigid, functional modules cannot be integrated; on the other hand, library information management system based on C/S mode[4] rely on client software, upgrade is complicated, there are many loopholes in this kind of system and it does not support cross platform. From view of information sharing, B/S model [5] is the mainstream of library information management.

The development of library information system has experienced 2 stages. Firstly, it was the development of C/S (Client/Server) mode, which is a service mode based on LAN. The client interacts with the system server by terminal to get information that they need. In C/S mode, users need terminal devices to use this mode, so the C/S mode is more suitable for a small and secure environment. However, with the continuous expansion of library and the development of mobile Web technology, the existing library system has not been able to meet the requirements. The B/S pattern has been developed on the basis of the C/S pattern, and services can be obtained by only a browser. Users can enjoy services by servers and remote login systems. As long as network support, ordinary devices can enjoy services, so many enterprises are more interested in B/S mode than C/S mode.

Library management stage is divided into four stages in foreign countries. First of all, the library system was based on data processing, library management information did not require logic processing, the data was not needed to classify, or to develop a framework, the data can be simply saved; then, the library information system can be carried out simply logic processing, it had the function of judging on electronic data; thirdly, the library management system can do data-decision, which means that the
system can carry on the data analysis, the analysis results would be provided to company for high-level decision-maker; finally, the library management system has already been transformed into intelligentization, and it can integrate complex business, realize the parallel processing.

The main programming language that we have used for the library information system is C#. Current systems that be represented by C# includes Visual Studio and ASP.Net. This programming language provides powerful and rich controlors, and programmers can easily use library functions. Compared to the JAVA language, the speed that we use C# in the web site is to 6 times as fast as the speed that we use JAVA, and the code by C# is only 2/3 of the code by JAVA. We need to design a database system for the design of the library information system, which is mainly included Oracle, Sybase, and SQL Server. Oracle is a relational database developed by ORACLE. It supports C/S mode and B/S mode. It can handle large scale data, and data storage performance is good. Data is represented by values in the table from logical level. The existence of data is independent of data logic. The current Oracle system has supported the functions of a distributed database, and a complete Oracle system can be composed of multiple Oracle DBMSs and SQL connections.

Sybase SQL Server is also a relational database, but it cannot support parallel server mode, that is, one query cannot be decomposed into multiple sub queries, and then executed on different CPU. When the volume of library business was increasing, increasing devices would greatly be increased the cost. If we can improve the performance of a single device, we can reduce the cost of expenditure, so it is more appropriate to choose Oracle database. SQL Server, in general, is a version of 2008. The SQL Server supports XML in this version, and data storage components have strong scalability and use easily. At the same time, it integrates Windows architecture to support search by English; SQL Server2008’s enterprise edition has functions of servers, large memory support and so on. What we need to be emphasized is that the SQL Server 2008 database has distributed query function, it can be called for data of different database and put them inside this database; data can be copied, so it also can be get multiple copies of data; the data can be sent to those mobile users who do not have connected to the server database; SQL Server can be deployed on any site, because it have their own management tools and the characteristics of inheriting Windows programming model.

We need to consider the feasibility of system in the process of designing system, that is, how to determine whether a project is feasible or not and the feasibility of the project must be analyzed. In the process of software development, feasibility analysis is essential. We need to prepare some resources and determine whether the current conditions are allowed, analyze whether it is necessary for the system to subsequent development, study the application scope and possible shortcomings of the system. Data sources include staff, administrators, readers and librarians, we design this platform based on information technology, we need to study from the perspective of feasibility: (1) we need to evaluate the technology, technology must be developed and implemented to meet the system requirements; (2) the system needs analyze economic benefits of schools, we need purchase PCs, printers and a lot of commercial software, also need to consider the operation of system, and consider whether what it produce economic benefits can recover the cost or not; (3) we need to consider the operation of the system, the on-line system is needed people to operate, but also need people to maintain, therefore we need to provide personnel support and skills.

When we designed the system, we would need to analyze the needs of the system, and provide the basic functions of book borrowing, reader management, and support data connection for a large number of tasks. Specific requirements should include: (1) system needs a reliable error-analysis system, the error rate is not greater than 3%; it can achieve efficient data-backup; (2) the operation should be simple, system should be needed to integrate functions, optimize the database structure so that can improve the site operational efficiency from the perspective of the system; (3) part data of library is needed to encrypt, system design must have the function of data encryption, it is very important for library management; (4) the system should be able to support a strong professional operation, friendly interface, so the relevant person can easy to understand and use; (5) the system should be able to cover every management module and link of library, it can not only connect the library resources, but also interconnect with other school information platform.

We analyze famous library information management system(LIMS) in China, and find that they can be supported circulation, the refer books, supported TCP/IP[6] protocol and mature database, which
included Oracle[7], Sybase, SQL Server[8] and other database technology. We need to pay attention to shortage of web services, lack of statistical function and characteristic resources in many library information management systems, and it is difficult to meet the need of readers. In view of this, we adopt research route of software engineering, and design a digital library information management system by B/S architecture and ASP.NET language.

2. Management Requirement Analysis of Digital Library

Requirement analysis can help software developers understand what problem should be solved and modeling of this problem scientifically. In the process of requirement analysis, we describe this paper by natural language and graphics. In the development of system, we need to consider many factors, which include humanized design, convenience, simple operation, friendly interface.

2.1. Organizational Structure of Digital Library

In order to further improve library information management and literature service level, we need to form an efficient organization structure. The organization structure of digital library studied in this paper is as follows:

![Digital library organizational structure](image)

Figure 1. Organizational structure of digital library

As is shown in the figure 1, we divide this digital library organization into four departments, which are editorial department, technology department, reader-service department and office. Among them, editorial department is responsible for interview, purchase, design of bibliographic database, information sharing; technology department is responsible for website construction of digital library, data maintenance and update of cyber resource; reader-service department is responsible for providing searching and borrowing service to readers, and help readers get better access to resources; office department is responsible for managing business of digital library and information of personnel, scientific research, logistics activities.

2.2. Example Modeling of Main Modules

Example modeling is more intuitionistic, main functional modules of the system are described in a graphical way, and concrete implementation is not displayed. The digital library management system in this paper includes several modules, which are Web platform, unified management platform, log management system and database. This paper mainly analyzes the example modeling of library Web platform module and database module.

Library Web platform is a major part of system, which can help readers get information resources better than before and experience humanized service. Web platform in this paper includes 6 sub modules, which include unified management platform, reader-discuss community, keyword-search of hint for bibliography, information retrieval, unified search interface and weight estimation of digital resources. Design of its example diagram is shown in figure 2:
Figure 2. Example design of Web platform module

(1) Example: reader-discuss community
Readers can express their opinions by reader-discuss community, which include time, topic and content.

(2) Example: unified search interface
System provides a unified search interface that can find resources such as indexes, periodicals, dissertations, and patents in the library.

(3) Example: keyword-search of hint for bibliography
Readers input different keywords, then system can recognize the form of keywords, so can help readers find the required literature quickly.

(4) Example: information retrieval
Information retrieval of this module is used for querying of some professional nouns, and it helps readers learn better than before by querying and popularizing basic knowledge of different disciplines.

(5) Example: unified management platform
Web platform stores many kinds of information, which include book information, patents and conference data. It needs to be managed, we set up the platform, which is good for administrators to maintain Web platform.

(6) Weight estimation of digital resources
Readers study different kinds of resource, can mark points and evaluate quality of resource, so they can choose resource they need more efficiently.

Database module is the most important part of Web platform module in the digital library, this module can be used for balancing different kinds of data. We put existing digital resource and platform of our school as basis, build distance education center, realize sharing of information resources, and provide a variety of digital resource services to reader. Database module here implements four functions, which include literature retrieval by author/ISBN/press, information retrieval of teaching and research institution, retrieval of expert information and downloading of academic paper, information retrieval of teaching materials. Its structure is shown in figure 3:
**Figure 3. Structure of database module**

1. Example: literature database
   - It provides search methods of book names, authors, press and ISBN, and it can download different educational resources in China. Online-reading requires CAJ reader.

2. Example: informational database of teaching institutions and scientific research institutions
   - Readers can retrieve the press of different papers, which include team of organization, organization profile, official web site and contact information.

3. Example: informational database of experts and scholars
   - This database helps readers retrieve personal information of expert and scholar in the literature, then search for their academic papers and books, and provides download in function.

4. Example: teaching material database
   - Readers can download material information of different subjects for free, including reference books, textbooks, and old exam papers.

3. Information Platform Design of Digital Library

In this paper, digital library adopts B/S architecture, library staff and readers can access resource of the library with the help of network. Readers can express their views on book and paper in the module of reader-discuss-community, also can enjoy the personalized service by database access; library staff can do statistics of reader information and maintenance of website backstage by log management system.

Information platform in this paper is divided into four layers, which include user layer, service layer, application layer and data layer. In the user layer, it includes library staff, reader, and system manager. System manager is generally served by senior technical staff, they have the highest authority, and can modify authority of library staff; authority of library staff is mainly on backstage data maintenance of information platform, information statistics of readers access and revision of literature priority; readers only can visit library resources, leave a message in the reader-discuss-community. The service layer is composed of multiple servers, and they can transform data, commands, and readers' messages into recognizable language of system and map them to different application modules. The application layer includes database module, web module, book borrowing module and log management module, its database module is used for storing different literature, document information; web module is used for displaying data from the service layer; book borrowing module is used for updating record and status of borrowing books; log management system is used for storing commands, execution process and startup / shutdown information into logs. In the data layer, we convert data of different types of information into data, store into different database based on size of data. The architecture description of information platform is shown in figure 4:
In the information platform, web platform is part of the application layer, adopts ASP.Net language to edit, use Dreamweaver[9] and Bootstrap[10] technology to beautify the page and display the necessary information, we design interface as concisely as possible and it can support different browsers; in order to support multiple applications, we need them to be integrated in a page, and design mapping of data; in order to transform log, instructions, reader access and other kinds of information into data, and do the classification for this data, need to design different kinds of information format, so we can convert conveniently, and keep in the data layer.

In the whole information platform, different data tables are involved. Web platform is the most important sub application of application layer, and amount of access is the largest. Therefore, we need to design related data tables for different users.

Table 1. User Information

| Field Name   | Data Type | Length |
|--------------|-----------|--------|
| UserID       | Int       | 4      |
| Name         | Varchar   | 40     |
| Password     | Varchar   | 40     |
| Sex          | Varchar   | 2      |
| Department   | Varchar   | 40     |
| Email        | Varchar   | 40     |

In table 1, UserID is the primary key of table. name, password, and Department is required for input, gender options can only input male or female, email description must be consistent with the description of mailbox.

Table 2. User Role

| Field Name | Data Type | Length |
|------------|-----------|--------|
| RoleID     | Int       | 4      |
| Role       | Varchar   | 8      |

In table 2, role and role ID is the primary key of table, two parameters are required options, the
same role may have multiple ID, also a ID may represent more than one role, so role and role ID is essential.

### Table 3. Publish Message

| Field Name  | Data Type | Length |
|-------------|-----------|--------|
| NewsID      | Int       | 4      |
| Title       | Varchar   | 40     |
| Body        | Char      | 300    |
| Create Time | Datatime  |        |
| IsShow      | Boolean   |        |
| IsTop       | Boolean   |        |

In table 3, NewsID is the primary key of table, title is set to Varchar type, its length is 40, the length of text cannot exceed 300 characters, data type of creating time is Datatime, and the IsShow field and the IsTop field are set to Boolean type, and that is True/False.

4. System Test of Digital Library

Information platform proposed in this paper is able to realize database connection, in the connection system. It is necessary to compile correspondingly database connection SQL statement in corresponding web, configuration file, and find CS file under its App, Code file, modify database connection configuration. After completing system design and software implementation, we do some tests for web platform module and reader-discuss-community module of digital library.

4.1. User login test under web platform

We input user name and password on the login interface of web platform, enter several user names and passwords randomly, and detect the judge ability of input format legitimacy. The result is shown in table 4.

### Table 4. User Login

| User Name | Password | Output |
|-----------|---------|--------|
| ‘’        | ‘ustf’  | fail   |
| ‘1041’    | ‘ustf’  | fail   |
| ‘10&3’    | ‘’      | fail   |
| ‘rewss’   | ‘11##’  | fail   |
| ‘rewss’   | ‘11 1’  | fail   |
| ‘rewss’   | ‘11#1’  | fail   |

From the output results, we can see that login user name and password symbols need to comply with certain norms, user name cannot contain NULL characters, password cannot contain NULL characters or specific character(‘#’‘$’&’).

4.2. Message Test in the Reader-Discuss-Community

After logging in, we enter reader-discuss-community module, test the function of giving a message,
the function of dragging a message, and the function of checking a message. The result is shown in table 5.

| Operator | Description                                      | Output               |
|----------|--------------------------------------------------|----------------------|
| Publish  | Input a message                                   |                      |
|          | Submit a message                                  | Operation Succeeded  |
|          | Check the message that has been released          |                      |
| Drag     | Choose a message                                  |                      |
|          | Drag the message                                  | Operation Succeeded  |
| Check    | Click links of all message                        |                      |
|          | Access all message pages                          | Operation Succeeded  |

From the result of module operation, they are normal to operate for readers to give a message, or drag a message check a message in the reader-discuss-community module. Since the system has been launched, many readers have published a lot of messages in different times, and they welcome academic and educational resources provided by this web site.

5. Conclusion
Continuous development of computer technology has promoted transformation of library management into digitalization. Both students and teachers can query, download and subscribe to information resources at any time. We consider that most books and information management systems have insufficient web services, weak statistical functions, and lack of characteristic of resource system, and it is difficult to meet the need of readers. This paper proposes a set of digital library information management system based on B/S architecture and ASP.NET language. We have designed the architecture of system and do the example analysis of its web platform module and database module. After completing system design and software implementation, we have tested several main modules of this system, and the results prove that it is effective.

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7. Reference
[1] Al Fadhli, M.S. and Johnson, I.M. “Electronic document delivery in academic and research organization in the Gulf States: a case study of Kuwait”, *Information Development*, Vol. 22 No. 1, pp. 32-47, 2006.
[2] Deng Lijun, W. Yang. “Platform Function Analysis Based on Mobile Library Development Influencing Factors.”, *Information & Documentation Services*, Vol. 35 No. 2, pp. 95-98, 2014.
[3] Adeleke, A.A. and Olorunsola. R. “ICT and library operations: More on the online cataloguing and classification tools and techniques in Nigerian libraries.”, *The Electronic Library*, Vol. 28 No. 3, pp: 453-462, 2010.
[4] T. S. Sidhu, Yujie Yin, “Modelling and Simulation for Performance Evaluation of IEC61850-Based Substation Communication Systems”, *IEEE Transaction on Power Delivery*, Vol. 22 No. 3, pp: 1482-1489, July 2007.
[5] Shuang K, Shan X, Sheng Z, et al, “An Efficient ZigBee-WebSocket Based M2M Environmental Monitoring System[C],” in Proc. IEEE International Conference on Dependable, Autonomic and Secure Computing. IEEE Computer Society., 2014, pp: 322-326.

[6] Chang I, Tiao G. C., Chen C. “Estimation of time series parameters in the presence of outliers.”, Technometrics, Vol. 76 No. 2, pp: 193-204, 1989.

[7] T. Y. Chen, F. C. Kuo, R. G. Merkel, and T. H. Tse. “Adaptive random testing: The ART of test case diversity.”, Journal of Systems and Software, Vol. 83 No. 1, pp: 60-66, 2010.

[8] Florian Funke, Alfons Kemper, Thomas Neumann, “HyPersOnic Combined Transaction and Query Processing.”, PVLDB, Vol. 4 No. 12, pp: 1367-1370, 2011.

[9] Carlson, Dustin A, Ravi, Karthik, Kahrilas, Peter J, Gyawali, C Prakash, Bredenoord, Arjan J, Castell, Donald O, Spechler, Stuart J, Halland, Magnus, Kanuri, Navya, Katzka, David A, Leggett, Cadman L, Roman, Sabine, Saenz, Jose B, Sayuk, Gregory S, Wong, Alan C, Yadlapati, Rena, Ciolino, Jody D, Fox, Mark R, Pandolfino, John E. “Diagnosis of Esophageal Motility Disorders: Esophageal Pressure Topography vs. Conventional Line Tracing.” Gastroenterology, Vol 110 No 7, pp: 967-967, 2015.

[10] Etienne Liais, Guillaume Croville, Jérôme Mariette, Maxence Delverdier, Marie-Noëlle Lucas, Christophe Klopp, Jérôme Lluch, Cécile Donnadieu, James S. Guy, Léni Corrand, Mariette F. Ducatez and Jean-Luc Guérin, “Novel Avian Coronavirus and Fulminating Disease in Guinea Fowl, France.”, Emerging Infectious Diseases, Vol 20 No 1, pp: 105-108, 2014.