Computer-Aided Multimedia Database Design of Intangible Cultural Heritage

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Abstract. Driven by interests, the blind development, large-scale reproduction and bottomless adaptation of the cultural connotation and expression of intangible cultural heritage have seriously misled the public's correct understanding of intangible heritage. In this paper, computer aided design is used as a technical means to carry out the teaching of cultural heritage protection. Carry out teaching exploration and practice of intangible cultural heritage exhibition halls. An optimized design scheme of multimedia information retrieval technology in ICH system is proposed. Improve the teaching effect of computer-aided design information technology by constructing cultural context. In the era of promoting quality education in an all-round way, the cultivation of students' various abilities is emphasized. Among them, using computers to obtain information, process information, display information and effectively use information technology are the information literacy and scientific and technological abilities that students must have in the information age. ICH is retrieved and classified through multimedia information database. Multimedia information retrieval technology is used to match the most suitable ICH category for users to realize the design of ICH system. The retrieval of intangible cultural heritage and related work is a new measure of epoch-making significance created by the profound scientific reflection and summary of human modern civilization after years of development and precipitation.

Keywords: multimedia information retrieval technology; intangible cultural heritage; data retrieval; computer aided design
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1 INTRODUCTION

When computers and information technology have penetrated into all fields with an irresistible trend, the integration of multimedia technology and teaching has brought profound changes to classroom teaching. Using computer information technology can create teaching situations that are difficult to observe directly in the classroom. The image and intuitive feeling of cultural situation can effectively stimulate students' interest in learning. Using the convenient and fast characteristics of computer information manipulation can maximize the teaching effect of computer information technology. Apply information technology to classroom teaching and create a cultural situation suitable for teaching development in real time according to the needs of curriculum teaching. It is conducive to improving the efficiency of classroom teaching, enhancing learning interest, and stimulating students' initiative to learn and explore. It is conducive to the development of students' creative thinking. The significance of applying information technology to classroom teaching. It is not only to change the traditional teaching mode, teaching strategies and teaching methods, but also to comprehensively improve the effectiveness of classroom teaching and improve the comprehensive quality of students based on computer information technology. We should do a good job in the teaching of information technology courses and improve the quality of computer-assisted subject teaching. In this regard, we should attach great importance to it so as to have a driving force in the training of teachers of information technology subjects. Schools should actively advocate and support students to participate in various forms of computer training. Abdelhamid [1] inputs the shape, size, position and other information of the solid object into the computer, and carries out digital modeling through CAD software to generate a three-dimensional model. CAD reconstruction can quickly and accurately restore the appearance and structure of buildings or cultural relics, providing an effective means for the protection and restoration of cultural relics. Gonizzi [2] uses virtual reality technology to project the digitized 3D model into the virtual space so that people can visit, interact and learn in the virtual environment. Virtual exhibitions can avoid the destruction of cultural relics and buildings by human activities, and also facilitate people's viewing, research and education. Tobiá š And Cajtham [3] believes that CAD reconstruction and virtual technology can be used for cultural relics protection. Digital recording and protection of cultural relics can also be carried out. At the same time, cultural relics can be presented to the public through virtual technology to improve the public's awareness and importance of cultural relics protection. The structural change and destruction of cultural heritage will affect the mechanical properties of cultural relics and buildings. The finite element method (FEM) used for mechanical analysis is largely used for modeling stress behavior. The workflow includes the use of CAD 3D models and the use of non-uniform rational B-spline (NURBS) surfaces. Gonizzi et al.[4] proposes an alternative method to generate the most accurate 3D representation of real artifacts from models based on highly accurate 3D reality, simplify the original model and make it suitable for finite element analysis (FEA) software. The most unique feature of cultural heritage is its uniqueness. To ensure that cultural relics are not affected by environmental degradation, deliberate destruction, and accidents, modern cultural heritage literature involves 3D scanning technology. In the case of fragmented artifacts, the digitization process is a necessary prerequisite to promote accurate 3D reconstruction [5]. Banfi [6] guided the analysis status of user development and visual language derogation, and analyzed the new situation of the model through in-depth understanding of the model artifacts and information.

In this paper, a feature reconstruction model of the ICH system retrieval optimization design system is established. The categories of ICH are retrieved and classified through the multimedia database, and the user's interest categories are retrieved by the information retrieval technology, and the fuzzy feature quantity of the ICH system retrieval optimization design is extracted. Its innovation lies in:

(1) This paper uses the information retrieval method in multimedia technology to reduce the execution cost of the algorithm.

(2) In this paper, the key features of the retrieval optimization design system of ICH system are constructed, and the multimedia database technology is used to realize the retrieval optimization design and identification of ICH system.

This paper studies the optimization design of ICH system retrieval. The architecture is as follows:

Section 1 analyzes the retrieval optimization methods of intangible cultural heritage, and puts forward the index of innovative contribution of the research. The amount of cultural heritage uses computer technology to educate and promote intangible cultural heritage, so that more people can understand and pay attention to the inheritance and protection of intangible cultural heritage. Section 2 analyzes the relevant research background that computer-assisted intangible cultural heritage protection can be digitally recorded. Section 3 analyzes the virtual display, 3D modeling, data mining and educational promotion. It provides new ways and means for the protection, inheritance and promotion of intangible cultural heritage. In section 4, the performance of the model is tested and the results are optimized. Section 5 summarizes the overall direction of the study. The direction of further research is pointed out.

2 RELATED WORK

Carried out the archival management of ICH from the perspective of archive pluralism, proposed the theoretical framework of archive management, divided ICH into minority ICH, adopted the social management mode, and adopted the centralized management mode for the declared ICH projects. Shanmugam proposed that images, as an important tool and means in the ICH community project, collect high fidelity image materials of various cultural forms such as natural scenery, architecture, clothing and crafts through the depth of images. Proposed that local people should be encouraged to actively participate in image shooting and use the image acquisition information method of joint shooting. And it is applicable to the image presentation practice methods of different intangible cultural ecology combined with interactive image design and live performance. Proposed an interactive image design based on immersive experience. According to the transmission characteristics of ICH information, they realized the image design application strategy of reproducing real scenes, presenting invisible information, and building behavioral relationships. Believe that the concept of ICH can be traced back to the "tangible cultural property" proposed by Japan in 1950, and then developed into "intangible cultural property", which is an intangible historical and artistic cultural form such as opera, music and art with high value in Japan. They divided ICH into four categories: oral culture, body culture, comprehensive culture, and modeling culture. Man and Gao [7] studied computer-assisted intangible cultural heritage protection based on VR technology. Digitize, protect, inherit and promote intangible cultural heritage using different computer technologies. Use digital technology to record, store and manage intangible cultural heritage, including cultural background video and other forms of information. Skublewska et al [8] analyzed the existing conditions for protecting cultural heritage based on the background development concept design of 3D technology. The computer graphics virtual technology is constructed for the development and promotion analysis of enhanced digital technology. Display and disseminate intangible cultural heritage in virtual form. Sun Liu [9] uses computer-aided design software to carry out three-dimensional modeling, restore and simulate intangible cultural heritage, so as to facilitate protection, research and inheritance. Mendoza et al [10] used computer technology to conduct data mining and analysis of intangible cultural heritage, so as to understand its characteristics, evolution process and relevant cultural background. It discussed the data analysis report of tangible cultural heritage and intangible cultural heritage, and determined the application focus of different digital technologies.

3 METHODOLOGY

3.1 Image Preprocessing of Intangible Cultural Heritage Using Multimedia Database

The construction of cultural context can improve the teaching effect of computer-aided technology. The main means of protecting cultural heritage. If we combine computer-aided design technology with digital pattern media database. Through the image retrieval function of computer-aided design technology, patterns of the same style or theme can be retrieved from the digital pattern media database. Then, we will redesign and develop embroidery and Paper Cuttings patterns, which will enable minority folk art to achieve a leap forward development from traditional handcrafting to computer-aided creation. Intangible cultural heritage images display a wealth of intangible culture and projects from different angles, and also attract people's attention and support for the protection and inheritance of intangible culture. The types of images can be divided according to short, medium and long periods, as shown in Figure 1.

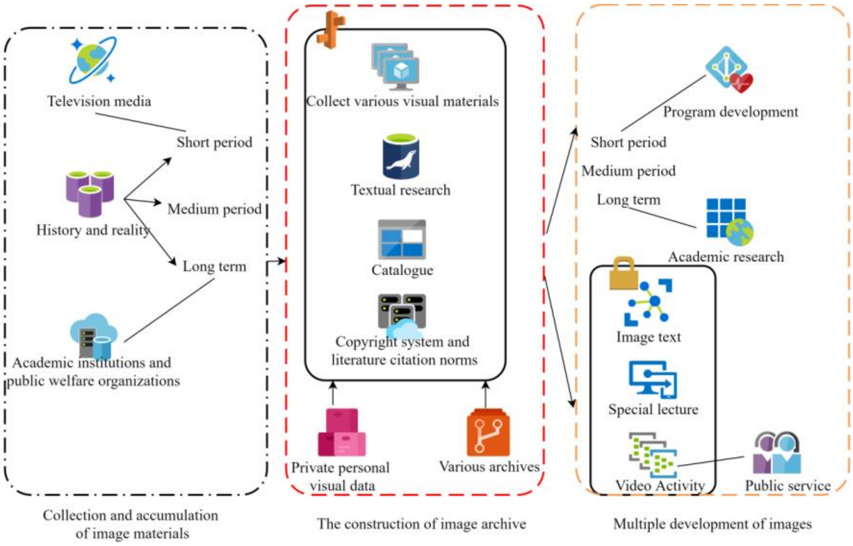

Figure 1: Overall framework of image recording under the vision of Yearbook school.

It is especially suitable for the processing of numerical value and character numeric data. It does not establish a real data model for multimedia objects, and a large number of media operations are required in the multimedia database. For example, feature extraction, multimedia combination and synchronization also require similarity retrieval based on image content. All these require a multimedia database system suitable for multimedia management.

Therefore, defining an appropriate similarity model has a great impact on the retrieval effect.

(1) L_1 distance and L_2 distance

If the components of the image feature are orthogonal and independent, and the importance of each dimension is the same, the distance.

$$D_1 = \sum_{l=1}^{N} |A_l - B_l| \tag{3.1}$$

$$D_2 = \sum_{l=1}^{N} (A_l - B_l)^2 \tag{3.2}$$

(2) Histogram intersection

$$\sum_{j=1}^{N} \min(I_j, Q_J) \tag{3.3}$$

The intersection of histograms refers to the number of pixels shared by two histograms in each bin. Sometimes, this value can be normalized by dividing by the number of all pixels in one histogram, so that its value belongs to the range of [0,1].

$$S(I,Q) = \sum_{J=1}^{N} \min(I_j, Q_J) / \sum_{j=1}^{N} Q_J \tag{3.4}$$

(3) Quadratic distance

The quadratic distance between the two color histograms I and Q can be expressed as:

$$D = (Q - I)^l A(Q - I) \tag{3.5}$$

(4) Mahalanobis distance

The mathematical expression of Mahalanobis distance is:

$$D_{mahal} = (A - B)^t C^{-1}(A - B) \tag{3.6}$$

Where C is the covariance matrix of the eigenvector. This distance standard is often used to calculate the similarity of SAR features.

When there is no correlation between the components of the feature vector, the Mahalanobis distance can be further simplified because only the variance c_i of each component needs to be calculated. The simplified Mahalanobis distance is as follows:

$$D_s = \sum_{i=1}^{N} \frac{(A_i - B_i)^2}{c_i} \tag{3.7}$$

Selecting an appropriate similarity measure method for an image feature is an important guarantee for obtaining satisfactory retrieval efficiency.

(5) Non geometric metric method

All the above methods are based on vector space model, and geometric distance is used as similarity measure. Such a distance function usually satisfies the conditions of self similarity, minimum, symmetry and trigonometric inequality of the distance axiom.

$$S(a,b) \succ S(c,d) \Leftrightarrow s(a,b) \succ s(c,d) \tag{3.8}$$

$$S(a,b) = f(A \cap B) - \alpha f(A - B) - \alpha f(B - A) \tag{3.9}$$

f is a function that reflects the saliency of features and measures the contribution of formulated features to similarity.

3.2 Optimization of Retrieval Design of Intangible Cultural Heritage System Based on Multimodal Multimedia Information Retrieval

The communication between different regions and different nationalities has also increased, and mutual cultural concepts and ideologies have also constantly generated friction, collision, and gradually cross and integrate, thus further promoting cultural diversity. ICH vividly reflects this feature, so its cultural value is more important and precious than other cultural heritage.

Figure 2 shows the system architecture using multimodal search mechanism. The retrieval and relevance feedback of multimedia objects by users are completed by the query and relevance feedback subsystem. Due to the multi-mode retrieval technology, users can query multimedia objects belonging to a specific mode, and can also query objects of multiple modes at the same time.

As shown in Figure 3, analyzes the underlying features of various objects such as text, image and video, extracts the link relationship between different objects in the multimedia document. The retrieval of multimedia documents is completed by the query subsystem. The underlying feature database of a certain mode in the query subsystem constitute the retrieval channel under this mode. Figure 4 shows the flow chart of multi-channel retrieval.

4 RESULT ANALYSIS AND DISCUSSION

The experiment randomly selects an image from the test data set as a query. The system returns 200 images as search results. Through this feedback, the experiment uses ibcr method to refine the retrieval results.

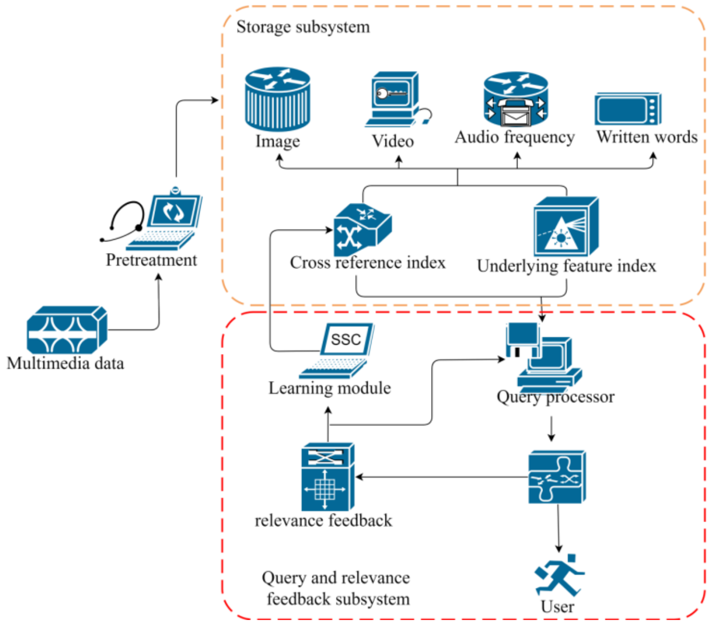

Figure 2: Architecture of multimodal retrieval system.

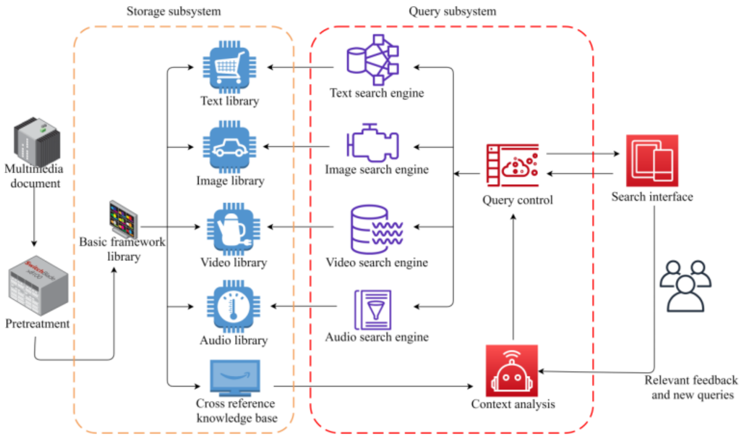

Figure 3: System architecture.

Here, we collectively call them retrieval precision. It is worth mentioning that in this experiment, the retrieval results include 20 randomly selected images, so the highest accuracy rate is 90%. We carried out 200 random queries using our proposed method, and gave 20 feedback for each query. The cross-reference index is cleared before each query. Figure 5 shows average feedback level of comparison results, we used the traditional CBIR relevance feedback method to test the same 200 queries. It is not difficult to see from Figure 5 that at the beginning, the two methods have the same retrieval performance. This is because the method in this paper is simplified to CBIR method because there is no cross-reference index at the beginning. With the progress of feedback, this method is obviously better than CBIR method, and the correct rate can be as high as 95% after the ingenious feedback. In contrast, the accuracy rate of CBIR method can only be maintained at about 50% after 15 feedbacks.

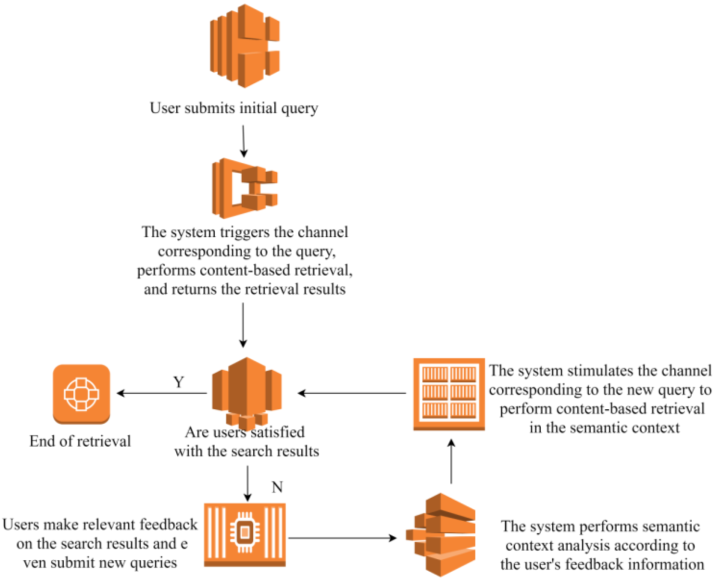

Figure 4: Multi channel retrieval flow chart.

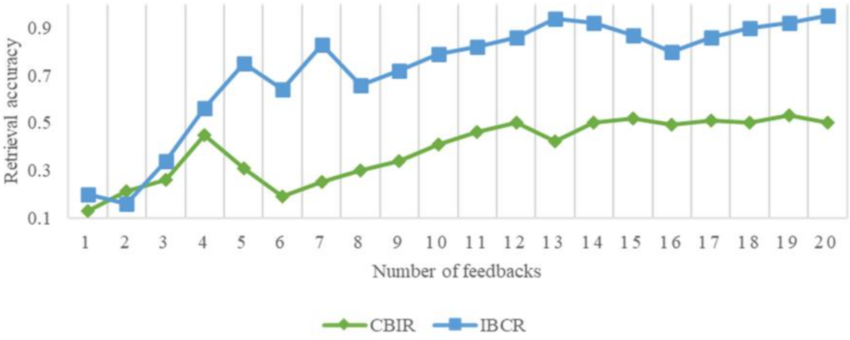

Figure 5: Performance comparison.

In addition to the above retrieval performance tests, the retrieval performance between multiple searches is also tested. The experimental design is as follows: for each subject class, we conduct a series of searches, and each search includes a random query and a feedback. Since the feedback in each retrieval will update the cross-reference index, the subsequent retrieval will benefit from the cross reference index obtained in the previous retrieval. We conducted experiments on all subject classes in random order. Table 1 lists the changes in the average correct rate. It is not difficult to see that the accuracy rate increases with the increase of the process, and can reach 50% after 15 processes. Since each process is fed back only once, this method is very effective to improve the long-term performance.

Session	*1*	*2*	*3*	*4*	*5*
Accuray(%)	13.5	23.1	25.14	26.22	30.25
Session	6	7	8	9	10
Accuray(%)	36.2	37.5	40.2	43.5	44.2

Session	11	12	13	14	15
Accuray(%)	45.23	46.8	48.7	49.5	50.4

Table 1: Search performance changes among multiple searches.

The result return method of directly returning the multimedia document sequence can retrieve the multimedia documents that do not contain the multimedia objects corresponding to the query object. That is to say, even if the query object provided by the user is an image, the multimedia documents that are related to the image but do not contain the multimedia objects in the mode of image may be retrieved. In order to illustrate the performance of this retrieval method, the content coverage rate is used to measure the performance of the system. The experiment provides 20 queries for each type of intangible cultural data, and the average content coverage in the calculation results is shown in Table 2.

Method	*Average content coverage obtained under each data set*			
	Shadow play	Twenty-four solar terms	Calligraphy	traditional opera
Pure image retrieval	45.32%	42.31%	41.23%	42.11%
Plain text retrieval	5.45%	6.45%	5.12%	6.55%
Pure video retrieval	13.23%	13.23%	13.23%	13.23%
Pure audio retrieval	14.11%	14.11%	14.11%	14.11%
Multimodal comprehensive retrieval	58%	54.33%	51.29%	50.18%

Table 2: Performance comparison between multi-modal synthesis algorithm and single-modal algorithm.

This makes the number of multimedia documents related to the query retrieved more than the number of multimedia documents obtained by the single-mode retrieval method.

In order to evaluate the effectiveness of the methods in this chapter, real large-scale multimedia data sets with different modes are selected, including 40000 text data, 70000 image data and 30000 video data. Table 3 shows the parameter settings in the experiment, where the bold combination parameter is the default value in the experiment.

Parameter	*Variation range*
Query radius for text data	0.1,0.15,0.2,0.25,0.3
Query radius for image data	0.3,0.35,0.4,0.45,0.5
Query radius for video data	0.3,0.4,0.5,0.6
K value in k nearest neighbor query	5,10,15,20
Metric function	Euclidean distance

Table 3: Parameter settings.

Figure 6 shows the comparison between the methods in this chapter and the ciindex method in terms of precision recall ratio. Ciindex is selected as the comparison method. A 1-dimensional index structure is used to reduce the original spatial dimension, and statistical methods are used to normalize the low-level features of different media objects to calculate the similarity. However, the disadvantage of ciindex method is to ignore the useful association information lost in the process of dimension reduction. In addition, the semantic expression of user query samples and multi-modal media data cannot be well understood by using low-level features. In the contrast test of precision and recall, a total of 200 multimedia objects with different modes are randomly selected from the cross-media data set as query samples to test the ibcr method and the ciindex method proposed in this chapter. The results are shown in Figure 6. It can be observed that the ibcr method is far better than the ciindex method.

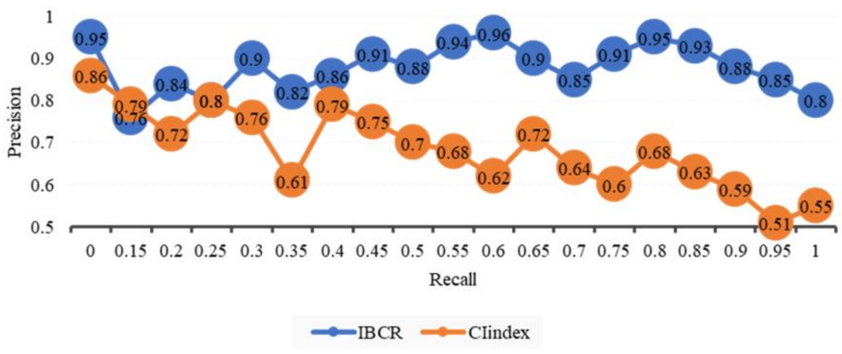

Figure 6: Evaluation precision recall.

In practical applications, cross media retrieval usually faces large-scale data. Therefore, it is necessary to test whether data sets of different sizes have an impact on the final retrieval results. In this section, the ibcr, cindex and conventional sequential scanning methods proposed in this chapter are compared and tested for data sets of different sizes, as shown in Figure 7-Figure 9.

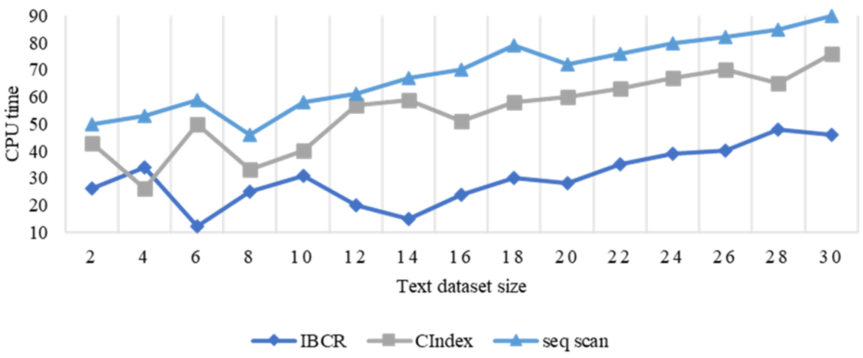

Figure 7: Performance test under text data set.

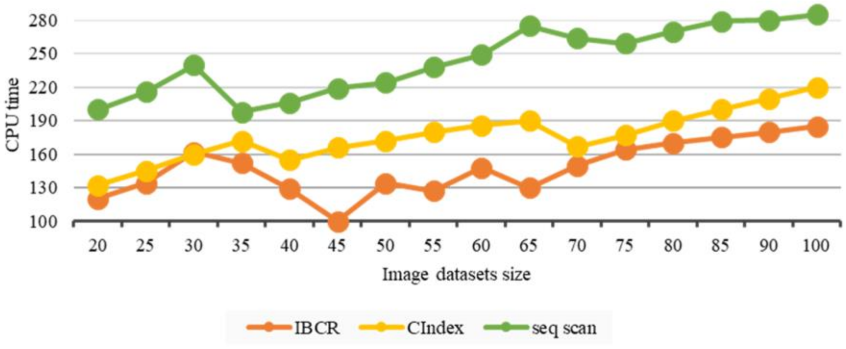

Figure 8: Performance test under image dataset.

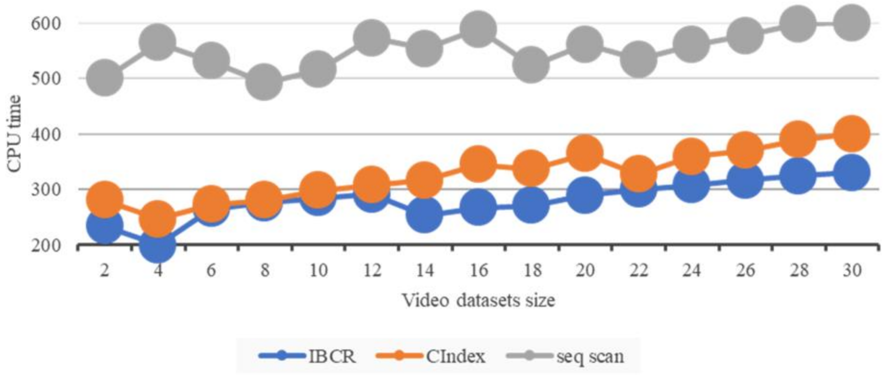

Figure 9: Performance test under video data set.

Figure 7-Figure 9 show the CPU cost of testing three methods on three different types of data sets. It is obvious that the ibcr method proposed in this chapter is far better than the other two comparison methods. When comparing three types of multimedia data sets, ibcr method is very stable in the process of gradually increasing these data sets. At the same time, it can be seen that sequential scanning method is indeed difficult to handle large-scale data sets. The experiments in this section also verify that the method proposed in this chapter can solve the problem of cross media retrieval facing large-scale data sets.

This chapter extracts the semantic features of different modal media objects, and constructs a multi-modal semantic association graph model by using the semantic association between multimedia objects. Secondly, a semantic space is constructed by measuring the semantic relevance between media objects in different modes, and media objects in different modes are mapped into the space. Finally, the experimental results show the effectiveness of the proposed method.

5 CONCLUSIONS

Therefore, once they disappear or disappear, it is difficult to recover or rebuild. This paper studies the intangible cultural heritage retrieval system. An optimized design scheme of multimedia information retrieval technology in ICH system is proposed. ICH is retrieved and classified through multimedia information database. Multimedia information retrieval technology is used to match the most suitable ICH category for users to realize the design of ICH system. This result fully shows that the multimodal semantic relationship diagram is modeled by using the semantic association between multimodal media objects. And all media objects in the multimodal semantic association graph are mapped to the homogeneous semantic space. Experiments on large-scale real cross-media data sets show that the method is effective and accurate.

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