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A Dynamic Study of Art Image Digitization Based on Metadata

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ABSTRACT

With the continuous development of the internet age, more and more art images are taking on digital forms, resulting in a new way of survival for art image digitization. However, the digitization process of art images is affected by various factors, resulting in poor results and low digital quality of art images. Therefore, this article conducted research on the digitization of art images based on metadata, and utilized BP (Back Propagation) neural network for metadata processing and analysis to achieve metadata visualization and interactive design. Animation production software was then utilized for image compression, transparent display, and modeling, and finally interactive display technology was used to display the dynamic design of art images. 4000 user feedback data and art image metadata from four age groups were collected and named A art image set. Starting from the visual communication effect, accuracy, and fidelity of art images, the differences in dynamic design of A art image digitization were compared. The experimental results showed that 2820 people were satisfied with the visual communication effect of dynamically designed art images, with a satisfaction rate of 70.5%. Only 1070 people in the control group were satisfied. The metadata accuracy of dynamically designed art images was greater than 80%, and the average accuracy was close to the median line, with small overall fluctuations. The deviation value between dynamically designed art image data and standard images is small, and the overall fidelity is relatively high. In short, the evaluation effect of digital dynamic design of art images is very good.

Keywords: Research on the dynamic digitization of art images; Digital Dynamic Research of Fine Art Images; Metadata Analysis and Processing; Back Propagation Neural Network; Visualization and Interaction Design of Metadata; Interactive Presentation Technology

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1. Introduction

The 21st century is the age of digital multimedia and the age of extensive use of graphics and images. Visualization technology based on graphic development and image processing is spreading rapidly through computers and their networks, and is changing the way of life of human beings unconsciously. In the era of technological development, how to use technology to break the visual space we already have and to reinvent the design language through the medium of innovative graphic and image technology is a new subject [1-2]. And every new technological advancement of mankind brings about a great change in art. The birth of digital graphic image technology can make almost everything artistic imagination at the same time has a huge inclusiveness of various art forms, which gives the new era of artists and designers to bring a greater degree of freedom in creation [3-4].

Digital libraries with the development of computer network technology and Internet technology, in recent years, digital library construction in full swing and construction, has made remarkable achievements [5-6]. In the network society, the construction of digital libraries requires networking, standardization and internationalization, which can realize the resource sharing and common construction. Art digital library construction is at the downstream level in the whole digital library construction, starting late and difficult [7-8].

Art image database is the means of realization and components of art library construction. Art image digitization is different from general text literature digitization, no matter what type of art image works, can be visualized through the image of communication with people, in the process of displaying the work, the image is more important than the text. How to turn these vivid images into digitalization is the focus and difficulty of art image database construction. From the presentation form, art image resources are generally divided into static and dynamic two kinds [9-10]. The so-called static art image works mow have plane and three-dimensional points. Plane works are generally also known as two-dimensional works, such as paintings and calligraphy, etc., and three-dimensional works are generally also known as three-dimensional or multidimensional works, such as sculpture works, installation art, etc. Static art digital resources are generally saved in digital image file format. Dynamic art works such as advertisements, animations, new media works, etc. are saved through audio-video file format [11-12].

At present, the definition of metadata has not been harmonized in the international arena, and is usually defined as, metadata is data about data. In order to better reveal the connotation of metadata, synthesize the various definitions, and finally define metadata as, Woods data is a kind of data that describes a specific resource object, and indexes, analyzes, and manages this object, and at the same time facilitates data retrieval [13-14]. A metadata generally consists of several descriptive items of specific data elements with different functions. The functions of metadata mainly focus on the following aspects, description, retrieval, selection, localization, management, evaluation, interaction and other functions. Whether these functions can be realized or not directly determines the good or bad metadata standard. A perfect metadata standard can reflect these functions in the establishment of specific metadata items [15-16].

The components of metadata generally have three parts, the core elements, the core elements of the library and individual elements. Metadata describes the resource object is generally a more complex composite object, but also an abstract object assemblage, which includes the original object, digital replica, object replica, etc [17-18]. Taking Chinese national painting works as an example, a national painting work may have many series or be divided into several localizations, then the composite object corresponding to this national painting work is the collection of the composite national painting work itself and several local digital images [19-20].

Rani, A elaborated that digital technology has brought a new dimension to the art of painting and is a new trend in the future of art creation, and at the same time deeply analyzed the characteristics of digital technology-enabled art of painting, pointing out that the artists in the art creators have

been progressively experimenting with technology such as photography, video and so on [21]. Cui, J reveals that the art of painting based on computerized digital technology has become a popular art form among the masses, and examines in detail the diversified manifestations of the art of digital painting, while looking forward to the future development trend of the new art form of digital painting [22]. Yang, S et al. introduced a strategy for searching digitized art images, i.e., a computer vision strategy with automatic metadata generation as the core logic, which enables unsupervised searching of digitized art images, and lastly, an art recommendation system was built to meet the needs of art lovers as well as art historians [23]. Digital painting art has become a popular trend, and the above researchers have carried out in-depth analyses of digital painting art from the dimensions of digital painting art characteristics, diversified performance and so on.

Image dynamization also has certain applications in the field of art, so understanding the concept of moving pictures, production logic and characteristics of moving pictures has a positive significance for art image dynamization. McCarthy, A attempted to understand the working logic of motion graphics by studying the digital dynamics of GIF online interactions, pointing out that motion graphics expand the cultural dimensions of crowd interaction and increase group creativity with a new form of human discursive communication [24]. Fan, Y introduced kinescopes as short audio-free loops based on the composition of motion sequences, and clarified the visual nominalization of kinescopes as well as the characteristics of visual remoteness, which somewhat facilitates the integration of kinescopes in computer networked media and written language [25]. Lin, J et al. conceptualized a payload allocation strategy adapted to different frames, which achieves the lowest embedding cost to allocate elements with less impact on the pixel values of the moving images, and also for regions with sufficiently large inter-frame variations, and ultimately confirms the effectiveness of the proposed method through experiments [26].

In summary, it is meaningful to use metadata standards for dynamic design in the process of digitizing art images. Therefore, this article first obtains and organizes the metadata of art images, and then uses BP neural network to process and analyze the metadata, realizing metadata visualization and interactive design. Animation production software tools and interactive display technology are applied to achieve dynamic design and representation of art images. Finally, taking the A art image set as an example, 4000 user feedback data and art image metadata from four age groups were collected, and the visual communication effect, accuracy, and fidelity of art images were tested to evaluate the effectiveness of metadata based digital dynamic design of art images.

2. Metadata Analysis and Processing

Metadata is an abstract concept used to describe data, and the information it contains can be regarded as the basic components of data. Therefore, effective organization and management of data requires analysis and processing of metadata. Generally, as long as there is an area of data, there is corresponding metadata. Only when the integrity and accuracy of metadata are fully guaranteed can data be more deeply understood and the value it contains be fully mined.

Taking art image as an example, art image metadata is not a standard for the artwork itself, but a metadata standard for digitizing book resources. Art image metadata is used to digitize and organize image resources, forming a collection with specific structures and functions.

The database of art images has already been established when carrying out digital work. However, due to the lack of a unified metadata scheme to guide, various heterogeneous databases have been formed, and there is a lack of correlation between each database. Art image resources still cannot be shared. It is necessary to design a metadata process with strong interoperability, specificity, and standardization.

2.1. Metadata Acquisition and Organization

Firstly, the relevant metadata of art images is collected, mainly including work ID (Identification) number, work type, work annotation, work copyright, work source, work volume number, author information, creation time, style characteristics, and work background. The metadata is organized and classified, as shown in Figure 1.

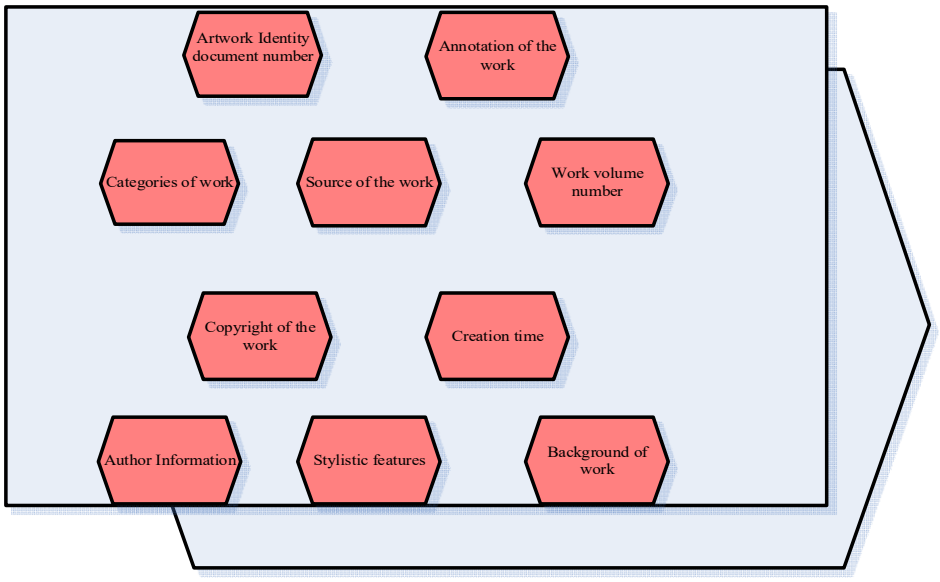


Fig. 1. Related metadata of art images

2.2. Metadata Analysis and Mining

After obtaining and organizing metadata, the data mining and analysis techniques of BP neural network are applied to conduct in-depth analysis of the metadata of art images, and discover the patterns, trends, and correlations among them. The art image metadata retrieval and analysis model based on BP neural network has been constructed.

The specific steps for mining and analyzing metadata using BP neural network are as follows:

1) The U and V matrices are initialized first. The value field of the Activation function determines the assignment interval. C is set as the maximum number of training sessions. J is the learning precision value, and $F(x)$ is the Activation function. Then, the formula is as follows:

$$F(x)=\frac{1}{\left(1+e^{-x}\right)} \tag{1}$$

2) Metadata preprocessing: The input of art image metadata is selected to output hidden layer Y_j and output layer as follows:

$$Y_j=F\left(X^C V_j^C\right), j=1,2,3\ldots n \tag{2}$$

$$S_j=F\left(H^C U_j^C\right), j=1,2,3\ldots n \tag{3}$$

3) According to the BP neural network, the error is calculated as follows:

$$e=\frac{1}{2}\sum_{j=1}^{2}\left(D_j-S_j\right)^2 \tag{4}$$

2.3. Metadata Visualization and Interaction Design

The metadata of art images is presented in a graphical manner for clear and effective information transmission or insight. The location, color, and region size of metadata are analyzed to reflect the differences between different metadata. At the same time, metadata is connected by "lines" to form a complete whole, better reflecting the changes in metadata.

When carrying out metadata visualization Interaction design, first, the information required by the user is transferred to the user. Users have a certain understanding of the current metadata during use, but they do not have much understanding of the overall situation. Furthermore, according to the user's needs, different filtering conditions are selected in the visual presentation screen, and visual iterative updates are carried out in interactive operations to better assist users in obtaining the required information. The metadata visualization interaction design interface is shown in Figure 2.

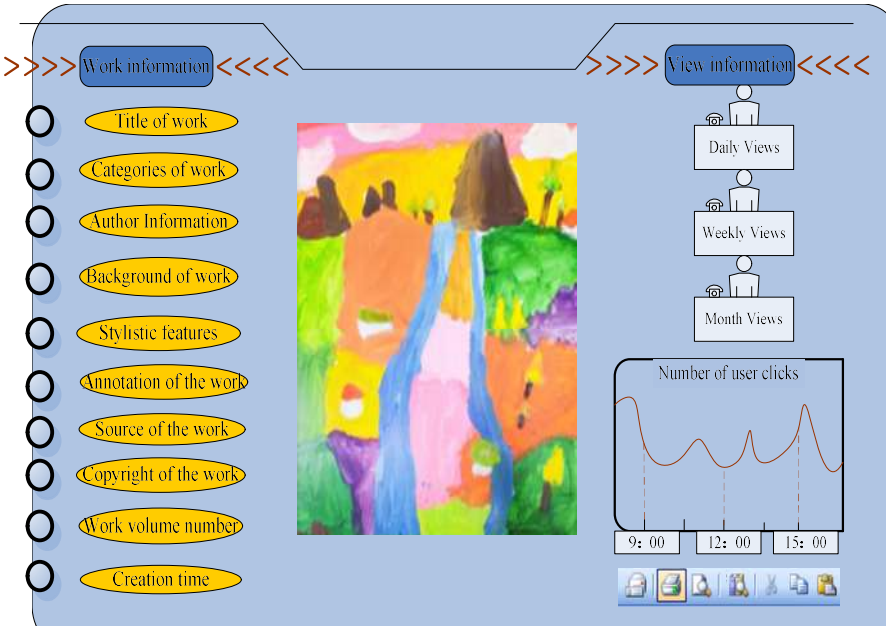


Fig. 2. Metadata visualization interaction design interface

3. Dynamic Design and Expression of Art Images

In modern society, with the rapid development of technology, the use of technology by humans is also increasing. Art images, as a visual information carrier, are no exception. Dynamic design, as a form of visual art expression, makes static art images vivid and lively, giving them unique artistic charm and cultural heritage. At the same time, dynamic design also provides a broader channel for the dissemination of art images. Adding dynamic design to art images not only attracts the audience's attention, but also increases their interest and attention in art images, enabling them to be more widely disseminated. Therefore, incorporating dynamic design into modern art images can enrich visual experience and artistic charm, thereby improving the dissemination effect of art images.

3.1. Dynamic Design Principles and Strategies

Based on the metadata characteristics and design requirements of art images, and combined with specific application scenarios, corresponding dynamic design principles and strategies are formulated, including motion effects, temporal changes, etc. In terms of motion effects, it is possible

to consider adding multiple cameras to shoot the same scene from multiple angles. In terms of temporal changes, it can be considered to overlay and display images from different time periods.

3.2. Dynamic Design Tools and Technologies

Relevant tools and technologies, such as animation production software and interactive display technology, are applied to achieve dynamic design and representation of art images. In the dynamic design of digital art images, animation production software is first utilized to compress the images. There are two types of image compression: lossless compression and lossy compression. Lossless compression is used to represent the original image with less data without affecting quality. Lossy compression is used to represent the original figure with a large amount of data under the premise of ensuring quality.

After the animation production software completes image compression, the image is transparently displayed. In color mode, color data is decomposed into a binary number to represent color information, which is represented by binary numbers of different colors. In this case, when the image is compressed, there is a phenomenon of contrast between the black and white color regions and other color regions, as shown in Figure 3.

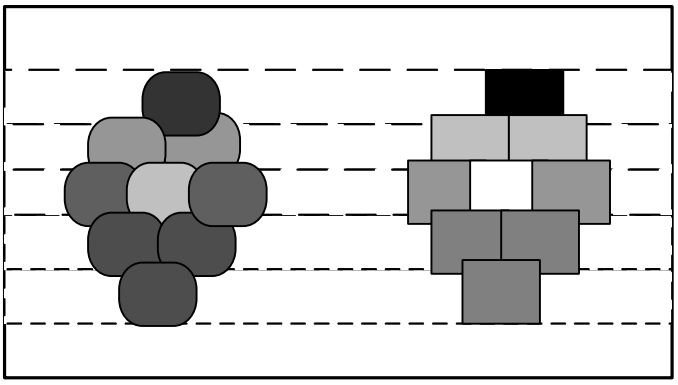


Fig. 3. Transparent display of images

After completing transparent display, visual effects, colors, and other information are utilized for modeling and expression. Traditional planar 2D (two-dimensional) models are converted into 3D (three-dimensional) graphics. The process and method of extracting various object features from computers and describing them are established. A variety of Artistic language and various graphic elements are used for display, and animation technology is used to make art images vivid and realistic, as shown in Figure 4.

Fig. 4. Display diagram of dynamic design of art images

Animation production software is utilized to complete dynamic design, and interactive display technology is further utilized to complete the presentation of dynamic design. Interactive presentation technology can enrich the content of art image display, better achieve online resource sharing, and provide users with a higher quality service experience, as shown in Figure 5.

The interactive display method is mainly reflected in Figure 5. Users can experience the charm of dynamically designed art images more intuitively through single touch, large screen touch, showcase touch, and holographic interactive touch.

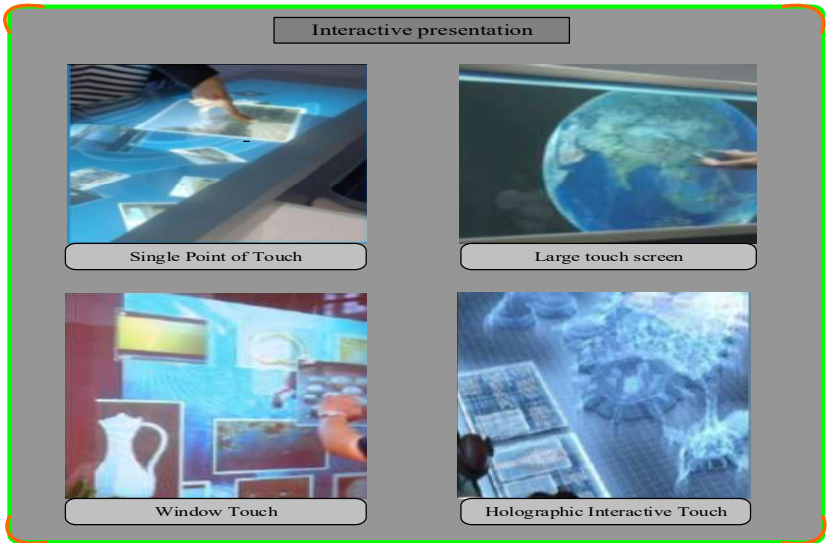


Fig. 5. Interactive display technology for digital dynamic design of art images

3.3. User Experience and Feedback

In order to enhance users' experience of dynamic design of art images and generate positive feedback, this article mainly considers the following aspects, as shown in Figure 6.

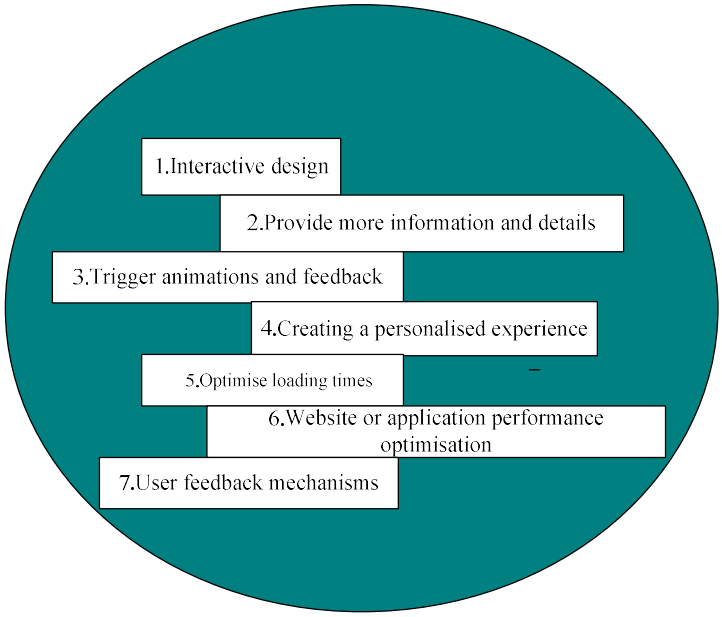


Fig. 6. Specific actions to enhance user experience and feedback

Figure 6 shows the following:

1) Interactive design. A simple and intuitive user interface and interaction method are designed to allow users to easily interact with art images. The learning cost and cognitive burden are reduced, and clear guidance and operational prompts are provided, allowing users to enjoy a seamless interactive experience.

2) Providing more information and details. Through animation, transition effects, and visualization methods, more information and details are displayed, allowing users to have a more comprehensive understanding of the content and meaning conveyed by the image, thereby enhancing their understanding.

3) Triggering animation and feedback. The animation effect of art images is displayed through user actions or triggering specific events. For example, dynamic changes in the image are triggered during operations such as clicking, sliding, and hovering. At the same time, user feedback is provided in a timely manner to enhance user perception and satisfaction with the interaction. The combination of dynamic design animation effects makes the originally static images more vivid and imaginative, giving people a more realistic and dynamic feeling, and making users willing to further explore.

4) Creating personalized experiences. Customization and adjustment are carried out based on the user's personal preferences. Users can choose different dynamic effects, visual effects, or other user interface settings to meet their needs and preferences, and enjoy a unique personalized experience.

5) Optimizing loading time. It is necessary to ensure that the animation loading speed of art images is fast and avoid users waiting for too long to load. The file size and format of the image are optimized, and compression algorithms are used to reduce the file size, improve loading speed, and ensure that users can quickly and smoothly enjoy dynamic design.

6) Website or application performance optimization. It is necessary to ensure that the dynamic effects of art images can run well on different devices and platforms. The code is optimized to reduce unnecessary resource consumption, improve website or application performance, and avoid lag and delay, providing a good user experience.

7) User feedback mechanism. A convenient feedback channel is provided for users to collect their opinions and suggestions. Users' preferences and opinions on dynamic design can be understood through surveys, online feedback forms, user comments, and other methods. Based on feedback, the design can be adjusted and improved in a timely manner to meet user needs and expectations.

Through interaction, personalization, and multi-dimensional information display, users' sense of participation and exploration are increased, and their satisfaction and retention rate are improved, making them more willing to interact and participate, and providing valuable feedback.

4. Experiment and Evaluation of Digital Dynamic Design of Art Images

4.1. Experimental Design and Data Collection

In order to verify whether the dynamic design of art images proposed above meets expectations, this experiment took the A art image set as an example. User feedback data was collected first, and four representative age groups of users were selected for the experiment, namely teenagers aged 10-16, young people aged 17-30, middle-aged people aged 31-45, and elderly people aged 46-60. 1000 people were randomly selected for each age group, totaling 4000 people. The dynamic design of art image digitization based on metadata was established as an experimental group. This experiment mainly compared the differences in dynamic design of A art image digitization. Those who did not perform dynamic design on the digitization of art images were set as the control group. In order to evaluate the effectiveness of dynamic design, the visual communication effect, accuracy of art image metadata, and fidelity (art image frame index 1-deviation value) can be used to evaluate the effectiveness and user perception of dynamic design.

Table 1 records the satisfaction of the experimental subjects with the visual expression effects brought by the experimental group. A total of 2820 out of 4000 experimental subjects were satisfied with the visual expression effect brought by the experimental group; 980 felt that the visual expression effect brought by the experimental group was average; and 200 were dissatisfied with the visual expression effect brought by the experimental group.

The visual expression effect brought by the satisfactory experimental group was the lowest among the population aged 46 to 60, with a total of 640 people, and the highest among the population aged 10 to 16, with a total of 780 people. Among the unsatisfactory visual expression effects brought by the experimental group, the number of people aged 46 to 60 was the highest, with a total of 66 people, and the number of people aged 10 to 16 was the lowest, with a total of 20 people.

Table 1. Survey of satisfaction of experimental subjects with the visual expression effects brought by the experimental group

Experimental subjects	Satisfied	Average	Unsatisfied
10-16year	780	200	20
17-30year	690	250	60
31-45year	710	236	54
46-60year	640	294	66

Table 2 records the satisfaction of the experimental subjects with the visual expression effects brought by the control group. Out of 4000 experimental subjects, 1070 were satisfied with the visual expression effect brought by the control group; 1860 felt that the visual expression effect brought by the control group was average; and 1070 were not satisfied with the visual expression effect brought by the control group.

Table 2. Survey of satisfaction of experimental subjects with visual expression effects brought by the control group

Experimental subjects	Satisfied	Average	Unsatisfied

10-16year	240	485	275
17-30year	220	455	325
31-45year	210	480	310
46-60year	400	440	160

From the data in Table 1 and Table 2, it is not difficult to find that the experimental group had more people who were satisfied with the selection regardless of their age group compared to the control group, while the control group had more people who were average and dissatisfied with the visual expression of the images regardless of their age group.

This experimental processing not only requires collecting user feedback data but also art image metadata. 12 images from the A art image set were selected as the experimental subjects, of which 6 images were digitized and dynamically designed based on metadata as the experimental group, while the other 6 art images were not digitized and dynamically designed as the control group. Afterwards, the accuracy of the data information for both groups was recorded, as shown in Table 3 and Table 4.

Table 3 describes the metadata accuracy of six dynamically designed art images in the experimental group. Among them, the metadata accuracy of these 6 dynamically designed art images exceeded 80%. The accuracy of the data in the first frame ranged from 80.29% to 92.29%, while the accuracy of the data in the second frame ranged from 80.64% to 97.77%. The accuracy of each data in the third image ranged from 82.44% to 99.89%. The accuracy of each data in the fourth image ranged from 80.7% to 94.58%. The accuracy of each data in the fifth image ranged from 81.5% to 99.83%. The accuracy of each data in the 6th frame ranged from 81.87% to 97.82%.

Table 3. The accuracy of art image metadata in the experimental group

Fine art image related metadata	1	2	3	4	5	6
Artwork Identity document number	85.62 %	88.66 %	89.82 %	81.34 %	89.88 %	82.17 %
Annotation of the work	92.29 %	90.68 %	87.29 %	94.58 %	99.83 %	97.82 %
Categories of work	83%	80.9%	99.89 %	81.55 %	98.79 %	94.47 %
Source of the work	80.29 %	92.25 %	98.09 %	83.92 %	81.5%	90.50 %
Work volume number	86.77 %	94.65 %	94.34 %	88.16 %	82.73 %	93.83 %
Copyright of the work	85.63 %	97.77 %	84.46 %	80.7%	97.45 %	88.51 %
Creation time	82.35 %	82%	91.94 %	84.68 %	84.97 %	93.68 %
Author Information	91.65 %	83.04 %	94.19 %	85.62 %	87.59 %	81.87 %
Stylistic features	88.76 %	91.37 %	82.44 %	81%	97.43 %	92.07 %
Background of work	89.2%	80.64 %	86.95 %	85.16 %	82.05 %	88.36 %

Table 4 describes the metadata accuracy of 6 undesigned art images in the control group. Among them, the metadata accuracy of these 6 art images without dynamic design was lower than 80%. The accuracy of the data in the first frame ranged from 53.58% to 72.56%, while the accuracy of the data in the second frame ranged from 53.92% to 79%. The accuracy of the data in the third frame ranged

from 53.88% to 73.72%, while the accuracy of the data in the fourth frame ranged from 51% to 78.37%. The accuracy rates of the data in the fifth frame were between 50.39% and 79.12%, while the accuracy rates of the data in the sixth frame were between 50.73% and 78.5%.

Table 4. Accuracy of art image metadata in the control group

Fine art image related metadata	1	2	3	4	5	6
Artwork Identity document number	62.37 %	55.03 %	70.77 %	74.44 %	76.73 %	50.95 %
Annotation of the work	57.07 %	70.60 %	61.54 %	53.84 %	63.85 %	62.61 %
Categories of work	66%	70.7%	61.97 %	78.37 %	73.67 %	78.5%
Source of the work	57.3%	59.99 %	69%	64.04 %	59.4%	60.37 %
Work volume number	62.69 %	53.92 %	73.72 %	69.37 %	57.71 %	66.46 %
Copyright of the work	72.56 %	64.90 %	53.88 %	52.3%	63.45 %	72.36 %
Creation time	59.87 %	79%	56.38 %	68.42 %	79.12 %	73.93 %
Author Information	53.58 %	71.14 %	72.43 %	73.83 %	50.39 %	77.73 %
Stylistic features	64.35 %	72.75 %	58.68 %	51%	70.56 %	50.73 %
Background of work	69.4%	69.18 %	68.17 %	52.94 %	78.11 %	75.64 %

The objective indicators for testing the effectiveness of dynamic design of art images include the fidelity and readability of the images presented. One of the objective indicators of an image is fidelity, which requires consideration of the degree of deviation between the evaluated image and the standard image, that is, the deviation value between the two. If the deviation value is small, the fidelity of the image is high. Twelve images from the A art image set were selected as experimental subjects. Among them, 6 images were digitized and dynamically designed based on metadata, designated as the experimental group, and the other 6 art images were digitized without dynamic design, designated as the control group. The deviation values between the metadata of two sets of images and the data of the standard image were recorded, as shown in Table 5 and Table 6.

Table 5 describes the deviation values between the experimental group's art images and the standard images. The deviation values between the metadata of the six dynamically designed art images in the experimental group and the standard image data were concentrated between 0.06 and 0.2. Among them, the first image had the highest deviation value of 0.2 for two metadata, while the fifth image had the lowest deviation value of 0.06 for two metadata.

Table 5. Deviation values between art image metadata and standard images in the experimental group

Fine art images / Metadata	1	2	3	4	5	6
Artwork Identity document number	0.11	0.14	0.08	0.09	0.14	0.06
Annotation of the work	0.17	0.09	0.19	0.10	0.18	0.19
Categories of work	0.15	0.08	0.08	0.09	0.07	0.09
Source of the work	0.19	0.12	0.16	0.07	0.06	0.13
Work volume number	0.14	0.14	0.16	0.06	0.06	0.18
Copyright of the work	0.20	0.18	0.16	0.08	0.11	0.15
Creation time	0.20	0.15	0.10	0.12	0.14	0.07
Author Information	0.14	0.10	0.15	0.18	0.08	0.07
Stylistic features	0.09	0.14	0.17	0.10	0.09	0.14
Background of work	0.11	0.10	0.18	0.07	0.17	0.07

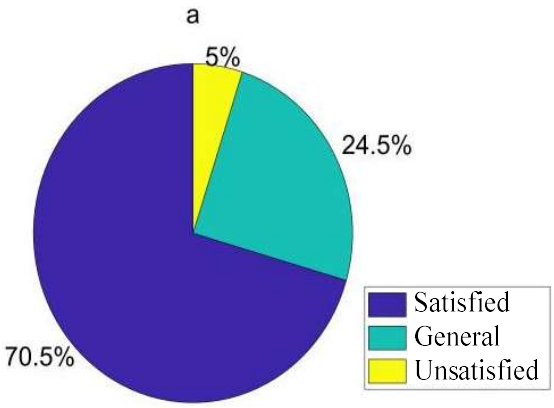
Table 6 describes the deviation values between the art images of the control group and the standard images. The deviation values between the metadata of the 6 undesigned art images in the control group and the standard image data were concentrated between 0.2 and 0.5. Among them, the first image had the highest deviation value of 0.5 for one metadata, while the fourth and sixth images had the lowest deviation value of 0.2 for two metadata.

Table 6. Deviation values between art image metadata and standard images in the control group

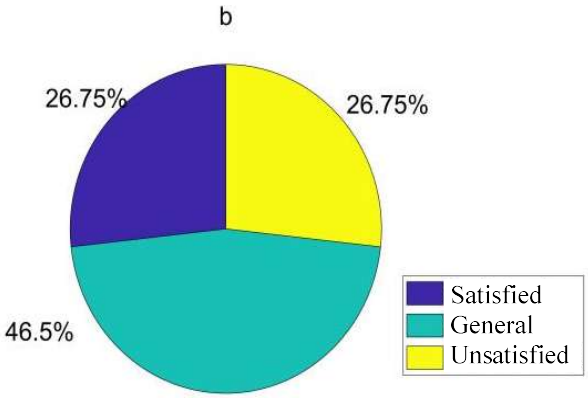
Fine art images / Metadata	1	2	3	4	5	6
Artwork Identity document number	0.40	0.25	0.30	0.48	0.48	0.35
Annotation of the work	0.39	0.41	0.40	0.44	0.21	0.47
Categories of work	0.34	0.37	0.37	0.49	0.41	0.24
Source of the work	0.40	0.38	0.38	0.29	0.42	0.22
Work volume number	0.35	0.31	0.44	0.22	0.26	0.41
Copyright of the work	0.50	0.33	0.44	0.22	0.43	0.45
Creation time	0.37	0.29	0.38	0.41	0.45	0.20
Author Information	0.24	0.36	0.47	0.24	0.45	0.31
Stylistic features	0.27	0.33	0.43	0.42	0.36	0.29
Background of work	0.45	0.39	0.36	0.20	0.37	0.25

4.2. Dynamic Design Effect Evaluation

Based on the survey results in Table 1, different satisfaction ratios were calculated, as shown in Figure 7.



(a): The proportion of satisfaction of experimental subjects with the visual expression effect brought by the experimental group



(b): The proportion of satisfaction of experimental subjects with the visual expression effect brought by the control group

Fig. 7. Proportion of satisfaction of experimental subjects with visual expression effects in the experimental group and control group

Figure 7 calculates the proportion of satisfaction of the experimental subjects with the visual expression effects brought about by T1 and T2. Under the same experimental conditions, the satisfaction rate of the experimental group was 70.5%, while the satisfaction rate of the control group was 26.75%. The satisfaction rate of the experimental group was much higher than that of the control group. It is obvious that users prefer the visual expression effect of digital dynamic design of art images based on metadata.

According to the data in Table 3, the average accuracy and median values of the six dynamically designed art image data in the experimental group can be calculated, as shown in Figure 8.

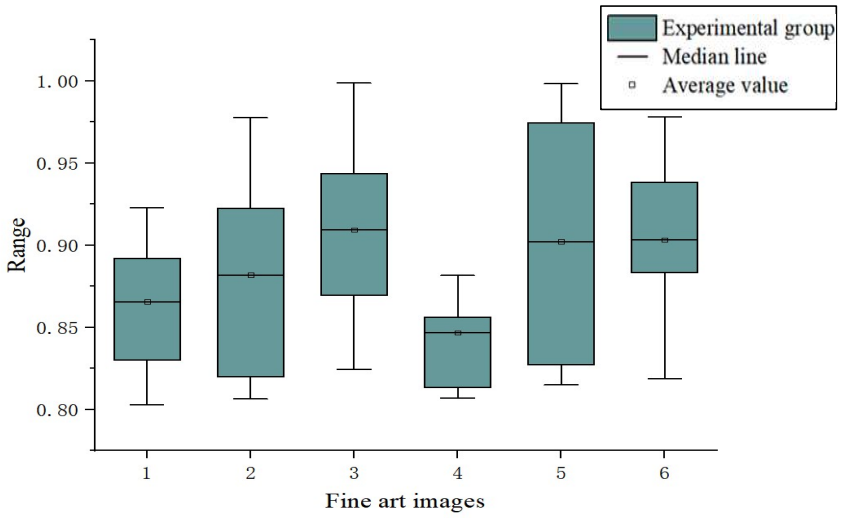


Fig. 8. Mean and median accuracy of art image data in the experimental group

Figure 8 shows the average and median accuracy values of six dynamically designed art image data from the experimental group. The average accuracy distribution of each image in the experimental group was between 84.67% and 90.94%, and the median distribution was between 84.3% and 91.29%. From Figure 8, it can be clearly seen that the mean is very close to the median line, indicating that the overall fluctuation of accuracy is relatively small and stable.

According to the data in Table 4, the average accuracy and median values of the 6 undesigned art images in the control group can be calculated, as shown in Figure 9.

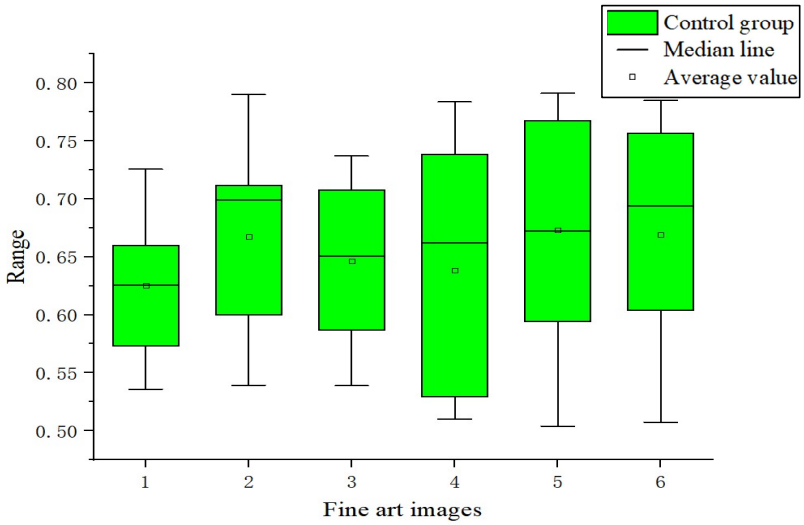
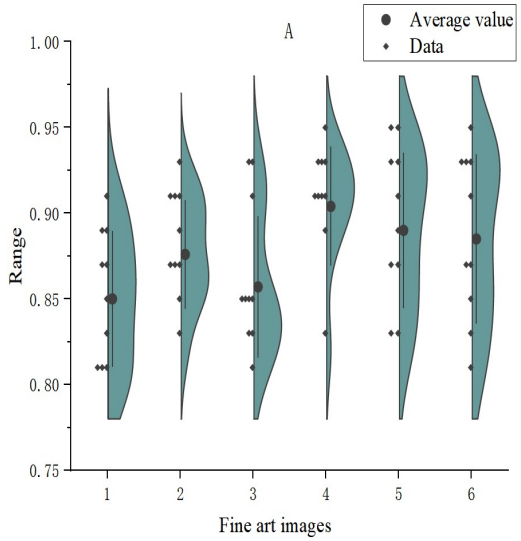


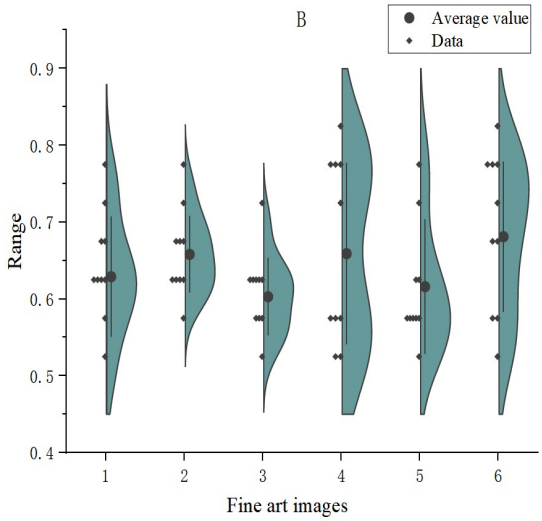
Fig. 9. Mean and median accuracy of art image data in the control group

Figure 9 shows the average and median accuracy values of 6 undesigned art image data from the control group. The average accuracy of each image in the control group was distributed between 62.52% and 67.3%, with a median distribution between 62.53% and 69.41%. It can be clearly seen from Figure 9 that the mean is not close to the median line, indicating that the overall accuracy fluctuates greatly and is not very stable.

According to Tables 5 and 6, the fidelity of the art images presented by the experimental group and the control group can be calculated. The fidelity is equal to the standard image data value 1 minus the deviation value, as shown in Figure 10.



(A): The fidelity presented by the art images of the experimental group



(B): The fidelity presented by the art images of the control group

Fig. 10. The fidelity of art images presented by the experimental and control groups

Figure 10 reflects the fidelity of the art images presented by the experimental group and the control group. The degree distribution of each data fidelity of the experimental group's art images was 0.8-0.94, and the overall fidelity (average range of fidelity) of each art image was 0.85-0.904. The fidelity of the art images in the control group was 0.5-0.8, and the overall fidelity degree distribution of each art image was 0.603-0.681. The fidelity of each art image in the experimental group was higher than that in the control group, which also indicates that the dynamic design of art image digitization based on metadata is more in line with the standards of standard images and more realistic.

5. Discussion

The dynamic research on digitalization of art images based on metadata is the foundation for achieving resource sharing in art image databases. The analysis and processing of metadata is not only for the development of art image databases, but also for more effective utilization of art image

databases. If there is no unified plan and comprehensive consideration for the dynamic research of digital art images, it will have a great impact on future work, causing some obstacles and losses.

This article finds that there are still many shortcomings in the digital dynamic design of art images based on metadata analysis and processing, as well as digital dynamic research. Therefore, it is necessary to use BP neural network to construct a retrieval and analysis model for metadata. The digital dynamic design of art images based on metadata meets the requirements of the times, which can not only improve the fidelity, accuracy, and visual communication effect of art images themselves, but also enhance user experience and achieve interactive display. The digital dynamic design of future art images can utilize artificial intelligence technology to achieve diversification of art images, allowing users to feel the charm of art images more immersively.

6. Conclusions

With the advent of the information age, the digitization of art images has gradually entered people's lives, generating a large amount of information and knowledge different from traditional art images in this process. This information and knowledge are very important. However, due to factors such as image storage and management, search engine limitations, and other factors that affect their effectiveness in the digitization process, dynamic design optimization based on metadata is needed. Therefore, this paper studied the dynamic design of art image digitization based on metadata. In the research process, metadata was sorted out first, and then BP neural network was used for processing and analysis to visualize metadata and interaction design. By utilizing animation production software and interactive display technology, the dynamic design of digital art images was achieved. Finally, experimental evaluation was conducted. In order to better evaluate the dynamic design effect of art image digitization, the visual communication effect, accuracy, and fidelity of art images were mainly verified. Taking the A art image set as an example, the experiment collected user feedback data and art image metadata from different age groups. Firstly, the visual communication effect of dynamically designed art images was studied. The experimental group had the highest satisfaction rate, far exceeding the control group, and the proportion of satisfaction rate in the experimental group was also the highest. Secondly, the metadata accuracy results of dynamically designed art images were higher than those of the control group, and the average and median accuracy values were similar, with small overall fluctuations. Thirdly, the deviation between dynamically designed art image data and standard images was relatively small, resulting in a high overall fidelity. In summary, metadata can better achieve digital dynamic design of art images. The study of digital dynamics in art images can not only help us understand the content of art images, but also provide reference opinions for creation, thus giving them better vitality.

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