Calligraphy Expressions Based On Electronic Musical Instruments Metaphor

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Abstract

We propose a new calligraphy drawing system based on the principles of electronic music samplers and synthesizers. Our purpose is to make it easier to digitally render the scratched brushstrokes and other expressions of calligraphy which had been difficult to achieve with drawing tools and to propose a new mode of expression by incorporating the electronic musical instruments metaphor. With a sampler metaphor, the user scans reference calligraphy images by tracing the strokes with a mouse-pointer and rewrites the calligraphy by outputting sampled images on the drawing window. With a synthesizer metaphor, we aimed to create digital brushstrokes in the way that synthesizers create sounds. We propose this as a function that has the ability to design expressions with a scratched or blurred look. We designed this system based on the principles of electronic music devices, and built this metaphor by adding further editing functions: an envelope controller and a mixer. Samples of calligraphy created by our system are provided at the end of this paper.

1. BACKGROUND

"Calligraphy is the art of lines" [Ishikawa et al 1994]. Sokyu Ueda, a pioneer of avant-garde calligraphy, also states that calligraphy has an independent quality in the beauty of its brushstrokes [Ueda 1963] and recognizes this independence as the figurative art of calligraphy. With the movements of Sokyu Ueda et al., attention began to be drawn toward the beauty of calligraphy as a figurative art that invoked a different sense of values from that of traditional classical calligraphy. It is also not common in recent years to see calligraphy being used for designs of items such as titles of newspapers, magazines and movies, and as logos for products. The Japan Design Calligrapher's Association designates such "designed written characters" used in advertising as commercial calligraphy or design calligraphy and conducts activities such as inviting calligraphers who specialize in design calligraphy to study together and promote design calligraphy. Thus, the calligraphy being used as designs, which one can currently see employed in a range of media, has the potential to become even more prevalent in future in the form of outstanding visual expressions independent of any writing style and target.

Furthermore, developments in information technology in recent years have created an environment in which anybody can easily create and present digital content such as movies, music, and illustrations. Works that hitherto necessitated expensive materials can now be created at a comparatively low cost on a single computer, and it has become possible to easily transmit these created works throughout the world. Thus, sites such as YouTube, pixiv, and flickr, where people who are not experts can upload and

release material, have become commonplace and can be seen to increase people's motivation to make their own creations. When considered in this context, further increase is expected in opportunities for even amateurs to design and publish their own material. Moreover, it is predicted that there will also be an increasing demand to include calligraphy as outstanding visual expression within designs. However, manipulating a brush and designing the kinds of calligraphy that one would like to create is not easy to achieve. It requires a high level of skill to pick up a brush and define lines as per one's wish, and it is extremely difficult to learn these skills. When compared with pencils or pens, brushes require a range of factors to be considered in addition to line thickness, such as scratched and blurred looks, and it is very difficult to express and draw these looks the way one wishes to draw. Much of the calligraphy currently seen in materials such as lettering for titles is created by calligraphers, and only an extremely small number of people who have a mastery over calligraphy are involved in designing of these characters. Another reason why not many people are involved in calligraphy design is that although several convenient software packages are available, which allow users to create a range of content, there is yet no software in widespread use that can render calligraphy at a satisfactory level of quality.

1.1 RELATED RESEARCH

A range of research has been carried out regarding pictures made by using brushes, and many painting software packages, such as Painter and Illustrator, are available in the market. Much of this research has focused on highly realistic expressions through simulations. Strassmann [1986], who conducted early research in this field, expressed the trajectory of brushes through methods that employed one-dimensional array. Research that focuses on scratched and blurred looks include studies that use fractal calculation methods [Nakamura et al 1996], fuzzy calculation methods [Nakamura et al 1995], and renormalization group calculation methods [Mano et al 1997]. Nelson S.H. Chu et al., have made rendering highly realistic graphic expressions possible through the shape modeling of brush tips using advanced simulations [Chu and Tai 2004] and MoXi that expresses the flow of ink [Chu and Tai 2005]. Although this kind of research has broadened the possibility of rendering calligraphy in a digital environment, none of the techniques have been able to perfectly realize the movements of brush tips in the body and on the screen and have yet to reach a stage where users can gain their desired results. In research that specifically targets calligraphy, apart from those on drawing, some are centered on acquiring calligraphic images. Songhua Xu et al., have acquired information on the constituent elements of characters written by specific people and have generated characters having the same features as those of the handwritten characters by those people [Xu et al 2008]. Howard Leung et al., have acquired data related to a certain piece of calligraphy, such as the shapes and gradients of brushes, and have made it possible to create a process to preserve the calligraphy [Leung et al 2008]. Although several examples of calligraphy are acquired by fitting the outline of a brushstroke with the correct size of ellipse, Droplet et al., [2004] makes it possible to acquire an outline that also considers scratched looks by fitting multiple drop shapes to the brushstroke. Yu and Peng have proposed an expression in which textures from other calligraphy works are fitted to the shapes of acquired calligraphy [Yu and Peng 2005]. Nakakoji et al., have proposed a system of calligraphy education that acquires brush movements of calligraphy experts and incorporates these movements and rhythms by reproducing them [Nakakoji et al 2007].

In addition, new expression methods have also been proposed for general drawing expressions by acquiring other works and drawing acts. Sequential Graphics [Sakurai and Eto 2008] has proposed a new expression in the form of imparting movement to pictures through incorporating movements of each brush without modification and has made it possible to create vibrant works. The edge brush of

the image editing program proposed by McCann and Pollard [2008] makes it possible to acquire edge information and creates images by tracing the edge section of the target image with a pointer. ThinkingSketch [Mima et al 2002] automatically generates pictures by using sections and color tones of existing pictures and plans introspective invigoration in production processes. The I/O Brush of Ryokai et al., [2005] renders hitherto unseen expressions by using a brush-type interface integrated with a camera which imports all kinds of objects from the real world as images and uses these as ink. Furthermore, by adding a function that allows referencing of the original acquired image after creation of the picture [Ryokai et al 2005], I/O Brush visualizes the processes of creating pictures and has made it possible to show the origin and background of each color. We proposed a new calligraphy drawing system based on the principles of electronic music samplers and synthesizers. We have conducted various demonstrations and trials of our system at venues such as conferences and have interviewed both observers and test subjects[Uchihira and Miyashita 2010]. In this thesis, we examined our system on the basis of the opinions and example works obtained on these occasions.

2 A SYSTEM FOR EXPRESSING CALLIGRAPHY

2.1 SYSTEM

This system has an interface design that separates the difficult maneuvering of brushes from the act of drawing, generates pre-strokes, and makes a drawing from these pre-strokes. Such separation of the unified act of drawing and the result of stroke generation in the actual experience of calligraphy is the same as the separation of the generation and performance of musical sound by electronic musical instruments. By separating the act from the result, we aim to reduce the difficulty in drawing. Through using such methods, we hope that this system will fulfill two goals: (1) realize highly realistic drawing expressions and (2) propose completely new expressions. Following Nakakoji's classification [Nakakoji 2006], we can conceive of this system as comprising two aspects: a tool for creating things and a tool for making the hitherto impossible things possible. We will discuss both of these aspects in our evaluation later.

The flow of the system is as follows. First, the strokes that are to be drawn are generated beforehand. There are two methods of generating these strokes: one incorporates the metaphor of the sampler and the other incorporates the metaphor of the synthesizer. After the strokes have been generated through either of these methods, drawing is conducted by outputting these. Following drawing, the drawn strokes can be edited through functions that incorporate the metaphors of envelope controllers and mixers used in editing functions of electronic musical instruments (Fig 1, Fig. 2 See also the video online http://youtu.be/9hq7HRkp3n0).

Fig. 1 Main Window
(Bottom left: Sampler tab; Top: Drawing/Browsing tab; Bottom right: Synthesizer tab
See also the video online http://youtu.be/9hq7HRkp3n0)
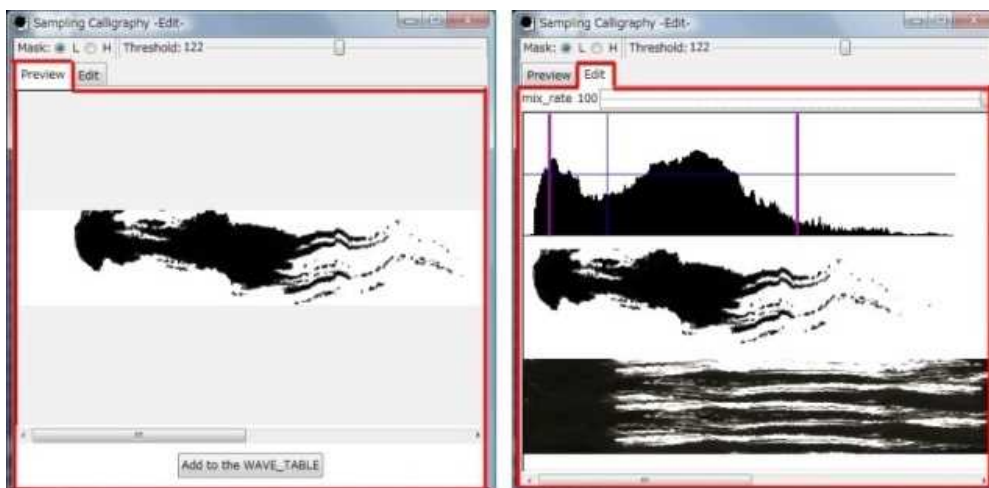

Fig. 2 Sub Window
(Left: Preview tab; Right: Editing tab)
See also the video online http://youtu.be/9hq7HRkp3n0)

2.2 STROKE GENERATION

The stroke generation function generates strokes through two methods: a method that incorporates the sampler metaphor and a method that incorporates the synthesizer metaphor.

2.2.1 SAMPLER METAPHOR

As a sampler makes it possible to sample the sounds of actual musical instruments and express these as highly realistic sounds, so does the method of stroke generation incorporating the sampler metaphor generate strokes by acquiring characteristics through sampling from model images. The characteristics acquired from models can output expressions that are even more realistic than expressions created through advanced simulations.

First of all, using a calligraphy image to be modeled after, users conduct sampling by scanning the sections of the image that they would like to acquire by dragging the mouse pointer and tracing them. In the process, scan lines that move and rotate in response to the movement of mouse pointer are displayed and the section of the model image within the displayed location of the scan lines is scanned. These scanned images (samples) are one-dimensional with the same linear form as the scan lines, and are stored sequentially. By operating scan lines that move in response to the movements of the mouse pointer, it becomes possible to sample the desired sections of the image.
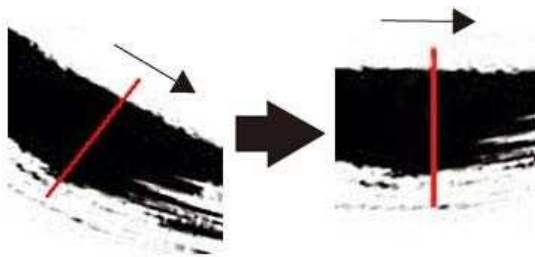
Fig. 3 Scan Lines during sampling
(Left: During sampling; Right: During storage)

2.2.2 SYNTHESIZER METAPHOR

Oscillators: In synthesizers, oscillators are mechanisms that form an essential part in creating sounds that generate waveforms. In our system, likewise, this oscillator part has a mechanism that generates simple waveforms.

The system has a function based purely on waveform generation in which users operate the parameters on their own and generate wave data. Although this study used square waveforms with the aim of generating strokes, we only focused on positive components and half cycles within these square waves for outputs, as there is no need to output waves that have positive and negative components on a cyclic basis.

Users can transform wavetables generated by oscillators into the required shapes by manipulating the parameters of frequency, amplitude, and phase. The parameters in this system can be translated as follows: frequency can be translated as stroke thickness, amplitude as concentration value, and phase as position. Transformations in waveforms by operating these parameters can also be carried out with the wave data that is read and generated by the memory playback oscillator, and effects such as blurring the stroke data of presets can be produced.
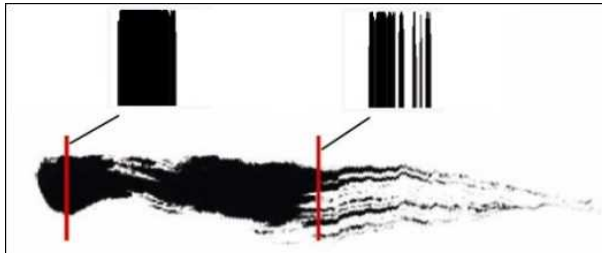
Fig. 4 Wave Data of a Stroke

2.3 DRAWING

Drawing is carried out by dragging on the drawing screen and outputting sample groups. On the drawing screen, too, direction of movement of the mouse pointer is constantly calculated as done during sampling, with samples outputted in order of storage as users rotate the samples in response to the direction of movement of the mouse pointer. Because strokes generated in both sampler metaphor and synthesizer metaphor methods are groups of samples with an angle of 0°, users can draw their preferred shapes, whether straight or curved, by once again rotating and outputting in response to the direction of movement of the mouse pointer. In cases where strokes during outputting are shorter than those during sampling, data is compressed and then outputted so as not to lose the whole image.

3. Evaluation

We have conducted various demonstrations and trials of our system at venues such as conferences and have interviewed both observers and test subjects. In this section, we examine our system on the basis of the opinions and example works obtained on these occasions. As stated, our system has two aims, and hence, it is necessary to evaluate both of these aspects. The first relates to the question, "Compared with other methods, does this system provide a better experience?" (evaluation of the system as a tool for creating things). To investigate this, we conducted interviews about the level of satisfaction with the operability of the system and works the participants produced using the system. These were compared with results for the traditional drawing tools. We also consider the question, "Does this system propose a completely new experience?" (evaluation of the system as a tool for making new things possible).

3.1 SAMPLER METAPHOR

We conduct our evaluations and considerations by making participants use our system and then interviewing them. The test subjects for our study comprised 10 people of both sexes with ages ranging from the 20s to the 50s. None of the participants had any particular experience in calligraphy. After having given a simple explanation on how to use the system, as well as showing a few example images prepared by us, we let them freely use the system to create their own images.

After having used the system, participant feedback regarding operability included opinions, such as "It is easy even for beginners to handle," "It has a simple interface design and can be operated intuitively," "I needed a little time to get used to operating the scan lines during sampling," and "I was not satisfied with the fact that I was unable to properly perform sampling of sections with turns and intersections." The opinions received were, on the whole, favorable and confirmed that the system is easy to use. The reason for receiving such high evaluations in this instance can be that it was a simple task of tracing the sampling, in which most of the operations were performed by using only the mouse. It can be also assumed the high evaluation of accessibility was because there were few specified parameters and these could be specified by dragging. After changes have been made to the parameters, because redrawing is performed immediately and the user can obtain visual feedback, even people who do not have an understanding of the parameters in numerical values are able to operate the system. Moreover, the opinion that one requires time to get accustomed to operating the scan lines can be due mainly to the rotation rules of the scan lines. The system deforms positional coordinates of the mouse on the screen and scan lines are rotated as it calculates the direction of progression from several dozen of the newest coordinates that have been pointed to. Thus, the calculated direction of movement is greatly influenced by the immediately preceding movements, and hence, when sudden changes in direction are made immediately prior to scanning, scan lines appear in unintended direction. It is inferred that in cases where participants were unable to gain a sufficient understanding of these rotation rules, they were unable to operate the scan lines as they would have liked to do. With the sampler metaphor, although the method using scanned model images gives users a sense of inconvenience that places limitations on creativity, in reality, it is possible to create as many different expressions as possible even when using the same model image, depending on the sampling and drawing methods, thus realizing free and creative drawings (Fig.5)

Fig. 5 Example Work entitled "Flower"
(Sampled from calligraphy strokes and an image of fireworks)

3.2 SYNTHESIZER METAPHOR

While the sampler metaphor relies on model images, the synthesizer metaphor is effective in instances where the user has no model image with the desired strokes or the model image cannot be used because of such issues as copyright.

The fact that wave data obtained from actual calligraphic images is being used implies that the generated strokes can be imparted with a certain degree of reality. For example, it has become possible through this function to add a scratched look by incorporating scratched wave data in strokes that are not scratched. In addition, new types of strokes can be generated by combining artificial wave data that was synthesized by operating the parameters of square waves and wave data obtained from actual calligraphy or from images other than calligraphy. Also with outlines through spline interpolation, it is possible to realize not only smooth designs but also designs with complicated outlines by increasing and creating the number of arranged samples. Moreover, with the methods of stroke generation

adopted for this study, strokes having a natural flow similar to those in real calligraphy are generated. Using our system, it is possible for users to control and design aspects of calligraphy that are difficult to control otherwise, such as scratched and blurred looks, and outlines of strokes(Fig. 6).

Fig. 6 Example Work entitled "Ran"
(Top: Generated stroke; Bottom: Drawn image)

4. CONCLUSION

As opposed to calligraphy expressions, where the behavior of the brush is unpredictable, our system realizes expressions that are largely rendered as intended through stroke designs that use model images and wave tables. Sampling is easy and can be performed by anyone, and although stroke design through the synthesizer metaphor increases the number of processes, it allows users to create their desired expressions in fine detail. Although separating the operation of brushes from the act of drawing is an approach that differs greatly from traditional methods, this definitely does not deny traditional calligraphy, but rather has the effect of allowing learners to observe each calligraphy composition right down to its fine details such as scratched and blurred looks. While much of the drawing software artificially generates picture results through simulation, our system can realize vivid and successive strokes with momentum, strength, and subtlety through the use of actual calligraphy and images. The beauty of excellent expressions created with actual brushes or performed with live instruments is not something that is easy to produce in a digital environment. We do not aim to replicate this but believe that our proposed method for incorporating without modification has been effective in realizing highly realistic visual expressions in a digital environment. At present, other image editing software may also be able to replicate the same drawing results as our system by expanding and contracting, rotating, and bending images. However, while we can say that these are aimed at detailed editing by controlling multiple parameters, we feel that they are not as intuitive as creative acts need to be. There is no doubt that images created in this manner are different from those made by creative acts realized through sequential and dynamic movements that use a brush to draw. Our system places emphasis on this creative act of drawing and writing and realizes an intuitive drawing experience.

Our system has obtained a high degree of freedom by realizing expressions of strokes of the kind created by calligraphers and allowing users to obtain their desired output results. Furthermore, it has

also suggested new forms of expression not found in existing calligraphy through its use of strokes that are not from calligraphy and through the function of browsing the referenced works. Through these achievements, our system has opened up the possibility for those who have until now not been very good at drawing calligraphy to design their own calligraphy. We further hope that the system will provide chances to expose the culture of calligraphy to people across the world, who have never picked up a calligraphy brush. We also recognize a hidden potential in our system as a new design method that does not stop at calligraphy, because it enables users to draw using distinctive strokes.

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