

ART HISTORY THEORY IN DIGITAL VISUAL CULTURE

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ABSTRACT

In order to meet the diversified visual aesthetic needs of the public, this paper constructs a digital visual model based on art history theory. Firstly, the SIFT algorithm is used to extract the art scene feature points, and the convolution operation is carried out by Gaussian function to form a three-dimensional scale space. Then the system reconstruction technology is applied to realize the reconstruction of digital images, and the completeness of the reconstructed images is ensured by setting visual symbols. Finally, texture segmentation is performed by combining pixel difference features, and according to the dynamic distribution of the corner points of the art scene, the local binary fitting method is used for the information enhancement and restoration processing of the art image. The results show that the drawing time of the model in this paper is always kept within 4s, and the completeness of the images all reach more than 99%, and the highest clarity can reach 0.99. It is verified that under the guidance of the art history theory, the attributes of the digitized visual culture have been innovated, and the art space has been expanded.

KEYWORDS

Art history theory; digital vision; SIFT algorithm; Gaussian function; system reconstruction technology

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1. INTRODUCTION

With the rapid development of information technology, the diversification of art media provides a favorable environment for the operation of sensory association mechanism in public space. The continuous progress of media technology makes multi-sensory interaction as the characteristics of super design become the main way of art communication in the information society [1]. Sensory interaction and media integration also make public space become an art museum without walls, which is an aesthetic realm where the light of science and technology ignites artistic ideals. Holographic technology fully mobilizes all our senses, dynamically presenting human cultural genes and historical codes through the perspective of art, promoting contemporary art to break the traditional aesthetics and take a solid step towards the future of art history [2-3]. Behind a certain art history writing practice, there is always a certain art history theory. Because the scientific and ideological aspects of art history are different from the scientific aspects of natural sciences and the ideological aspects of other humanities and social sciences, art history theories will undoubtedly understand the scientific and ideological aspects of the artworks with variations and uncertainties at the same time, which will make the scientific aspects and ideological aspects realize the mutual intertwining in themselves [4]. The presentation of art and cultural information cannot be separated from the participation of visual technology. The continuous updating of visual technology promotes the constant change of cultural communication. Nowadays, digital technology is widely used in all aspects of people's life world, and cultural information is more often presented in the form of visual images, which has become the most powerful communication method in contemporary times [5-6]. In the new period, it is of great practical significance to study the innovation and development of visual communication design in the digital era.

Based on the theory of art history, this paper constructs a digital visual model and adopts the SIFT algorithm to adjust the transparency and grayscale value, which enhances the visual communication effect of art and culture packaging. The construction of a symbol library and material database with information and the development of technologies such as image retrieval can improve the efficiency of researchers and conservators in querying relevant data, and can expand the traditional visual art expression. On the basis of the texture information characteristics of digital images, the optimized design of digital simulation synthesis of art images is carried out. In the practical analysis, the feasibility of the method of this paper is verified by performance testing, image quality testing and creation cost. It is proved that art history theory shapes new ways of information acquisition and interpretation, contributes to new thinking and cognition, highlights the challenging nature of postmodernism, shapes art history into a visual trajectory, and realizes the breakthrough of art history from static research to dynamic research.

2. LITERATURE REVIEW

Potashova, K The technique of attracting pictorial elements into textual poetics, outlining the special way in which vision is associated with the perception of the envisioned world as a picture, identifies the mechanism of linguistic color transfer. The vastness of the universe is represented by complex color nicknames in rich semantic shades, wild animals are considered as aesthetic objects, and the vastness of the universe is represented by a large number of colorful minute details [7]. He, L. aims to analyze the possibilities of mixing the modern image visualization with the emerging VR technologies, proposing a model of artistic image design based on the process of visual interaction, a rigorous sequence of assembly, and a suitable mode of equipment. The VR-based design achieved promising results, realizing three basic image manipulations: illumination change, occlusion change and color change, proving that the technology is feasible and suitable for combining with the visual design of artistic images [8]. Midak, L. et al. visualized the educational process of the chemical discipline based on augmented reality technology, whose 3D model appears to be manipulable in some way to better understand its structure, working principles, etc. The application of augmented reality objects gives the teacher the opportunity to explain a large amount of theory quickly and efficiently, while the student memorizes it effectively, fosters creativity and increases motivation to learn [9]. He, W proposed a further application based on the JTFA method to reconstruct the frequency 3D sliced image visualization to represent the distribution of the main frequency components in the measurement area. The frequency C-scan can be reconstructed after using the proposed signal processing process. By segmenting the frequency C-scan, the frequency distribution of the surface at a specific radar time/depth can be obtained [10].

Pintus, R through MLIC's latest integrated view as a means of gaining insight into objects through analysis and visualization of acquired data. By fusing all acquisitions into a single augmented image, the focus is on methods that produce relightable images through intermediate representations. This is achieved using various analytical forms of the fitted light transformation function, but also by locally estimating the parameters of physically plausible shape and reflectance models and using them for visualization and analysis [11]. Gulyaeva, G explores the phenomenon of Chinese realism and the premises and factors that influence the process of acceptance of modern art in China. Using a systematic and holistic approach to analyze the realism of Chinese painting, it reveals the diversity of forms and directions of Chinese painting and provides a basis for the evolution of Chinese painting in the context of Chinese art and culture in the twentieth century, and develops ideas about how artistic consciousness changed throughout the era [12]. Qi, B takes the subject of the Chinese and Western art history course in a school and first summarizes the teaching features and flaws, and explains the method of applying big data technology in it. Through actual statistics, students' views on the new education model are counted. Through data analysis, the help of the new education mode on students' learning outcomes is obtained [13]. Peng, Y proposed a visual communication design method for websites based on user experience. With the enhancement of website user

experience as the main line of research, the elements that need to be considered in webpage design are summarized from the perspective of visual communication design. Design elements are extracted from several large commercial websites in China, and a website emotion evaluation scale is constructed and tested for its credibility and validity. Finally, taking the design process of a thematic website as an example, the specific realization method of visual communication elements in the process of website construction is given [14].

3. ART HISTORY THEORY VISUAL COMMUNICATION

The study of art history can not only explain the causes of artistic trends and styles through history and society, but also interpret and reveal the material and spiritual connotations of the development of human civilization through the themes and styles of artistic phenomena and works [15]. The study of art history is by no means only to examine the general laws of artistic development and stylistic evolution, and to provide theoretical and empirical guidance for artistic creation, but it should be a humanities discipline as a study of history and culture. Relative to the text, the research object of art history is visual culture dominated by images, which involves a wider scope than painting and sculpture in the general sense [16]. Therefore, in visual communication, in order to assist the meaning of the main sign, it is transformed into a visual symbol on the graphics to convey the meaning. Art graphics in visual design not only to express their own design intent, but also to play its visual beauty, that is, art graphics should be in line with its laws, but also to consider its special characteristics. Art graphics play a role in strengthening the main elements and emphasizing the overall atmosphere in the components. Through digital technology, the design process and design methods are constantly improved, gradually developing in the direction of diversification and multidimensionalization, digitizing all kinds of text, images and graphics, and bringing people a richer visual experience.

4. CONSTRUCTING A DIGITAL VISUAL MODEL

4.1. VISUAL REPRESENTATION PROCESS

The human sensory system, mainly visual and auditory, plays an important role in the art creation of the aesthetic subject and the art appreciation activities of the aesthetic object. The visual communication design in the digital era is the realization of interactive communication between human and machine, and the new medium of visual communication design can form a good interactive function and interactive interface to quickly convey important information content [17-18]. Through the continuous improvement of the design process and design methods, it gradually develops in the direction of diversification and multidimensionalization, and digitizes all kinds of text, images and graphics to bring people a richer visual experience [19]. Therefore. Based on the theory of art history, this paper uses limited digital media to realize swifter and more accurate communication and improve the quality and effect of

visual communication. Figure 1 shows the digital visual embodiment process, through the pre-processing module to get the input data and initialized graphics required for structural analysis, the values obtained by the calculation module calculation are transferred to the post-processing module to output the relevant data and construct the three-dimensional visual model, based on which, the SIFT algorithm is used to regulate the transparency and grayscale value, to enhance the visual communication effect of the art and culture packaging. The construction of a symbolic library with information and material database and the development of technologies such as image retrieval can improve the efficiency of researchers and protectors to query the relevant data, can expand the protection ideas of the remains of traditional visual art expressions, promote innovative thinking, and improve the level of protection and research on the remains of traditional visual art expressions as a whole [20]. Through digital visualization. The information communication form presents diversification and multidimensionalization, and the deconstruction and reorganization of text, pictures, images and other graphic design elements, and the combination of two-dimensional and three-dimensional space can design more diversified, more vivid and more visually striking works, which can strongly stimulate people's vision and psychology.

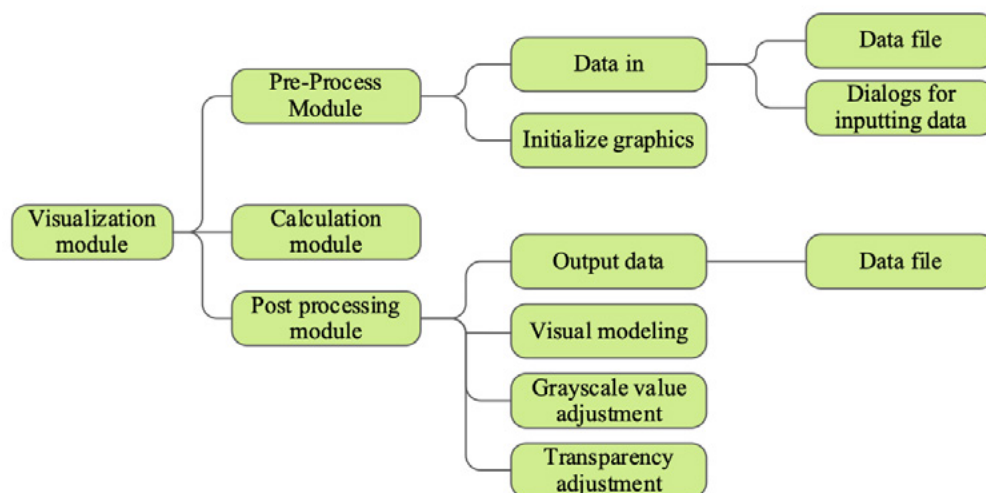


Figure 1. Digital visualization of the process

Based on the theory of art history in the visual language to express, can have a lot of space for activities, can be cross-linguistic and cross-script communication, there are tens of millions of languages in the world, not through the language of the text can become a kind of independent graphics, but also can become a kind of information dissemination of symbols. Through the integration of digital technology, visual communication design can integrate graphics, video, sound, text, animation and other media into one, and a variety of media synergies to achieve a combination of sight, sound, touch, and unity, making the information transfer more intuitive and convenient compared to the text. And visual communication from two-dimensional gradually shifted to three-dimensional, from static gradually shifted to dynamic, and gradually developed into dynamic three-dimensional image, which makes the traditional design of the expression of a more technological, digital, to achieve the desired effect, to meet the audience's multiple visual aesthetic needs.

4.2. EXTRACT IMAGE FEATURE POINTS

In this design, visual communication technology is referred to the process of art scene processing, and a variety of visual symbols are set in the processed scene, and the processed scene is categorized and stored through the symbols, and a special file is set to improve the precision and speed of scene processing during reconstruction [21]. In the setting of visual symbols, attention is paid to the format of the scene to ensure that the symbols are used in the processed scene as a basis for feature point extraction.

Using the processed scene, the SIFT algorithm is used to extract the art scene feature points. First, the three-dimensional scale space is constructed, and the Gaussian function with different scale factors is convolved with the scene to form a series of images with different scales and image pixels, and the scale space is set to be $A(x, y, \partial)$, the original image to be $B(x, y)$, and the Gaussian function to be $C(x, y, \partial)$, then there are

$$A(x, y, \partial) = B(x, y) \otimes C(x, y, \partial) \quad (1)$$

where ∂ is the scale space factor. It is set to increase exponentially, and each value has a corresponding image, which is formed into a Gaussian pyramid for feature extraction of the art scene, and its extreme points are set to be the feature points of the image, i.e:

$$D(x, y, \partial) = (C(x, y, n\partial) - C(x, y, \partial)) \otimes B(x, y) \quad (2)$$

where n is the scale shrinkage factor. Find the extreme value point in the result of equation (2), which is the feature point of the image. The acquired feature points are matched and their consistency is calculated to derive the key points for image reconstruction and complete the 3D digital visual reconstruction.

4.3. DIGITAL IMAGE RECONSTRUCTION

Using the feature points obtained above, the original system reconstruction technology is used to realize the reconstruction of digital images. The image information after setting the visual symbols is used in the reconstruction to ensure the completeness of its reconstruction, and the digital image reconstruction process is shown in Figure 2. On the basis of the original digital image reconstruction system, the visual communication technology is quoted to ensure the feasibility of the application of this technology in the three-dimensional image reconstruction system, and the specific process is designed as the following steps:

1. After inputting the image, capture the original image and preprocess the image to make the picture more suitable for processing and operation than the original image.

2. Supplement the missing parts of the spatial domain of the image to enhance the spatial domain of the original image and improve the appearance of the image.
3. Describe the image with different resolutions respectively, and cooperate with the image self to the resolution description after the image segmentation, adapted to the most suitable resolution.
4. Complete the image processing and output the new image.

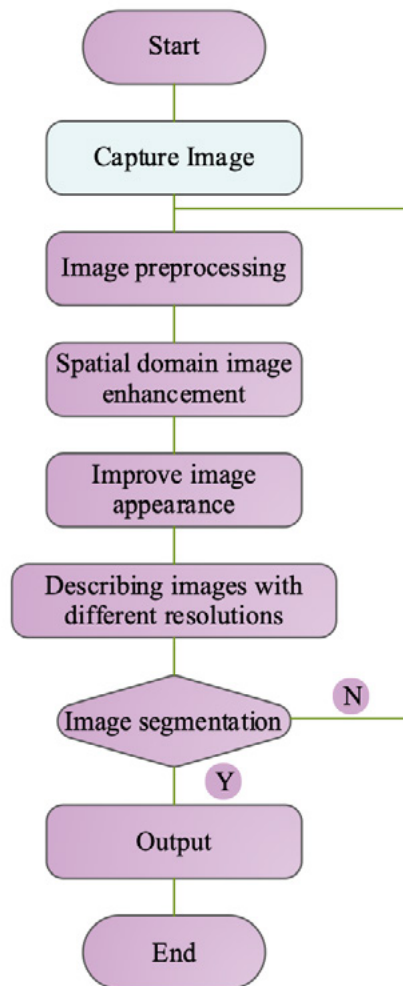


Figure 2. Digital image reconstruction process

Through the above process to realize the reconstruction of three-dimensional image, the reconstructed feature point set is set to u, S for the reconstructed three-dimensional image image vector, the original image feature point is p , in the reconstructed image has a point of overlap, the accuracy of its operation does not take into account the overlap part, then:

$$I(n) = (S(n) \cdot u + S(n) \cdot p)/n \quad (3)$$

Where, p is the 3D image section, after reconstruction, the 3D image error does not exceed 0.1% is qualified.

4.4. ENHANCEMENT OF ARTISTIC MESSAGES

Initializing the model and combining the 3D data distribution synthesized from the digital simulation of the art scene, the following iterative equations for the contour curve evolution process are obtained:

$$v_{i,d}^{k+1} = \omega \cdot v_{i,d}^k + c_1 \cdot \text{rand}() \cdot \left(c_3 \cdot \text{rand}() \cdot \text{pbest}_{i,d}^k - x_{i,d}^k \right) + c_2 \cdot \text{rand}() \cdot \left(c_4 \cdot \text{rand}() \cdot \text{gbest}_d^k - x_{i,d}^k \right) \quad (4)$$

where C_3 and C_4 are called the secondary matching templates of the 3D digitized image of the art scene. In the process of contour curve evolution, the texture segmentation is performed by combining the pixel difference features, and for the gray sample set $\{x_i, y_i, z_i\}$ of the art image, x_i is used to denote the input of the sparsity texture feature of the prints, y_i denotes the output of the corresponding edge pixel set, and z_i denotes the output of the pixel intensity feature, and the geometrical feature distribution function of the digitized simulated synthetic image of the art scene is obtained as:

$$f(x) = w^T \varphi(x) + b \quad (5)$$

where w is the gray scale inhomogeneous pixel feature component and b is the bias.

In this paper, the art history theory is used to optimize the art information of art scenes through digital technology. On the basis of the texture information characteristics of digital images, the optimization design of digital simulation synthesis of art images is carried out. In the gray scale pixel area, according to the dynamic distribution of the corner points of the art scene, the image digital simulation synthesis is carried out by the local binary fitting method to establish the Lagrangian function:

$$L(w, b, e, \alpha) = J(w, e) - \sum_{i=1}^l \alpha_i \left(w^T \varphi(x_i) + b + e_i - y_i \right) \quad (6)$$

where α_i is the Lagrange multiplier. In the whole visual communication process, information interpretation and visual symbol reception are a more complicated process. In this paper, the art history theory is used as the basis for dynamic feature segmentation of digital images of prints by combining edge contour segmentation and texture segmentation techniques. The local binary fitting method is used for information enhancement and restoration of art images, and the information fusion technology is used to realize the analog synthesis of digital images.

5. ANALYSIS OF DIGITAL VISUAL MODELING PRACTICES IN ART HISTORY THEORY

5.1. PERFORMANCE TESTING

5.1.1. MAPPING TIME

In order to verify the performance of the system, an art image is taken as the research object, and the system is verified from the visualization point of view, and in order to compare the performance of the system, the model of this paper is compared with the sensor-based visual communication system and the visual system based on feature extraction, and in the process of the model drawing the image, the size of the image affects the time of drawing, and the time required by the system to draw the image in the case of different image sizes is shown in Table 1, and the time required by the system to draw the image is compared with the other two methods at the same time. The drawing time of the system in this paper is compared with the other two methods implemented. With the growth of the image size, the drawing time increases gradually, but the model in this paper always stays within 4s, the drawing time is faster, while the other two systems drawing time grows continuously, the longest drawing time has been more than 10s, indicating that the model constructed in this paper is more efficient in drawing, and it can improve the work efficiency in the process of practical use. Digital information acquisition and processing technology can better organize, collect and record the information of visible artistic expressions of national folklore, which can break through the display requirements and real effects that cannot be achieved by the protection methods in the traditional sense.

Table 1. System drawing time

The image is large Small /dpi	Theoretical models of art history/s	Visual communication systems for sensors/s	Visual systems for feature extraction/s
256×256	2.36	4.28	6.85
640×480	2.96	4.87	7.34
1024×768	3.18	5.19	8.64
1600×1 200	3.49	5.67	9.66
2048×1536	3.97	6.35	10.35

5.1.2. ENERGY CONSUMPTION

A delicate and beautiful image can attract people's attention and give them a good emotional experience. The visual environment conveys artistic and cultural connotations and aesthetic requirements in the form of image modeling. There are also differences in the energy consumed by the system in drawing images, for

example, the size of the image of 1600 × 1200 dpi, the model of this paper and the other two systems in the drawing of the image of the energy consumed as shown in Figure 3. With the increase of the system use time of the system energy consumption of this paper does not change much, always keep below 0.45J, and the trend is relatively smooth. While the other two systems with the increase of the system use time energy consumption in general shows a rising trend, in which the sensor-based visual communication system fluctuates more during the working time, indicating that the stability of the system's energy consumption is poor. The theoretical model of art history consumes the least amount of energy in the design of the experimental object, and in the actual use of the process, it is able to preserve the digital information that meets the needs of the legacy of traditional visual art expressions, and it can exert its advantages of convenience and lower cost. It makes the modern visual communication design works richer in content, more diverse in form and more profound in connotation, forming a stronger visual impact and thus achieving a more desirable visual communication effect.

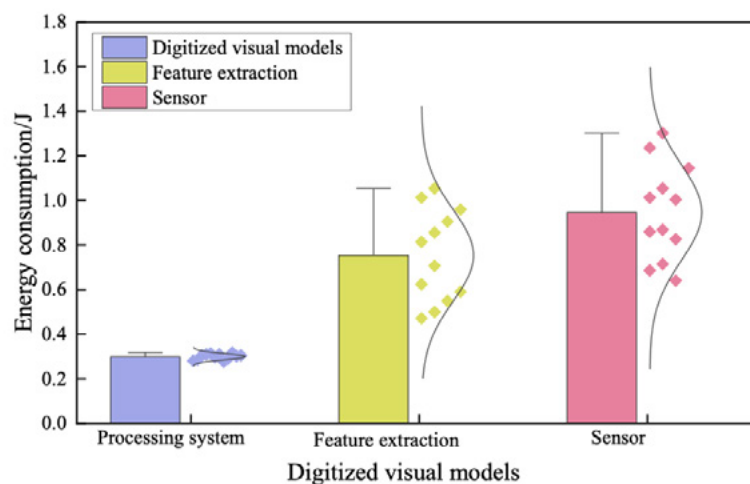


Figure 3. The amount of energy expended when drawing an image

5.2. IMAGE QUALITY DETECTION

5.2.1. IMAGE INTEGRITY

In order to verify the feasibility of the designed digital visual model based on art history theory, a test session is set to judge its feasibility by comparing the integrity of the reconstructed images. The test is based on the reconstruction results to build a 3D reconstruction platform, based on the image editing tools, 3D production equipment and professional engine, using C language as the platform development language, and adopting a multi-architecture network to transmit the image data to ensure its timeliness and completeness. The editor selects highly integrated equipment to improve the operation speed of reconstruction. Table 2 shows the results of the comparison of the integrity of the reconstructed image, using the art history theory model to reconstruct the image of the results of the integrity is significantly higher than

the original image, and the degree of completeness of more than 99% of more stable, while the original image fluctuations are larger. Through the comparison, it can be seen that the original image texture and color matching and samples differ greatly, the reconstruction results of this paper and samples are more consistent. To ensure the integrity of the image edge structure, effectively combined with the characteristics of the depth image, to obtain a complete image after processing. Through the theory of art history, and the completion of the digital media, so that its artistic characteristics have undergone a great transformation.

Table 2. Comparison of image integrity after reconstruction

Sample serial number	Size	Original image		Reconstructed image	
		Resolution/dpi	Completeness/%	Resolution/dpi	Completeness/%
1	50×50×50	112	98.9	170	99.01
2	100×120×10	215	93.5	300	99.3
3	20×35×40	306	97.26	360	99.0
4	55×60×90	118	94.5	211	99.89
5	20×180×9	198	90.81	246	99.67

5.2.2. IMAGE CLARITY

In order to test the feasibility of this proposed idea of creating a digital visual model based on art history theory, as well as to verify the adaptability in the field of digital media, certain digital media art scenes are selected as examples of digital media art creation using the sub-design method, and in order to make the experimental results and experimental data more illustrative, this experiment adopts numerical comparisons, selecting the sensor-based visual communication system and the feature extraction based visual system for comparison. Since clarity can reflect the clarity of digital media art images, the higher the clarity value, the clearer the digital media art image is viewed by the naked eye and the higher the image quality. The experiment randomly selects 10 images of different scenes and records the art image clarity. Table 3 shows the results of image clarity comparison, the application of digital visual model based on the theory of art history created by the art work image clarity is relatively high, the highest clarity can reach 0.99, the lowest clarity is 0.96. The average value of the image clarity of the art work image clarity is 0.97, which can be controlled at more than 0.95, which is a higher level, indicating that the use of this paper's design methods the quality of the art images created is relatively high and the picture quality is clear. On the other hand, the image clarity of art works created by sensor-based visual communication system and feature extraction-based visual system is relatively low, the maximum value of image clarity of sensor-based visual communication system and feature extraction-based visual system are 0.74 and 0.66 respectively, the minimum value is 0.51 and 0.52 respectively, and the average value

is 0.55 and 0.57 respectively, which indicates that the visual cultural research objects often overlap with art history, which promotes the pace of exploration of digital media art on contemporary art, brings infinite possibilities for its development, and broadens the original boundaries.

Table 3. Comparison results of image clarity

Serial number	Theoretical models of art history/s	Visual communication systems for sensors/s	Visual systems for feature extraction/s
1	0.98	0.56	0.55
2	0.96	0.74	0.63
3	0.99	0.71	0.58
4	0.97	0.65	0.64
5	0.98	0.59	0.66
6	0.99	0.54	0.61
7	0.96	0.62	0.59
8	0.97	0.62	0.54
9	0.99	0.69	0.52
10	0.98	0.51	0.55

5.3. COSTS OF ARTISTIC CREATION

Since the cost of art creation directly affects the benefit of art design, this paper respectively applies the digital visual model based on the theory of art history, the visual communication system of sensors, and the visual system based on feature extraction to different scenes for art creation, and records all the cost data during the creation process, and Figure 4 shows the results of the comparison of the cost of art creation, in which the model constructed in this paper has a relatively low cost, all of which are less than 10000 yuan, and the cost of creation in urban greening is low, at about 2800 yuan. While the visual communication system of the sensor has the highest cost of creation in commercial land reaching 23895 yuan, the cost of creation in indoor landscape is lower, and the cost of visual system based on feature extraction in indoor art creation reaches 23465 yuan. It shows that the digital visual model of art history theory can not only ensure the quality of picture quality in practical application, the image clarity of art works is relatively high, but also the creation cost is relatively low, which meets the needs of digital media creation.

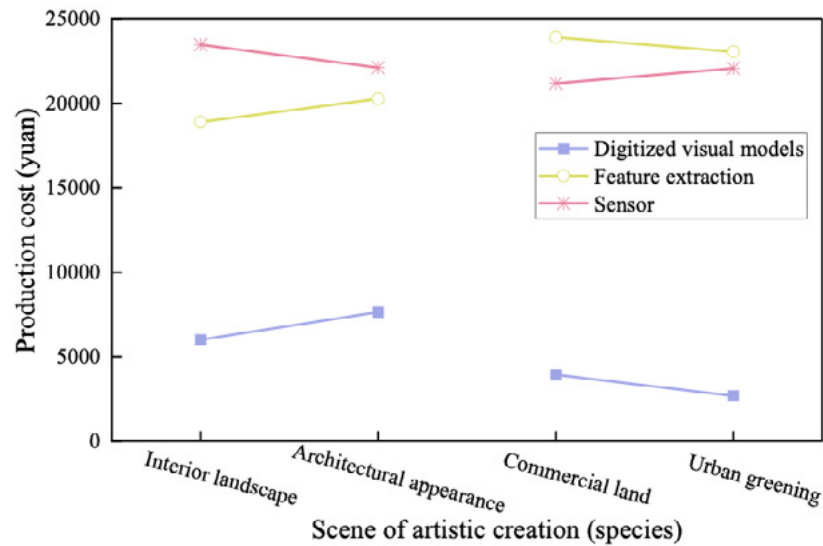


Figure 4. Comparison of the cost of art creation

6. CONCLUSION

This paper investigates the mention of art historical theories in visual communication by constructing a digital visual model. The conclusions are as follows.

1. In the performance test, with the growth of image size, the drawing time of the model in this paper always stays within 4s. The energy consumption situation always stays below 0.45J, and the trend is smoother. It shows that the model constructed in this paper can better collect the information of visible artistic expressions, ensure the integrity of the image edge structure, and effectively combine the features of the depth image.
2. In the image quality detection, the image integrity are more than 99% more stable, and the art work image clarity is relatively high, the highest clarity can reach 0.99, the lowest clarity is 0.96. It shows that the object of research of visual culture often overlaps with art history, to ensure the integrity of the image edge structure, and to promote the pace of exploration of digital media art to contemporary art.
3. In the analysis of the cost of creation, the model constructed in this paper want more low cost, are more than 10,000 yuan, in the urban greening in the creation of low cost, in about 2800 yuan. It shows that the digital visual model of art history theory in the practical application can not only ensure the quality of the picture quality, the image clarity of the art work is relatively high, and the cost of creation is also relatively low, to meet the needs of digital media creation

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