The Comparative Study on Underlying Features of Paining Tang-ka Images and Natural Images

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Abstract. Our purpose was to find the difference between the color features and texture features of natural images and painted Tang-ka images. Taking natural images as a reference, painted one were analyzed in HSV color space. The natural image and painted Thang-ga texture features were extracted, using the Tamura’s method. The data showed that the natural image’s coarse was larger than the painted Tang-ka, and painted Tang-ka were more saturated than natural images. Compared with natural images, the painted Tang-ka’s directonality has higher value. By contrast, the red Tang-ka had a higher value than the golden one.

1. Introduction

Tang-ka is flat and wide painting with scroll, and it is a unique artistic expression of the Tibetan people in China. Since the 7th century, Tang-ka art been born on the Qinghai-Tibet Plateau. It has a history of 1,300 years. Until now, Tang-ka is still being created in Tibet, even its influence is gradually expanding in China and the world. The Tang-ka covers many contents, such as religion, politics, culture, medicine, history, economy, science and technology. It is called the encyclopedia of Tibetan national culture. Tang-ka reflects the Tibetan people's understanding on pursuit of truth, goodness and beauty. The famous Tang-ka research scholar Della only thought Tang-ka should be divided into 32 categories, according to his own research results. The painted Tang-ka could be roughly divided into the colour, the black, the red and the golden, according to its background color. In addition to painted Tang-ka, there are also printed Tang-ka, embroidered Tang-ka, piled Tkang-ka, scrapped Tang-ka and beaded (gemstone) one. In the process of development of Tang-ka art, there were been Nepalese school, Qiwugang school, Chin school and Karma school. Image processing has its own advantages in retrieval and recognition. If the method of combining images was used to carry out related research on Tang-ka, it could effectively promote the development of Tang-ka [1-3].

Using HSV color model, the pixes of Tang-ka image and natural image are counted to find the difference between them. Saturation of the color Tang-ka image is higher than natural image. For value, the natural images is higher than the color Tang-ka images. Value of the red Tang-ka images were better than the golden Tang-ka image. Tamura’s algorithm is used to extract the texture feature of Tang-ka image and natural image. The values of the painted Tang-ka images is lower than that of natural images [4-5].
2. Material and Methods

2.1. Analysis of Color Feature of the Painted Thang-ga Images

Tang-ka’s artistic expressions and painting methods were in the history of world art. Exaggerated artistic imagination and shock were unique, so the painted Tang-ka image were used as the material for this study. Four types of painted Tang-ka and the natural images were shown in Figure 1. a) was the color Tang-ka, b) was the black Thang-ka, c) was the red Tang-ka, d) was golden Tang a. e), f), g) and h) was the natural images from wiki database. In the process of painting Tang-ka, red, green, golden, black and blue were used more.

![Figure 1. The painted Tangga images and the natural images](image)

2.2. The Painted Tang-ka Image Processing in Hsv Space

Color is a dominant visual feature with strong robustness. HSV model was consistent with human visual characteristics, so it was easy to think of using this model to analyze color feature of painted Tang-ka images. The three attributes of the HSV model were hue, saturation and value. The analysis steps for the color Tang-ka in HSV spaces were as follows:

Step 1:
In the painted Tang-ka data set, 240 different types of Tang-ka were extracted as Tang-ka tested data, and 60 the natural images were extracted from Wiki database as tested data.

Step 2:
The tested data in step 1 were processed in MATLAB 2018b by RGB conversion HSV algorithm, the data in the HSV model were quantized in non-equal intervals to a range of 0 to 256.

Step 3:
According to the classification, the tested data were counted; the pixels of H, S and V components are calculated finally.

Step 4:
The natural images were used as a reference, and the tested data of the painting Tang-ka were compared with it, then found out the difference between the two types of images.
2.3. Texture Feature Analysis of painted Thang-ka Images

Tamura et al. proposed that texture features that could be represented by a vector with 6-element. Usually, an image could be distinguished by only three elements. The three elements were coarse, contrast and directionality, it could be represented by the formulas (1), (2), (3) and (4).

\[
F_{cm} = \frac{1}{m \times n} \sum_{i=1}^{m} \sum_{j=1}^{n} S_{best}(i, j) \tag{1}
\]

\[
F_{con} = \frac{\sigma}{\alpha^4} \tag{2}
\]

\[
\alpha_s = \frac{\sigma^4}{\mu_4} \tag{3}
\]

\[
F_{dir} = \sum_{p} \sum_{\Phi \in \Phi_p} (\Phi - \Phi_p)^2 H_p(\Phi) \tag{4}
\]

In the formula (1), \( F_{cm} \) was image coarse. \( m \) is the line of image. \( n \) is the column of image, \( S_{best}(i, j) \) is the optimal size of the window; in the formula (2) \( F_{con} \) is contrast, \( \mu_4 \) was the fourth moment of image gray scale. \( \sigma^2 \) was the variance; In the formula (4), \( F_{dir} \) is directionality, \( p \) was the peak of the image histogram. \( n_p \) was all the peaks in the histogram. \( n_p \) is all areas covered by the peak, \( \Phi_p \) was the center of the peak. \( H_p(\Phi) \) represented the peak gradient [6].

The specific steps for using the Tamura method were as follows:

Step 1:

The texture features of the natural image and the painted Tang-ka were extracted, using the Tamura method.

Step 2:

The painting Tang-ka were divided into two categories, the color Tang-ka and the black Tang-ka were the same class, the red Tang-ka and the gold Tang-ka were another one.

Step 3:

Taking natural images as reference, the elements of the texture feature vector of the painted Tang-ka image were analyzed, then searching the difference between painting Tang-ka and reference [7-8].

3. Results

3.1 Test Results of Color Feature of the Natural images and the Painting Tang-ka

According to the above Tang-ka color analysis method, the hue, saturation and value of painted Tang-ka image and natural image were simulated respectively. The natural images were always used as reference images in the analysis below. The natural image hue and pixel’s simulation diagram were shown in Figure 2. The color Tang-ka image’s hue and pixels simulation diagram were shown in Figure 3. The horizontal axis was the hue, and the vertical axis was the pixel in the figure. Overall, Figure 2 and Figure 3 were very similar in shape. Both simulation’s diagram had two peaks and two valleys. In the hue [0, 37] and [147, 172] interval, there was a large of pixels. In the hue [56, 129] and [181, 219] interval, there were a few pixels. For the color Tang-ka, there were a large number of pixels in the hue [0, 44] interval. In the hue [62, 102] and [181, 231] intervals, there were a few pixels. At the second peak, the pixel’s increase were not significant, the pixel’s increase was obvious at hue 171. It showed that both area of the hue were still different, although they had the same shape. In hue 24, the red Tang-ka’s pixels were the highest, but the natural image had the highest pixels in hue 16. The relationships between natural image saturation and pixels were shown in Figure 4. The relationship between color Thang-ka saturation and pixels is shown in Figure 5. According to Figure 4 and Figure 5, the differences between the saturation of natural images and color Thang-ka images were very obvious.
Figure 2. The natural image hue and pixel simulation diagram

Figure 3. The red Thang-ga hue and pixels simulation diagram

Figure 4. The natural image saturation and pixels simulation diagram
Figure 5. The natural image saturation and pixels simulation diagram

In the saturation interval \([0, 16]\), the pixels of the natural image continued to increase, when the saturation increased. Except for the saturation of 64, 86, 128, the image pixels continuously decreased as the saturation increased. At a maximum of 256 saturation levels, the pixels increased dramatically. In the saturation \([0, 13]\) interval, the color image of the color Tang-ka image increased with the increase of saturation. In the interval \([13, 235]\), the color Tang-ka remains essentially the same as the saturation increased. At the saturation maximum of 256, the color Tang-ka pixels also increased dramatically. It was enough to show that the saturation of the color Tang-ka was higher than the saturation of the natural image.

4. Conclusions

Based on the results and discussions presented above, the conclusions are obtained as below:

(1) The color Thang-ka images are more saturated than natural images, and the saturation and value of the red Tang-ka is better than the golden Tang-ka.

(2) The directionality of painting Tang-ka is higher than natural images.

(3) In the interval \([13, 235]\), the color Tang-ka remains essentially the same as the saturation increased.

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