Application Research of Ink Brush Technology Based on Adobe Photoshop

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Abstract. Through redesigning the brush tool in Photoshop software, this paper discusses how to use Photoshop brush to draw pictures in digital painting, to form a unique texture of ink brush and achieve innovative picture performance. Firstly, Photoshop Brushes are analyzed; Then, through the redesign of the brush tools in Photoshop software, three different types of digital brushes are designed for the painting methods of Chinese painting, i.e. line drawing brush, dyeing brush and texturing brush, to achieve innovative image performance.

Keywords: Digital painting; Photoshop brush; Brush model; Line drawing brush; Dyeing brush; Cun tecnique brush

1   Introduction

In the era of digital painting, more and more creators are not limited to using software to simulate real hand-painted effects. They will modify and design custom brushes in order to pursue more unique effects that cannot be achieved by hand-painted. The use of Adobe Photoshop software is of great significance in every process of digital animation production. The application of brushes in Photoshop plays a vital role in reforming the various processes of traditional animation production. Understanding the specific application of brush tools in Photoshop in specific situations can better create digital paintings and provide creative practice basis for creating excellent hand-painted animation works.

2   Introduction to Photoshop brush tool

Photoshop brush refers to the tip shape brush of the brush in Adobe Photoshop software. It is a way to control the application of color through the tip options of the brush and the settings in the options bar. Although the brush tool is one of the commonly used tools in Photoshop, it is not easy to use the brush tool skillfully or even innovate. The main reason is that the options for customization of the brush tool are complex and changeable, and beginners often use only a small part of it. The creator can use gradient, soft edges, large brush strokes, various dynamic brushes, different mixing attributes and brushes with different shapes to apply colors, brush strokes to apply textures to simulate painting on canvas or art paper, and airbrush to simulate spray painting[1]. Through the brush settings panel, creators can modify existing brushes and design new custom brushes. Using the import brush function, you can import various free and purchased brushes into Photoshop for use by creators.

3 Design idea of ink brush

This research is based on the traditional Chinese painting knowledge, using digital equipment to restore the visual effect and Oriental Aesthetics of ink painting in a new way of painting and presentation. The brush is indispensable to paper-based Chinese painting. The skills, experience and proficiency of the brush also show the artist's artistic skills. As a special tool, the brush is made of animal hair and bamboo. The characteristics of ink and water on the paper are the charm of Chinese painting. In order to achieve the nature of traditional Chinese painting produced by the collision between brush and rice paper, this study designed a pen model for the drawing method of Chinese painting and applied it to Photoshop software. By putting the brush model file into the Photoshop brush tool, adjust different template parameters to get three different types of digital brush brushes, namely line drawing, dyeing and texturing, in order to better interpret the picture effect.

3.1 Brush Model

By observing the traces left by brush painting on the paper, we can sum up the characteristics of these brush traces as follows: first, the "hair like" effect: each brush can be seen as a scan line with a certain width. Some of the scan lines of some brush traces are uneven and colorless. In fact, this is the "trace" swept by the brush. The brush can be discretized into a certain number of pen points with a certain size, and a certain number of pen points are arranged first and last to form a one-dimensional brush. Second, "flying white" effect: refers to the "colorless" phenomenon that sometimes appears on the pen track. According to this feature, pen points can be divided into "real points" and "empty points". Solid dots, i.e. pen dots with ink; Empty dots, i.e. pen dots without ink. The empty point does not leave ink marks during the movement, which can realize the flying white effect of virtual and real[2].The brush model based on the above assumptions can not only meet the real-time requirements, but also not lack of flexibility.

1) Brush initialization

In the creation of ink painting, different strokes can create different effects. "Center" and "side" are the two most basic strokes. In this pen model, the initialization parameters are set as follows: The choice of pen - choose the center and the side; Maximum width of pen - during initialization, when the width of the pen of the center is within the maximum width range, no empty point will occur; Otherwise, the "bifurcation" effect will be generated, which shows that there are empty points and the empty points are randomly distributed;

Ink amount--including global ink amount and pen dot ink amount;

Ink concentration--the concentration reflects the ratio of ink and water, $D \in (0,1)$,This parameter has an important impact on the presence and change of ink color and the degree of diffusion;

The ink density is an attribute of the pen point.

2)Ink dipping

Ink dipping is the initialization process of ink amount and ink density of the pen. When the ink of the brush is saturated, there is sufficient ink on each of the bristles. During the pen operation, even if the ink of those bristles contacting the paper is exhausted, the ink will be transferred quickly because the ink on other bristles is sufficient; When the brush is dipped with less ink,

the ink on the bristles will be less and less during the painting process, so that the ink on the bristles contacting the paper is exhausted and no more ink falls on the paper.

3) brush deformation

Rotation is to simulate the phenomenon of pen head rotation in the process of painting. As a digital brush, its rotation transformation is a simple matrix transformation of the position of each pen point:

$$P' = \begin{bmatrix} \cos(\theta) & -\sin(\theta) & X_r(1-\cos(\theta)) + Y_r\sin(\theta) \\ \sin(\theta) & \cos(\theta) & Y_r(1-\cos(\theta)) - X_r\sin(\theta) \\ 0 & 1 & 1 \end{bmatrix} P$$

(1)

Where: (Xr, Yr) is the coordinate of the reference point, generally the midpoint or pressure point of the brush, θ Is the angle of rotation.

The scaling of the brush is used to simulate the size change of the contact area between the brush and the paper due to the pressure. Within the maximum width range of the brush, the scaling of the brush is essentially the increase or decrease of the pen points. However, there are different ways to reduce the pen points between the center and the side. Because the pressure point of the center is in the center, the increase or decrease of the pen points occurs on both sides; Since the pen tip always contacts the paper, the increase or decrease of the pen point occurs at the edge of the pen root. In the brush model, bifurcation is realized by "empty points". Similar to the real brush, when the pressure is too large (the width of the brush becomes larger), the brush will appear bifurcation. The rules for adding "empty points" are shown in Figure 1.
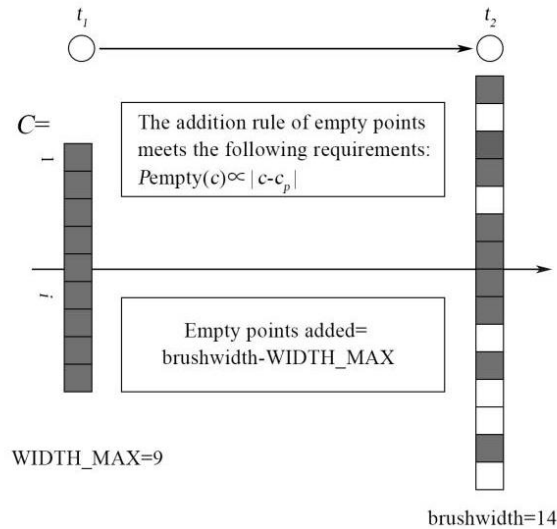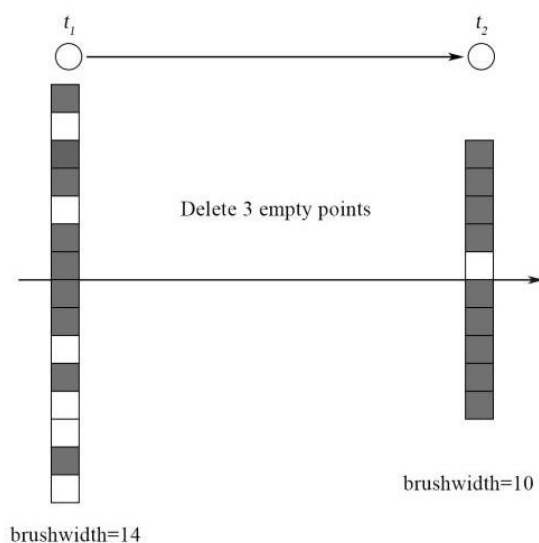

Fig. 1. Adding empty points

When the width of the pen exceeds the maximum width, empty dots will appear. The number of empty dots is n deadcell = brushwidth width max. The bifurcation effect at the pressure point

in the real brush track is the least, so the distribution of "empty points" in the brush model also follows this probability distribution,That is,

$$P_{dead}(c) \propto |c - c_p|, \quad P_{dead}(c), \quad (2)$$

it represents the probability of inserting an empty point at the position of the pen point c, c represents the position of the pen point, and represents the position of the pen point at the center point. The deletion rule of "empty point" is shown in Figure 2.

Fig. 2. deleting empty points

When the pen width decreases, if the brush has empty points, you should delete the empty points. Empty points farther from the pressure point are deleted first, and the number of "empty points" to be deleted is equal to the amount of pen width reduction.

3.2   Brush in Line Drawing

Line drawing, also known as line drawing, is the modeling foundation of Chinese painting[3]. As an important part of Chinese painting, line drawing has its unique features, that is, freehand brushwork and emphasis on calligraphy. Chinese painting has a long history of line modeling, and the styles of line drawing works in various dynasties are different, but the aesthetic pursuit of lines has not been reduced. Line drawing requires a high level of skill in painting performance, and requires forcefulness, fluency and change in pen use. In line drawing, there can be many changes in the lines, such as length, thickness, straightness, density, weight, rigidity and softness. Different strokes are required for different objects to show different spiritual characteristics. (Fig.3).

Fig. 3. The digital painting effect of Line drawing brush

The line brush in Adobe Photoshop is set by using the expression method of the brush. The texture of the brush is relatively soft and rhythmic. At the same time, there will be slight light and dark changes when painting on the rice paper. Therefore, it is necessary to pay attention to these characteristics when making the brush. When the brush tip is set from the preset brush, the brush brush is selected. The lines used during painting are expected to be long and thin and have a halo feeling. In order to enhance the halo feeling, when the texture option is checked, the texture is set for each pen tip, and the mode is changed to subtraction, and then the double brush and the mottled rich brush touch are checked to open the shape dynamic、 scattering texture（Fig.4）、double brush、 transfer（Fig.5), create and smooth templates. The specific parameter settings are as shown in the figure4-5.
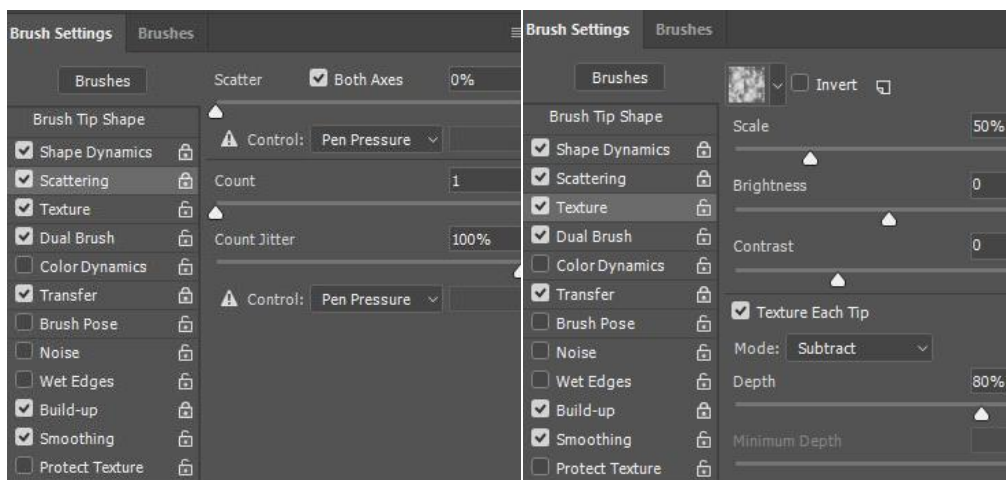
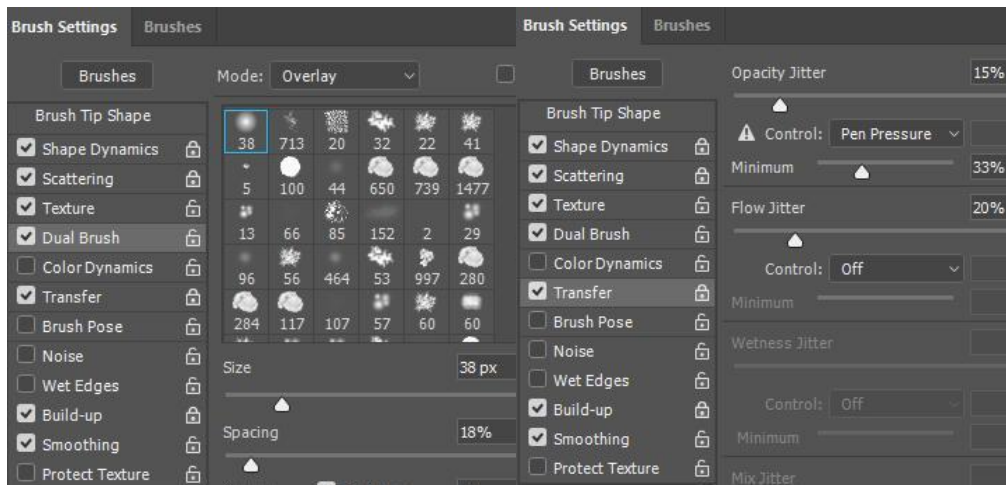**Fig. 4.** The setting parameters of line brush (scattering, texture).

Fig. 5. The setting parameters of line brush (dual brush, transfer).

3.3   Brushes in dyeing and painting

Dyeing is one of the important techniques of Chinese painting. In the "six methods", He Xie put forward the theory of "color according to the class", that is, color is applied according to the different inherent colors of the objects[4].Halo dyeing is a kind of dyeing method to express the intensity of color, and it has gradually formed a set of dyeing methods different from other painting types. Two pens shall be used for color fading. One pen shall be dipped with the required pigment. After coloring, the original color shall be gradually diluted and evenly transferred by using a clear water pen. For example, digital painting can be used to express the emptiness of the scenery in the mountains and rivers, so as to achieve an ethereal realm (Fig.6).
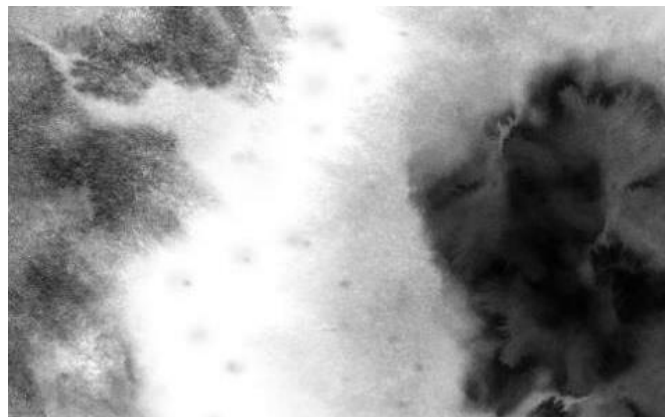

Fig. 6. The digital Smudge brush painting effect.

Photoshop's own watercolor texture brush has some problems: the color of the first brush is not the color that the creator wants, and it needs to be superimposed continuously, which is ineffi-

cient; After multiple strokes are superimposed, the transparency of each stroke will be superimposed on each other, and the texture may be overwritten. When modifying details, it may be necessary to repeatedly absorb color and shade, which is a little troublesome. Therefore, in the debugging of double brush presets, a pen tip shape with hand-painted texture is selected to open the shape dynamic, scattering, texture (Fig.7), double brush、transfer (Fig.8), create and smooth templates. The specific parameter settings are shown in the figure 7-8.
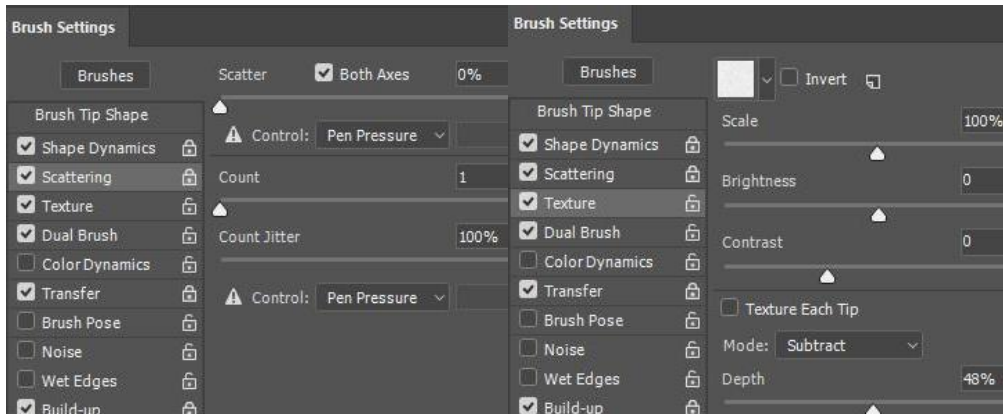

Fig. 7. The setting parameters of Smudge brush (scattering, texture).
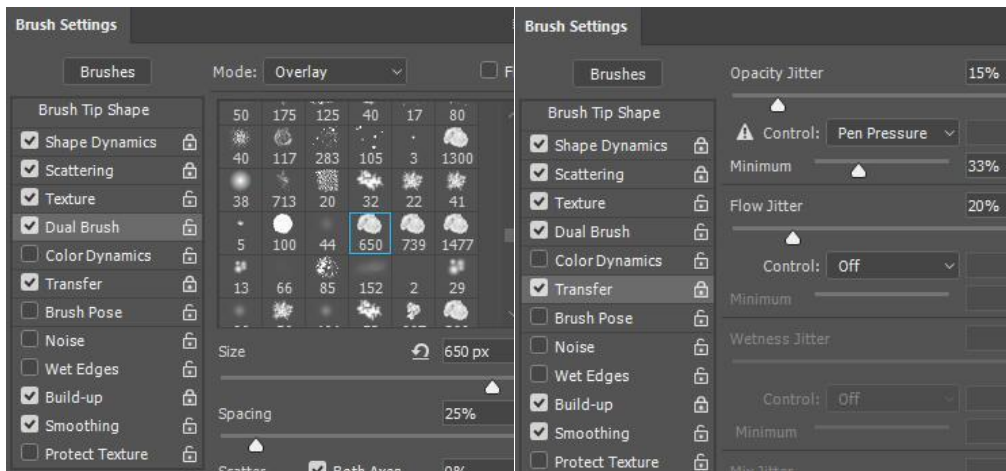

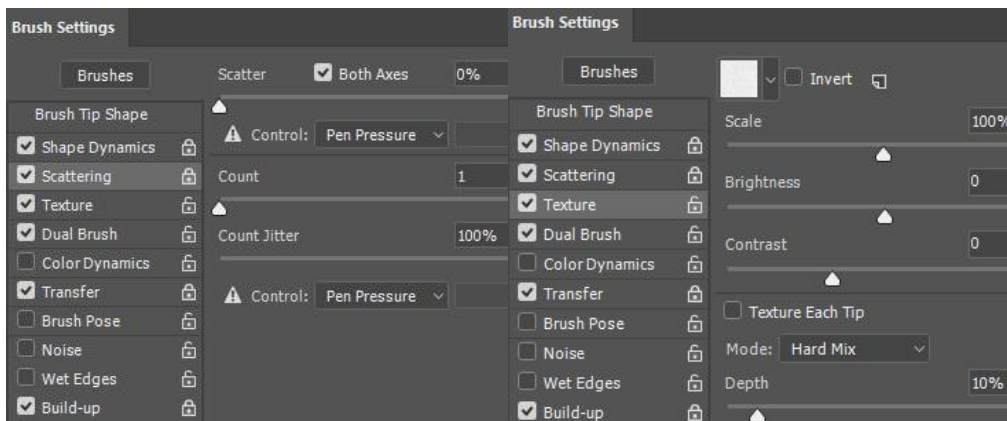**Fig. 8.** The setting parameters of Smudge brush (dual brush, transfer).

3.4   Brushes in Cun Technique

The Cun technique is a painting method to show the veins and textures of the rocks, peaks and trees. When drawing, draw the outline first, and then draw with light dry ink side brush[5]. The formal beauty of texturing is mainly reflected in the beauty of lines, strength and texture (Fig.9). The texture of the Cun technique should be coarser and stronger than that of the halo dyeing method, so I chose the brush tip shape with scratch feeling. The particles have a stronger sense

of whiteness, with slight light and dark color changes and edge roughness. Open the shape dynamic, scattering texture (Fig.10), double brush, transfer (Fig.11), establish and smooth templates. The specific parameter settings are shown in the figure 10-11.

Fig. 9 The digital Cun brush painting effect.

Fig. 10. The setting parameters of Cun brush (scattering, texture) .
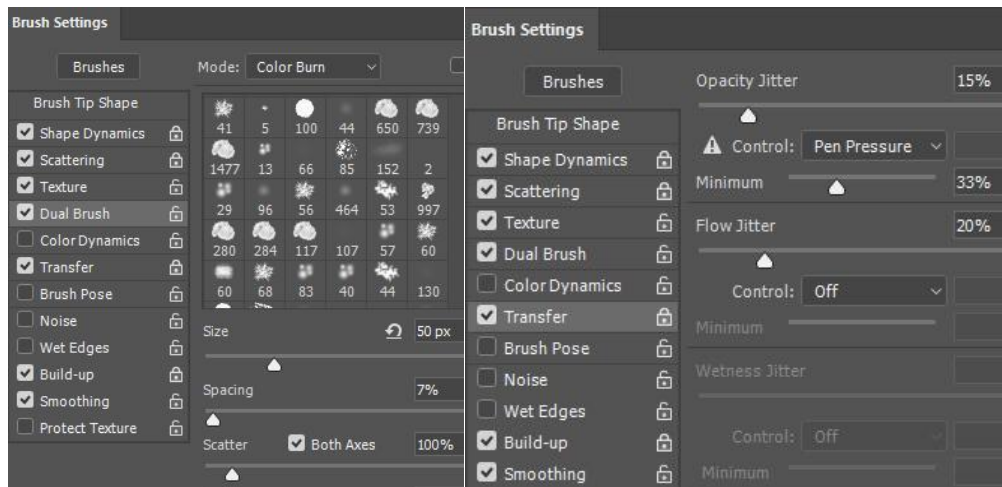
Fig. 11. The setting parameters of Cun brush (dual brush, transfer).

4   Conclusions

The brush selection is very important in digital painting. Through the research, it is found that digital painting and paper-based painting are different in the sense of pleasure. Among the many brushes in Photoshop, there are few strokes that can be highly imitated, and the use of them lacks some flexibility. After decades of development, Photoshop brush tools have become very powerful. By adjusting various parameters and settings, you can simulate real painting tools or make their unique special effects. In the painting process, the digital painting lacks the rhythm of the brush on the rice paper as in the paper-based painting. In the process of ink painting, the use of the brush needs to be improved and adjusted. The creator needs to have sufficient knowledge and proficiency in the brush function, and also understand the needs of the picture performance. Only by flexibly modifying and setting the brush tool in Photoshop can the brush model be better used.

The current brush model needs to be further improved. First of all, it can not complete the simulation of the effect of pen receiving and pen starting, especially the pen receiving effect, which still needs to improve the pen model; Secondly, the parameter analysis and calculation formula of the ink transport mechanism should be further explored, so as to naturally simulate the special effect of the brush track; Thirdly, it is also necessary to summarize the effects of various brush and ink methods, so that they can be more effectively used in the rendering of ink painting in the future.

Acknowledgment

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