



Artistic information extraction from Chinese calligraphy works via Shear-Guided filter[☆]



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ARTICLE INFO

Article history:

Received 14 March 2016

Revised 18 June 2016

Accepted 18 July 2016

Available online 19 July 2016

Keywords:

Artistic information extraction

Spirit information

Shear-Guided filter

Evaluation parameters

Chinese calligraphy works

ABSTRACT

Chinese calligraphy is a unique visual art, and is still emitting fascinating artistic brilliance and charm. The artistic beauty of Chinese calligraphy is constituted by two elements, i.e., form and spirit, which attract continual attentions by calligraphy artists. In this paper, we present Shear-Guided filter to extract the artistic information. Shear-Guided filter is designed by combining the shear transformation and the guided filter. It has both the edge-preserving smoothing property from the guided filter and the linear multidirectional property from the shear transformation. Shear-Guided filter can extract more spirit information from the calligraphy images, especially in the half-dry strokes. Furthermore, the previous evaluation parameters consider all pixels equally, which is against the truth. Here we put forward three new parameters to solve this issue. Finally, experiments show that Shear-Guided filter can extract the information of form and spirit more accurately, and the new evaluation parameters have better performances in evaluation.

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1. Introduction

Chinese calligraphy is the outstanding representative of Chinese traditional culture, it is the crystallization of Chinese culture, and embodies the essence of Chinese culture for thousands of years. Chinese calligraphy is also of great significance for Chinese traditional cultural heritage, and an art in the form of writing Chinese characters in black and white. It looks simple, but is fascinating; it is colorless, but has the glamour of the painting; it is silent, but has the rhythm of the music.

The artistic beauty of Chinese calligraphy includes two elements, i.e., form and spirit. Form, related to the static spatial information (as shown in Fig. 1(a)), includes the size and shape of the strokes, and the position and structure of a character. Spirit, reflecting the artist's expression and personality related to the brush movement in time and space (as shown in Fig. 1), includes ink concentration or thickness, and ink variations from the brush movement [1]. Chinese calligraphy lays emphasis on the subtle

variety of the ink, in which the writing rhythm of the calligraphers contains, and the cadence, which is contained in the writing process, is a reflection of the external visual form to the variety of the ink. Therefore, only when the calligraphers write in ink perfectly, the beauty of calligraphy will appear. While spirit is embodied on the basis of form, and both of them are compacted together as the whole characters. Fig. 1 shows the results of the same character wrote by the same calligrapher at different speeds and rhythms. From left to right, with the increase of the writing speed, the ink of the characters varies dramatically, and the spirit strengthens gradually.

In fact, for the traditional culture in China, people prefer to consider the spirit more important than the form. That's because the spirit represents the artist's idea and esthetic orientation. Therefore, in order to learn and appreciate Chinese calligraphy, people need to grasp both of these elements, especially for the spirit. While for most Chinese calligraphy lovers, there are lots of challenges to learn and appreciate the famous calligraphers' works. The first one is that many people have only limited access to these works. The second one is that somebody, who learns and appreciates a calligrapher's works, requires an expert's help, since it is difficult for an ordinary person to understand the spirit of Chinese calligraphy. Thus, only a few talented people can practice

[☆] This paper has been recommended for acceptance by Zicheng Liu.

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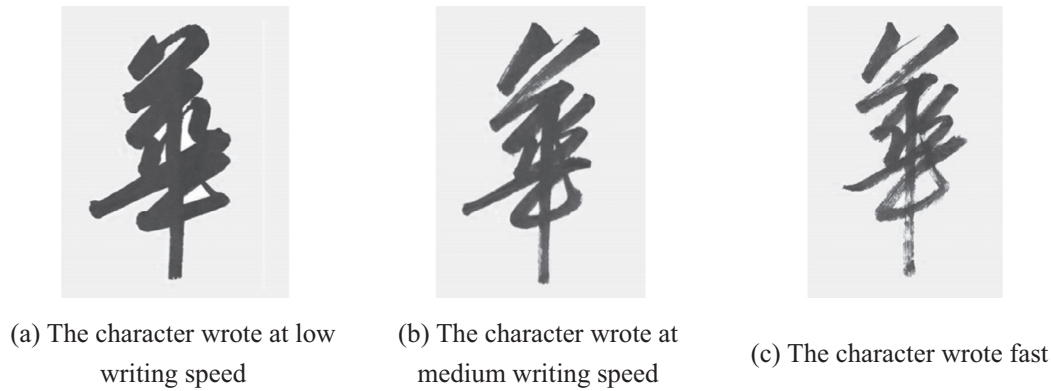


Fig. 1. The results of the same character wrote by the same calligrapher at different speeds.

sufficiently, and have a taste of the artistic beauty of the calligraphy works, which causes difficulties in the development of Chinese calligraphy. Moreover, the number of these people, who can appreciate the calligraphy works, will decrease as time goes on. If we are not to promote Chinese calligraphy in a timely manner, there will be fewer people who can access to Chinese calligraphy, let alone to learn and appreciate them. That will be a significant loss for Chinese cultural heritage.

So how to resolve these problems? The simplest solution is to display the calligraphic relics (including the tablet and writing works) all over the country and even the world. Obviously, this way is not in conformity with the reality, it is costly, time-consuming, and would be adverse to the protection of these calligraphy works. In recent years, the digital image technology has been used, numerous calligraphy works written by famous calligraphers have been widely digitalized, and these digital forms of the calligraphy works have become important network resources to facilitate the calligraphy appreciation and learning. For example, there is a database containing lots of the images of the ancient Chinese calligraphy works in Zhejiang University Libraries System [2]. Compared with other ways, the advantages of digitizing the calligraphy works are mainly reflected in that these digital calligraphy images can be stored, disseminated and processed easily [3,4].

On the basis of these digital images, researchers have conducted studies on the calligraphy images to solve character/stroke feature analysis [5–7], image search [8–10], calligraphy style recognition [11,12] and calligraphy works retrieval [13–15]. In most of these works, it has been assumed that the Chinese characters have been extracted from the calligraphy images by some simple extraction methods, but that is not at all the case. In some calligraphy images with low quality, especially in some images of the writing works, the existing methods are difficult to extract the characters accurately and completely. Most methods ignore the extraction of the characters' spirit, which results in that they cannot efficiently solve the deeper issues, such as the recognition of calligraphers and calligraphic relics. Therefore, to perform these studies effectively, it is necessary and essential to extract both the form and spirit (see Fig. 2).

At present, the methods based on binarization or image segmentation are applied to extracting the characters from the calligraphy images. These methods work well on obtaining the characters' strokes, but in the half-dry strokes (It is a style of calligraphy characterized by hollow strokes, as if done with a half-dry brush, and the ink in this area is sparse), these methods are difficult to extract the spirit information which is of high artistic and esthetic values, as shown in Fig. 4(a). In the calligraphy images, especially for the writing works, there are several challenges for extracting the spirit. For example, the ink is diffused on the paper,



Fig. 2. The calligraphy image of a character.



Fig. 3. A part of Fig. 2.

which results in that the edges of the strokes are hard to determine. The pixels of the half-dry strokes are difficult to separate from the background, as shown in Fig. 3. Moreover, extracting the spirit from the calligraphy images with low quality is more challenging.

In 2014, Zheng et al. [1] stated that the extraction of the spirit is very important for efficiently solving the deeper issues for the first

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