Design and Research of Digital Painting Online Learning and Communication System Based on Visual Semantics

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Abstract. This paper mainly describes the design and implementation of digital painting online learning and communication system. Based on the research results of publishing and matching mechanism of visual services and the needs of service resource management, this paper designs a publishing and matching model of visual services, and implements a prototype system by using technology, which enables users to conveniently publish, query, manage and share visual service resources, and the prototype system has good scalability and is easy to upgrade. And the overall operation flow of the system and the data flow diagram of the three user function modules, i.e. administrator, teacher and student, are designed in detail. Finally, each information data table of the background database of the digital digital painting online learning and communication system is designed.

Keywords: Visualization; Digital painting; Online learning; system design

1. Introduction
With the development of pedagogy, autonomous learning has become a modern educational method. The focus of college education is no longer "teaching-centered", but gradually becomes "learning-centered". Teachers do not have to carry out "paternalistic" teaching [1]. Teachers are only counselors to help students, while schools only build platforms, and students become the main body of the teaching process. Many paintings can reflect the creators' understanding of traditional culture and the spirit of the times, and their unique feelings of natural phenomena. In this learning process, the means of information dissemination will turn to interactive system more, and realize its dynamic and fast way of information exchange and transmission, so that students can discuss with other students and ask teachers for advice in time when they have questions and problems they can't solve in the learning process. The rapid development and wide application of computer network technology and artificial intelligence have a positive and far-reaching impact on all aspects of modern education and teaching management [2-3]. There are great changes in the way of professional study and assessment.

In recent years, computers as an important means of classroom teaching have already been accepted by people. It can be seen that computers are generally installed on teachers' platforms in domestic universities and even primary and secondary schools for teachers to use when giving lectures [4]. As an application of service matching in visualization field, visual service matching not only has the commonness of general service matching, but also has the distinct personality of visualization technology itself. According to the characteristics of information in the wide-area resource distribution
environment and the above requirements, this paper designs an integrated information description model based on semantics, and implements a visual information description tool SUDTI based on this model. The system can greatly save manpower, material resources and financial resources, reduce the workload of teachers, and make the examination more scientific, systematic, automatic, fair and equitable.

2. Analysis on the overall demand of digital painting online learning and communication system
The process of digital painting online learning and communication system is complex, involving a large number of people, but it needs to simplify its operation as much as possible, so it needs to carry out strict demand analysis, divide its functions, and make clear the functions of each part and its concrete realization possibility. Includes meta-information such as serial number, name, type, physical location, description of information source content, importance level, creation record, usage record, etc. After processing by the business logic of the server, the server can never actively update the client. Services define a set of operations that can be accessed through standardized messaging on the network as software interfaces of services [5-6]. Moreover, the protocols used by services are usually development standards, such as and.

Semantic search is a technology that uses more structured query statements to search and query semantic data, so as to provide more accurate and close search results to users' needs. Different information classes can have the same attribute name, and attributes with the same name in different information classes can have different types. Teachers can add information in specific databases according to their own teaching process, and can also participate in discussion in forums. The function of students is to enter the system and browse the page information related to the selected course and communicate with teachers in the forum according to the teacher's guidance. It can make full use of HTML codes sent from the server to the browser to generate controls, and at the same time, the server maintains and manages the controls uniformly, thus realizing the automatic and unified management of the server-side controls.

3. Functional analysis and design

3.1. Development tools
This digital painting online learning and communication system is an important component module in the network learning platform of the computing center. In order to facilitate the maintenance and improve the scalability of the system, this system has chosen the Browser/Server (B/S) three-tier architecture mode. At this time, SQL Server 2000 manages each server separately, and the server complex, that is, multiple servers in the same group, share a larger database processing load. Run in that WEB server, it receive the user's request from the customer lay, and transmits the service required by the user to the business logic layer for corresponding analysis and processing. The third layer is the database server layer, which mainly stores various data of the system, and exchanges and queries data with the business logic layer through certain instructions [7].

SUDTI description model expands the management metadata of information classes and their attributes to facilitate further information processing. When there is updated content, the server actively pushes it to the client. This method can obtain lower delay. There are two common solutions, one is to store multimedia information such as pictures in the form of a file on an external storage device, and then the storage path is called data storage, and the file can be called under the operating system by retrieving the path. Therefore, Microsoft SQL Server 2000 is selected as the platform for database design and implementation in the digital painting online learning and communication system of this subject.

3.2. Overall system design
The online learning and communication system of digital painting is analyzed and designed. The system is mainly divided into login management function module, user management module, course
management module, notification management module, oil painting masterpiece management module, photographic works management module, teacher works management module, works picture display page and interactive forum between teachers and students. Administrators and teachers enter the corresponding management modules after registering and logging into the system, and realize the management of information rights, examination questions, examination papers, grades and announcement information. The relationship between information classes and attributes is also an important kind of relationship, which is called attribute relationship [8]. Meta-information describing a relationship includes the name, location, existence type, constraints, etc. It provides a shareable framework, which uses a series of basic attributes and classes to describe services, so that services become objects understandable by machines, and then realize automatic discovery, interoperability, invocation, composition and execution of services.

Students enter the corresponding learning test module after registering and logging in on the homepage of the system, and realize corresponding operations such as changing passwords, browsing news announcements, taking online tests, inquiring scores, and learning independently online. The front page design of the system includes four functional areas: login, registration, password retrieval and news announcement. The overall module design of the system is shown in Figure 1.

**Figure 1** Schematic diagram of relationship among functional modules of the system

**Figure 2** Use case diagram of basic data management function of administrator

3.2.1 **Administrator.** The duties of the administrator role are divided into two parts. One is the management of the basic data of the system, including teacher user management, student user management, curriculum management and notification management, and also includes oil painting masterpiece management module, photography work management module and teacher work management module. There is also a forum management, including section management, theme management and post management. Relationship is used to describe the semantic connection between
information classes. Information objects are examples of information classes, and the relationship between information classes represents the relationship between information objects. Administrators can make relevant settings for fine arts majors, including professional addition, deletion and modification. Administrative area for announcement and release. Administrators can add, delete or update information such as system news or teaching notice. The main functional design of the administrator module is shown in Figure 2.

3.2.2 Teacher function module. According to the analysis of teachers’ needs, the functions that the examination system should provide to teachers after they log in through the authority authentication on the homepage of the system are: question bank management, examination paper management, examination management and score management. When the program is executed, the server only returns the execution result to the client browser, which is no longer restricted by the client browser type, and can also reduce the burden of the client browser and greatly improve the interaction speed. The amount of information expressed by an ontology is limited. When there are more nodes in a subtree, the amount of information carried by each node will decrease. The database management function of the teacher's works management module sets the database of the works you need, and uploads these data to the database manager to generate the corresponding display page. In addition, teachers can also participate in the discussion in the forum. The specific functions of teachers are shown in the teacher module design drawing in Figure 3.

![Teacher module design drawing](image)

3.2.3 Student function module. The function of students’ role is to browse related art works preset by teachers according to their own selected courses after entering the system. Students can also participate in the discussion in the forum. Graphical modeling symbols of information class relations in SUDTI description model are represented by three relationships: "association, inheritance and aggregation (combination)" in UML class diagram [9]. Service providers can be used to describe the services they provide, and service requesters can be used to describe the services they need. It is mainly used to describe the functional information, non-functional information and some additional feature information of the service.

Any relationship with more than two connected entities can be transformed into a binary set of many-to-one relationships without losing any information. Following the principles of system design stability, security, and friendly interface, and combining with the professional training characteristics of digital art, the detailed data flow design and analysis of each functional module of the system are carried out. If the semantic coincidence degree between two concept nodes is greater and the semantic distance is smaller, then the similarity between concepts is greater [10]. Two groups of different parameters are taken to calculate the conceptual similarity, and the results are compared to observe the influence of each parameter on the semantic similarity. See the use case diagram in Figure 4 for the specific functions of students.
3.3. Detailed design of system module

The similarity between strings of some words is very high, but the semantics of expressions are different, so the similarity of concepts calculated by string matching algorithm will deviate greatly from the actual situation. In this case, the semantic meaning expressed by vocabulary can be used to calculate the similarity value. In connection with database, ASP.NET upgraded ADO in ASP to ADO.NET, and ADO.NET adopted standard XML as data exchange format, so that different systems on the network can also operate with each other. Different users use corresponding accounts and passwords to register and log in. This data is checked and matched with the background database of the system, so as to pass the identity verification. After the identity confirmation is successful, they can enter the corresponding user identity module page and carry out the corresponding operation at the next level. The overall flow chart of the system is shown in Figure 5.

3.3.1 Login management function module. As the administrator of the examination system, the detailed data flow of function realization starts from the identity login confirmation. No matter at any time or place, as long as they can surf the Internet, students can leave their own questions and find the best answers, so that students can achieve the best learning effect. The application support platform is mainly composed of application middleware core service components, which provides the service interface of core business upwards and writes necessary data information downwards; The application layer is mainly composed of business applications, such as anonymous login mode. The system provides users who log in anonymously with permission to browse ontology information, and limits permission for some operations such as modifying ontology library, so as to maintain information.
security. The system flow chart of login function is shown in Figure 6.

![Login function system flow chart](image)

**Figure 6** Login function system flow chart

3.3.2 Read ontology operation. The File option in the menu bar provides users with three functional module operations: reading ontology, calculating ontology concept similarity and creating new ontology. Each functional module supports different shortcut key combinations. The background system of the online learning platform includes the background management system of the digital painting online learning communication system, which is accessed from the teacher entrance of the homepage. On the teacher function page, the system announcement can be viewed first. Unlike the administrator, the teacher cannot modify the news data table information of the announcement information, but can only view it. The permissions of teachers and students are fixed, so there is no need to set user permissions in this function module. And users in the database are generally not deleted, but are usually deleted in batches on a regular basis. As shown in fig. 7.

![Menu bar function](image)

**Figure 7** Menu bar function

3.3.3 User management module. The user management module includes two parts: teacher user management and student user management, and its authority belongs to the administrator. Before using this model to query services, service requesters need to log in with the user name and password registered in this model. When browsing data, users interact with the system, adjust the browsed data sets repeatedly, and understand and learn the knowledge in the data. Secondly, students can choose majors and difficulty of test questions in the autonomous learning module, extract online test questions by accessing the system background test data table, practice independently and carry out personalized learning.

3.3.4 Enter service inquiry information. After service login authentication, the service requester can input some information about the service request in the service query interface, such as service name, service description, service category, merchant information, service processable data model, service publication, service input and output parameter information and service upload. It not only provides cross-platform features such as platform independence, but also provides richer description format and semantics for information exchange. Relatively speaking, the curriculum settings of a college and
major are relatively fixed, so the curriculum information is generally stored once when the system is initialized, and generally no changes are made.

4. Database design

In order to help users understand the entities in search results, the result entities and their related entities are often displayed as a set of results to help users understand the result entities. Among them, the service input and output parameters and the data model that the service can handle are selected and entered based on the drop-down list of ontology, which can well eliminate the heterogeneous problem of service description between service requester and service publisher. Here, by using the push technology of DWR framework and adopting the freely combined question-and-answer mode, the latest content (question or solution) is actively pushed to each user in real time, so as to arouse the enthusiasm of users to learn and communicate as much as possible.

SUDTI provides a separate input interface for each possible data input mode, and these input interfaces can be completely customized to meet different types of data input requirements. According to the functions of the administrator system, a teacher data table is established for the information storage of teachers and administrators. The specific structure of the data table is shown in Table 1. Teacher data table contains the following four fields: Tid stands for teacher number, Tname stands for teacher name, password stands for login password of teacher or administrator, grade stands for teacher grade and authority, a value of 0 indicates that the user is an ordinary teacher, and a value of 1 indicates that the user is an administrator, that is, has administrator authority.

| Listing | data type | Length | Allow null values |
|---------|-----------|--------|-------------------|
| Tid     | char      | 8      | √                 |
| Tname   | char      | 8      | √                 |
| password| char      | 8      | √                 |
| grade   | int       |        | √                 |

In order to improve the operation efficiency of the online learning and communication system of digital painting, Ajax technology is used on the basis of ASP.NET framework to achieve the effects of partial page refresh to obtain the contents of other web pages, asynchronous reading and desktop application mode. Students and teachers are provided with the function of article query, that is, the title information of corresponding articles that meet the query conditions, as well as hyperlinks for viewing detailed contents and replying to article contents are provided. Most of the redundant information is removed, and a non-redundant information description XML database is established, so that the information stored in the background database can fully meet the requirements of later data processing (retrieval/query).

In this paper, according to the needs of registered students, a student information data table Student is established, and the specific structure of the data table is shown in Table 2.

| Listing | data type | Length | Allow null values |
|---------|-----------|--------|-------------------|
| Sid     | char      | 8      | √                 |
| Sname   | char      | 8      | √                 |
| Password| char      | 8      | √                 |
| Class   | char      | 8      | √                 |
| Tel     | char      | 8      | √                 |
| mail    | char      | 8      | √                 |

This data table contains the following five fields: Sid stands for registered student ID, Sname stands for student name, class stands for student class, tel stands for student telephone, and mail stands for student email.
5. Conclusions
The online learning and communication system of digital painting is mainly realized by ASP.NET technology. Based on the specific field of teaching resources information, according to the actual situation and referring to English dictionaries and other tools, the information is classified and summarized, and the related ontology is constructed; Online grouping can be performed after setting the basic conditions of the test paper. At the same time, the system realized the test paper management module of automatic test paper generation, online test paper modification, test paper saving and extraction. The prototype system is realized by technology. The prototype system enables users to conveniently publish, query, manage and share visual service resources. At the same time, the prototype system has good scalability and is convenient for upgrading the prototype system. For applications under different architectures, with the increasing number of Internet users, the application requirements of high performance, multi-concurrency, low latency and fast response, how to push content from the server to the client in real time needs further improvement and research.

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