Interactive drawing with user's intentions using image segmentation

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Abstract

This study introduces an interactive drawing system, a tool that allows user to sketch and draw with his own intentions. The proposed system enables the user to express more creatively through a tool that allows the user to reproduce his original idea as a drawing and transform it using his body. The user can actively participate in the production of the artwork by studying the unique formative language of the spectator. In addition, the user is given an opportunity to experience a creative process by transforming arbitrary drawing into various shapes according to his gestures. Interactive drawing systems use the segmentation of the drawing image as a way to extend the user's initial drawing idea. The system includes transforming a two-dimensional drawing into a volume-like form such as a three-dimensional drawing using image segmentation. In this process, a psychological space is created that can stimulate the imagination of the user and project the object of desire. This process of drawing personification plays a role of giving the user familiarity with the artwork and indirectly expressing his her emotions to others. This means that the interactive drawing, which has changed to the emotional concept of interaction beyond the concept of information transfer, can create a cooperative sensation image between user's time and space and occupy an important position in multimedia society.

Keywords: Interactive drawing, Touch-based drawing, Image segmentation, Gesture recognition

1. Introduction

From the perspective of art history, drawing has been recognized as a fundamental part of the art creation process for a long time as the most basic result of drawing acts. A drawing which is a fundamental element of art creation and handwork, and which describes the artist's temperament in a stylized language, reveals the artist's personality because its production method is direct. Not only space, depth, real feeling but also the most freedom to express emotions, it can be considered as the most creative in art form.

Drawing is considered as an independent area in today's art, is the most basic step for the free imagination and experimental work of the artist, and is a creative process that well represents modeling thinking. Drawings that are opening up new concepts of contemporary art are shown in three dimensional drawings utilizing escape from a two dimensional plane and vivid drawings that can be felt tactually. In the drawings of contemporary art, the implicit meaning that the artist tries to express rather than the personality such as the technique of the artist and the method used in the artwork is regarded more important, and the technical
function of the drawing is deteriorating. Therefore, diversification of material and form is done, which shows new possibilities of drawing.

Drawing plays an important role of deriving human's diverse needs as a visual thinking method of recognition. It is an optimal candidate for expressing the sensibility and inner aspects of the artist and is a free direct expression. Also, it is possible to express the artist's sensibility through fast, thick, or directive that the line shows, with no shortage of exposure of the inside of the artist with only a single stroke or line. A simple line or a touch which is expressed by the hand of the artist is a modeling element in which their spirit is contained. In this way, the drawing which is the model element that can express the inner world of the artist most purely is not a practice piece expressing sketches and ideas, which is the preliminary stage of an artwork. We want to show through this study that drawing itself may be a painting artwork.

The purpose of this study is to develop a drawing tool that allows users to express their own creative thoughts. Drawing is a behavioral expression that human beings express unconsciously. Humans have the ability to observe and understand things with their own unique perspectives. Therefore, the shape of the drawing depends on who draws it. The proposed interactive drawing enables the more creative expression through this system that organizes the process of developing the drawing idea of the users, and reproduces the morphological idea that comes to mind and transforms it by their body. By actively participating in the production of the work, users can explore the direction in which the drawing independently advances in contemporary art, and can make artworks by researching the unique formative language of the users.

In the proposed system, the input drawing information of the user has the feature of graphically deforming. Drawings no longer need to be flat or in the frame. Every act of man is an expression of inner and includes intention. If an act of the user leaves a certain mark and expresses personality, there is no more pure drawing. We expect that the three-dimensional drawing that combines space with the drawing represented by the line is more conceptual and mental. Interaction of visual thinking and drawing is important for users to creatively express their ideas. The gestures of the user act as a factor causing synesthesia. The users are able to express their intention to the outside by expressing freely on the screen by combining their inner sensibility into the gesture. In the process of transforming into a voluminous form such as a 3D drawing, a psychological space is also created that can stimulate a user's imagination and project an object to desire. The process of personification of the drawing image gives the users familiarity with the artwork and allows the user to use this artwork as a tool for indirectly expressing their own emotions to others. Interactive drawing, which has transformed beyond the concept of information transfer to the emotional concept of interaction, can create a cooperative sensation between time and space and occupy an important position in the multimedia society.

2. Related Works

The development of interactive technology and the spread of pen-based or touch-based interfaces has made it easier for many people to access drawings [1-2]. Representative tools for implementing interactive drawing include a human interface device (HID) such as a mouse or tablet pen that reflects the user's body movements, and a camera-based sensor that recognizes the user's actions.

One example of a drawing tool that utilizes hand motion by the touch sensor is Motion Sketch in figure 1 and HabilisDraw in figure 2. Scott Snibbe's Motion Sketch allows users to record their movements via a mouse or tablet and play them back as animations of graphic objects in virtual space [3]. HabilisDraw is a drawing application that supports interaction between drawing objects using tools such as pens, pushpins, compasses, rulers, and so on [4].
Experiments of Search Query Performance for SQL-Based Open Source Databases

Figure 1. Time lapse from *Motion Sketch*

Figure 2. A drawing generated in *HabilisDraw*

Myron Krueger's *VideoPlace* in figure 3 is the first artwork to provide a drawing experience with real-time motion recognition of the camera [5]. This artwork is a virtual space where users interact with virtual objects. In this work, he expressed the movement of the viewer as a change of the image. Another example is the *KinectGraffiti* by French interaction designer Jean Christophe Naour in figure 4 [6]. This is a digital graffiti tool using Microsoft's Kinect camera. The idea of this project is to track the movement of graffiti using Kinect. This visualizes the body motion and drawing information in real time by changing the viewing angle. Therefore, while gazing at this artwork, viewers can understand the structure of the surrounding space and the flow of time.

Figure 3. *VideoPlace* of M. Krueger

Figure 4. *KinectGraffiti* of J. C. Naour

There are also tools that help users draw using computer vision algorithms. *iCanDraw* uses face recognition technology to provide users with drawing instructions to help them draw portraits more easily [7]. *ColorSketch* [8] and *Drawing Assistant* [9] is an interactive drawing system that produces drawings or provides drawing instructions using pictures that are already existing digital images, rather than directly inputting information for drawing. *ShadowDraw* dynamically updates the shadow image to guide the user through the contours that can be easily drawn [10].

In addition, there are tools that produce drawings using specially designed user interfaces. The *I/O brush* has a compact video camera that looks like a physical paint brush but has an internal illumination and touch sensor [11]. This brush creates a drawing composed of the user environment pattern using the color, texture, and motion information of the brush surface acquired from the attached camera. There are also researches on how to visualize the sound coming from a microphone as a drawing [12].
3. Interactive Drawing with Association

The association is a concept used by the empirical philosophers of England from the 17th century to explain their perceptions and memories. This is the inherent emotional effect that people feel when they feel something or recall an image from a color or form. Thus, associations are influenced by individual subjective feelings, culture, environment, emotion, thoughts, and experiences. In other words, association is the reflection of the experience and the contents of the individual when the person thinks, watches and listens to something and comes up with other contents.

Free association of arbitrary images can be created with diverse and creative ideas limited by human internal images. A wide range of ideas and associative abilities are very important elements in a modern society where individuality is required. It also arouses people's interests and interests, helping to create creative and original ideas. Therefore, the expression activity through association can make the emotions and feelings of the person more visible and linked with the expressions of the intrinsic emotions, thus effectively expressing subjective intention of expression and being appropriate for individual expression.

It is possible to elicit a broader and more stable association by making out the association with letters or pictures rather than just imagining it in people's minds. Drawing is a visual representation of people's associations using various colors and shapes. Therefore, visual drawing is an original idea based on various knowledge and environment that people have experienced so far, and it is also a molding element that causes symbolic and narrative action. Visual drawing allows the user to intuitively and simultaneously grasp the image and provide spatial intuition to better understand what the image is intended to convey.

With the development of computing technology, the appearance of software developed to enable drawing changes the intrinsic meaning of drawing. If an anthropomorphic process is added to a drawing that originally represents a person's idea, the drawing can be extended to a more familiar and dynamic visual medium that can inspire the emotions of the target image. The rapid interaction with the drawing image leads to the creation of original artworks containing the personality of the user by instantly inducing people to switch quickly and instantly. Users interact with the drawing image to refine or reconstruct the image and generate an association in the mind in various ways. And they express their associations in a natural and meaningful way, drawing freely as scribbling.

4. Interactive Drawing System

The system proposed in this study is a real-time interactive drawing using user's association and gestures. This is a system that combines a drawing image input by the user with a motion and outputs a transformed new image. The drawing image entered by the user using the touchpad is subjected to image segmentation process first for transformation. Figure 5 shows a schema of the interactive drawing system.

The segmentation of an input drawing image means an image processing process for extracting interaction points, which are points for connecting with a user's gesture information. This image processing process includes Binarization, Thinning and Contouring. The user's gesture information is collected through skeleton point extraction using Microsoft's Kinect sensor.

A weighted nearest matching algorithm is used to synchronize the gesture information of the drawing image and the user gestures in real time. Weighted nearest matching is an algorithm that takes the weight values into consideration when connecting the nearest interaction point of drawing image to the skeleton point of user on the standard canvas.
Equation 1 is an expression for calculating the distance between the interaction point \( I_i = (I_x, I_y) \) and the skeleton point \( S_i = (S_x, S_y) \) in the weighted nearest matching algorithm.

\[
\text{disi}(I_i, S_i) = w_i \times \sqrt{(I_x - S_x)^2 + (I_y - S_y)^2}
\]

Equation 1.

In the above equation, weights are given in ascending order of skeleton points with large momentum. Table 1 shows the ten skeleton points with the greatest momentum and the set weights by observing the movement of 10 participants.

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Skeleton Points</th>
<th>Movement</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HandTipLeft</td>
<td>2687.69</td>
<td>0.500</td>
</tr>
<tr>
<td>2</td>
<td>ThumbLeft</td>
<td>2434.78</td>
<td>0.607</td>
</tr>
<tr>
<td>3</td>
<td>HandTipRight</td>
<td>2434.12</td>
<td>0.608</td>
</tr>
<tr>
<td>4</td>
<td>HandLeft</td>
<td>2348.46</td>
<td>0.644</td>
</tr>
<tr>
<td>5</td>
<td>ThumbRight</td>
<td>2221.21</td>
<td>0.698</td>
</tr>
<tr>
<td>6</td>
<td>HandRight</td>
<td>2162.18</td>
<td>0.723</td>
</tr>
<tr>
<td>7</td>
<td>WristLeft</td>
<td>2108.34</td>
<td>0.746</td>
</tr>
<tr>
<td>8</td>
<td>WristRight</td>
<td>1937.53</td>
<td>0.818</td>
</tr>
<tr>
<td>9</td>
<td>FootRight</td>
<td>1344.47</td>
<td>1.070</td>
</tr>
<tr>
<td>10</td>
<td>FootLeft</td>
<td>1305.41</td>
<td>1.086</td>
</tr>
</tbody>
</table>

As shown in Figure 6, the weighting method as described above enables more dynamic output drawing by connecting more interaction points to active parts such as the user's arms and legs. One problem occurred when drawing the interaction points according to the position of the matched skeleton. It is likely that the
shape of the drawing image is over-transformed and unfamiliar to the user. We set the offset value as a way to keep the shape when the user takes a standard posture.

Figure 6. Interaction points of the drawing connected to the user's skeleton point

The input image of the user and the output image of the system are created in line form and made in 3D form. The reason for choosing a line as a means of image representation in this proposed system is that it is an important expression element of plastic art, is functional enough by itself. A line is a very active medium because it shows various directions of motion, meaning and properties according to its shape. A line has several characteristics depending on its shape. The curve shows softness, elegance, complexity, splendor, vertical line is strong, clarity, horizon is stable, calmness, sloping line is unstable, dynamism, vibrancy. We used a method of drawing lines in multiple layers in 3D space to express the cubic effect, and the thickness of the z-axis direction line was more dynamic in accordance with the frequency of the music set by the user.

Interactive drawing is an interactive media installation used for actual exhibition in figure 7. The viewer was able to experience the effect of moving their drawing images with vitality in the projection screen. The viewers who participated in the exhibition immersed themselves in more aggressive interactions, looking at the transformed shape of the drawings synchronized with the gesture. Also they enjoyed free association and play of transformed drawing. Figure 8 shows a variety of transformed forms of the input drawing image made with the viewer's interaction result.

Figure 7. Exhibition using interactive drawing  
Figure 8. Transformed images of input drawing
5. Conclusion

The human desire to constantly imagine a new image, transform it, and express it is an unchangeable part of human being. Interactive drawing, which utilizes new digital media to satisfy these human needs, has enough potential for emotional interaction that can satisfy variable and playful elements.

This study applied the drawing act, which is the most basic method of visualizing human thought, to the creation of computer art that imitates human thought system, enhancing the meaning of drawing used in various fields of art, education and technology. The proposed system is an artwork that utilizes an interface that can communicate with viewer by breaking away from the artist-oriented concept of existing works of art. The viewer is essential to the completion of the artwork, and has authority not just to appreciate the image, but to transform it. The viewer must make a minimum effort to complete the artwork and focus more on the artwork through the interaction process. The combination of image segmentation and viewer's interaction leads to the creation of a unique artwork in the world.

Interactive drawing is a process of instantaneous and improvisational expression that reveals the viewer's living feelings without filtering. By participating in a variety of ways, from visual response to manipulation of the artwork of the viewer, the static drawing changes dynamically and the perfection of the artwork is enhanced. It also extends the concept of art in terms of making the general public closer to art. The synaesthetic expression using digital media can be linked to the aesthetics of play in that it is completed through the use of digital control tools and the participation of viewers. Through the intuitive visual expression of drawing, it is possible to create a new aesthetic experience by creating a new media art platform that is easy to access and able to collaborate in a multi-dimensional way.

References


