THE RESEARCH OF HUMAN-COMPUTER INTERACTION BY COMBINING AFFECTIVE COMPUTING INTO CHINESE CALLIGRAPHY ART

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Abstract. Calligraphy is one of the important cultures in Chinese world. The rich strokes, structures and forms make the Chinese calligraphy an art. As the writing script is closely correlated to the emotions of the writer, a lot of scholars explore the correlation between the Chinese calligraphy lines and affect from the perspectives of psychology and art. In this study, it introduces the affective-computing technology and combines the digital media from the perspective of Chinese calligraphy and emotions, to develop an interactive calligraphy-art device. It re-interprets the Chinese calligraphy art with the digital tool and installs the pulse sensor and pressure sensor in the Chinese pen brush, so as to detect the user’s pulse and writing power. Moreover, it converts the physiological signals into affect and provides visual feedback in real time, which includes the changes and motions of the Chinese calligraphy lines. The study proposes contacting the traditional Chinese calligraphy with a new human-computer interaction mode. With the visual feedback effect during the interaction, it allows the user to know the close correlation between the Chinese calligraphy and the emotions. Through the work, the Chinese calligraphy art can be carried forward.

Keywords. Chinese Calligraphy Art; Human-Computer Interaction; Affective Computing.

1. Introduction

With the long history of China, Chinese calligraphy inherits the cultural connotation of a century. Till now it still takes up an extremely important place in Chinese culture. The rich strokes, structures, lines and forms make
the Chinese calligraphy quite unique, which is even an art. Kuang-Nan Huang (1989) once mentioned that Chinese calligraphy and painting are two types of art China, which is agreed by the intellectual people and familiar to the fans. The unique character combination of the Chinese calligraphy presents the imagery changes of natural life or visual effect of aesthetic form, which shows the importance of Chinese calligraphy in the art field.

With the coming of digital era, people change to type in texts by keyboard rather than handwriting. This trend brings great impact to the Chinese calligraphy which emphasizes on the writing process, making it not practical as before. Moreover, its place is getting weaker and weaker in the digital era. Thus, the calligraphers start to present the Chinese calligraphy art in a new way, so as to break through the current difficulties. For example, Yang-Tze Tong (2009), the renowned calligrapher in Taiwan, combines her own calligraphy work with the digital media, so the presentation media is not restricted to the Xuan paper and Chinese pen brush any more. It interprets the traditional calligraphy with the modern technology, and finds a new way to present Chinese calligraphy in the digital era.

Any art contains the thought and emotions of the creator during the creation process. For example, the musician demonstrates the inner affection with the ups and downs of the music, so does the calligrapher. The Chinese calligrapher art is closely correlated to the affect because the emotion of the writer affects the writing script under the pen brush. The handwriting is an expressive action, which varies with the affective change of the writer (Kao, 1991). Thus, we often say Chinese calligraphy can present one’s personality and affect. Lately some scholars use technology as the bridge for the measurement between the affect and Chinese calligraphy, most of which are applied to medical care and education.

In order to pass down the important Chinese calligraphy art, this study digitalizes the traditional writing process with the technology such as the electronic media. To make the people have a better understanding on the close correlation between Chinese calligraphy and affect, it adopts affective computing to present the abstract affect in a scientific way, which is shown in the artwork. In this way, it makes use of the technological power to convey the connotation and importance of the traditional Chinese calligraphy art.

2. Literature Review

2.1. CHINESE CALLIGRAPHY ART AND AFFECTIVE PRESENTATION

The handwriting with a Chinese pen brush originated from China is called Chinese calligraphy. Chinese pen brush is made of the soft animal hair, so it
can write down various writing scripts of characters with the special edge, which is the reason to make the Chinese calligraphy art so important. Chinese calligraphy is composed of Chinese characters, while the Chinese characters are formed by lines. Thus, the lines show influence on the presentation of Chinese calligraphy. The Chinese calligraphy is an art of free lines, which is the affective form of straight lines and curves composed of dot movements and extensions (Yu-Fang Shu, 2002). And Kuang-Nan Huang (1989) explained that, during the presentation of Chinese calligraphy art, the calligrapher often pay attention to the power and size. Especially in pursuit of power, its tension and extension are the point to generate the aesthetic perception of the Chinese calligraphy, in which the guiding media is the application of lines. Therefore, we can know the importance of line presentation in the Chinese calligraphy art.

Besides the exploration of style and form for the art, the affective message left by the creator in the artwork is also an indispensable part. Although the calligraphy can present the writer’s mood through the characters, the psychological changes of the writer can be explored by the tracks left in the writing process. The handwriting is an indicator of one’s current psychological status, and the visible writing tracks, which is a permanent record left by human. If one writes more freely, it can present the inner affection more expressively (Sassoon, 1993). Yu-Fang Shu (2002) analyzes “Memorial Nephew Script”, one piece of work from the ancient calligrapher Zhen-Qing Yan (709-785), which was created by Zhen-Qing Yan at the loss of his nephew with sorrow. Thus, the work shows the fast writing and repeated correction, as well as the sharp lines and strong contrast, which indicates the affective fluctuation process, as shown in Figure 1.

![Figure 1. Memorial Nephew Draft (Zhen-Qing, Yan, 758).](image)

2.2. AFFECTIVE COMPUTING

Affect is a complicated term involving a wide range of fields. The scholars from different fields make various definition for this term, among whom Schechter (1970) believes that “Affect is the label used to connect the indi-
individual with a certain physical state based on our general hypothesis. The affect described by individuals refers to the cognitive factors and physiological arousal”.

Apart from the definition, the classification of affect is also the focus of the academic study. The major affect can be classified into four categories, namely, happiness, anger, fear and sorrow, which are considered as the essential or original affect (Guan-Fu Ping, 2005). Ekman (2004) classifies the essential affect into six categories based on the human facial expression, including joy, distress, anger, fear, surprise and disgust.

The rapid technological development resolve a lot of problems in our daily life, but its impression is still rigid and non-sentimental. However, Rosalind Picard proposed affecting computing in 1995, expecting to grant affect to the computer. “Affecting computing is correlated to the affect, originated from affect, or has influence on the affect” (Picard, 1997). It applies various sensors to obtain the expressive or physiological change signal caused by the affect, analyzes the data and identifies the human affect, finally give proper response.

2.3. INTERACTIVE TECHNOLOGY

With the progressive technology, the interaction between human and computer is getting closer, which is called human-computer interaction. Kantowitz and Sorkin (1983) propose, people have sensors and responders, while computer consists of displays and controls. When people sense the display on the computer, they will give response through the brain and then control the computer. The bridge linking up these two is interface, as shown in Figure 2.

![Figure 2. Human factors view in the human operator in a work environment (Kantowitz and Sorkin, 1983)](image-url)

In the past, the audience could only appreciate the artwork quietly. However, with the technology added, it can greatly change the relationship between the audience and the art. The creator creates the art device with new media, which requires the interaction with the audience to present the connotation of the artwork. All approaches, techniques or technologies used in a
device to interact with the audience can be called interactive technology (Jia-Xiang Li, 2005), which shortens the distance between human and art successfully. Calligrapher re-presents the beauty and value of the Chinese calligraphy art by using the interactive technology. Below will introduce the artworks of the Chinese calligraphy combining with the interactive technology.

2.3.1. Sound of Silence

The Sound of Silence (Microplayground, 2007) reviews the possibility of interaction between the strokes, lines, and ink rhymes of the traditional handwriting and the media. It is equipped with four plasma display panels to display “Heartstrings”. The participants blow the microphone to derive each vivid character through digital computing. In this way, the ink will be dissipated like strings, so as to create an interactive work of the traditional Chinese calligraphy and user participation.

2.3.2. Flow of Qi

Flow of Qi (The Industrial Technology Research Institute, 2007) applies the Ultra Wide Band non-contact sensor to detect the frequency and amplitude in human breath, so as to simulate Qi in Chinese culture. It is also the essence of the Chinese calligraphy art. The piece of work is finished by two participants together. One controls the writing speed by the breath rate, the other controls the level of the ink by the breath depth. In this way, the audience could experience the conviction of integration between heaven and human. This work makes use of cutting-edge technology to present the Chinese calligraphy art in a new way. This work allows the audience to concentrate on controlling the affect, and fully show the inner peace valued by the Chinese calligraphy art.

2.4. SUMMARY

Since affect shows influence on our thoughts and actions, we all hope to obtain positive feedback when using the product. Thus, when we are in a computer era, the affective computing is proposed to adjust the user’s affect by using the computing capability of the computer, and give appropriate feedback.

In this digitalization era, the Chinese calligraphy art also starts to find a new way for presentation. Thus, the calligraphers have started the interdisciplinary cooperation, and re-interpreted the traditional Chinese calligraphy through the technological power. By using the affective computing technology, the study focuses on the close relationship between the Chinese callig-
raphy and human affect, and integrates with the digital media to develop the Chinese calligraphy art device. The interactive technology is applied to make people experience the traditional Chinese calligraphy art.

3. System Design

3.1. INTERACTIVE CALLIGRAPHY ART SYSTEM

In the past, the scholars used the calligraphy to record the history events and express the moods. The lines and strokes can be also used to explore the emotions of the calligrapher. With the technological development, there are less and less people who have contact with the calligraphy. However, such an important culture shouldn’t be swallowed by the technological trend; instead, it should be passed down with the technological power. Thus, the study makes use of the digital media to develop the interactive work of calligraphy art, which realizes the handwriting in a new way, and allows the user to experience the charm of the calligraphy art during the process. Moreover, the close affective relationship between the calligraphy and the human can be known via such device.

The user may pick one copybook of poetry, and put it on the RFID reader. When the content of the copybook is shown on the display in the front, the user can start writing with the pen brush on the touch screen. The word lines and colors will change with the user’s emotions. After the writing is finished, the screen will play the animation consistent with the user’s affect and the content of the copybook. The concept map of the work is shown in Figure 3, and the user’s operation flowchart is shown in Figure 4.

![Figure 3. Interactive Calligraphy Art Device](image)
3.2. DESIGN OF INTERACTIVE DEVICE

The interactive calligraphy art device designed in this study replaces the traditional Xuan paper with the resistive touch screen. The user just needs to write on it with a common pen brush. It also uses the RFID reader to read the copybook installed with RFID Tag, so the system can identify the calligraphy written by the user. In order to explore the correlation between the calligraphy art and the affect, the study develops a digital pen brush, which is equipped with the pulse sensor and the pressure sensor on both sides, as shown in Figure 5. Through the sensors, the user’s physiological profile can be read and converted into the affective status. The affective value will influence the visual output of the pen brush on the touch screen.
The data read by the sensors and RFID will be transmitted to the computer via Arduino for computing. Moreover, the data will be shown on the touch screen with the visual effect of Chinese calligraphy. In this way, it presents the affective fluctuation of the user during the process. The data read by RFID will be shown on the touch screen in the front. The system architecture of the study is as shown in Figure 6.

![Figure 6. System Architecture(Drawn by the study)](image)

### 3.3. SYSTEM SCENARIO PLANNING

In order to present the relationship between the calligraphy art and the affect, the study takes the human pulse and writing power as the source of visual feedback. The visual feedback of the study is divided into two parts. One is the change of lines, the other is the animation. Both will change with the affective fluctuation of the user. Table 1 lists the sensors used by the study, as well as the corresponding affect and visually changing effect.

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Sensor function</th>
<th>Words line presentation</th>
<th>Animation presentation</th>
<th>Corresponding user’s Emotions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulse sensor</td>
<td>Change thickness of strokes.</td>
<td>Fast: line thick</td>
<td>Object moves fast</td>
<td>Tension, Anger</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medium: line medium</td>
<td>Object moves medium</td>
<td>Joy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slow: line thin</td>
<td>Object moves slow</td>
<td>Calm</td>
</tr>
<tr>
<td>Pressure sensor</td>
<td>Change ink shades.</td>
<td>Heavy: dark ink</td>
<td>Darker tones</td>
<td>Tension, Anger</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medium: medium ink</td>
<td>Medium tones</td>
<td>Joy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Light: light ink</td>
<td>Brighter tones</td>
<td>Calm</td>
</tr>
</tbody>
</table>

### 4. Experiment

The user writes on the resistive touch screen with the digital pen brush loaded with the pulse sensor and pressure sensor. The system catches the contact points of the pen brush, and tracks the change of the distance between the
contact points. The further distance indicates faster writing of the user. Accordingly, the shorter distance indicates slower writing of the user, and the lines will be thinner. The character size written by the pen brush varies with the writing speed of the user, as shown in Figure 7. The fast the user writes, the thicker the lines will be. It indicates the user is in tension or anger. On the contrary, when the user is in peaceful mood, the lines will be thin. The affective change is so fast that the user may not find it during the writing process. However, the visual feedback computed by the computer allows the user to view the affective fluctuation after the writing is finished.

![Figure 7. Writing Process of the User And the Finished work (Photographed by the study)](image)

The study produced the space on both sides of the pen brush to install the pulse sensor and pressure sensor in it, so the user can touch the sensor when holding the pen brush. The thumb of the user must be placed on the pulse sensor, while the index finger and the middle finger can press the pressure sensor. In this way, the changes of the user’s pulse and writing power can be detected during the writing process.

![Figure 8. Installation of Digital Pen Brush (Photographed by the study)](image)

5. Conclusion

The importance of Chinese calligraphy art is inexplicable in Chinese culture, which is even expanded to the western countries. However, the change of lifestyle results in that the Chinese calligraphy is not as practical as before, and people have less opportunities to get contact with it. In order to pass down the Chinese calligraphy art, it is quite a good way to make use of the modern technology. For example, the popular digital art presents the art by
using various technologies. In spite of using different media, the essence and spirit of art are still there. Thus, the study takes advantage of the digital technology to interpret the Chinese calligraphy art.

The design focus of the study lies in the correlation between the Chinese calligraphy and emotions. Therefore, the affective computing is applied to convert the unique physiological signal, pulse and writing power into the changing lines in the Chinese calligraphy. It is expected to allow the user to understand the close relationship between the Chinese calligraphy and the emotions when operating the work. Moreover, it integrates with the digital media and affective computing to develop the interactive device, so as to make the traditional Chinese calligraphy more interesting. With the experience of the Chinese calligraphy writing process in a new and easy way, it aims at achieving the more important objectives, namely, allowing the user to understand the Chinese calligraphy culture with a long history, and also continuing and promoting the Chinese calligraphy art.

The study only conducts a preliminary research on the physiological signal, and the affect conversion deserves in-depth research to strengthen the correlation between the physiological signal and the affect, and to reflect it on the visual feedback effect of the Chinese calligraphy art. By doing so, the user could know the affective track during the experience process. Regarding the digital pen brush, the user may not easily contact the sensors on the pen brush initially made in this study. Thus, the future will also re-design the digital pen brush, so the user will contact the sensors more easily.

References