

Research Article

Illustration Art Based on Visual Communication in Digital Context

Yanqi Wang 

School of Fine Arts and Art Design, Kunming University, Kunming 650200, China

Correspondence should be addressed to Yanqi Wang; t17301099@stu.ahu.edu.cn

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With the rapid advancement of digital media technology in recent years, a digital context has emerged and developed under its influence. Visual communication relies heavily on illustration art. It is widely used in many fields of modern design because it is an important form of visual communication. We propose a visual communication design method for small and weak target images based on temporal and spatial filtering. We calculate the probability of gray pixels appearing using the histogram equalization method, assign thresholds to pixels, and enhance the gray value of images using the equalization process. We analyze the characteristics of each element of the 3D video system and the appropriate visual communication design form after performing calculations and combining them with the basic theory of visual communication design. Create system test links, test indicators, and test results. It has been demonstrated that the restored image integrity of the system is higher than that of the existing system, and that its performance is better.

1. Introduction

Illustration is an important form of visual communication as an art. It holds a prominent position in modern design, with its intuitive image, vivid sense of life, and aesthetic taste, and is widely used in all social fields [1, 2], including cultural activities. The combination of visual communication design and other disciplines, influenced by the digital context, fully embodies the uniqueness of the digital media era. Visual communication design has specific features in language, communication, and aesthetics as a result of the influence of the digital context, and it better integrates into all aspects of people's lives. Visual communication design has evolved from a two-dimensional plane to three-dimensional and four-dimensional expressions, with the transmission mode shifting from one-way manual transmission to two-way information exchange and the presentation carrier shifting from print media [3]. The digital age has given birth to a new visual communication design language, as well as influencing existing design patterns and concepts. As a result, in the reform process, we must constantly improve and integrate in order to achieve more timely expression.

Digitalization is the mark of the times in today's art development stage. With the rapid development of science, technology, and economy and the popularization of computer network, more and more people pay attention to and participate in the field of digital figure illustration. People are always fascinated by beautiful things. With the inevitable improvement of public aesthetic taste, digital figure illustration is becoming more and more popular [4]. This kind of convenience is mainly divided into two points. The first is the convenience of creation. Literature [5] puts forward the inevitable trend of digitalization. Literature [6] summarizes the previous creation and experience, and expands the research on it. Reference [7] expounds the principles to be considered and factors to be used when creating visual communication design. I am glad to know that these problems can be answered in the practice of visual communication design. Literature [8] mainly uses empathy theory when discussing visual forms. At the same time, the empirical research on visual forms in psychology has greatly promoted the research process of visual forms. Literature [9] defines art as "the creation of human emotional symbols." He believes that artistic creation must consciously use

artistic intuition to capture the “symbolic connection” between artistic forms and logical forms of life, and create “meaningful forms” that are “consistent with emotions and life forms.” Literature [10] holds that it is not materials and technology that determine the change and development of forms, but the change of perception. The emergence and rise of digital figure illustration will make designers and painters face these problems in the creative process, which will make it more urgent and practical to study the performance of visual communication design in digital figure illustration.

Seeing, staring at, and identifying any visual information is a process that requires mental participation or “thinking” to complete. The social landscape has changed dramatically in the digital sphere. Visual communication design, as the face of information transmission, must create works that meet the needs of the times and adapt to the new mode of communication. Without a doubt, advances in media technology have had a significant impact on traditional visual communication design teaching and design methods. As a result, this paper discusses the history and development stage of digital figure illustration, as well as performance characteristics, visual communication elements, language, and other aspects. At the same time, it discusses the digital figure illustration expression technique as well as the continuation and breakthrough of a new figure illustration. Learn to understand problems, find new problems, and deal with new problems objectively through hands-on summary with the problems and influences of tool convenience.

The originality of this study is as follows:

- (1) Illustration art is the most unique and beautiful design, and modern illustration art has become a form of people's spiritual and material life. In this paper, the theories and methods of different disciplines are applied to the field of visual communication for a comprehensive study. Through the intersection of the two, the innovation of comprehensive research, design form, and application field can be realized.
- (2) In-depth analysis of the changes of new media to traditional media forms, looking for new creative rules suitable for development, understanding digital media art from the perspective of visual communication and artistic production and consumption, and opening up new perspectives.

This article has five sections: the first section primarily discusses the context of the topic selection, the state of research at home and abroad, and the significance and purpose of the study. The second part introduces the theoretical foundations of illustration art research in the digital context, which is based on visual communication. The third section focuses on the related concepts of visual communication design and digital media, as well as the relationship between them, as well as the design and optimization of a visual communication method of illustration art, which serves as the experimental foundation for the following discussion. This paper's method is realized through experiments in the fourth section. This paper's fifth section concludes with a prediction.

2. Related Work

Literature [11] carefully combs and presents the historical development of visual culture from painting to the Internet, deeply discusses why visual media occupies such an important position in modern daily life, and provides an important perspective. Literature [12] holds that most of people's experiences come from a vision, and almost all the information and knowledge people get come from a vision. Modern society is a vision-oriented society. Reference [13] analyzes the significance of image culture research and the problem structure of image culture research. Digital media art is like a polygonal prism, which reflects different lights with the change of viewing angle. With the help of digital media, a large number of digital art practices and dissemination have broken the traditional cognitive framework, brought about unprecedented new patterns and trends, and raised many new problems. Literature [14] explains the relationship between virtual reality and art in detail, describes virtual reality as the central relationship between people and images, and shows how this relationship is expressed in old and new media. He used the virtual reality model as the key physiological and psychological perception to prove that his audience's sensory experience was correct. Literature [15] describes the information, strategies, methods, management, and evaluation of art communication, analyzes the relationship between art communication and interpersonal communication, mass communication, organizational communication, and network communication, and predicts the art communication in the postmodern era. Literature [16] systematically and comprehensively introduces the development history, present situation, research scope, practical methods, and application fields of modern digital media art from the perspective of science and art development.

In a sense, visual communication is an activity that uses visual symbols as information transmission channels to realize information exchange and mutual sharing, and is the main way to spread information [17]. Literature [18] regards visual communication as the use of visual symbols as a channel of information transmission, an activity of information exchange and mutual sharing, and also the main way of information dissemination. However, weak target information is difficult to detect, and because of the low signal-to-noise ratio of the image, in order to accurately transmit target information, it is necessary to improve the detection performance. Reference [19] proposes a video-image communication method based on virtual reality environment. This method uses the mathematical model of retinal neuron recognition to preprocess the image and detect dim targets. Reference [20] proposed an adaptive 3D reconstruction algorithm of light field based on array images. References [21, 22] used wavelet to decompose the image twice to obtain the high-frequency component features of the object. In the virtual reality environment, the two features are fused to output the detection results of weak targets and small targets in complex background.

The above research shows that the development of digital media has received great attention in the field of design art,

and scholars have done some research in different fields. Among them, the research of digital media has matured, and the cross-research of digital media and visual communication design is still in progress. It puts forward a breakthrough and several new development expectations.

3. Methodology

3.1. The Relationship between Illustration and Visual Communication. Illustration is a vital component of visual communication, as it aids in the transmission of information and the expression of emotions. It houses the artist's personal consciousness. Patterns can express and process images in a variety of ways, including fantasy, exaggeration, emotion, symbolism, and universal language. Because of its intuitive image, realism is an important form of visual communication in modern design that is widely used in many fields. The information age's development trend is the functional extension of visual communication design to digital media. The goal of traditional graphic design, dynamic visual design, multimedia design, and interface design is to transmit information. Consistency is the most basic visual element of aesthetics. Visual communication design will naturally create new features and forms of expression, despite the fact that digital visual communication design and graphic design share visual elements. It has evolved. The characteristics that distinguish it from existing print media are interactivity, vitality, and multimedia.

Illustration is an artistic amplification of specific text information, with features and functions that text cannot replace. Illustration belongs to the art of painting and has visual appeal. Illustrations not only show unique instantaneous shapes of faces and lines, but also often express artists' specific aesthetic orientation. Illustrations are not only visually pleasing, but also can give them other missions and meanings. In the era of reading pictures, no one will refuse to use pictures as an intuitive way of communication. With illustrations, concepts are no longer vague and words are no longer abstract. We can easily accept the ideas it conveys to us unconsciously.

The elements of formal beauty are basic design elements such as point, line, surface, color, and space, but it is especially reflected by the combination of the basic composition and attribute rules of figure illustration. Make up your own body and shape for the character. Design, implementation, and release of visual design in digital media are all highly flexible. It is not constrained by specific material properties, and it can be updated and adjusted relatively quickly to suit changing time and environmental conditions. Many designs in the digital context are based on the creative experience of audience participation, and the incomplete presentation of works leads to design results that are uncertain and diverse. Inextricably linked are illustration design and painting art. Illustrations are similar to painting art in many ways, but they are more active in their pursuit of diversity. The depth and breadth of theme performances have been improved significantly. The application scope of illustrations is

constantly expanding, thanks to direct and rapid communication of information.

3.2. Design of Visual Communication Method of Illustration Art. Because of the different media attributes of the two sides, language features will invariably change when digital media technology and visual communication design are combined. With the advancement of time and the influence of scientific and technological innovation, visual communication design now combines the virtuality of visual language with the interactivity of design language, resulting in multi-dimensional imagination and human experience. When these characteristics shift, the digital context becomes the vision's uniqueness. Introducing digital painting and illustration painting to a previously untapped field. The Internet, as a new form of media, has characteristics such as high transmission speed, large amounts of data, non-localization, and strong interactivity. The expression of the central idea or appeal concept, the basic concept expressed to achieve a specific purpose, and the core of artistic appeal, which determines the style and value of many illustrations, is the first step and important premise of illustration design, the expression of the connotation, and sensibility of illustrations.

Illustration is a type of art that has a place in modern design because of its intuitive image, realistic sense of life, and lovely charm. The design theme for modern illustration should be unique and simple. Simplicity is favored in illustration design. Simplicity is not synonymous with ease of use. Simplicity implies less expression and simplicity. Many descriptions are tedious and redundant because graphics and images have such strong persuasive power. Illustration, as a sub-discipline of graphic design, gives design a distinct life. Visual communication design is an integral part of art design, and image is one of the most important topics in art design research. Visual communication design is primarily defined as an artistic creation that employs visual symbols to convey various types of information using words, images, and colors as the primary components. The image function can be convolved with the smoothing function to suppress noise. Gaussian smoothing function is

$$G(x, y, \sigma) = \frac{1}{2\pi\sigma^2} \exp\left(-\frac{x^2 + y^2}{2\sigma^2}\right). \quad (1)$$

The smaller the adjustable parameter σ , the higher the spatial positioning accuracy and the worse the suppression of high-frequency noise.

In order to get a better photo group $V(p)$, it is filtered by the following formula:

$$|V^*(p')|(1 - g^*(p)) < \sum_{p \in U(p)} (1 - g^*(p)), \quad (2)$$

where $U(p)$ represents all patches that do not meet the required visible information.

M represents a solid model, and then the spatial indicator function used in surface reconstruction is

$$\Phi(p) = \begin{cases} 1, & p \in M, \\ 0, & p \notin M, \end{cases} \quad (3)$$

$$p(\alpha_i) = \begin{cases} \frac{p}{h}, & h_i > p, \\ \frac{h_i}{h}, & h_i < p, \end{cases} \quad (4)$$

where $p(\alpha_i)$ represents the occurrence probability of the i th gray value and h represents the total number of pixels. α_i is the background gray level.

However, using this method directly will supersaturate the background and mix the subject and background together. Therefore, this paper sets a threshold to reasonably limit it. Therefore, when counting histograms, statistics are performed by assigning thresholds to grayscale pixels.

The key of the above method is to properly limit the enhancement of noise gray level and leave enough gray-level space for the enhancement of target details. The enhancement effect is closely related to the selection of threshold. Many experiments show that for weak targets, the threshold must be selected in a positive integer within 100 to obtain good enhancement effect.

For visual images, virtual packaging modeling technology must be used in the links of image correction vision system and label position relationship, and the order of related links must be strictly operated to accurately judge the visual reading. The image calibration process is shown in Figure 1.

The two-dimensional code shadow area of the video image is separated. Visual predistortion is

$$W'(\omega) = \partial \cdot (\omega) \cdot \frac{1}{P(\omega)}, \quad (5)$$

where $W'(\omega)$ is the frequency response of the visual image after predistortion; $W(\omega)$ is the original frequency response of the visual image; ∂ is the compensation coefficient; and $P(\omega)$ is the impact frequency response of visual image [23].

The method of this paper extends the image block discriminator to a multi-perception discriminator based on the general behavior habit of human eyes in artistic appreciation, that is, the combination of overall perception and key feature analysis. The neural network structure of this method is shown in Figure 2.

Here, we only discuss the conversion process from real face images to their corresponding realistic portrait illustrations, and the reverse conversion process is the same. Generator $G_{P \rightarrow C}$ includes encoder-decoder $E_D_{P \rightarrow C}$, style encoder E_C^S , and guide $I_{P \rightarrow C}$, and $S_C^{D_C}$ in sampler $S_C^{D_C}$, $I_{P \rightarrow C}$ in multi-perception discriminator D_C has the same network structure and parameters.

In the mask module, first, learn a mask M_i from the input feature map x_{in}^i through convolution operation, then multiply x_{in}^i, M_i points to get the mask residual r_{M_i} , and finally pass the r_{M_i} to the deep network for reuse. Therefore, the output of the i -th residual block in $E_D_{P \rightarrow C}$ is as follows:

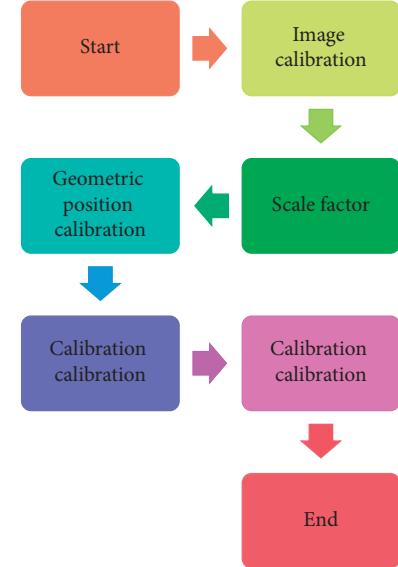


FIGURE 1: Visual image calibration process.

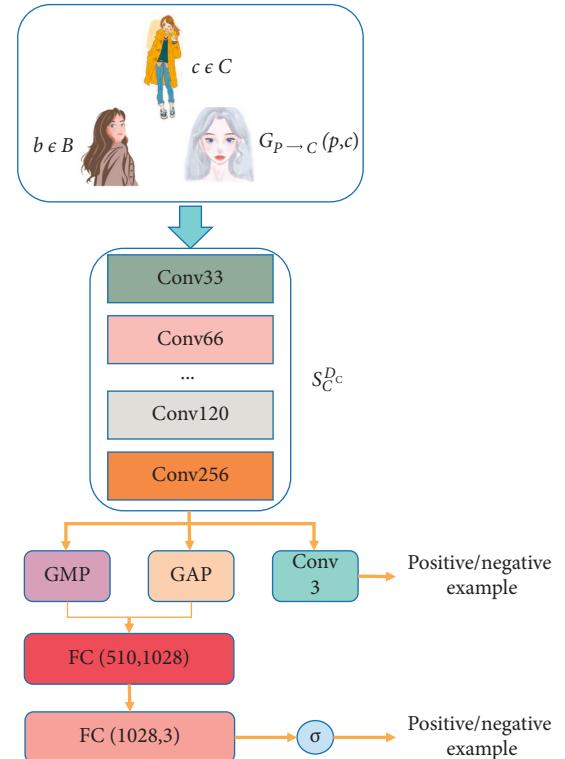


FIGURE 2: Multi-perception discriminator.

$$x_{\text{out}}^i = \begin{cases} F_i(x_{\text{in}}^i), & i \leq \left[\frac{n}{2}\right], \\ F_i(x_{\text{in}}^i) + r_{M_i}, & i > \left[\frac{n}{2}\right], \end{cases} \quad (6)$$

where F_i is the operation on the i th residual block, n is the number of residual blocks, and $r_{M_i} = x_{\text{in}}^{n-i+1} M_i$.

3.3. Visual Communication Optimization Design.

Illustration design at the boundary of art and design is no stranger to us. In recent years, illustrations frequently appear on books, magazines, fashion shows, advertisements, music, and TV screens. For all classes, illustration design is becoming more and more important in the historical process of human information dissemination. With the widespread adoption of cultural media ranging from traditional paper to modern computers, as well as the emergence of the network dubbed “the fourth media,” communication has shifted from handwriting to books, the Internet, and expression. As the network evolves from 1D to 3D, the 4D space evolves. The rapid development of the economy and society has been aided by the exchange and advancement of science and technology, which has simplified an otherwise difficult task. For example, the vivid and detailed representation of magnificent fantasy digital role illustrations was previously impossible, but many imaginations became easier with the help of digital tools. Then convert the surface image into a 3D image by preprocessing the original 2D data.

The system software is optimized for image integrity, and visual communication technology is used to improve the performance of the original system. Image filtering technology is used to process image data from the camera, a Gaussian filtering model is used to estimate the pixel value of unprocessed pixels, and point cloud technology is used to calculate pseudo-pixels. By using the system input device, find the parts that need to be analyzed and matched through graffiti, extract image elements, find the outline points and pixel values of elements, and use the image processing module’s image grouping attributes to get grouping attributes such as line width, color, and transparency.

Using the processed image, SIFT feature point extraction technology is used to extract feature points [24]. If the scale space is $A(x, y, \sigma)$, the original image is $B(x, y)$, and the Gaussian function is $C(x, y, \sigma)$, then

$$A(x, y, \sigma) = B(x, y) \otimes C(x, y, \sigma). \quad (7)$$

which is reflected by the DOG definition, and then there are

$$D(x, y, \sigma) = (C(x, y, n\sigma) - C(x, y, \sigma)) \otimes B(x, y). \quad (8)$$

Using the optimization method to estimate the position of spatial point X , and using the criterion of minimizing the geometric distance between image point and re-projection point, the geometric error cost function is established:

$$C = d(m, \hat{m})^2 + d(m', \hat{m}')^2, \hat{m}'^T F \hat{m} = 0. \quad (9)$$

$d(*, *)$ is the Euclidean distance between points. \hat{m} is mapped to \hat{m}, \hat{m}' by a projection matrix compatible with F . The cost function can be solved by optimization method. In this paper, L-M algorithm is used to estimate the spatial point position.

When texture mapping is carried out on the object surface formed by triangulation, the same gray level as the pixel gray level of the original image is used as the pixel gray level of the new image. Use normal affine projection transformation.

$$x = Ax' + t. \quad (10)$$

Here, x, x' is the coordinates of corresponding points on two images, A is a 2×2 matrix, and t is a 2×1 vector. The six parameters in this formula can be solved by using three points that are not on the same line, and we consider three vertices of the triangle.

The reconstruction of 3D digital images using the feature points obtained above is realized by using the original system reconstruction technology. Reconstruction ensures the integrity of reconstruction by using image information after establishing visual signature. The 3D digital image reconstruction process is shown in Figure 3.

Face-to-face projection usually has a far-field effect and requires projection transformation, so if you get the original image from the triangle using the above texture mapping method, you will get: as a result, when working, you should first think about how to get the front image of each triangle block, because if there is one, the deformation will be much smaller when doing affine projection. The goal of visual communication design is to effectively communicate with your audience so that they can appreciate the beauty of design and feel a sense of resonance. Design is primarily based on paper media, movies, and television works due to the influence of traditional media. First, it is a time- and space-influenced public aesthetic digital media technology that transcends time, space, and region to realize the cross-display of space in time. It allows people to go beyond the confines of time, to experience the characteristics of design at each stage, and to go beyond aesthetics in space. Second, virtual reality gives the audience a surreal aesthetic experience.

4. Experiment and Results

4.1. Test Platform. By studying the scene geometric information of digital images formed by perspective images, the stereo vision method is applied to the process of detecting the authenticity of digital images, and the results are more intuitive by using the quantitative analysis of stereo vision. Using the scene information (basic matrix) to calculate the nuclear geometric relationship of digital images, measure the projection error of epipolar lines, and compare the nuclear geometric error of the object to be detected with that of the scene (background) and in the scene with the detection target as the scene, different targets come from the same imaging process and produce quantitative and intuitive detection results.

Combined with the hardware environment and system modules designed above, the platform image element adaptive matching system is designed. In order to effectively explore how to deal with the original system problems in the design results, a system test link is designed to obtain the system performance difference. The test platform is designed and simulated by PC, and the running environment of the test platform is shown in Table 1.

Using the abovementioned software and hardware to build a system test platform, the original system and system designed in this paper are installed on the test platform, and the selected plane images are tested for element matching, and the test results are obtained.

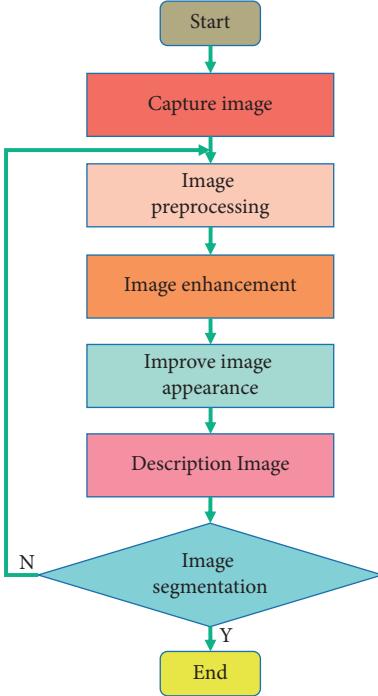


FIGURE 3: Three-dimensional digital image reconstruction process.

TABLE 1: Test platform running environment.

Structure	Content	Parameter
Software part	Operating system Development tools	Windows 7 OpenCV
Hardware part	Processor Internal storage Hard disk	Intel core series 4 GB 128 GB

4.2. Result Analysis. In order to verify the practical application performance of visual communication design for weak target images and small target images based on spatio-temporal filtering, an infrared frequency collector with fast moving targets is selected for verification. The success rate of visual communication of different methods is shown in Figure 4.

It can be seen that the visual communication success rate of the method proposed in this paper is over 90%. This is mainly because the method in this paper transforms the problem of visual communication into the problem of weak target background and foreground segmentation.

In this experiment, six sample groups were set up and reconstructed to increase the validity of the test. The reconstruction results are shown in Table 2.

On this basis, various methods are tested, and the change of transmission time according to image size is compared. The comparison result is shown in Figure 5.

It can be seen that the time required for visual communication in our method does not change significantly with the increase of image size, and the time required is obviously less than that of the two conventional methods. This is mainly because the particle swarm optimization algorithm applied in this method has nothing to do with the

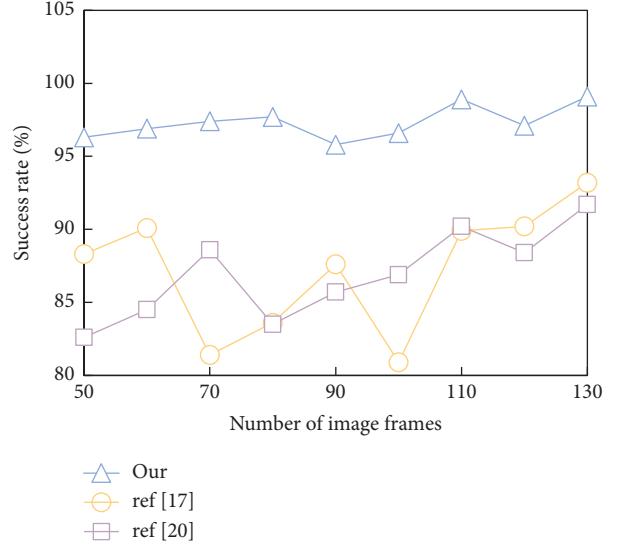


FIGURE 4: Comparison of visual communication success rate.

size of its neighbors, which reduces the number of iterations, reduces the complexity of the algorithm, and realizes the fast visual communication of images of any size. In addition, in order to carry out experimental comparative analysis, the system of this paper and the stereo vision system proposed in literature [17] and literature [20] are used to reconstruct the illustration images in three dimensions, and the reconstruction accuracy and user satisfaction are evaluated. The results are as follows: Figures 6 and 7.

From the results of 3D reconstruction accuracy of different images, we can see that the 3D image virtual reconstruction system designed in this paper is almost the same as the stereo vision system in references [17, 20]. However, in terms of user satisfaction, the system in this paper has more advantages, because it effectively uses the design principle of visual communication effect. There are 6 groups of images in the sample. Except for 2 groups of images due to image distortion in preprocessing, we only match the other 4 groups of images. Figure 8 shows the matching results between the system designed in this paper and the original system.

Compared with the experimental results, it can be seen that the image matching error rate of the original system is between 9% and 10%, which is too high compared with the system designed in this paper. The matching error rate of the system designed in this paper is between 3% and 5%. The lowest error rate of the original system is 9%, and the highest error rate of the system designed in this paper is 4.5%. From the above data, it can be seen that the image registration error rate of the original system is much higher than that of the system designed in this paper, which can effectively reduce the image registration error. Experiments show that the system designed in this paper can make up for the high error rate of image matching in the original system, ensure that the processed image meets the standard, and promote the popularization and application of modern image processing technology.

TABLE 2: Sample reconstruction result.

Sample serial number	Measure (mm × mm)	Resolution (dpi)	Vein	Color matching
1	50 × 50	160	Level and smooth	Deeper
2	100 × 100	330	Level and smooth	Deeper
3	150 × 150	390	Level and smooth	Deeper
4	200 × 200	201	Deep texture	Normal
5	250 × 250	251	Deep texture	Normal
6	300 × 300	288	Deep texture	Normal

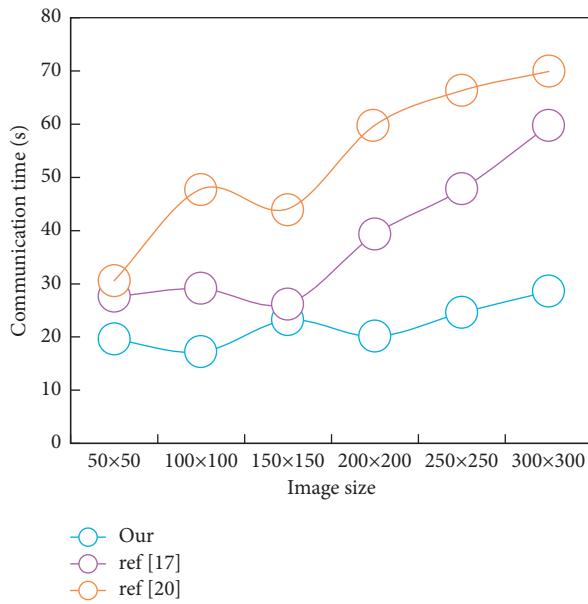


FIGURE 5: Communicate the change of time with size.

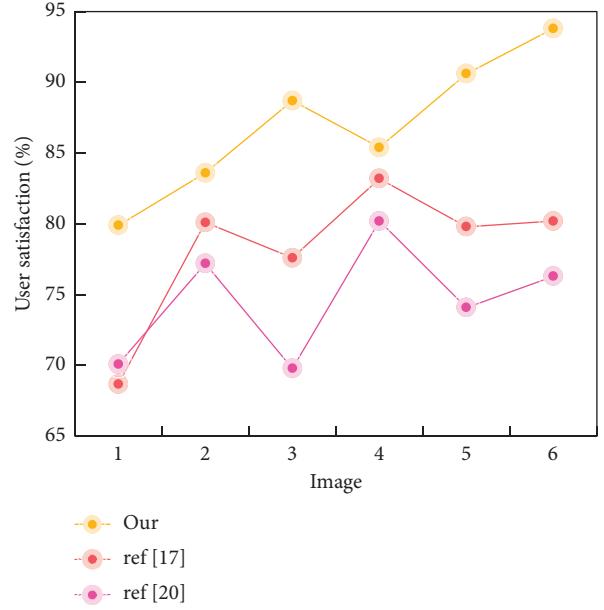


FIGURE 7: User satisfaction comparison results.

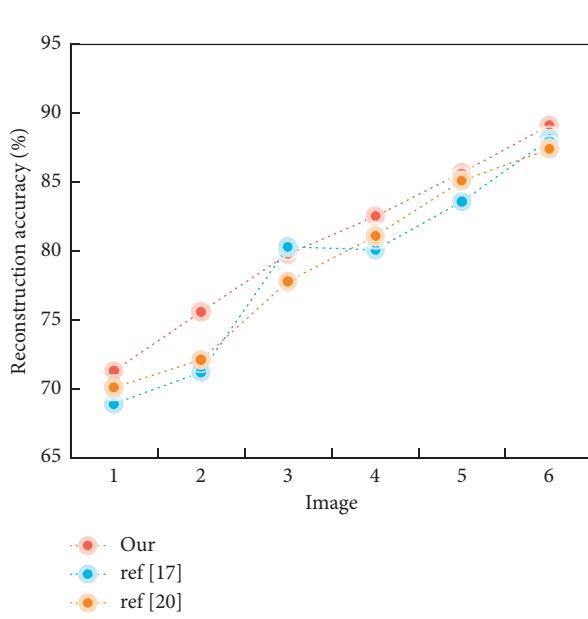


FIGURE 6: Comparison result of reconstruction accuracy.

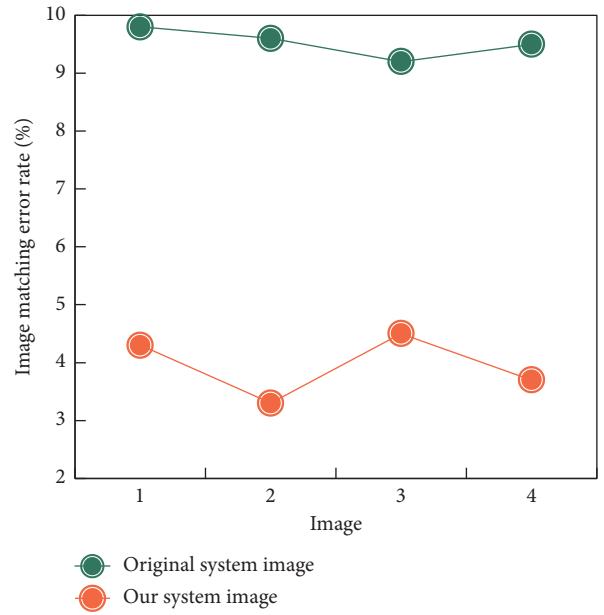


FIGURE 8: Error rate of image matching between the original system and the system designed in this paper.

5. Conclusions

In a digital context, visual communication technology presents some challenges, but the benefits of development are clear. The visual communication design has achieved the perfect integration of inheritance and innovation against a digital backdrop, and the creative mode has changed accordingly. In comparison with other digital illustrations, the visual communication design performance in digital role illustrations has the fundamental characteristics of visual communication and includes new functions created by digitalization. The inductive filtering and differential equation used in the visual communication method of dim target image based on spatio-temporal filtering suppresses the target background and improves the visual communication effect through image enhancement and feature extraction. It is beneficial to improve the accuracy of reconstruction results by using visual communication technology to establish corresponding visual signs during the image reconstruction process. If the design system described in this paper is put into practice, it can help to promote the growth of related industries. Figure illustration's development as an independent art form has been uneven. Theoretical research on figure illustration is becoming increasingly important as its value to people grows. It is necessary to continue to develop and innovate the illustration of digital works in order for it to progress. Do not forget about the past glory, open your mind, and use traditional and unique things to develop your imagination in addition to learning the strengths of other art forms.

Data Availability

The data used to support the findings of this study are available from the author upon request.

Conflicts of Interest

The author does not have any possible conflicts of interest.

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