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The improvement of museum information flow based on paste functional mapping method

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Abstract

As a subsidiary institution of collecting and preserving cultural relics, human cultural heritages and developing information resources, museums are important places to display, disseminate and study excellent national cultures. With the development of the economy and the improvement of people's living standards, people's demand for spiritual culture is getting higher and higher, and museums are getting more and more attention from people. Thanks to the rapid development of computer technology, more and more museums are focusing on informatisation. This article will use the information system's functional mapping method based on the museum's improvement and test analysis, which can make the museum's business unit with the use of the unified system platform, under a unified, homogeneous standard data for the orderly organisation of information resources sharing and efficient, rapid building of information resources of lateral connection, make the administrative, business interaction and interrelated information collection with Word Perfect data integration, and create a museum management platform more conducive to innovative thinking. The innovation system mechanism, to improve the way of ZhanChen for the museum, to speed up the informatisation construction museum, make a museum of play to better spread knowledge, transfer civilisation, materialisation of education function and the important window displaying the world the outstanding civilisation achievement effect, and promote the development of cultural undertakings, where science has a very important realistic and far-reaching historical significance.

Keywords: museum, informatization, information technology, functional mapping, the system test.**AMS 2010 codes:** 62M20

1 Introduction

Nowadays, every corner of our life has been permeated with information; information technology has enriched our lives, and with the help of the network we can get the required information in a short time. At present, museums and memorial halls all over the country are also advancing with times and attach importance to their own information construction. The new situation of information construction has emerged in the cultural and

museum circle and has become a major role in the construction of museums [1]. However, many museums in China still have various problems in the process of digital construction, which need to be further explored.

As an extension of traditional museum management methods, museum information management plays an important role in the museum operation system. However, in the process of development and construction of museum informatisation management in China, due to the lack of a unified and effective system of guiding design methods and the particularity of museum operation and management, the informatisation construction of museums in China presents a situation of separation, independent governance and low degree of interconnection of information projects [2, 3]. This separate ‘information island’ mode of museum information management system has hindered the construction and development of museum information resource systems from the perspective of administrative management, business interaction and information resource sharing. Therefore, it is of great practical significance to use the functional mapping method to improve the comprehensive management of museum informatisation.

2 Museum informatisation

2.1 Needs for museum informatisation

(1) Collection custody. Collection management of the museum has been a core issue since its establishment. The common approach is to establish a set of the information management process, including computer network system, collection management information system and the corresponding management system. At present, the application of a collection management system is the most basic standard to measure the degree of museum informatization. The application of a collection management system has an important influence on reducing the difficulty of storage and improving the security of storage [4].

(2) Academic research, exhibition and public services. Previous academic research and exhibitions were usually based on the collections or exhibits themselves, without the use of information equipment or technical means. Information technology represented by the Internet has changed this situation. It can be seen that from the mobile Internet application in exhibitions to various websites, the information release and public interaction of social media all reflect the progress of museum staff in the information age [5].

(3) Operation management. The operation and management of the museum is the best link of information application at present. Relying on the national informatisation development strategy, the application of information technology in the basic office infrastructure, finance and other aspects is more advanced. In China, comprehensive management services such as the digital office of museums have generally realised informatisation, and the management efficiency has been improved through informatisation means. In addition, the basic network environment is basically the same as the social average level of hardware and software conditions. And the office automation system, data information centre and so on are gradually being established in various museums.

2.2 Status quo of museum informatisation

(1) Construction of information resources has begun to take shape

At present, China’s museum document information resource database has been initially built. The information is collected in an all-around and multi-form manner, stored in a standardised way, and scientifically reprocessed to form a variety of data in different formats, including text, graphics, images, video, audio, three-dimensional models and so on.

(2) Digital display methods are constantly enriched

Almost all the exhibits in early museums were static ones, and the exhibits’ explanatory signs could not carry more historical background information. With the development of multimedia technology and digital technology, museum exhibition has been revolutionised and is no longer limited to a single physical exhibition form in the museum. Many large museums have also introduced various digital technologies earlier, and started the exhibition display mode of scene, motion and interactive so that the audience can have a comprehensive un-

derstanding of the exhibits, generate a sense of intimacy, arouse the curiosity and interest of the audience, and attract their attention to the museum [6, 7].

(3) Information technology cooperation has deepened

The cooperation between information technology and museums is mainly reflected in the following aspects: First, to accelerate the construction of information network and comprehensively support the information construction of cultural and museum systems; Second, speed up the use of video, 3D, VR, AR digital means, continue to promote the information construction of museums, in-depth excavation of the value of cultural relics, to meet the needs of people's cultural life; Third, to speed up the construction of an ecological system, operators give full play to the advantages of user resources, intellectual property rights and operation capacity, speed up the opening of capacity, and form capacity synergy, resource sharing and advantage superposition with all sectors of cultural relics.

3 Mathematical model construction

3.1 Design and implementation of functional mapping mathematical model

The quadratic programming model of support vector machine (SVM) for fuzzy data location is established by using the singular semi-positive qualitative principle. Assume that the matrix Q is a semi-positive definite matrix, when:

$$\alpha = (\alpha_1, \alpha_2, \dots, \alpha_n) \neq 0 \quad (1)$$

The homogeneous solution of the fuzzy data location SVM model satisfies:

$$\alpha^T Q \alpha = \sum_{i=1}^n \sum_{j=1}^n \alpha_i \alpha_j Q_{ij} \geq 0 \quad (2)$$

Assuming that there are N samples in the information data set S_s , then:

$$Q' = \begin{bmatrix} 0 & y_1 & \dots & y_n \\ y_1 & Q_{11} & \dots & Q_{1n} \\ \vdots & \vdots & \ddots & \vdots \\ y_n & Q_{n1} & \dots & Q_{nn} \end{bmatrix} \stackrel{def}{=} \begin{bmatrix} 0 & y^T \\ y & Q \end{bmatrix} \quad (3)$$

According to the above assumptions, the stable periodic point distribution matrix Q is positive definite, and the inverse matrix Q^{-1} and Q^{-1} of Q are also positive definite matrices. Due to:

$$\begin{bmatrix} 0 & -y^T Q^{-1} \\ 0 & I_n \end{bmatrix} \begin{bmatrix} 0 & y^T \\ y & Q \end{bmatrix} = \begin{bmatrix} -y^T Q^{-1} & 0 \\ y & Q \end{bmatrix} \quad (4)$$

It can be obtained that the fuzzy data location of museum information and the paste point set satisfies:

$$\det(Q') = \det(Q) \cdot (-y^T Q^{-1}) \neq 0 \quad (5)$$

Thus, it can be proved that Q' always exists in an inverse matrix, that is, the fuzzy data location is convergent. By extracting the graph model of fuzzy data location, the constraint conditions of fuzzy directivity control are obtained:

$$(D - \omega L)x^{(k+1)} = [(1 - \omega)D + \omega U]x^{(k)} + \omega b \quad (6)$$

$$x^{(k+1)} = (D - \omega L)^{-1} [(1 - \omega)D + \omega U]x^{(k)} + \omega(D - \omega L)^{-1}b \quad (7)$$

Make

$$\begin{cases} L_\omega = (D - \omega L)^{-1} [(1 - \omega)D + \omega U] \\ f_\omega = (D - \omega L)^{-1}b \end{cases} \quad (8)$$

Then the positioning convergence process of test data meets the following requirements:

$$x^{(k+1)} = L_{\omega} x^{(k)} + f \quad (9)$$

The fitness function is obtained, and the positioning centre is adjusted through the fitness value, then:

$$(x_k - \alpha)^2 \approx (x_{k+1} - \alpha)(x_{k-1} - \alpha) \quad (10)$$

The clustering centre obtained by the SVM model was taken as the neighborhood data set, the training template set was constructed, and the function was performed by convex combinatorial quadratic programming method:

$$\alpha \approx \frac{x_{k+1}x_{k-1} - x_k^2}{x_{k-1} - 2x_k + x_{k+1}} = x_{k+1} - \frac{(x_{k+1} - x_k)^2}{x_{k-1} - 2x_k + x_{k+1}} \quad (11)$$

Among them:

$$\bar{x}_k = x_{k+1} - \frac{(x_{k+1} - x_k)^2}{x_{k-1} - 2x_k + x_{k+1}} \quad (12)$$

The expected output of fuzzy data positioning is as follows:

$$E_i \left(s_j^*, (s_i^*)_{i \in N \setminus \{j\}} \right) = \sum_{j=1}^m \sum_{k=1}^l p(x_{j_1}) \dots p(x_{j_w}) u_{k_i} \quad (13)$$

4 Test environment

The system has a client and server-side. Only Internet Explorer is required for the client and Microsoft SQL Server 2010 database and WebLogic Server 9.0 are required for the test SERVER.

4.1 Test methods and procedures

The object-oriented software testing process of this system involves three levels of activities: only to ensure the correctness of the interaction between class members and the methods contained in them, can the operation of the whole system be basically guaranteed. In the test of this system.

Specific static testing methods for the cultural heritage management system are as follows:

- (1) Record all kinds of environmental data before the test begins;
- (2) After the test started, the read rate was tested at different positions;
- (3) Analyse the test data after obtaining the test results.

The more complex and bulky the software, the harder it is to test. In general, there is a common test procedure for large and complex software, as follows:

- (1) Send the programme to test;
- (2) Identify the target to be tested;
- (3) Test requirement analysis, the reference content for the software function description and demand description;
- (4) To prepare the test plan;
- (5) Carry out the design of test cases;
- (6) Design the use case after the completion of implementation;
- (7) Evaluate the test results of the software.

4.2 Basic functional testing

Log in the system with different identities on the terminal, including ordinary staff and administrators, and conduct a more comprehensive and complete test of the validity and legitimacy of user registration, user grouping

and authority identification, catalogue processing, mirror update and data modification by using the black-box test method [8, 9].

Testing of each basic functional module:

Authentication module

Legitimately unregistered user data in English and figures;

User management module

Enter nothing in the user group name field and nothing in the administrative permissions field;

Mirror processing module

Select the database to be operated respectively to perform the image content update;

(4) Catalogue modification module

Enter 4 significant digits starting from 0001 in the Modified Catalogue Number input field; Add other non-numeric characters after entering 0001 in the catalogue number input field under revision J:

(5) Data modification management module

Do not enter any content in the fields of entry number, name of cultural relic, style, colour, author, excavation site, etc. Enter any characters in the fields of entry number, cultural relic name, style, colour, author, excavation site, etc. Select different options in the Revamp, Discover, and Release checkboxes.

4.3 Safety performance test

The handheld device can replace the reader to read the attached electronic tag information of cultural relics, and then synchronise it with the database in the background using the wireless network so that the staff can see the status of cultural relics at any time, and take timely measures in case of problems of cultural relics to ensure the safety of cultural relics to the greatest extent. If the electronic tag with temperature and humidity sensor is attached to the cultural relic, it can sense the temperature and humidity of the surrounding environment no matter where the cultural relic is located. Once the temperature and humidity change causes harm to the cultural relic, the information will be read by the reader, and then the computer will be used to control or remind the relevant personnel, to achieve the purpose of protecting the cultural relic. The staff can see the state of cultural relics at any time and can take timely measures in case of problems of cultural relics to ensure the safety of cultural relics to the greatest extent [10]. The fixed reading and writing function is only applicable to the occasion when the cultural relics are fixed in the museum. Once the cultural relics leave the specific place, how to ensure the safety of the cultural relics is the task of the mobile reading and writing function. Mobile to read and write functions using hand-held mobile tracking of cultural relics, hand-held can substitute for readers to read attached the electronic tag information of cultural relics, and then use the wireless network and the background database synchronisation, staff can always see the status of the cultural relics, the problems of the cultural relics can timely take measures to guarantee the safety of cultural relics.

It is not rigorous and we find it reasonable from the perspective of computer information management, whether from the aspects of information specification and the rationality of project establishment. This card does play a certain role in the whole process of management of cultural relics, and it has been accepted by a lot of managers of cultural relics. Completely abandoning this management mode will cost one dearer, so the best thing to do is to keep them based on its utility, to adjust its unreasonable place, and finally reach the requirement of information management that is acceptable to the user.

Cultural relics (collections) warehouse management system enables the unit to change the existing outdated paper and card cultural relics information management mode and provide security and confidentiality of the cultural relics information storage, which will improve the utilisation rate of cultural relics data information. The system is fully combined with the actual situation of the unit, which is flexible and convenient to operate, and greatly reduces the amount of labour of cultural relics (collections) warehouse management personnel. In addition, the system has a powerful statistical retrieval function, providing a variety of classified details and summary query reports to reflect the detailed information of cultural relics, warehousing and warehousing lists, which provides great convenience to the work of cultural relics management departments.

5 Test results

5.1 Summary of system test content

This paper proposes a cultural relic management system based on the functional mapping method and combined with Web Service technology. The paper makes an in-depth study of the framework design and functional design of the system, and the main work is as follows:

The research background and existing problems of the heritage management system are analysed, and the principle and application of the functional mapping method are summarised.

Based on the functional mapping method, I uses the client/Web Service/server three-tier architecture system to realise the framework design of the whole system, with the management authority and cultural relic registration information as the core.

Realise the function module of the system, and test it.

Given the original design goals, it is basically achieved:

The heritage management system based on the functional mapping method is designed by combining the client/server (C/S) structure with the browser/server (B/S) structure.

The system development environment includes development tools, server-side software and client-side software.

Based on demand analysis and system design, this paper realises a cultural relic management system in normal operation. The museum heritage management system based on the functional mapping method designed and implemented in this paper can work normally after testing.

5.2 System test results

Figure 1 shows the access efficiency when 100 users visit. It can be seen from the figure when the test user fills in the form and submits the data. It takes a lot of system resources and takes a little longer response time, but it is also within the acceptable range.

Fig. 1 Access efficiency.

As shown in Figure 2, the response time graph of the simulated transaction setting of 100 concurrent users shows that the response time is the longest when the page is submitted for the last time.

In this test, 100 users were simulated to make concurrent requests to the system, and the average response

Fig. 2 Response time for the performance test.

time of the system was obtained as follows, as shown in Table 1.

Table 1 Transaction response times

Transaction processing	The maximum	The minimum value	The average	Rate of change
Start	0.00	0.00	0.00	0.00
System administrator identification	13.98	16.40	14.54	1.80
Heritage Information Display	26.69	19.67	24.87	1.68
Museum management of cultural relics	12.16	2.10	8.21	1.97
Management of outbound cultural relics	17.74	7.56	12.98	1.27
Visitor Information Display	0.08	0.24	0.33	0.07
The end	0.00	0.00	0.00	0.00

In the three input fields of account, password and verification code on the login page, only the correct information can be entered into the system normally, otherwise an error message will be displayed; Reaction time meets the requirements.

(2) If a new user group and permissions have the same name or the input does not meet the requirements, the corresponding prompt will be given when saving, and it is forbidden to save, but the system will report an error when the user permissions are too long; It is consistent with the design requirements, but problems occurred during testing. After debugging, the operation is normal.

(3) The reaction time test of cultural relics entering and leaving the museum can meet the design requirements.

(4) Time class attribute reading for cultural relic data modification. Meet the design requirements.

6 Conclusions

The informationisation of the museum comes into being with the advent of the information age. From management and operation mechanism to collection custody, from cultural research to exhibition, many aspects of museums are being changed by information and information technology. The information technology, with its

own advantages of innovation, multiplication, permeability and mobility, has expanded the development space of the museum to a certain extent. Compared with other industries, the museum informatisation, the main content is that with the help of the advanced information technology, integrate the resources of cultural relics, culture, give full play to the social service function of the museum, the museum social connotation development and extension of all, from a higher level and wider meet the spiritual and cultural needs of the public.

Based on literature analysis, this paper studies the present situation of museum informationisation construction, and analyses the application of museum informationisation construction from the functional mapping method. The rapid development of information technology makes it difficult for traditional museums to meet the spiritual and cultural needs of the people. The informatisation construction of museums is an inevitable trend of development and reflects the development direction of advanced culture in human society. Will depth of information technology into the museum of cultural relics protection, display, popular science education and scientific research management, realise the museum inside and outside the high efficient and reasonable utilisation of resources, promote the development of the wisdom of the museum, interaction, real play to the advantages of information technology, can make the museum culture and collection of cultural relics truly 'live'.

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