Computer Image Processing Technology in Illustration Design

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Abstract. Since the birth of computer technology, although its development time has not been long, it has achieved a large number of development results, and its integration with people’s daily life and work has become more and more intensified. It has become one of the indispensable technologies for people’s production and life. Among them, the computer graphics and image processing technology provides a new technical direction for the processing of graphics and images. The graphics and images processed by this technology are intuitive and vivid, and the processing efficiency is also a highlight. Therefore, it has become a very popular major in many secondary professional universities and higher professional universities. With the development of technology, computer image processing technology has also achieved epoch-making development in the application field. Applying computer image processing technology to illustration design to give full play to the effect of illustration design, using mature computer image processing technology can not only improve the artistic sense of illustration design, but also make the impression of illustrations more profound. It not only relies on computer image processing technology, but also reflects people's understanding of art and beauty, and promotes the diversification of social aesthetics. Computer image processing software applications are becoming more and more extensive in modern design fields including graphic design, UI design, illustration drawing, product packaging, rendering, etc. In order to fully understand this new design method, obtain information, and cultivate sensibility, this article will focus on the application of computer image processing technology in illustration design and the application of specific applications in illustration design.

Keywords: Computer Image Processing Technology, Illustration Design, Computer Technology, Application and Research

1. Introduction
Computer image processing technology is based on images, processed by computer technology, involving digital technology, multimedia technology and many other technologies. Nowadays, the application effect in illustration design is very significant [1]. Computer image processing technology is based on images, processed by computer technology, and reasonable use of computer image processing technology, the final processed image can meet the actual requirements [2]. In the process of using computer image processing technology for illustration processing, the texture, color and brightness of the design software are perfected by computer image processing technology. The
application of technology is used to complete the processing of illustration models and design models. At the same time, the technology is used to eliminate hidden lines and hidden surfaces in the illustration, design the curve and surface of the image through reasonable operations, and finally make the picture digital. Export in three dimensions. The various illustrations designed have largely replaced language to communicate in society [3].

Illustration is a form of using image language. Influenced by computer technology, the art form of illustration has undergone tremendous changes. Its concept, form of expression, scope of application and aesthetic feelings are all developing in a different direction from the past [4]. The improvement of material and cultural life and the development of society provide conditions that are conducive to the development of illustrations, and can also allow people to see the development potential and huge prospects of the combination of illustrations and computer image processing technology. Computer image processing technology has given richer formal language and emotional meaning to illustrations. In an era when all people read pictures, what people lack most is the "stimulus" from patterns and colors [5]. When those complicated illustration designs can indeed grab people's attention in the first time, but too many and frequent appearances will cause psychological pressure on the audience [6]. Especially in the context of a fast-paced era, it may even have disturbing feelings. Therefore, posters that highlight the most essential features of things with a few strokes and allow people to quickly capture the content they need are more popular [7].

Photos have the characteristics of realism and artistic beauty. Adding photos to the illustration design will attract the attention of the audience in terms of image and texture. This is the use of computer processing that integrates text, images, etc., to stimulate users to explore and browse visually [8]. For example, Photoshop software is used to process pictures, which can improve the beauty of illustration design and meet the requirements of users’ exploration. The computer system not only constructs the database during operation, but also automatically analyzes the input images to form the chart matrix parameters [9]. The parameter value comparison method can better analyze the main information in the image. When carrying out illustration design work, if you want to optimize the image, it is bound to involve the problem of image selection skills. First of all, it is necessary to know the several formats and characteristics of computer images. Although there are many formats, there are only three image formats that are most commonly used and have the best effects, namely PNG format, JPEG format, and GIF format [10]. It is suitable for different types of illustration designs. If designers can fully grasp these image formats, then they can choose to use different formats of images in the design process according to actual needs.

2. Algorithm Establishment

2.1. Optical Flow Method

The calculation of the optical flow method is based on advanced mathematics. The specific calculation method is as follows: Assume that the gray value on all images in the time t coordinate (x, y) is I(x, y, t). At time t+Δt, the point moves to the next position, which is recorded as (x + Δx, y + Δy), and the gray value of this point is recorded as I(x + Δx, y + Δy, t + Δt). According to the image gray coherence hypothesis dI(x,y,t)/dt = 0, that is, the gray value in the image at this time moves the gray at the previous position Value I(x, y, t). Then there are:

\[ I(x,y,t) = I(x + \Delta x, y + \Delta y, t + \Delta t) \]  \hspace{1cm} (1)

Expand the above formula Taylor to:

\[ I(x + \Delta x, y + \Delta y, t + \Delta t) = I(x,y,t) + \frac{\partial I}{\partial x}\Delta x + \frac{\partial I}{\partial y}\Delta y + \frac{\partial I}{\partial t}\Delta t + \varepsilon \]  \hspace{1cm} (2)

The above formula will cancel an infinite \( \varepsilon \). ΔtSince the time interval is 0, we can get:

\[ \frac{\partial I}{\partial x}\frac{\partial x}{\partial t} + \frac{\partial I}{\partial y}\frac{\partial y}{\partial t} + \frac{\partial I}{\partial t} = 0 \]  \hspace{1cm} (3)
Let \( I_x = \frac{\partial I}{\partial x}, \ I_y = \frac{\partial I}{\partial y}, \ I_t = \frac{\partial I}{\partial t} \), the above formula can be rewritten as:

\[
I_x u + I_y v + I_t = 0 \tag{4}
\]

According to the optical flow constraint equation, the discrete expression of optical flow error is:

\[
e^2(i,j) = I_x u(i,j) + I_y v(i,j) + I_t \tag{5}
\]

\( I_x, I_y, I_t \) represents the gradient in the x and y directions of \( I(x, y, t) \) and the gradient in the time direction respectively, \( u(i,j) \) and \( v(i,j) \) are the optical flow at point \( (i,j) \) The x and y components.

The smoothing amount \( s^2(i,j) \) of optical flow is expressed as:

\[
s^2(i,j) = \frac{1}{4} \left[ u(i,j) - u(i-1,j) \right]^2 \tag{6}
\]

The minimization function expression is:

\[
E = \sum_a \sum_b \left( e^2(j,i) + as^2(i,j) \right) \tag{7}
\]

The final iterative equation of optical flow is:

\[
\begin{align*}
  u^{n+1} &= \overline{u^n} - I_x \frac{I_x u^n + I_y v^n + I_t}{a + I_x^2 + I_y^2} \\
  v^{n+1} &= \overline{v^n} - I_y \frac{I_x u^n + I_y v^n + I_t}{a + I_x^2 + I_y^2} \tag{8}
\end{align*}
\]

\( \overline{u}, \overline{v} \) represents the average of the neighborhood of \( u \) and \( v \) at \( (x, y) \) points, and \( n \) represents the number of iterations. When the first repetition number is 0, if the difference between the results of two adjacent repetitions is smaller than the critical value, the repetition stops.

According to the above optical flow calculation method, it can be used in target detection. The moving target entity in the area is perspectively projected to the two-dimensional plane through the camera, and each pixel in the two-dimensional projection is given a velocity vector to ensure that these points correspond to the points on the three-dimensional entity one to one, thus forming a velocity vector motion field. When there is no moving target in the scene, there is no relative movement between the optical flow vector and the background, indicating that there is only the background environment in the scene; then the object position is detected, and the moving target shape can be outlined to complete the target function.

### 2.2. Inter-frame Difference Method

The inter-frame difference method is a method of extracting the contour of the object through the operation of adjacent images in the image sequence that highlights the image characteristics. In the case of no change in the background environment and slight changes in the latter, if the pixel difference between adjacent images is less than the preset threshold, the point is determined as a background point; if the difference is greater than the threshold, the point is considered to be a certain point in the image. Combine all the front spots to get the shape of the target. The basic principles of the inter-frame difference method are as follows:

\[
v_i(x,y) = |f_i(x,y) - f_{i-1}(x,y)| \tag{10}
\]

In the above formula, \( f(x, y) \) represents a continuous image, \( v(x, y) \) shows the difference image of two adjacent image frames, and then specifies the critical value of the final difference image:

\[
B_i(x,y) = \begin{cases} 1 & d_i(x,y) \geq m \\ 0 & d_i(x,y) < m \end{cases} \tag{11}
\]
Where \( m \) is the set threshold, and when the pixel difference is not less than \( m \), the pixel value of this point is set to 1 (white); otherwise, it is set to 0 (black). The white part represents the picture target.

3. Modeling Method

3.1. Computer Image Processing Model

First scan the M*N image horizontally. When the object area is found, specify the label until all images are scanned, and merge the labels of the related fields according to the connectivity of the field. In this way, unique labels are assigned to each area of the image, and individuals are distinguished. There are marks corresponding to each area behind the image. The image at this time is the image attacked by hackers, and the pixel \( f(i, j) \) is the label value. If the field is the background, \( f(i,j)=0 \), and when the field is the target, \( f(i,j) \) is not 0, and the same area A has the same pixel point \( f(i,j) \). Calculate the moment characteristics for each region separately, the \( p+q \) moment formula of \( f(i,j) \) is:

\[
m_{pq} = \sum_{(i,j) \in A} i^p j^q f(i,j) (p,q = 1,2,3,...)
\]

In addition:

\[
S = m_{00} = \sum f(i,j)
\]

\( m_{00} \) is the two-dimensional 0,0 order moment of area A, and also the effective area of area A (that is, the number of effective pixels). Since the moment feature of the image is related to the location of the area, the central moment of the area is obtained according to the centroid of the area. The central moment has nothing to do with the position of the image. According to the central moment of the area. The main axis direction angle and equivalent ellipse parameters of the area can be calculated again.

The central moment is:

\[
\mu_{pq} = \sum_{(i,j) \in A} f(i,j)(i - \bar{i})^p(j - \bar{j})^q \quad (p,q = 1,2,3,...)
\]

The spindle direction angle \( \theta \) is expressed as:

\[
\theta = \arctan \left[ \frac{2\mu_{11}}{\mu_{20} - \mu_{02} + \sqrt{\left(\mu_{20} - \mu_{02}\right)^2 + 4\mu_{11}^2}} \right] (\mu_{20} \geq \mu_{02})
\]

\[
\theta = \arctan \left[ \frac{\mu_{20} - \mu_{02} + \sqrt{\left(\mu_{20} - \mu_{02}\right)^2 + 4\mu_{11}^2}}{2\mu_{11}} \right] (\mu_{20} < \mu_{02})
\]

Its purpose is to use a function to measure the attributes of an image area, and get the attributes of the area. These features include the area, direction, weight center, boundary, and the corresponding ellipse base and smaller axis of the specified image area. If the length of the image is the main axis, then the axis of the image is a scale with the same standard two-degree center length (in pixels).

4. Evaluation Results and Research

In recent years, with the development and application of computers, researchers have used platform scanners to obtain digital images of illustrations, and established methods for measuring the area of illustrations through Photoshop software or self-edited software. However, there has been no computer image processing method for measuring illustrations. A report on the area method of a specific design site. Therefore, this research has explored a set of methods to use photoshop filter tools to process images, and to determine the area of a specific design part of an illustration through image segmentation, and to study the method.

Scan resolution is an important factor that affects scan quality and measurement results. Since the accuracy of the image collected by the scanner is determined by the scanning resolution, the time taken, the disk space occupied and the pixel information of the image to be collected by different
scanning resolutions are not the same, so choose the appropriate scanning resolution to make the measurement work. It is of great significance to improve work efficiency and save resources, which can scan out images with higher precision in a shorter time and use less disk space. In this study, the scan results of six scan resolutions were compared and screened.

![Figure 1. The effect of scanning resolution on scanning time](image1)

![Figure 2. The effect of scanning resolution on disk space usage](image2)

Judging from the measured time (see Table 1), the average time spent designing three illustrations manually was 2.2 hours, while the average time spent designing three illustrations with computer image processing technology was only 0.25 hours. This experiment scans 6-10 pieces at a time based...
on the size of the illustration. If you switch to scanning with a larger width scanner, the measurement time will be shortened. Therefore, when an illustrator designer assists in using computer image processing technology to design illustrations, the method is more accurate and efficient than the traditional manual method of designing illustrations.

5. Conclusion

The application of computer technology makes the design space wider and creates more and more design methods and concepts. Computer image processing technology is more and more widely used in illustration design, combining natural attributes and humanitarian attributes, and at the same time conforming to the times and public aesthetics, and is no longer a pure art form. Humans have become a medium of reason and emotion. For example, although different types of computer image processing software have their own advantages, the powerful functions, flexible work and constantly changing artistic effects of Photoshop have become the most popular software in image processing. The illustration design process requires designers to have high knowledge and professional ability. The use of computer image processing technology in illustration design is the main trend, which can not only improve the quality of illustration design, but also improve the overall beauty of the illustration. Research shows that image processing technology plays an important role in the process of illustration design.

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