Establishment and Application of Chinese Painting Mineral Pigment Color Database Based on Web Technology

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Abstract. Based on Web technology, SSM architecture and MySQL database, the database platform of Chinese painting mineral pigment color can be built. Through the powerful data information organization, storage and sorting functions of database technology, the digital construction of Chinese painting mineral pigment color resources is realized, and efforts are made to solve the protection and inheritance problems of current mineral pigment color usage methods and preparation techniques. Relying on the currently developed network information technology and data processing technology, the system comprehensively combs and integrates a large number of oral materials, written works, picture examples and other resources, and further improves the knowledge system of Chinese painting mineral pigment colors by means of scientific and systematic organization and management. At the same time, the system also supports the functions of information retrieval, online browsing, data export, etc., which can not only realize online learning and exploration of Chinese painting mineral pigment color knowledge, but also improve the recognition and awareness of Chinese painting mineral pigment color, thus being more conducive to the spread and development of Chinese painting culture.

Keywords: Database Technology · Mineral Pigment Colors · Mysql · Digital

1 Introduction

Color is an important formal element that arouses our aesthetic pleasure in painting. Compared with lines in painting, color is more expressive and infectious. For Chinese painting, the use and treatment of color is very distinctive, showing a style and form quite different from that of western painting. The application of color in Chinese painting originated from the original mural painting, and the source of pigment is directly derived from the soil and minerals in nature. Only through simple grinding can the painting be colored, so the mineral color has been widely spread and used in the history of Chinese painting. Then, with the development and evolution of Chinese painting in different periods, the color of mineral pigments gradually reached the peak of application, and the color selection of paintings was bold and gorgeous, and the development and preparation technology of pigments became more and more perfect. Common mineral pigments are

cinnabar, hematite, limonite, realgar, orpiment, gold, malachite, atacamite, azurite, lapis lazuli, gypsum, kaolin, calcite, aragonite, mica, talc, graphite and so on. The existence and use of mineral color makes Chinese painting show its unique artistic charm and artistic aesthetic interest with oriental color in the world painting system, and glow with oriental color [1].

The unique texture and temperament of mineral pigment color in Chinese painting gives Chinese painting more possibilities and expressiveness. Today, we can still find the different color combinations of mineral pigments and their own particularity from ancient paintings, murals and even porcelain, sculpture and architecture, which have created new texture and color levels [10]. For example, Gu Kaizhi's "Nymph of the Luo River", Han Huang's "Five Oxen", Gu Hongzhong's "The Night Revels of Han Xizai", Wang Ximeng's "A Thousand Li of Rivers and Mountains", Dunhuang Mogao Grottoes mural, Maijishan Grottoes Thousand Buddhas Gallery and so on. Although these works are a long time ago, their color still does not fade, their color is stable and not easy to change color, and they also have special luster, which is not as good as other pigments. It can be seen that the production of mineral pigments is a delicate and complicated skill with important inheritance value. However, with the changes of the times, the use scale of many mineral pigment colors began to shrink, the mining amount of mineral pigments was small, the manufacturing process was complicated and some minerals were toxic, which directly accelerated the loss of the use and manufacturing methods of mineral pigment colors. In addition, the appearance of synthetic pigments in a large area under the industrial and chemical technology has caused modern painters to know little about color, and even if handed down, they will lose the purest use techniques. Therefore, this paper holds that building a database platform of Chinese painting mineral pigment color by using contemporary data processing technology and network information technology can complete the networking and digital information resource construction of mineral pigment color use and configuration process, open up new channels for the protection and inheritance of mineral pigment color, provide professional information resources for the current Chinese painting education, and strengthen the protection of Chinese painting, an excellent traditional culture.

2   Related Technical Introduction

2.1   Database Technology

Database technology is a software science that studies, manages and applies databases. Since its birth, it has a close relationship with computer science and technology, network information technology, etc., which promote each other to form a collaborative work mode and build a management information system (MIS) suitable for various industries and fields. As a core technology of management information system, database technology solves the problem of organizing and storing a large amount of data information in current production, work and study by studying the basic theory and implementation methods of database structure, storage, design, management and application, and realizes the functions of reducing data storage redundancy, data sharing, ensuring data security, retrieving data and processing data.
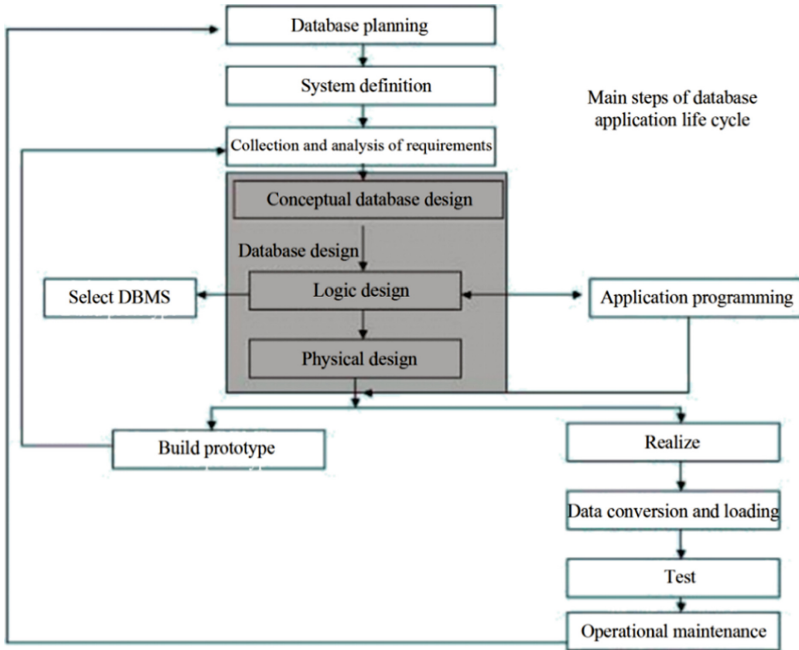
Fig. 1. Database design flow chart

The application and development of database technology can be divided into six stages, namely, requirement analysis, conceptual structure design, logical structure design, physical structure design, database implementation, database operation and maintenance, as shown in Fig. 1 [5]. The overall design and development follows the principle of user priority, that is, it emphasizes the foundation and importance of user demand analysis. SA (Structured Analysis) structured method is commonly used as the method of user demand analysis. SA method starts with the top system organization structure and analyzes the system in a top-down and layer-by-layer way [2]. After the requirement analysis, the conceptual structure design stage will comprehensively synthesize and highly abstract the user requirements to form an independent and concrete conceptual model, and provide necessary support for the subsequent logical structure and physical design. Logic design mainly relies on the important tool E-R diagram to complete the conversion and optimization of conceptual structure and determine the attributes and codes of relational schema. In the physical structure design stage, the logical structure model will complete the setting of physical structure, such as data storage structure and data access method, to meet the requirements of database implementation stage.

2.2 Web Technology

Web is an Internet service that can access server-side resources by inputting URL from client browser. The whole process relies on the HTTP protocol to complete the communication and transmission between the client and the Web server. With the continuous
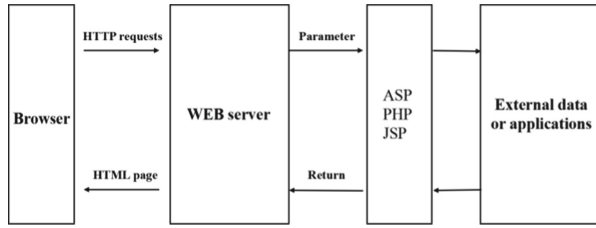
Fig. 2. Web server technical architecture diagram

innovation and development of technology, a single static Web service cannot meet the ever-changing needs of users. The Web server needs to call external Web applications through interfaces to realize the expansion of functions. The Web applications include multiple static Web resources and dynamic Web resources, such as Html, Css, Js files, Jsp files, Java programs, support Jar packages, configuration files [8].

Web technology is a collection of technologies used to develop Web applications based on the Internet environment. Web technology can be divided into client technology and server technology. Among them, the Web client design technology mainly includes: HTML language, Java Applets, script program, CSS, plug-in technology and VRML technology. Web server technology mainly includes server, CGI, PHP, ASP.NET and JSP technology, as shown in Fig. 2. Through the combination of Web client technology and server technology, and with various application architectures of Web server, the division, decoupling and splitting of users' requirements are realized, which makes the function of Web more and more powerful, and can be applied to the design and development of most application systems.

2.3 SSM Architecture

SSM (Spring + SpringMVC + MyBatis) framework set is the integration of Spring, Spring Mvc, and Mybatis framework, which belongs to the standard MVC pattern. Among them, Spring framework realizes the control and management of business objects, Spring Mvc framework is responsible for the forwarding of requests and the management of views, and Mybatis framework solves the persistence of data objects [4].

Under the standard SSM framework, Web servers are divided into different levels, namely DAO layer, Service layer, Controller layer and View layer. Among them, the DAO layer is the persistence layer, which completes the encapsulation of the database contact task and supports the Web server to handle the data business. Among them, because of the high coupling degree, the Controller and View layers need to be developed together, but they can also be developed independently of the first two layers as a whole. Figure 3 shows the working principle of SSM framework. Using SSM framework can simplify the whole system process and realize the agile development of the system with its good reusability.
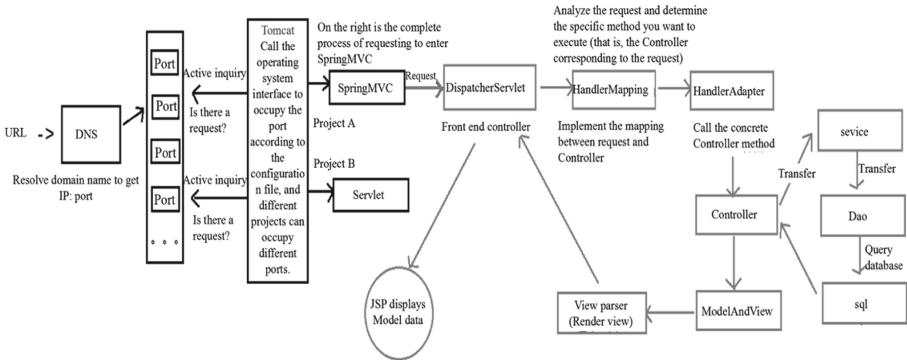
Fig. 3. Schematic diagram of SSM architecture working principle

2.4 Development Environment

According to the system development requirements and the use requirements of the above key technologies, the configuration and deployment of the development environment can be completed. The overall development of the system is based on Windows 10.0 operating system, the basic development environment is Java, JDK version 1.8 and above, Eclipse Version: 2020-03 (4.15.0) is selected for Java editor, Tomcat 8.5 is selected for Web server, and MySQL 5.7 is used for database server. In the process of building the overall development environment, the template engine developed by the Web server is JSP, and the integration of Spring-Spring MVC-MyBatis is completed based on SSM architecture. In the development of Web client, JQuery and H-ui are selected as the main framework, and HTML, CSS and JavaScript are used as the basic framework to complete the design and development of dynamic pages.

In the process of building the development environment, firstly, the installation and configuration of Tomcat and JDK are completed, and then a new Maven project is built under Eclipse and the matching with Tomca server is completed. Introduce Jar packages such as Spring core package, Mybatis core package, Spring-Mybatis integration package, Mysql connection package, Json parsing package and so on under Maven to complete the SSM framework, as shown in Fig. 4. After the above settings are completed, deploy the configuration file to the project, that is, the overall development environment is completed.

Through the brief introduction of the above key technology theories, we have determined the overall environment of system development, the configuration of related software and tools, and the technical feasibility of the overall project of Chinese painting mineral pigment color database platform based on Web technology.
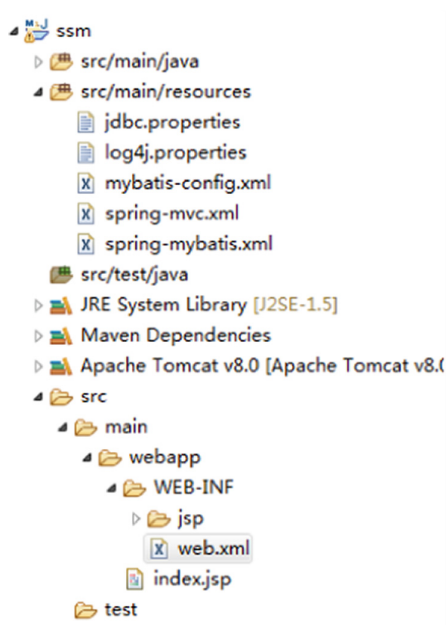
Fig. 4. Project creation completion directory

3   Requirement Analysis

3.1   Functional Requirement Analysis

The MySQL-based Chinese painting mineral pigment color database platform can support the setting of two different roles of system administrator and ordinary users. It focuses on forming digital information resources of related attributes, brief introduction, representative works and preparation methods of Chinese painting mineral pigment colors, and at the same time, combining the color proportioning modulation, pigment and ink skills and the education and teaching of Chinese painting techniques to form a perfect knowledge system of Chinese painting mineral pigment colors. Thereby forming a comprehensive application platform integrating protection, dissemination, research, teaching and other functions.

For ordinary users, users can search the data in the Chinese painting mineral pigment color database platform according to their own needs, see relevant data in time, and support online browsing and data export functions, which not only greatly reduces the time for users to search a large amount of data, but also supports comprehensive display

in the form of pictures, videos, audio, etc., so that ordinary users can truly feel the unique beauty of Chinese painting mineral pigment colors from different angles, and also perceive the rich artistic style and powerful art of Chinese painting from the side. For the administrator side, the administrator's main job is to continuously build and supplement the resources of the database platform. At the same time, it also takes into account the data audit of ordinary users, the update and maintenance of database data, and the timely overhaul and maintenance of the system to ensure its smooth and smooth operation.

3.2   Global Design

In view of the functional requirements of Chinese painting mineral pigment color database platform, combined with the application and configuration of related technologies mentioned above, the overall design of the system is completed. The whole system design takes Web technology as the core, and uses B/S architecture to divide the whole system into three parts: application layer, business control layer and data service layer. As shown in Fig. 5, the overall operation flow chart of the system is shown. Users log in through the Web client and send requests to the Web server on the application layer (View layer) interactive interface. The controller layer accepts user requests and parameters and carries out corresponding process processing. The service layer controls the specific business logic, the DAO layer realizes the specific operation of data information in the database, and the MySQL database provides storage for the data resources of the whole system to support the operation of the system. Under the application of SSM framework, the front end pays attention to the interface presentation, while the back end pays attention to the business logic, with a clear division of labor and clear responsibilities, and finally the system runs concisely and efficiently.
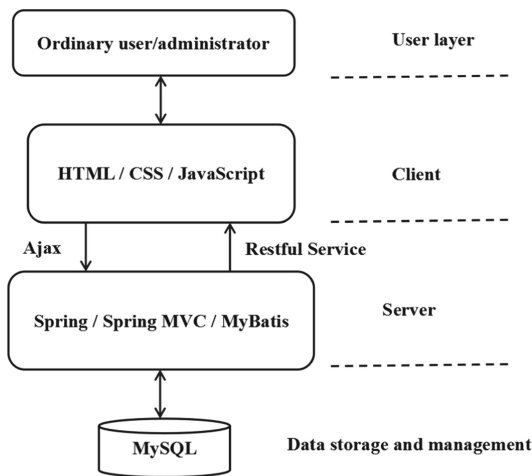

Fig. 5. Overall operation flow chart of the system

4 Function Realization

4.1 Global Design

4.1.1 Data Modeling

According to the demand analysis of Chinese painting mineral pigment color database platform, it is necessary to model the data of the database. The process of data modeling is to organize all kinds of data abstractly, determine the scope of the database to govern, the organization form of data and so on until it is transformed into a real database [6]. That is, through conceptual structure design, logical structure design and physical structure design, the database can be implemented. At present, the common method is to use the conceptual model of E-R diagram to explicitly complete the conceptual model of database system with three basic components: entity, relation and attribute. After the conceptual model design is completed, the corresponding data table will be established in MySQL in combination with the functional modules of the system, that is, the logical structure design will be completed. In the Chinese painting mineral pigment color database platform, there are 3 main tables and 15 slave tables.

The first main table is the mineral pigment table, that is, the mineral pigment information table, which is used to store the basic information of mineral pigments. The specific content is shown in Table 1.

The second main table is the colour table, that is, the mineral pigment color information table, which is used to store the basic information of mineral pigment color. The specific content is shown in Table 2.

Table 1. Structure of the mineral pigment information table

Field name	Field type	Allow null value	Remarks
Id	Int	N	Number
Name	Varchar	N	Name
Colour_System	Varchar	N	Colour system
Colour	Varchar	N	Colour
File_Picture	Varchar	N	Master drawing
Element	Varchar	N	Ingredient
Origin	Varchar	N	Place of production
Form	Varchar	N	Form
Manufacturing	Varchar	N	Manufacture craft
Age	Int	N	Time of appearance
Meaning	Varchar	N	Meaning
Representative	Varchar	N	Representative work
Toxicity	Varchar	N	Toxicity

Table 2. Structure of the mineral pigment color information table

Field name	Field type	Allow null value	Remarks
Id	Int	N	Number
Name	Varchar	N	Name
Colour_System	Varchar	N	Colour system
File_Picture	Varchar	N	Master drawing
Mix Proportion	Varchar	N	Combination ratio
Mixing	Varchar	N	Modulation process
Representative	Varchar	N	Representative work

Table 3. Structure of user information table

Field name	Field type	Allow null value	Remarks
Id	Int	N	Number
Login	Varchar	N	Account number
Password	Varchar	N	Password
State	Varchar	N	State
Authority	Varchar	N	Authority

The third main table is the user information table, which is used to store the user's account number, password and other information. The specific content is shown in Table 3.

In addition, under the platform of China Painting Mineral Pigment Color Database, the administrator also needs to set other subsidiary slave tables such as picture table, video table, audio table, etc., to support the data association of the main table, and also provide support for the retrieval function of ordinary users.

4.1.2   Data Management

On the administrator side, the data management module is the backbone of the database background, which mainly includes adding, modifying and deleting data information. Administrators can enter the detailed design information interface of database structure, modify data, add data to add data, check the name corresponding to mineral pigment color, and delete data. Before deleting, the system will automatically jump out of the prompt box to confirm whether it is necessary to delete again, so as to prevent data information from being deleted by mistake [3].

4.2 Ordinary User Side

On the ordinary user side, ordinary users need to register their accounts and log in for the first time. Each user has a unique account number and password as an identifier. In the subsequent log-in, the system will automatically compare the account number and password entered by the user with the user information table in the database, and the user can log in successfully after checking them correctly. On the front page of the system, there will be news related to Chinese painting, exhibition consultation, exhibition of paintings and calligraphy works, introduction of famous artists and other sections, which will not only facilitate ordinary users to obtain information resources of Chinese painting major, but also help to inherit and popularize traditional Chinese mineral pigment color making skills, and promote the spread and development of Chinese painting culture [7].

4.2.1 Information Retrieval

Under the platform of Chinese painting mineral pigment color database, the system provides accurate retrieval and fuzzy retrieval. Accurate retrieval is conditional retrieval, that is, ordinary users can limit the attributes of mineral pigments to retrieve relevant data information that meets the conditions. For example, "color system" is limited to "blue system", "toxicity" is selected as "non-toxic" and "age" is limited to "Tang Dynasty". Then the final search result is azurite, which is composed of alkaline copper carbonate, with columnar or thick crystals and mineral chemical formula. The corresponding colors are divided into first green, second green, third green, which are produced in Hubei Province. Wang Ximeng's "A Thousand Li of Rivers and Mountains" is the representative work. In the "A Thousand Li of Rivers and Mountains", the painter used mineral pigments such as azurite and malachite, highlighting the rich decorative effect of mineral stone colors [9].

Accurate retrieval design can make users more clear about current retrieval conditions and improve retrieval efficiency. However, when users are not clear about the information of the retrieval purpose, they can only carry out fuzzy retrieval based on key fields, and select the retrieval information that meets their own needs from numerous retrieval results.

4.2.2 Online Browsing

When ordinary users complete information retrieval, users can browse the corresponding data information in detail, including detailed introduction of various attribute information of mineral pigments and full-screen display of representative works, and support enlarged browsing of pictures. In addition, the detailed introduction of the retrieval information also includes some video or audio materials, which is convenient for users to perceive the historical evolution, manufacturing techniques and existing situation of mineral pigments from multiple angles.

4.2.3 Data Export

When the user needs to export the data information of the desired mineral pigment color, the data information can be exported through the "data export" button. The information

export supports various file formats such as Word, Excel, PDF, PNG, MP3 and FLV, which is convenient for the user's various needs. In addition, users can click "collection" in the upper left corner of the interface to collect the retrieved information. After clicking, the "collection" button will automatically change to "cancel collection" and click again to cancel.

5   Conclusions

Based on MySQL database and Web technology, the database platform of Chinese painting mineral pigment color is built. With the help of network information technology and database development technology, the Chinese painting mineral pigment color is digitized, virtualized and networked, and the scientific information organization and management of data materials are completed, so as to accurately reflect the history, present situation and development trend of Chinese painting mineral pigment color. While realizing authenticity protection, it also provides necessary information for the inheritance, innovation, development and research of mineral pigment color making technology. At the same time, it also provides a new way and path for the dissemination, education and protection of Chinese painting, an excellent traditional culture.

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