Abstract

Calligraphy is a popular visual art form that intends to produce pleasant writing, especially in East Asia. However, it is not easy for amateurs to write calligraphy due to the delicate writing trajectory and brush pressure control. To help beginners with calligraphic writing, calligraphic animation videos are extremely helpful to show the writing trajectories and brush pressures at all writing positions. Besides, calligraphic animations are frequently used in different digital media as a better way to present and animate the text, such as in movies, dramas, cartoons, and advertisements. While there are tools available for manually producing calligraphic animation, the process is tedious and requires professional skills. An automatic calligraphic animation generation system would help much in this tedious and time-consuming calligraphic animation making process. What's more, the generated animations with writing trajectories and brush pressures can be directly used in robot writing as well.

An automatic calligraphic animation generation system includes three parts: segmenting the calligraphic image into individual strokes, identifying trajectory and brush pressure for each stroke, and generating animations to all strokes. There are several key challenges to be solved. Firstly, the writing topology of a calligraphic character may not be the same as the formally written one (Figure 1). So, even though the writing order of the strokes for formally written characters is well defined, the calligraphic character may not follow the defined writing order. So, it is not realist to hardcode the writing order for animation generation. Secondly, the writing habits are very different for modern and traditional Chinese. The modern Chinese is customed to write from first left to right and then top to down, while the traditional Chinese is customed to write from first top to down and then right to left (Figure 2). It is needed to identify the writing order before animating the characters. Finally, the generated writing trajectory and brush pressures should be precise and smooth to simulate the real writing.

Despite the usefulness of the system in education, entertainment, and automation, the existing methods generally only focus on one part of the system. Without taking consideration of the whole system, the existing stroke segmentation methods usually only generate low-resolution output, so the segmented individual strokes can hardly be directly used for animation generation. Besides, the state-of-the-art stroke generation methods are usually trained in a specific font style and are error-prone to even minor font changes (Figure 3). On the other hand, the existing text animation generation methods generally rely on hardcode writing topology of each character, the character writing order and calligraphic characters that do not obey the defined writing topology are still lack in discussions.

In this project, we propose a novel system which consists of a novel learning-based stroke segmentation module, a contour-based trajectory and brush pressure identification module, and a learning-based stroke animation generation module. The key idea of the stroke segmentation module is an iteratively refined stroke segmentation network to gradually adapt the network to different calligraphic fonts. The key to the trajectory identification module is to obtain the precise trajectories with brush pressure based on the contour information. The key to the stroke animation generation module is to first identify the writing

order of the corresponding calligraphic image and then generate the ordering and animations of the strokes based on the identified writing order.

With the proposed system, we believe the tangible outcomes, e.g., publications and algorithms, should directly benefit the industry and the research society. The research project would also provide an invaluable chance in developing the skills of the teachers and the students in artificial intelligence and digital entertainment technology, which is also part of the curriculums and programmes offered by the school and the institute.