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Application of Virtual Image Symbol Reconstruction Technology in Advertising Design

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Abstract. Computer Aided Design (CAD) has greatly promoted the practical technological reform of media advertising. Virtual reality technology, as a prominent feature, is characterized by its interactivity, immersion, perception, and autonomy. Modern advertising design companies can endow their advertising works with more fresh vitality through the rational introduction, promoting users to obtain an immersive experience. This article studies the application of CAD virtual image symbol reconstruction in cultural creativity in advertising design. This article selects the image with the best visual effect from low resolution CAD images and uses it as the initial estimation of the interpolated and filtered super-resolution image. Research has shown that denoising reconstruction and inner product reconstruction are the best, with similarities of 81.1% and 84.9% to the histograms of sampled CAD images, respectively, much higher than the 38.1% similarity between SR images and the original image. The experimental results show that K-means clustering significantly reduces the size of the 2D digital field and improves the speed of CAD 3D image reconstruction by preprocessing 3D images.

Keywords: Image symbol reconstruction; Advertising cultural design; Computer Aided Design (CAD); CAD 3D image reconstruction
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1 INTRODUCTION

In the advertising design industry, with the development of science and technology, the influence of CAD virtual reality technology is gradually expanding. Due to the variety, quantity, and single mode of advertising, the audience has developed a sense of resistance towards them. And CAD virtual reality technology improves this issue by providing users with an immersive experience through its interactive viewing mode. Agarwal et al. [1] increased the flexibility of CAD models by automatically refining the parameterization of computer-aided design (CAD) models. The application of CAD virtual reality technology in advertising design can not only effectively improve

the high-cost issues in traditional advertising design, but also reduce the difficulty of advertising shooting. Barreto et al. [2] developed a CAD editing image supervised substation plan and virtual reality software. By simply integrating 3D and symbolic modeling conventions, an architecture for precision and centralized software in the VR environment has been constructed. The results indicate that CAD has some help in describing VR environments. Because traditional advertising shooting not only requires setting up different scenes, but also adjusting the time of the staff and photographers. Virtual reality technology, on the other hand, does not require shooting from different locations, greatly reducing the difficulty of shooting. Virtual reality technology only requires one computer operating device, and this device can be applied multiple times to advertising design. Ben and Cengiz [3] conducted an analysis of industrial robot matching algorithms for CAD models. By analyzing the matching algorithm of NCC, the matching stability of robot vision has been improved. De Freitas et al. [4] provide a new perspective on visualization of CAD virtual reality, inspiring new insights. Virtual reality technology can transform designers' creativity into real visual effects through computer digitization, allowing viewers to experience a more stunning experience. For example, in computer advertising design, designers can use CAD virtual reality technology to display products in a virtual space, allowing consumers to have a more intuitive understanding of product characteristics, thereby deepening their impression of the product. In addition, virtual reality technology can also enhance the visual impact and attractiveness of advertisements through animation and special effects. Computer assisted virtual reality technology can bring more diverse forms of expression to advertising design. For example, in advertising, designers can use virtual reality technology to create advertising images with three-dimensional and dynamic effects, allowing consumers to have a deeper understanding of product characteristics. In addition, CAD virtual reality technology can also engage consumers in the interactive process of advertising through interactive experiences, enhancing the fun and sense of participation of advertising. In short, virtual reality technology has broad application prospects in visual communication and advertising design, which can help designers better express their creativity, enhance the attractiveness and dissemination effect of advertisements.

2 RELATED WORK

Fan and Li [5] analyzed computer assisted image processing technology using mobile image information transmission as a medium. Through the information characteristics of images, this paper conducts theoretical research on computer related psychology and semiotics. Gelmez and Arkan [6] pointed out that CAD virtual reality lacks effective application in advertising design courses. It developed advertising construction and reconstruction knowledge under the CAD command guidance course. Through the results of peer design, learners are required to be prepared for a specific audience. In addition, this study combines assessment strategies with these learning activities through formative assessment tasks. Han and Ge [7] studied the use of CAD virtual technology to showcase the services of advertisers. Through virtual reality technology, customers can observe products from different perspectives and environments, thereby better understanding the characteristics and advantages of the product. This greatly reduces costs and saves the cost of environmental layout and labor costs for each tourist attraction. Jones et al. [8] conducted a data structure analysis on assembly modeling in computer-aided design (CAD). It proposes a predictive CAD type matching mode that enhances the compatibility of the topological structure of commercial CAD system parts. Computer aided design has greatly promoted the practical technological reform of media advertising. Jung and Heo [9] identified the chaotic influencing factors of social media advertising in this context. By reducing the factors that affect harmful advertising chaos (i.e., advertising types and advertising personalization), consumers tend to selectively focus on local advertising areas. Kujur and Singh [10] proposed a new network social model for visual media communication. Consumer survey analysis was conducted through corporate brand social media pages. The structural equation model has been used and validated to investigate the impact of virtual visual effects with informative, entertaining, and rewarding content on consumer engagement. The virtual theoretical model proposed by it can well reflect the

relationship between consumers and brands. Pedersen et al. [11] conducted a digital model analysis of architectural drawings. By performing visual feedback calibration of monitoring parameters, digital information was assigned and labeled. Tang et al. [12] constructed an image dataset creation and network improvement method based on CAD models and edge extraction operators. By detecting the 3D image dataset, an effective training dataset is generated, which can achieve good detection performance of the target detection network without any tedious work. Compared with traditional methods, this method has more efficient efficiency. Wang [13] explores the development trend of art creation under intelligent vision and elaborates on the experimental analysis results of computer-aided vision. CAD interactive visual communication organization refers to the organization that utilizes CAD software and virtual reality technology to communicate the design concepts and styles of products or services to potential customers in an interactive visual manner. Wei and Han [14] use CAD software and virtual reality technology to quickly construct styles and effects in advertisements. Advertisers can use virtual reality technology to showcase different design effects in a short period of time, thereby better expressing their design concepts and styles. Willis et al. [15] provided an introduction to a parameterized CAD data model. This model was programmed and constructed in the design sequence of the 360-image library. Computer graphics production has now become a good practical template for landscape design in application development. Xu and Wang [16] conducted virtual reality landscape design. Computer assisted support for landscape design was provided by referencing immersive landscape paintings. Yang and Fugen [17] utilized VR technology for packaging design training. CAD virtual technology can help designers master more design skills and methods. This process can be carried out in a virtual environment to better simulate the actual situation. Yun and Leng [18] used CAD software for packaging design modeling, converting the 3D model of the product into a 2D drawing. This process can help designers better understand the structure and characteristics of products, thereby better expressing their design concepts and styles. Zhang [19] has conducted reverse optimization design in the field of visual interaction art design. By establishing an image processing model for human-computer interaction interface and analyzing information features, an enhanced processing system for visual communication information was constructed. It discussed how to better integrate visual interaction experience with creative design, and analyzed the key points of visual interaction work creation process, design, and technology.

3 RESEARCH METHOD

3.1 The Cultural Attribute and Reconstruction of Image Symbols in Advertising Creative Design

The principle of originality in advertising creativity. The principle of originality refers to the courage to be innovative and innovative in advertising creativity, rather than following the beaten track. Original advertising creativity has the greatest psychological breakthrough effect. The substantive principles of advertising creativity. Originality is the primary principle of advertising, but originality is not the end. Whether advertising creativity can achieve promotional purposes basically depends on the efficiency of conveying advertising information, which is the substantive principle of relevance, including comprehensiveness and relevance. Understanding refers to being easily accepted by a large audience, while relevance refers to the internal correlation between image combinations and advertising theme content in advertising creativity.

According to the different application fields of advertising design, there are various methods to express and represent images, or to display images in a certain form. Image representation is the foundation of CAD image display, and image display is one of the important modules of computer vision systems. To express and display an image, it is necessary to express and display each unit of the image. Each basic unit in an image is called an image element. The expression and display of images are closely related, and image display is a visual representation of images. The display of 2-D images can take many forms.

The phenomenon of visual symbols being associated with specific objects and meanings is called arbitrariness in symbols, which indicates that any symbol system is premised on arbitrariness. Every unit in the entire world is in a temporary variable state, and the premise of flexibility and dynamism is that it must follow the rules of the system, which can be referred to as deep structure. According to convention, the design of iconicity symbols has been completed, from images to charts and then to metaphors, from concrete to abstract and then to concrete image symbol reconstruction design.

Due to the diversity and complexity of people's emotions, it is usually impossible to describe their feelings about products with single-dimensional perceptual words. These images work together to form a set of product images, which are used to describe the overall impression of the observer on the object. This classification method can effectively describe and divide the multiple images of products, and help designers to clarify the primary and secondary in the design process.

Assuming that the unit design factor has m images, a total of n subjects evaluate their image values, the image value is x, and the first image value of the ith user is x_{ij}, thus the evaluation matrix A^X of the unit design factor user image value can be obtained, which is an $m \times n$-order matrix.

$$A^X = \left[x_{ij}\right] \tag{1}$$

In this paper, the design factor image is divided into two gradients: idea image and sub-image. According to the above definition, if the jth image value is x_j, the ratio of this image value to the total image value B_j value is:

$$B_j = \frac{x_j}{\sum_{a=1}^{n} a}, \quad 1 \le a \le n \tag{2}$$

This article divides the conceptual image of advertising design elements. Firstly, in order to prevent the complexity of the problem, CAD virtual reality concept images are used as the only criterion for dividing design factor images. Through image analysis of multidimensional design factors, identify internal relationships, and construct a design factor database based on image cognition.

Therefore, the user's image cognitive model of design factors is a cognitive system based on multidimensional features. By expressing the multi-dimensional comprehensive symbolic features of design factors through the user's CAD virtual reality cognitive mechanism under physiological stimuli, psychological images are generated. Thus, a virtual reality image model of design factors was constructed, as shown in Figure 1.

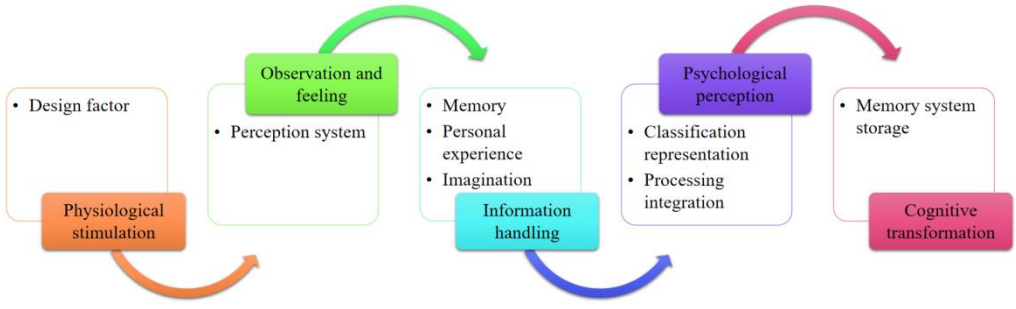

Figure 1: Factor image cognitive model.

Typically, CAD virtual reality visual symbols are selected from computer images and then recreated with visual symbols in other contexts. This method can be referred to as re encoding. Cultural and creative design strategies should systematically integrate cultural resources, improve their analysis and materials, and plan the development priorities, directions, and goals of cultural and creative products. Attractive cultural and creative brands are developed systematically within organized and diverse cultural elements. As a means of artistic expression, there are various design strategies for CAD virtual reality visual symbols. By analyzing and extracting symbols, and recreating visual symbols in other contexts, the reconstruction of image symbols is equivalent to the reproduction of image concepts and narratives.

3.2 Graphic Image Processing and Virtual Reality Technology

The most critical technology in virtual reality technology is environmental modeling technology. By computer-aided image processing, the extraction of object contours in the scene can be achieved, and graphics is a favorable means for describing the shape of objects. In addition, through the lighting model processing technology in CAD graphics, the realistic display of the "image" effect can be achieved, which is the virtual reality of graphics. From this, it can be seen that the extraction of image contour features and the drawing of graphic lighting models are the bridges and bonds between graphics and images. They are also the essential connection between graphics and images. SR(Super resolution) image reconstruction technology has a wide application prospect. A mathematical model is a simplified description of complex phenomena and processes in CAD image reconstruction technology. It can provide a basic framework for problem analysis and numerical processing. The correct model can be used as prior knowledge or constraints for image reconstruction. Only by establishing an accurate observation model can we determine which parameters to estimate and establish appropriate objective equations.

For linear space invariant imaging systems, the imaging process can be described by the following formula:

$$g(x) = f(x) * h(x) \tag{3}$$

NP (Non-deterministic Polynomial) difficult problem is a kind of problem that no polynomial algorithm can solve so far. If we want to simplify the non-deterministic polynomial difficult problem, we need to turn ℓ_0 optimization problem into ℓ_p optimization problem:

$$\min_{x \in R^N} \|x\|_p, \; s.t. \;\; y = \Phi x \tag{4}$$

Gaussian random matrix is the most frequently used measurement matrix, because each element in the matrix obeys independent normal distribution, and has nothing to do with any sparse matrix. The construction method is as follows: firstly, a matrix Φ with the size of $M \times N$ is constructed, and all elements of the matrix Φ obey the normal distribution with the mean value of 0 and the variance of $1/\sqrt{M}$, so that:

$$\Phi_{i,j} \sim N\left(0, \frac{1}{\sqrt{M}}\right) \tag{5}$$

$$1 - \varepsilon \le \frac{\|\Phi\theta\|_2}{\|\theta\|_2} \le 1 + \varepsilon, \; \varepsilon \in [0,1] \tag{6}$$

Then K projection sparseness can be solved from M observations.

On the basis of image space reconstruction, it is necessary to restore the color channels of the image through interpolation algorithms. Different interpolation algorithms have different practical

effects, and an excellent interpolation algorithm should be able to accurately estimate the color of the original image. In the image interpolation algorithm, using these irregular segmentation intervals as the threshold for selecting adjacent points is the core idea of the reconstruction-based interpolation algorithm in this paper. Therefore, when the reconstruction-based interpolation algorithm is operated, it actually corresponds to two linear interpolation. The process of iterative reconstruction algorithm is shown in Figure 2:

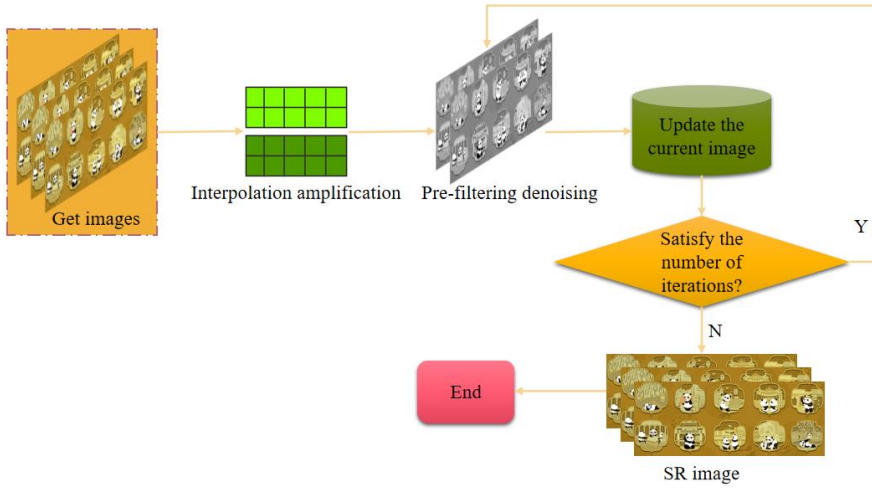

Figure 2: Flow chart of iterative reconstruction algorithm.

4 ANALYSIS AND DISCUSSION OF RESULTS

In order to better apply CAD virtual reality technology to product advertising, it is necessary to formulate reasonable development strategies. Standardizing virtual reality advertising requires starting from the construction of a formal virtual reality platform. Generally speaking, CAD virtual reality platforms are mainly composed of three highly interactive systems, namely individual social interaction, virtual reality devices, and virtual reality environments. By coordinating and managing the data within the three systems, it is beneficial to improve the application effect of virtual reality technology in preset scene design and information data transmission. In practical applications, it is necessary to build a reasonable virtual reality platform, in which individuals can be transformed into a series of information data that can be analyzed and tracked. Understand user needs and characteristics through data analysis. Provide reliable data support for subsequent platform optimization. At the same time, it is necessary to further improve the content review ability, and promote and implement higher quality content in a more comprehensive service system in the virtual reality environment. It will bring users a different virtual reality experience.

Firstly, classify the semantic adjectives of the collected form, color, and meaning images into inverted matrix styles based on the matrix. Further collect the questionnaire, average the data obtained from the form, color, and semantic similarity questionnaire, and calculate the reciprocal. The statistical results of the form image semantic similarity questionnaire data are shown in Table 1 and Figure 3:

Vocabulary	*contracted*	*polite*	*scattered*	*unique*	*rational*	*plump*	*vivid*	*modest*	*stable*	*simple*	*graceful*	*gorgeous*
contracted	2.766	0.663	3.461	2.617	4.697	4.583	4.593	2.757	2.868	5.028	4.154	4.298
polite	1.116	1.079	1.488	3.898	4.914	0.276	0.772	4.893	3.901	1.513	3.656	1.803
scattered	3.468	0.814	1.635	1.643	1.401	3.387	1.305	3.721	4.094	2.31	5.008	2.343

unique	1.975	1.207	0.471	1.555	0.942	0.478	1.434	1.299	4.395	2.059	1.946	2.179
rational	2.466	0.882	1.17	1.881	2.63	4.587	5.033	2.23	0.278	4.507	2.303	0.473
plump	2.038	1.575	3.172	3.092	4.764	4.515	1.687	3.957	0.791	3.547	1.555	3.846
vivid	2.912	0.709	1.479	3.542	1.852	4.334	5.114	2.305	1.35	5.032	1.839	4.132
modest	3.204	2.099	2.136	1.672	2.823	0.624	3.228	1.06	2.888	3.228	1.819	2.831
stable	1.724	0.374	1.522	2.322	3.933	1.219	2.599	3.851	3.325	3.246	1.243	0.392
simple	1.458	1.437	2.045	2.161	1.281	1.756	2.528	1.901	4.021	1.268	4.375	3.829
graceful	3.496	3.839	3.361	3.159	0.843	3.474	1.309	1.567	2.016	3.338	3.13	3.599
gorgeous	2.963	1.689	1.566	3.118	0.774	1.649	3.996	4.968	2.159	2.834	2.986	3.9

Table 1: Semantic similarity survey results.

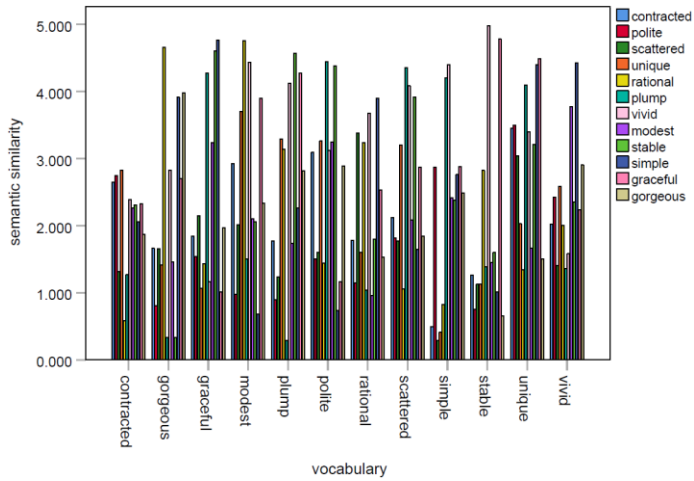

Figure 3: Image similarity data distribution histogram.

Using SPSS software and Pearson correlation, the valid data obtained are analyzed by K-means clustering, and the members are clustered to calculate the similarity between image semantics, so as to determine similar images. The clustering results of semantic lexical similarity are shown in Table 2, Figure 4 and Figure 5.

Final clustering center		
	Cluster	
	1	2
contracted	1.881	2.240
polite	0.917	2.342
scattered	1.882	1.652
unique	2.228	2.198
rational	3.722	1.241
plump	0.912	3.428
vivid	4.007	2.878
modest	1.541	2.670
stable	2.071	3.309
simple	2.357	2.972
graceful	3.638	2.427
gorgeous	2.264	2.210

Table 2: Semantic word similarity clustering results.

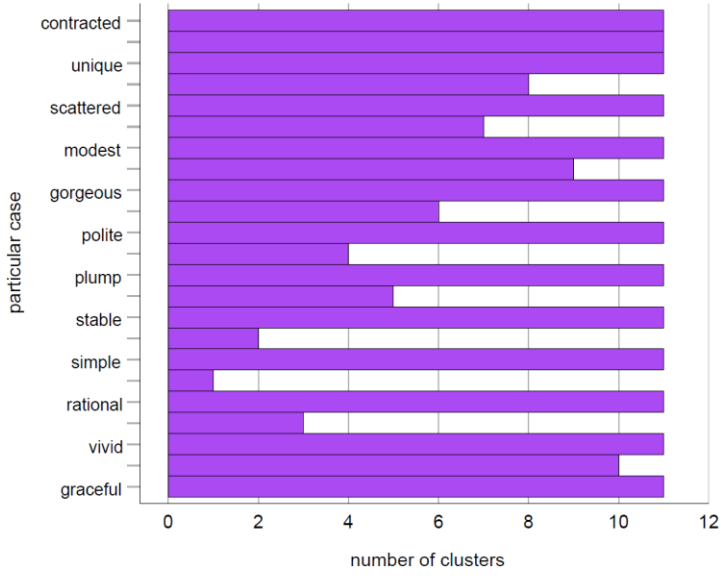

Figure 4: Cluster icicle diagram.

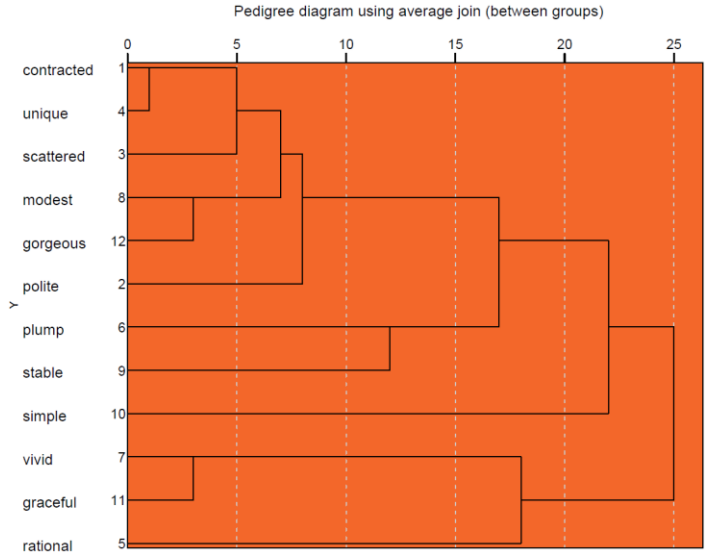

Figure 5: Cluster pedigree diagram.

The results showed that there were 5 sets of similar images. Among them, there are two sets of adjectives with similar images, namely simple, simple, and plain. Lancelot interpolation and pixel region relationship resampling interpolation, are selected as the data control group of the reconstruction-based interpolation algorithm. The results show that an average interpolation algorithm with a period twice the size of the filter can effectively eliminate noise interference, but it also causes some detail loss.

In addition, this article utilizes the prior knowledge of SR images to propose an improved mean interpolation method based on denoising, which has also achieved good results. The sample results are shown in Figure 6 and Figure 7.

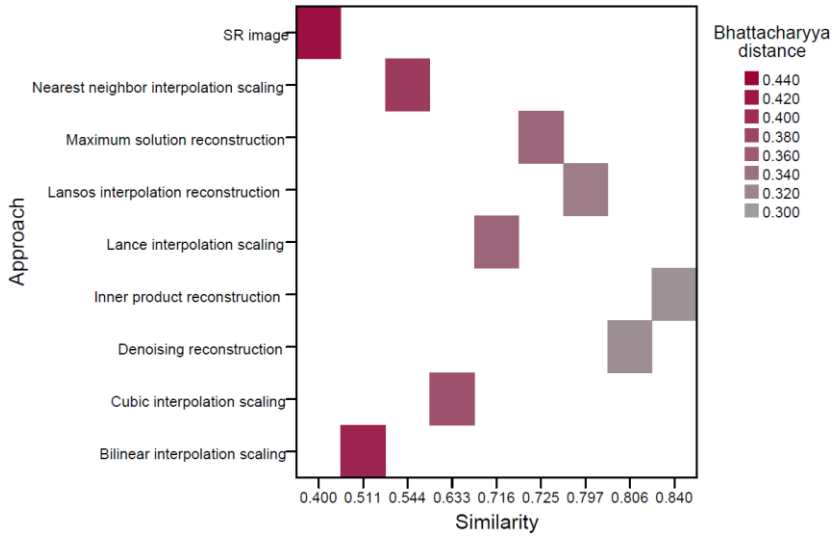

Figure 6: Similarity of original image histogram and Babbitt distance.

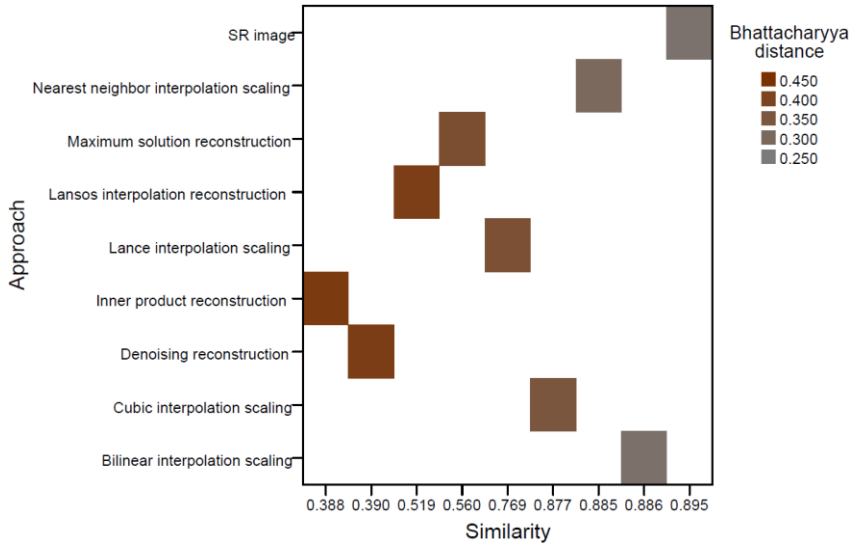

Figure 7: SR histogram Babbitt distance.

The data show that denoising reconstruction and inner product reconstruction are the best, and the similarity between them and the histogram of the sampled image is 81.1% and 84.9%, which is much higher than the similarity between SR image and the original image of 38.1%, and higher than that of the regional resampling interpolation scaling algorithm of 62.5%. It can be seen from the Babbitt distance that the denoising reconstruction and inner product reconstruction are only 20.01% and 20.72%, far lower than the Babbitt distance of about 3.8% of the scaled image.

Compared with the iterative back projection method, the image interpolation method has simple and direct advantages, such as fast operation speed and simple algorithm. The disadvantage is that the reconstructed image has the edge step distortion effect and edge blur effect. The image reconstructed by iterative method effectively reduces the edge effect and suppresses the edge blur.

5 CONCLUSION

This article implements the optimization design of visual effects for print advertising and proposes a visual optimization design method for print advertising based on virtual reality technology. Establish a visual optimization feature information sampling model for print advertising, and complete the design of CAD virtual 3D similarity symbols, from images to charts, to metaphors, from concrete to abstract, and then to concrete image symbol reconstruction design. Studied the application of computer-aided image symbol reconstruction methods in advertising cultural creative design. The SR image is segmented into small pieces with liquid crystal dot regions as a whole. In the image interpolation algorithm, using these irregular segmentation intervals as the threshold for selecting adjacent points is the core idea of the reconstruction-based interpolation algorithm in this paper. The results show that denoising reconstruction and inner product reconstruction are the best, with similarities of 81.1% and 84.9% with the histogram of the sampled image, respectively. Far higher than 38.1% similarity between SR images and the original image. From the Bayesian distance, it can be seen that denoising reconstruction and inner product reconstruction are only 20.01% and 20.72%, respectively, far lower than the Bayesian distance of about 3.8% for scaled images. The PSNR and MSE-MSE of the iterative method are 34.962 and 0.0116, respectively, which outperform the cubic interpolation algorithm in terms of performance. Through the establishment of a sampling model for the visual information characteristics of print ads, the visual information of print ads is integrated and processed using the visual database. Create various real-time interactive 3D visual environments for flat advertisements in CAD 3D simulation scenarios, and achieve visual optimization design for flat advertisements in CAD virtual reality simulation environments. The simulation test results show that this method can effectively achieve visual optimization design of print advertising, improve the visual feature expression effect of print advertising, and has good application value in print advertising design.

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