

Beautifying Font: Effective Handwriting Template for Mastering Expression of Chinese Calligraphy

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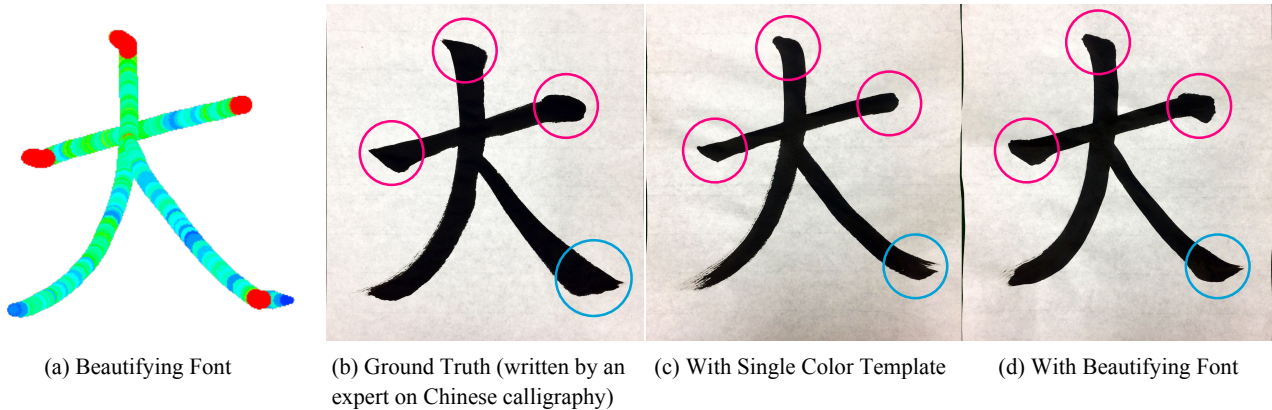


Figure 1: (a) Beautifying Font. (b) Ground Truth written by an expert on Chinese calligraphy. Comparison; (c),(d) written results without and with help of Beautifying Font. The red circles in (b), (c), (d) indicate *tome* (stop) points and the blue circles are *harai* (sweep) points. They show that our system lets the appearance of (d) closer to that of (b) especially in these circles.

ABSTRACT

We propose a novel font called Beautifying Font to assist learning techniques in writing Chinese calligraphy. Chinese calligraphy has various expressions but they are hard to acquire for beginners. Beautifying Font visualizes the speed and pressure of brush-strokes so that users can intuitively understand how to write.

CCS CONCEPTS

• **Human-centered computing** → *Human computer interaction (HCI); Heat maps;*

KEYWORDS

Learning Support, Chinese Calligraphy

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1 INTRODUCTION

Chinese calligraphy is a traditional and important culture in Asia [Chiang 1973]. Asian students learn Chinese calligraphy as a part of education. Chinese calligraphy has various expressions (e.g., *tome*(stop), *harai*(sweep)) as shown in Fig.1 (b), but learning these techniques is difficult for beginners. In order to express the Chinese calligraphy correctly, controlling the writing speed and pressure is important. Traditionally, students learn these techniques by understanding teacher's explanation and imitating their motion. However, these instructions are not intuitive and hard to understand because the writing speeds and pressures are continuously changing.

Narita et al. [Narita and Matsumaru 2015] introduced the system which supports learning Chinese calligraphy-strokes using projector and depth sensor. This system visualizes the status of brushwork and displays the brush stroke animations, so that users can learn the calligraphy-strokes by following the animation. However, this system is not intuitive because it is hard to follow the temporally changing animation. In addition, this system demands a special device.

In this paper, we present a novel font called Beautifying Font which can also support learning of brushwork in writing Chinese calligraphy. Beautifying font has three features:

- visualizing writing speed of expert
- visualizing writing pressure of expert.
- including shape detail of each stroke.

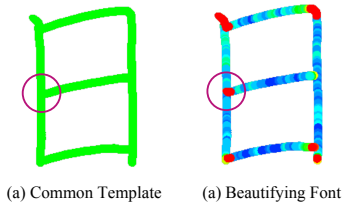


Figure 2: Comparison between common template and Beautifying Font at the point of overlapped strokes.

Users use Beautifying Font by display or projector when they are practicing. Beautifying Font enables users to refer to the brushwork of expert including writing speed and pressure visually. In addition, users can check the shape of the overlapped strokes. Beautifying Font does not require special devise, and it is similar to a conventional learning method. Therefore, Beautifying Font is both helpful and easy to use. To study the performance, we conduct a user study to investigate the acquisition degree of writing strokes of Chinese calligraphy. According to the result, Beautifying Font actually can assists users to learn techniques of Chinese calligraphy better.

2 OUR APPROACH

Beautifying Font is built by experts of Chinese calligraphy. It has captured writing trajectories with pressure data. Here, we convert a stroke as a set of points $p_i (i = 1, 2, \dots, N)$. Then we synthesize a circle at each point. The radius of the circle is proportional to the level of pressure. The color which represents the speed of writing is calculated from the data of trajectory. On this basis, we define the degree of the speed $S(p_i)$ as

$$S(p_i) = \sum_{j=1}^N \exp\left(-\frac{d^2(i, j)}{2\gamma^2}\right). \quad (1)$$

where $d(i, j)$ is the distance between p_i and p_j on the trajectory.

$$d(i, j) = \sum_{k=i}^j \|p_i - p_{i+1}\| \quad (2)$$

We get hue in HSV color space from $S(p_i)$.

$$h(p_i) = \begin{cases} (1.0 - S(p_i)) * 240/360, & \text{if } S(p_i) \leq 1.0 \\ 0, & \text{otherwise} \end{cases} \quad (3)$$

This means when $S = 0$, the color is blue, and when $S \geq 1.0$ the color is red. When we synthesize the circles, with color is blended in order to improve the visibility of stop and sweep points.

In addition, since trajectory of each stroke of Beautifying Font is well captured, we can clearly check through the point of these overlapped strokes (Fig.2).

3 RESULTS AND USER STUDY

We conduct a user study to investigate the acquisition degree of Chinese calligraphy-stroke for beginners. At this time, we compare the results of practice between previous approach and our approach. Fig.3 shows overview of using the implementing Beautifying Font. Users draw a character by tracing a character template projected on

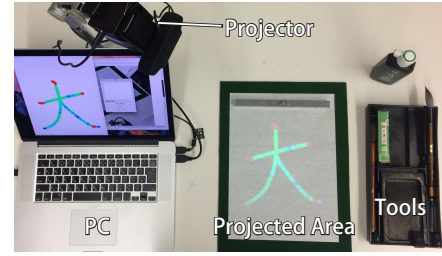


Figure 3: Appearance of the system implementing Beautifying Font

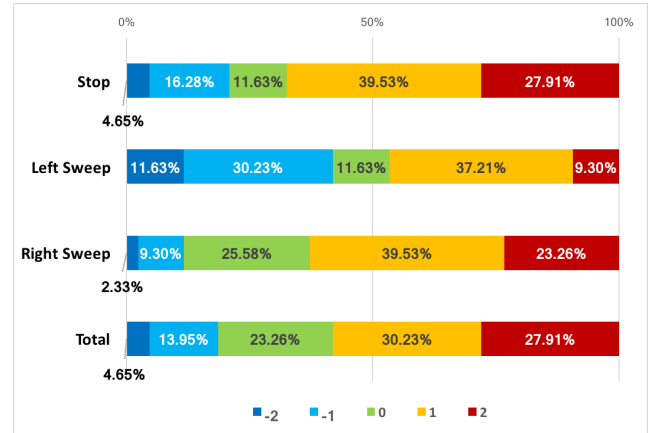


Figure 4: Results of the evaluation.

the paper with single color template (green) and with Beautifying Font. Fig.1 shows a result without/with Beautifying Font.

Chinese calligraphy experts evaluate the results by comparing the set of two results (single color / Beautifying Font, drawn by a same user) and then score each performance with five levels (1: The left one is better. 2:The left one is better if anything. 3: Either is good/bad. 4: The right one is better if anything. 5: The right one is better). The positions of the two samples are randomly determined. Evaluation mainly depends on four points (Stop, Left sweep, Right sweep, Total evaluation). Fig. 4 shows the evaluation results. There are 9 users evaluated by 5 experts. The positive score represents the performance of the ours template and the negative score represents the performance of the single color template. The graph shows the results supported by Beautifying Font obtain higher evaluations. Whereas the effect on Left Sweep expression was not so remarkable, the expressions of Stop and Right Sweep are preferred by experts.

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