Research on the Analysis and Design of General Test Database Management System

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Abstract

In order to help teachers to free from the traditional artificial exam management method, and to improve the efficiency and the quality of teaching, this paper researched the analysis and design of the general test questions database management system. Introduced the research background, analyzed the functional requirements of the system by using object-oriented method and UML (Unified Modeling Language) modeling technology, designed the system’s architecture structure and the logical relationship of database, and discussed the key technologies involved in the system. Design results show that the system is general and open, it is easy to seamlessly expand its content and function, and the system can support the separation of teaching and examination for many courses, can avoid the waste of resources caused by repeatedly construction. The system design has high flexibility, maintainability, portability, and availability. The research has important practical significance and application value in deepening the reform of teaching exam and promoting the application of information technology in the education field.

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keywords: management system; general test database; requirement analysis; system design

1. Introduction

Examination is an important link to ensure the quality of teaching in traditional teaching activities. At present, many universities are advocating the separation of teaching and examination. The separation is the effective means to improve the quality of teaching. The construction of test database is the premise and foundation of the separation. The establishment and application of the test database can reduce the
burden of teachers, evaluate the teachers' teaching effect fairly and objectively, and can facilitate test questions management and maintenance as well[1]. The traditional manual test management method, not only low productivity and too much repeated labor, but also too difficulty to guarantee the quality of the proposition, so urgently need to have scientific, convenient and perfectly computer test management system as the effective tool to accumulate test questions, to generate test paper automatic, and to save test paper and to analyze examination paper etc [2].

2. requirements analysis

2.1. System target

To meet the actual test subjects need, for the system's main research targets put forward the following requirements:

In practical aspect, general examination management system can be easily used in all kinds of different course exam, meet the demand of teaching-examination separation, at a predetermined environment can correctly complete anticipate function. In available aspect, the system should have clearly structure which can directly reflect questions’ demands, easy to understand and operation, run quickly, and interface well. In flexibility aspect, the system should be modified and improved easily, its expandability is strong, convenient to maintain, controllable strong [3].

2.2. Functional requirement

In the guidance of object oriented software engineering idea and UML(Unified Modeling Language) modeling technology[4], combing with teaching actual demand, here around the implement of the target of the system analyzes the system’s main functional requirements. There are three kinds of main users in the system. They are students, teachers and administrators. Each kind of users plays a different role in the examination, so their function requirements are different.

(1) The functional requirements of the teachers’ platform

The main affairs of teachers are questions management, test paper management and test paper review. In test questions management module, teacher can manage the corresponding subjects code, the test questions difficulty levels, questions type, questions score, knowledge code, and the connection of knowledge and test questions etc. In test paper management module, teacher can manage papers’ information, include examination paper analysis, generation, editor, save and the answer extraction; can set various formats print examination paper according to different template. In test paper review module, mainly review students’ online exam results.

(2) The functional requirements of the students’ platform

Students' test can be divided into two forms: One is when do not have online examination conditions, according to template, test papers are generated by teacher in the teachers' platform, after papers are distributed to students, students participate in the closed-book examination; Another case is when have the online test condition, the students can attend online examination, the online exam questions papers are export by administrator, students in the allotted time log in and acquire verification to take an examination, , exam results are save to the database server for teachers to review. No matter which kinds of form of exam, final result have been submitted to the database server, students can inquire their achievement.

(3) The functional requirements of the administrators’ platform

Administrators can undertake course management, all kinds of users management, Account and authority distribution, and system maintenance operation. In order to improve the safety of the test
system, the system doesn't provide registered function, the question database maintenance authority for each course, only be appointed by the administrator to several teaching team members that teach this course, students taking exams in advance are also imported to the system database table, all users after login to use their corresponding platform.

![UML Use Case Diagram](image)

Fig. 1. With UML use case diagram representation system’s function model

In addition to the above three types of platform function, the system for all users that have access provide personal information maintenance and password modification functions. Summarize the system’s functional requirement, can conclude the system’s functions model in UML use case diagram is shown in figure 1.

3. System design

3.1. Architectural Design

System architecture can be divided into three kinds of design patterns, they are B/S(browser/server) pattern, C/S(client/server) pattern and B/S combined with C/S pattern. In the system, adopted the B/S combined with C/S pattern, teachers and students’ platform adopted B/S pattern, administrators’ platform adopted C/S pattern. B/S pattern because client just need browser, the workload will not rise sharply with the increase of client, and will not affect the reliability of the system. In the case of client number is not very big, C/S pattern is a mature operation environment, has the very good reliability and confidentiality. Mixed structure pattern can be safe and effective management systems, and can let all users convenient use system; enhance the flexibility of the system management. Improve the processing power of system to ensure that the system is stable operation efficiency and security [5].

3.2. Database design

Following the guiding principles of database design, according to above function analysis, designed the relationship between the correlation database tables which is shown in figure 2. Among them, the key table is the test questions table which stored the test related attributes information. In SQL server, its physical structure is shown in table 1.
Fig. 2. The database relation model of the system

Table 1. The physical structure of the table of test questions

<table>
<thead>
<tr>
<th>Column name</th>
<th>Data type</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>question ID</td>
<td>int</td>
<td>4</td>
</tr>
<tr>
<td>subject code</td>
<td>int</td>
<td>4</td>
</tr>
<tr>
<td>course code</td>
<td>int</td>
<td>4</td>
</tr>
<tr>
<td>knowledge code</td>
<td>int</td>
<td>4</td>
</tr>
<tr>
<td>question type code</td>
<td>char</td>
<td>10</td>
</tr>
<tr>
<td>difficulty coefficient</td>
<td>char</td>
<td>10</td>
</tr>
<tr>
<td>content</td>
<td>image</td>
<td>16</td>
</tr>
<tr>
<td>question score</td>
<td>char</td>
<td>10</td>
</tr>
<tr>
<td>call number</td>
<td>int</td>
<td>4</td>
</tr>
<tr>
<td>answer</td>
<td>image</td>
<td>16</td>
</tr>
<tr>
<td>investigation level</td>
<td>char</td>
<td>10</td>
</tr>
<tr>
<td>use time</td>
<td>datetime</td>
<td>8</td>
</tr>
</tbody>
</table>

In table 1, subject code field and course code field are designed for system function expansion, content field and answer questions field are set to image types, in order to be conveniently stored in the database as binary form, ensured the safety of the test questions, and to prevent the questions from the database leakage. The test questions associating with knowledge directly, but not associating with teaching books, can break through the limitation of the teaching material, and expand the test data sources.

4. Key problem analysis

Key techniques by using a computer to realize the test questions database management mainly involved in the system database access, test question editor design and the test paper generation algorithm. (1) Database access
Because system adopts visual studio integrated development environment, so the database access can use ADO.NET (access data object) technique. It is the solution scheme for Microsoft to data access in .NET; it is also the core service for .NET development system.

(2) Test question editor design

In order to convenient manage all kinds of courses’ test questions, the system should provide an online editor to support text, digital, formula, images and other multimedia data. It is proposed to use OLE (Object Linking and Embedding) embedded Word document technology in the system, the technical route’s obvious advantage is able to make full use of the Word document editor to edit test questions, no need to develop additional questions editor, as long as document can be edited by the Word, it can as a complete test question to store in the database.

(3) Test paper generation algorithm

The core of the test questions management system is to have a good test paper generation algorithm. At present, there are four ways, including artificial method, random selection method, back in method and genetic algorithm. The former three methods have the defects of slow speed, quality low, and success rate low, but genetic algorithm has the characteristics of parallelism, commonality, global optimization, robustness, operation and simplicity etc [6]. With genetic algorithm is presented to solve the problem has good effect, so in this system using the genetic algorithm to generate test papers.

5. Conclusions

Using object oriented software engineering idea and UML modeling technology, combing with teaching actual demand, analyzed the main function of the system requirement, designed the system software system structure and database relation model; established system function model that based on UML use case diagram, given UML class diagram to represent database concepts model, and discussed the key technologies involved in the system. The system combining test questions with knowledge points effectively, broke the limits of the teaching materials, expanded the system’s data sources. By using the rich resources, safe test resources management mechanism, scientific test paper generation algorithm, ensured the objectivity of exam. The system has the actual operational technology solution scheme, which is convenient to extend the scope of application. The research of the general test database management system provided a new idea for the teaching reform exam. The research results contributed to the deepening of the reform of teaching.

References


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