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Computer-Aided Design AND APPLICATIONS

Design of Visual Communication Digital System Based on CAD Technology

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Abstract. In the digital information environment, the way people get information has also changed. The visual focus is no longer only on traditional media, but on emerging media. The emerging media is constantly impacting the traditional graphic design with paper media as the core and static design as the main form of expression, and the fields involved in graphic design are constantly expanding with the growth of the times. Computer-aided design (CAD) technology has three-dimensional and dynamic special effects, which changes the traditional flat and static characteristics of images, transforms image products into virtual information images, and expands the extension of traditional communication design. In this article, CAD technology and image enhancement algorithm based on improved convolutional neural network (CNN) are used to highlight the structural information of the image, so that visual communication has better three-dimensional and dynamic effects. The results show that compared with the support vector machine (SVM) algorithm, the proposed visual communication image enhancement method has the highest accuracy improvement of 26.74%. Which can effectively solve the problems of unclear and insufficient stereo images. The visual communication automation digital system based on CAD technology has better visual communication effect, higher accuracy, better efficiency of conveying visual information than the traditional system, and better effectiveness and reliability.

Keywords: Computer Aided Design; Visual Communication; Digitization; Emerging Media.
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1 INTRODUCTION

The emergence of "numbers" is the fundamental source of characters. It is the first and very important project of national spirit in the history of China. It not only reflects the primitive way of human cognition of the world, but also reflects the way people master and understand the world

today [1]. Computer technology plays a very important role in people's life. It can help people get information faster and provide an information exchange platform [2]. As far as visual communication is concerned, although the concept of communication design came into being earlier, its effective combination with computer graphics and image technology brought the function of communication design into full play. In this process, people can have a deeper understanding of the connotation and concept of things through observation. Under the background of the accelerating social rhythm, people can't get a deep understanding of a thing for a long time, hoping to get the desired information intuitively through their own eyes. Graphic image processing technology designs, modifies and stores pictures by computer to achieve ideal results. The stage of converting and creating graphic images by using graphic and image processing technology is all processed by computer [3].

With the popularization and application of computers, the requirements for computer graphics and images are getting higher and higher, and the computer graphics and image technology has developed rapidly and gradually formed a relatively mature technical system. The communication design of emerging media technology and art design, under the background of today's times, has been widely used in various industries, and has been continuously improved and developed in the practical application process [4]. People's aesthetic demand for creative expression of digital symbols is more and more diversified, and the visual expression forms are constantly updated. As a carrier of certain emotions and knowledge, numbers should keep pace with the times and express the personality characteristics of the times in which they are transmitted. In the field of communication design, the laws of objects in an image can reflect the essential features of the image, and the essential features of the image can be extracted by statistical extraction technology to achieve the purpose of visual communication [5]. In this article, CAD technology and CNN-based image enhancement algorithm are used to highlight the structural information of images, so that visual communication has better three-dimensional and dynamic effects, thus providing technical support for the construction of visual communication digital system.

If the moving light source is used, the object can be fixed in a cone area, and under the action of the forward-looking scanner, multiple sets of three-dimensional data parameters can be obtained. This article presents a strategy of building a digital system of visual communication based on CAD technology. Its main innovations and contributions are as follows:

(1) In this article, by improving CNN to extract features and model visual communication images, the sample blocks with a large quantity of unknown pixels are avoided from being processed, and the error accumulation caused by matching errors is reduced.

(2) The digital system of visual communication based on CAD technology and deep learning can effectively solve the problem of unclear and stereo images, while maintaining the clarity of visual communication images.

2 RELATED WORK

Manis et al. [6] has verified the effectiveness of the vision communication automation digital system based on CAD technology and confirmed the feasibility of the system. The image acquisition, processing, transmission, storage and control are completed through the system hardware. Build a software development environment to improve the performance of visual communication automation digital system. The CAD technology is used to highlight the structural information of the image so that the visual transmission has better stereoscopic and dynamic special effects. Solved the problems of traditional visual communication digital system. Ramadhan et al. [7] improves the image transmission effect and efficiency. By using infrared sensors as transmission equipment, the transmission time of the system is reduced. In order to maintain the dynamic and multi-dimensional image, the fast infrared radiation is applied to improve the transmission effect of image information. The automatic digital system of visual communication based on CAD technology has achieved good results in the image transmission module of the system. Xu [8] assists the CAD image controller to control the transmission and transmission of

images. The transmission effect of the image is improved. The generation module mainly generates the transmission signal through the refreshed and updated image data. By converting the rich data interfaces on the VGA image controller, the page of image data is automatically updated and refreshed. After the image is stored, the image control module controls the stored image, which has strong control ability and conversion ability. Zhang and Kou [9] adopts the central control structure system in the design, and the model display and user interaction are realized through the user layer. Set the shared object on the server, and the modeling model is provided by the server to complete the shared model. CAD obtains the input data and initialization graphics required for structural analysis through the pre-processing module, and the values calculated by the calculation module are transferred to the post-processing module to output the relevant data. On this basis, the HO visualization algorithm is used to adjust the transparency and gray value to enhance the visual transmission effect of product packaging. The traditional communication solution cannot solve the problem of equipment access in the expressway outfield. With the integration of the expressway communication monitoring toll network, this problem will become more and more prominent. Zhou et al. [10] uses packet transmission network to carry out passive optical network communication transmission, eliminating outdoor active equipment, and all signal processing functions are completed by switches and users' indoor equipment. Its transmission distance is shorter than that of the active optical fiber access system, and its coverage is smaller, but its cost is low, and there is no need to set up another computer room, so it is easy to maintain.

At present, the three-dimensional image visual communication system based on visual interaction technology is widely used, which mainly realizes the visual communication of three-dimensional images by applying the three-dimensional visual interaction technology and constructs the three-dimensional image visual communication system. In this article, CAD technology and improved CNN are used to extract features and model visual communication images, which can avoid the processing of sample blocks with a large quantity of unknown pixels and reduce the accumulation of errors caused by matching errors, thus constructing a digital system for visual communication of three-dimensional images.

3 METHODOLOGY

3.1 Convey the Basic Connotation of Visual Design

At present, there are a lot of design data in the memory. When processing the data, the processor needs to execute the drawing design and display the drawing in the drawing software or monitor. The technology of processor movement is computer graphics and image technology. From the perspective of visual communication, this technology is more realized through artistic elements with differences, such as graphics, colors and texts. Visual communication means that in the stage of information transmission, visual symbols are the main channel and visual language is the main way of expression and communication. There are similarities and differences between computer image processing technology and visual communication. Therefore, we should fully understand their advantages and disadvantages, make them better integrated, make graphics and images better realize visual communication, and achieve the purpose of beautifying and improving pictures.

The innovative principle of visual communication is the transformation of image, form and meaning, based on point, surface, shape and light. Computer graphic design is a combination of dynamic and static graphics and colors, focusing on the selection and growth of materials and software technologies. The design data is usually stored in the memory. When processing this part of data, it is usually need to make much of relevant computer technology to design the drawings and display the drawings in the drawing software or display. This technical means is computer graphics and image technology. Before making computer graphic design, communication design already existed.

Communication design can screen, reasonably arrange and carefully design the images, words and other elements in complex information, and finally transform them into easy-to-understand forms. Throughout modern daily life, the shadow of communication design permeates everywhere. The growth of modern culture and commerce cannot be separated from the support of communication design, and the growth of modern commerce needs communication design everywhere. The cognitive stage of visual communication based on CAD technology is shown in Figure 1.

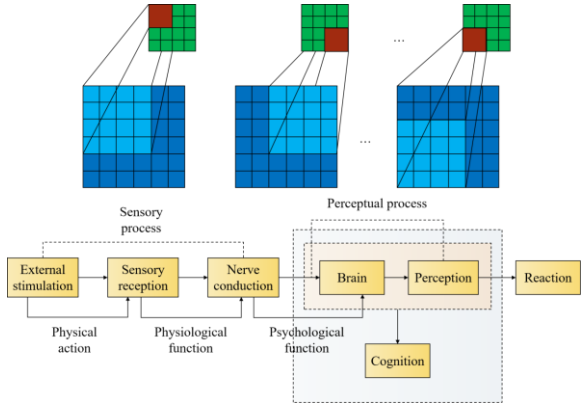

Figure 1: Cognitive stage of visual communication based on CAD technology.

Graphic design is a typical communication design, which mainly includes advertising design, packaging design, logo design and corporate image design, etc. These designs are all based on printed materials. The works designed by computer graphics and image processing technology retain both static beauty and dynamic beauty, and combine them to form works in two-dimensional and multi-dimensional space. Therefore, designers can combine the advantages of the two methods according to their needs, and use different methods to deal with the work, thus presenting satisfactory results. In order to achieve effective artistic creation in the stage of communication design, the basic elements that need to be applied include arrangement, graphics, colors and words, which have a direct impact on people's daily life . From the perspective of visual communication system, visual communication system is more suitable for the conversion between different painting styles, and it can deeply process painting images and express the author's thoughts more clearly, which is more acceptable to readers. The computer graphics and image technology is better at dealing with the collection of dynamic and static images, which not only maintains the static beauty, but also maintains a certain degree of 2D and 3D.

3.2 Visual Communication Image Enhancement Algorithm

In the fast-paced social living environment, the speed of information dissemination is getting faster and faster, and people are more likely to accept visual information. Through visual elements such as visual semantics, shape and color, people can get information conveniently and quickly. Different graphics have different symbolic meanings, and expressive graphics, as an important visual symbol, can convey information, communicate emotions and embody unique aesthetic significance. Communication design has a great influence on people's spiritual life, material life and way of thinking. It is designed directly for the audience and plays a vital role in communication. If we can make good use of these image elements, the design will be more vivid, full and artistic, thus producing good social and economic benefits. Arrangement plays an important role in visual communication, and computer graphics and image technology has a great influence on this element. In fact, the layout elements themselves have a wide range of applications, such as image

creativity, advertisement design, etc. Reasonable layout of images and pictures in advertisements can produce unexpected design effects.

Static image has existed since the beginning of design development, and it is also the most common form in communication design. It is widely used. Static images impress audiences by carefully designing static pictures, texts, symbols, etc. and color matching, so as to attract people's interest. Compared with static images, dynamic images are easier to catch the attention of the audience visually, and some dynamic images are accompanied by music, so that the audience can have a more comprehensive visual and auditory experience. The image enhancement stage of visual communication based on CNN is shown in Figure 2.

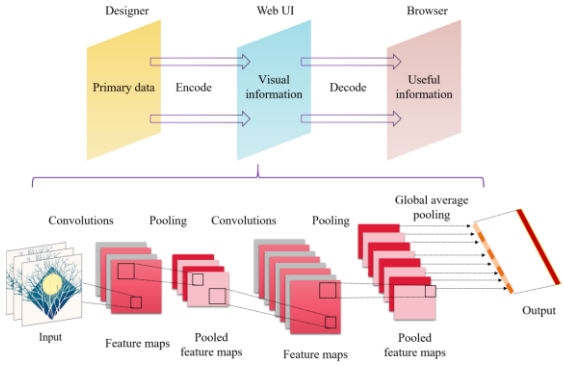

Figure 2: Visual communication image enhancement process.

Creative design is an important branch of design art, and strong commercial purpose is the main feature of this type of design, which makes it possible for designers to give full play to their imagination and creativity, which is also the main reason why designers gradually form their own characteristics and styles in their design works. Computer graphics and image technology can also provide a guarantee for designers to give full play to their creativity. Under the background of full application of graphics processing software, various irrelevant pictures or information can be effectively arranged. The CNN function of the visual communication image feature model is defined as:

$$x_j^l = f\left(\sum_{i \in M_j} x_i^{l-1} \times k_{ij}^l + b_j^l\right) \tag{1}$$

$$F_j^{(n)} = \sum_i w_{ij}^{(n)} * F_i^{(n-1)} + b_j^{(n)} \tag{2}$$

Where: $*$ is a two-dimensional convolution; $w_{ij}^{(n)}$ and $b_j^{(n)}$ are convolution filters and deviations, respectively; $F_j^{(n)}$ is the j^{th} output characteristic map at the n^{th} layer. The formula of active layer after convolution is as follows:

$$F_j^{(n+1)} = f\left(F_j^n\right) \tag{3}$$

Where: f is a point-by-point activation function. Convert each data item x_i in the small batch $B = \{x_1, x_2, x_3, \ldots, x_m\}$ with size m to y_i:

$$y_i = \gamma \hat{x}_i + \beta \tag{4}$$

$$\hat{x}_i = \frac{x_i - E_M(x_i)}{\sqrt{Var_M(x_i) + \varepsilon}} \tag{5}$$

Where: $E_M(x_i)$ and $Var_M(x_i)$ are the mean and variance of batch B, respectively. Scene modeling is the foundation of the whole virtual roaming system.

There are various forms of semantics, and a visual figure conveys not only the visual sense, but also its inner meaning. The same graphic for different people to watch will also lead to different understandings. What information can be obtained from it is also related to the audience's own way of thinking and values. The audience will selectively understand and judge the graphic they see. Graphics and images can be effectively divided by computer graphics and image technology, forming bitmap and vector images, in which the former needs to use the method of bitwise icon alignment in the drawing process, while the latter needs to record the geometric figures by digital method in the drawing process. When designing dynamic graphics, it is need to control the audience's feelings about the time rhythm of dynamic graphics through different design means, which needs to start from many aspects. Including the content design of dynamic graphics, the intensity and speed of visual changes, and the amount of information covered per unit time. Communication design is designed for the whole society, which has a very important influence on people's three views. Therefore, the principle of authenticity is the first thing that communication design should abide by to ensure the authenticity of the design, so as to ensure the authenticity of the conveyed information and ideas.

Let X_i^k denote the sum of the inputs of the neurons i in layer k and Y_i^k as the output. The weight of the neuron j in the $k-1$layer to the neuron i in the k layer is W_{ij}, which has the following functional relationship:

$$Y_i^k = f\left(X_i^k\right) \tag{6}$$

$$X_i^k = \sum_{j=1}^{n+1} W_{ij} Y_j^{k-1} \tag{7}$$

Usually, f is taken as the asymmetric Sigmoid function:

$$f\left(x_i^k\right) = \frac{1}{1+\exp\left(-X_i^k\right)} \tag{8}$$

Assuming that the output layer is the m-th layer, the actual output of the i-th neuron in the output layer is Y_i^m. Let the corresponding human body signal be Y_i, and define the error function e as:

$$e = \frac{1}{2}\sum_i \left(Y_i^m - Y_i\right)^2 \tag{9}$$

The background image is obtained by statistical averaging of continuous image sequences, that is, continuously collected frame images are accumulated and averaged:

$$B_k = \frac{1}{N}\left(f_k + f_{k-1} + \ldots + f_{k-N+1}\right) = B_{k-1} + \frac{1}{N}\left(f_k - f_{k-N}\right) \tag{10}$$

Generally, the larger the N, the better it is to obtain a more realistic background estimate.

Let S_i be a 3-dimensional array composed of the background image of the N frame saved last time, the first two dimensions represent the pixel position (x, y) in the reference image, and the third dimension represents the index quantity of the image in the array. Therefore, $S_i(x, y, l)$ is the gray value of pixel (x, y) in the l-th frame image. The choice of parameter N is selected according to the performance of the corresponding time and output background:

$$LTB(x, y) = median\{S_i(x, y, l), \ldots, S_i(x, y, N)\} \tag{11}$$

Introducing the constant α representing the update speed, the update of the Gaussian distribution parameters at this point can be expressed as:

$$\mu_{t+1} = (1-\alpha)\mu_t + \alpha \cdot X_t \tag{12}$$

$$\Sigma_{t+1} = (1-\alpha) \cdot \mu_t + \alpha \cdot d_t d_t^T \tag{13}$$

If the update rate is 100%, the background model method degenerates into the inter-frame difference method. The probability of each distribution model reflecting the change of background objects is updated as follows:

$$h_i(X, t+1)(1-\gamma)h_i(X, t) + \gamma H_i(t) \tag{14}$$

The input signal $I(X, t)$ is compared with N distribution models, and then the matching model is updated. If:

$$\left|I_j(X, t) - \mu_{ij}(X, t)\right| < \tau D_{ij}(X, t) \tag{15}$$

$I(X, t)$ matches model p_i. Where τ is a global threshold, i represents the i-th distribution model, and j represents the component in (s, r, g) space. If $I(X, t)$ matches more than one p_i at the same time, the distribution model with high probability, small variance and small difference from $I(X, t)$ is selected for updating. That is, the distribution model satisfying the minimum similarity distance $d_i(X, t)$ is updated. $d_i(X, t)$ is defined as:

$$d_i(X, t) = \sum_{j=s,r,g} \frac{\left|I_j(X, t) - \mu_{ij}(X, t)\right| D_{ij}(X, t)}{h_{ij}(X, t)} \tag{16}$$

Update the matching p_i according to the following formula:

$$\mu_{ij}(X, t+1) = (1-\alpha)\mu_{ij}(X, t)\alpha I(X, t) \tag{17}$$

$$D_{ij}(X, t+1) = \min\left\{\left[(1-\beta)D_{ij}^2(X, t) + \beta\left(I(X, t) - \mu_{ij}(X, t)\right)_2\right]^{1/2}, D_{\max}\right\} \tag{18}$$

$\alpha \in (0,1)$ is the update factor of mean, which determines the update rate of mean, $\beta \in (0,1)$ is the update factor of variance, which determines the update rate of variance, and $D_{\max}$ is the estimated value of the maximum variance in all models, which is the global upper limit of variance.

Compared with static graphic design, the development time of dynamic graphic from rise to maturity is shorter, and the analysis of its design elements is more complicated than that of static graphic design. Dynamic graphics add dynamic design to traditional static graphics, and the main visual elements of them are the same.

4 RESULT ANALYSIS AND DISCUSSION

Although the edge sharpening method enhances the image contour, the details will be blurred, and the overall effect is not ideal. Although the visual communication image enhanced by SVM method highlights the edge of the image after edge sharpening, compared with the visual communication image enhancement algorithm proposed in this article, there is still some ambiguity in detail processing. Compare and analyze the processing time of different image enhancement methods, as shown in Figure 3.

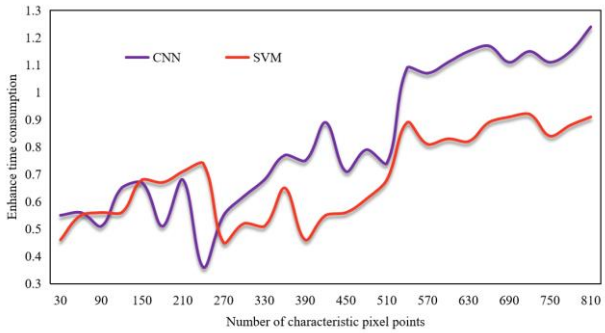

Figure 3: Comparison results of processing time of different image enhancement methods.

As can be seen from Fig. 3, the processing time of visual communication image enhancement by the traditional method increases with the increase of the quantity of pixels of feature information, which takes a long time. Although CNN-based visual communication image enhancement takes an increasing time, it takes less time than traditional methods. Figure 4 shows the comparison of modeling accuracy of different algorithms.

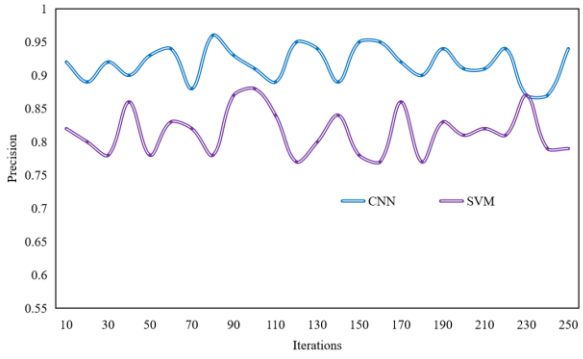

Figure 4: Accuracy results of different algorithms.

Compared with the contrast SVM algorithm, the visual communication image enhancement method proposed in this article has the highest accuracy improvement of 26.74%. It can effectively solve the problem that the image is not clear and stereoscopic, while maintaining the clarity of the visually conveyed image.

Image information transmission transmits image information to digital system through image transmission equipment, and image data information reception is mainly responsible for caching the collected and transmitted image information, so as to use CAD technology to design image information in plane and three dimensions. After the plane is formed, CAD technology is used to design it in three dimensions to form a three-dimensional and dynamic image. Each point in the image data needs to be mapped into a three-dimensional space, and then binocular parallax stereoscopic display and true three-dimensional stereoscopic display technology are used to process the original three-dimensional image. In the experiment, the time needed to retrieve visual communication images with different numbers of images and different nodes was tested. The experimental results are shown in Figure 5.

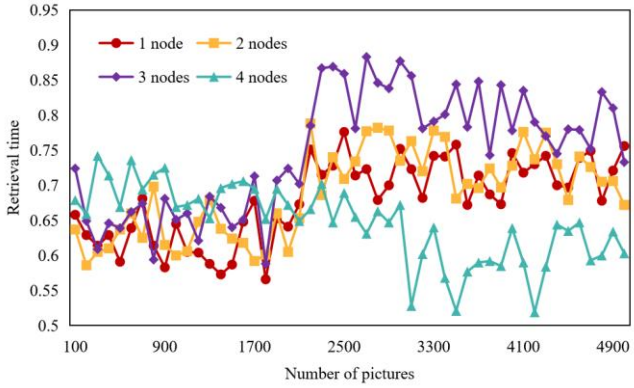

Figure 5: Time consumption of image retrieval.

It can be seen from Fig. 5 that when the quantity of visually conveyed images is small, the more nodes there are, the more time it takes for image retrieval. With the increasing number, the advantages of multiple nodes can be revealed. By setting information with CAD-assisted technology, image analysis can be realized, image feature points can be better processed, and automatic processing can be completed.

The traditional automatic digital system of visual communication can only design a single element, but it is difficult to design multiple elements. In the stage of automatic visual communication, there is a lack of visual order relationship, which leads to the low efficiency of traditional system in conveying visual information. In this article, the automatic digital system of visual communication based on CAD technology is designed, which uses CAD technology to design images in depth, forms 3D stereoscopic images, uses binocular parallax stereoscopic display technology to process 3D stereoscopic images, uses true 3D stereoscopic display technology to analyze images in depth, and uses image enhancement technology to optimize the displayed 3D stereoscopic images. The results of testing samples using SVM model are shown in Figure 6. The results of sample test using the improved CNN model are shown in Figure 7.

It can be analyzed that the visual communication image enhancement algorithm based on improved CNN is better than SVM in both accuracy and efficiency. As the automatic digital system of visual communication requires high visual communication efficiency, the image enhancement technology is used to optimize the three-dimensional images, so as to make the displayed three-dimensional images have better quality and improve the visual communication effect. The automatic digital system proposed in this article can quickly realize identification, screen out valid data in a short time, and transmit the screened data to the database for comparison, and finally display the transmission results on the display.

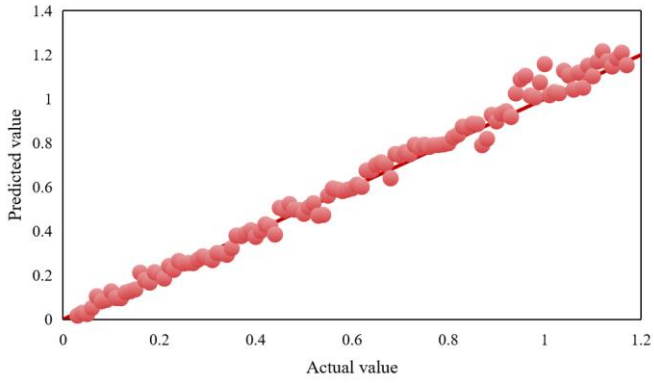

Figure 6: Scatter diagram of actual value and predicted value of SVM.

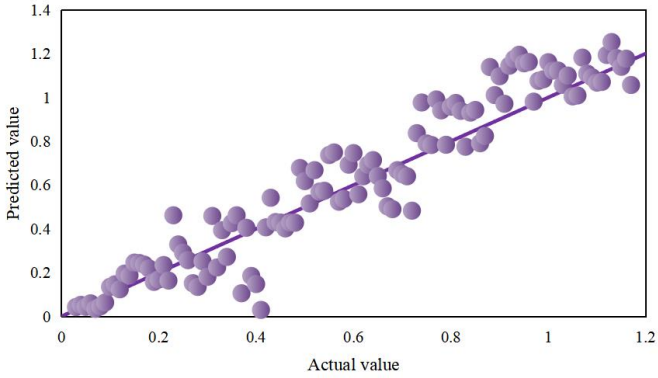

Figure 7: Scatter chart of CNN actual value and predicted value.

When designing graphics and images, people need to use computer graphics and image technology to distinguish and plan, that is, the former is classified as a bit map and the latter as a vector map, so that designers' creative ideas can be expressed more professionally.

5 CONCLUSIONS

Under the background of the accelerating social rhythm, people can't get a deep understanding of a thing for a long time, hoping to get the desired information intuitively through their own eyes. When the system transmits complex multi-dimensional images, it needs to introduce CAD technology, which can simplify and draw multi-dimensional images to show the structural information of the images. In this article, CAD technology and CNN-based image enhancement algorithm are used to highlight the structural information of images, so that visual communication has better three-dimensional and dynamic effects. The results show that the accuracy of the proposed visual communication image enhancement method is improved by 26.74% compared with the contrast SVM algorithm. It can effectively solve the problem that the image is not clear and stereoscopic, while maintaining the clarity of the visually conveyed image. Digital technology is the product of scientific and technological innovation in the new era. In order to improve people's experience, visual communication also combines computer vision art to improve its own

system, and the content of improvement starts with images, sounds and animations. The appearance of computer graphics technology can enrich and perfect the information in images. This provides many favorable conditions for the growth of communication design, and meets the current people's requirements for image information.

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