iMake : Eye Makeup Design Generator

Ayano Nishimura
Ochanimizu University
Bunkyo, Tokyo 112-8610,
Japan
nishimura.ayano@is.ocha.ac.jp

Itiro Siio
Ochanimizu University
Bunkyo, Tokyo 112-8610,
Japan
siio@acm.org

ABSTRACT

Many women enjoy applying makeup. Eye makeup is especially important for face makeup, because eyeshadow color and eyeline shape can dramatically change a person's impression on others. In addition to standard eye makeup, there is "artistic eye makeup," which tends to have a greater variety of designs and is more ostentatious than standard eye makeup. Artistic eye makeup often has a motif of characters or symbols, such as a butterfly, heart or rose. Needless to say, it is often difficult for non-artistic people to apply this type of eye makeup. Artistic eye makeup requires a special technique; therefore, we propose and implement a computer-aided eye makeup design system called "iMake." This system generates artistic eye makeup designs from the colors and shapes of a favorite character selected by a user. Once the user has selected the desired eye makeup pattern, an ink-jet color printer prints it on a transfer sheet that the user can apply to his/her eyelids. The user can design any type of eye makeup with a simple operation, and then apply the transfer sheet makeup without any special techniques. The usability evaluation provided by eight participants has shown that our system is sufficiently useful for practical eye makeup.

Author Keywords

Eye makeup; Image processing; Transfer sheets; Augmented Fashion.

ACM Classification Keywords

I.3.8. Computer Graphics: Applications

General Terms

Design;

INTRODUCTION

Makeup forms part of an individual's personal appearance, and many women enjoy applying makeup. In addition, it is no longer uncommon to see some men apply makeup as well. In particular, eye makeup is one of the most effective makeup methods, because it is possible to easily change a person's expression and his/her impression on others by changing the eyeshadow color or eyeline shape.

Figure 1. Artistic eye makeup examples.

For ordinary eye makeup, people use eyeshadow colors, blending them to create gradations on the eyelids, and draw an eyeline using an eyeliner. Finally, the individual uses an eyelash curler and applies mascara or false eyelashes. This is the standard makeup method.

Conversely, designable and ostentatious eye makeup also exists. Many of these have game, anime, or comic character motifs, or attractive symbols such as a butterfly, heart or rose. This type of eye makeup is called "artistic eye makeup" (see Fig. 1 for examples). Artistic eye makeup involves the use of many eyeshadow colors and brilliant design drawings using an eyeliner.

Obviously, it is difficult for non-professionals to apply such eye makeup. In general, artistic eye makeup is applied by professional makeup artists who have experience with special techniques. Ordinary people must ask professionals for help in applying artistic eye makeup, because many people usually experience considerable difficulty even when drawing simple eyelines required for standard eye makeup. Artistic eye makeup requires many eyeshadow colors that average women do not possess: most women have just two or three different groups of colors. For example, although a red eyeshadow is not used in standard eye makeup and most people do not have it, it is often used in artistic eye makeup. With this in mind, we have implemented a system to support artistic eye makeup. Once our eye makeup application becomes available, it can help make complex artistic eye makeup easy, and many people may readily enjoy ostentatious eye makeup design.

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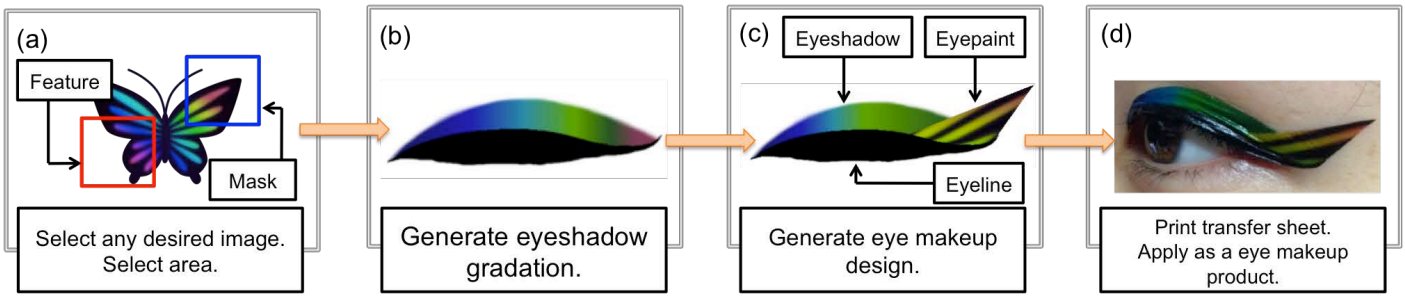

Figure 2. Makeup design workflow of iMake.

In this paper, we describe a computer application called "iMake" that provides designable eye makeup opportunities for non-artistic individuals. The application could be widely accepted and modify the conventional makeup methods of its users. Thanks to our application, artistic eye makeup could become a familiar and popular entertainment for ordinary people.

RELATED WORK

Many studies have been performed in order to assist or simulate makeup. For example, Liu et al. [5] and Wang et al. [11] developed systems utilizing face recognition techniques that simulate makeup based on the user's face. Tsumura et al. [10] and Huang et al. [3] focused on makeup simulation and proposed a computer graphics (CG) method to generate the real feel of skin. Guo et al. [2] and Tong et al. [9] developed CG-based simulation systems that transfer makeup applied to one person onto another person. Scherbaum et al. [8] developed a CG-based makeup simulator that suggets the best makeup method for a given user. Rahman et al. [7] proposed a smart mirror system that reads an RFID tag attached to a cosmetic product, and represents a 3D CG model of a user's face that simulates the result of applying facial makeup using the product. Nakagawa et al. [6] implemented a "Smart Makeup System" that helps users find new makeup methods by sharing makeup pictures and cosmetics usage on the web. Jain et al. [4] developed an imaging based virtual color consultation system that automatically recommends cosmetic products for the user by detecting the user's skin tone from an image.

Facial makeup for special situations, such as theater drama, has also been studied. There is a makeup design support system for the Peking Opera [1]. This system generates new designs by combining the eye, nose, and mouth on the design; the user can see these designs on a 3D rendered model.

These studies have proposed technical improvements for makeup application using simulations. In this paper, we propose a novel makeup method supported by a computer application. By using this system and printing the results on a transfer sheet, it is possible for a user to apply better eye makeup easily, without requiring great skill or expertise, or any cosmetic products.

SYSTEM OVERVIEW

iMake is a computer application that generates eye makeup designs from the colors and shapes of images provided by users. Subsequently, users can apply their designs to their eyelids after printing the design on transfer sheets.

Fig. 2 shows the system's makeup design workflow. iMake utilizes an image provided by the user (Fig. 2 (a)). The user can select any desired image. In the first step, the user selects areas (Fig. 2 (a)) that will be especially reflected in the following eye makeup design steps. In the artistic eye makeup design process that features characteristic images, a technique or design sense that reflects image features is required. In our system, the design process is semi-automatic; the manual process merely requires the user to select a feature area and a mask area within the image, and adjust the size, position and angle of the figurative part of the design. iMake automatically creates the eyeshadow's gradation (Fig. 2 (b)) and reflects the feature area and the mask area on the final design (Fig. 2 (c)). We shows these details in the following section.

Once the eye makeup design is complete, the user can print it on a transfer sheet and apply it to the eyelids (Fig. 2 (d)). The user cuts the transfer sheet to be suitable for his/her eye shape at this time. Although this process could be automated by detecting the user's eye shape by computer vision technology, we think that it will not be difficult for many women because they are accustomed to performing a similar task when they applying false eyelashes.

The user can create an eye makeup design for any situation (e.g. a wedding ceremony, school festival, carnival, or stage play) by adopting this semi-automatic system.

TRANSFER SHEETS

The transfer sheets that the iMake system uses are similar to the fake tattoos applied by adhering them to the human body. The user cuts around the image. Then, the user places the transfer sheet on the desired spot and presses it with a wet cloth or paper towel in order to adhere the image to the skin. Although some people might think the action of adhere something around the eyes is strange, we think this method will be familiar to people who use products such as false eyelashes. We

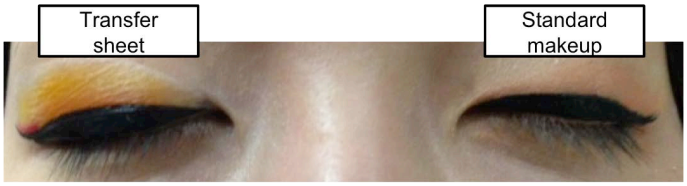

Figure 3. Comparison of eye makeup using a transfer sheet (left), and standard makeup (right).

compared the transfer sheet method with the conventional eye makeup method to evaluate the feasibility of applying transfer sheets for eye makeup. As shown in Fig. 3, transfer sheets display a more vivid eyeshadow color and are applicable to eye makeup. Eyelines also look natural. From these results, we think transfer sheets are sufficiently feasible for use in the eye makeup process.

Using transfer sheets, ordinary users who have no makeup skills can easily apply artistic eye makeup once the design has been generated by a computer application. Additionally, the number of colors that can be used in eye makeup design prepared by a color ink-jet printer is much greater than that of conventional makeup design, where the number of colors is limited by the eyeshadow palette that the user possesses.

CREATING THE EYE MAKEUP DESIGN

In this section, we describe the method adopted to generate the eye makeup design from images selected by a user. We organize the eye makeup design into three elements to simplify the design generation: "Eyeshadow," "Eyeline," and "Eyepaint," as shown in Fig. 2 (c). "Eyeshadow" and "Eyeline" are common terms used in eye makeup. Conversely, "Eyepaint" is a term defined in this paper to indicate the figurative part of the design.

We developed a system that semi-automatically generates the eye makeup design. iMake produces the eyeshadow design by generating a gradation from the overall image that the user prepared. Then, the system creates the eyepaint area utilizing the "feature" and "mask" areas selected by the user with the rubber band rectangle interface from our application. We believe the rectangle rubber band method has a simple and easy operation. We will improve this method by adding a delete function to exclude unnecessary parts in the selected rectangle area.

We implement this system with OpenCV, OpenGL, C++, and Qt Creator.

System Interface

iMake is composed four panels as shown in Fig. 4. The top left panel represents the eyepaint design (Fig. 4(a)). The user can see details of the eyepaint's design in this panel. The top right panel represents the generated eye makeup design(Fig. 4(b)). The result of this edited design can be saved as a JPEG file. The user prints this file on transfer sheets, and applies it to his/her eyelids. The bottom left panel shows the original image (Fig. 4(c)).

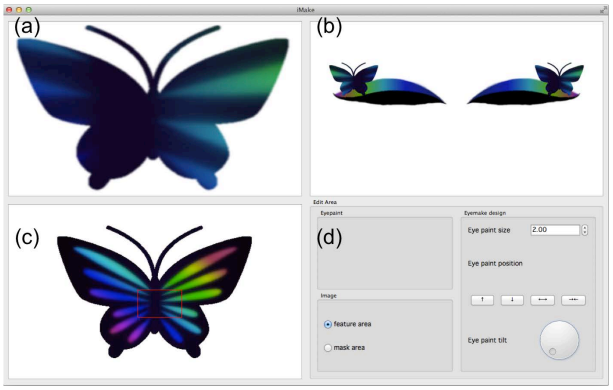

Figure 4. System interface is composed four panels: (a)eyepaint design; (b)generated eye makeup design; (c)feature and mask area selection; (d)eyepaint editing controls and feature to mask image controls.

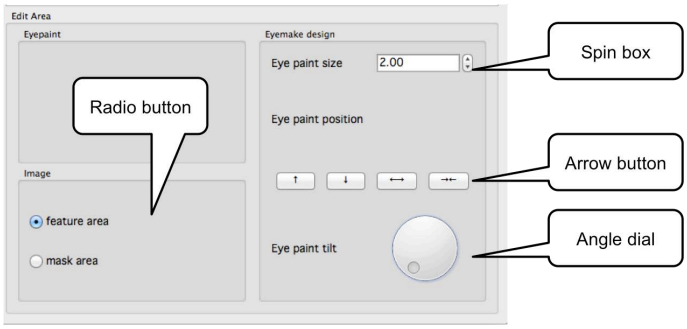

Figure 5. Details of the bottom right panel.

The user selects the feature and mask areas in this panel. By selecting a radio button, the user can select either a feature or mask area. In addition to radio buttons, there are other widgets: a spin box, arrow buttons, and a dial in the bottom right panel, as shown in Figs. 4(d) and 5. The spin box (range 0 to 10), arrow buttons, and dial are used to change the size, position, and angle respectively, of the eyepaint shown in Fig. 4(b).

Eyeshadow

Creating gradation is the most difficult process when people attempt to apply eyeshadow. In the usual makeup steps, people create gradation by rubbing eyeshadow powder using a finger or cotton swab. However, our system can automatically generate beautiful gradations by utilizing the OpenGL computer library.

iMake extracts eight representative colors from the given image to create eyeshadow gradation. In the typical makeup process, eyeshadow gradation is created with four or five colors. Considering the conventional makeup methods, we believe that eight representative colors are sufficient to create gradation featuring the original image. The eight representative colors are selected by reducing colors in the original image using K-means clustering, as shown in Fig. 6 (b).

In the common eye makeup technique, the most characteristic color is placed on the inner part of the eyelids.

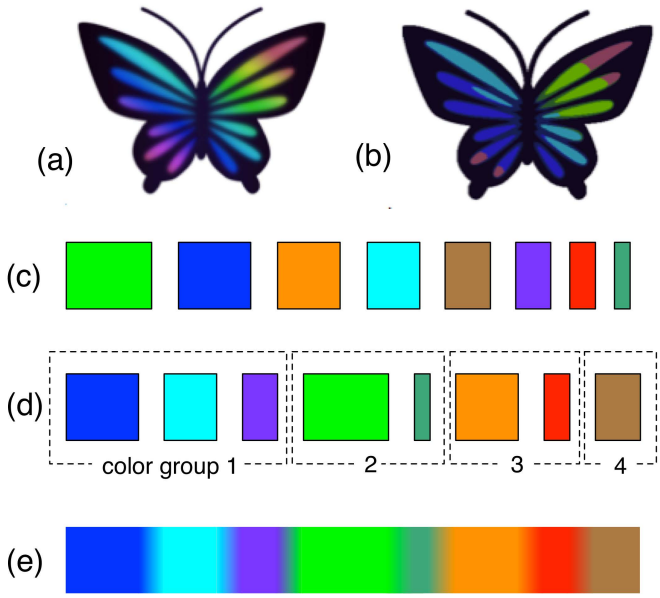

Figure 6. Eyeshadow generation: (a) Original image; (b) Color-reduced image (eight colors); (c) The size of each 8-color box reflects the number of pixels that have the indicated color; (d) Color boxes grouped into 19 color groups and sorted by the number of pixels in each color group and reduced color; (e) Gaps between color boxes are filled by gradation. Note that the colors and box sizes used in this figure are only for reference.

Our system also places the color that appears in the largest number of pixels on the inner part of the eyelids. However, this algorithm occasionally generates an unnatural repetitive striped pattern because similar colors might be aligned separately.

We define the color groups in order to avoid striping patterns. The system groups the extracted eight representative colors into similar color groups (see Fig. 6 (d)). We prepare the following 19 color groups: white, black, gray, brown, skin, orange, khaki, yellow, light green, deep green, green, sky blue, blue, ultramarine, navy, purple, pink, magenta, and red. These groups have been revised for use as makeup color based on the Munsell color system.[1] iMake groups the representative colors into these color groups by evaluating their hue-saturation-value (HSV). Because white and black do not work well for eyeshadow gradation, we remove these two colors before creating the gradation. Then, our system lines up color groups that have a large number of pixels at the inner part of eyelids. When a color group has more than two representative colors, the color with the larger number of pixels is placed at the inner position. Through this process, we can arrange the more representative color at the inner eyelid position, while keeping the natural eyeshadow color gradation.

[1]The Munsell color system is a color space that specifies colors based on three color dimensions: hue, value (lightness), and chroma (color purity).

Figure 7. Extracting contours from a natural image.

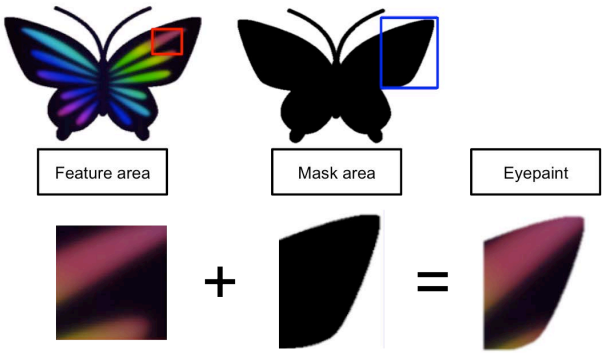

Figure 8. Creating eyepaint.

In the last step, color gradation is generated to connect each representative color block. The system assigns wider color blocks to colors with larger number of pixels, and creates gaps between these color blocks. Then, the system generates gradation using the OpenGL library to fill the gaps, as shown in Fig. 6 (e).

Eyeline

Creating the eyeline is the most difficult aspect in eye makeup. There exist many types of eyeliner products, such as liquid, pencil, or gel liner. Additionally, sweat or sebaceous glands can easily cause the eyeline created with these products to run, thus spoiling the makeup. iMake includes eyeline in the makeup design that is printed on the transfer sheet, so that the eyeline process becomes dramatically easier to apply and more durable than with current products. In the current prototype, only one type of eyeline with a standard shape and black color is generated. The user adjusts the size and shape of the printed design to his/her eyes by cutting the transfer sheet.

Eyepaint

To generate the eyepaint pattern, the user utilizes the rectangle rubber band interface available in our application to select the "feature" and "mask" areas required in the generation of said pattern. The system creates a mask pattern from the selected mask area image by utilizing the contour extraction function from the OpenCV library. It is possible to get contours not only from characters or symbols but also from natural images such as the one shown in Fig. 7.

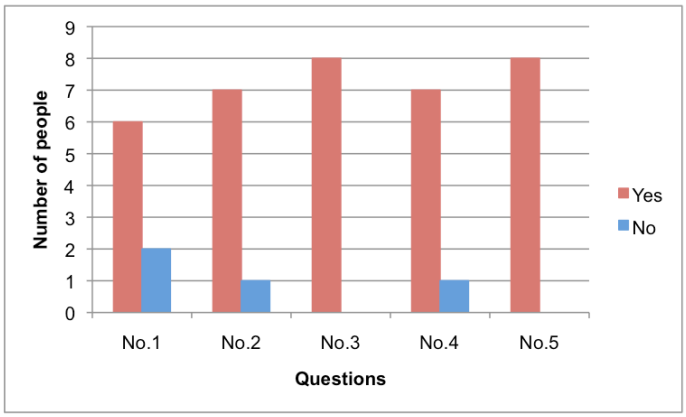

Figure 9. Survey results (Questions 1 to 5).

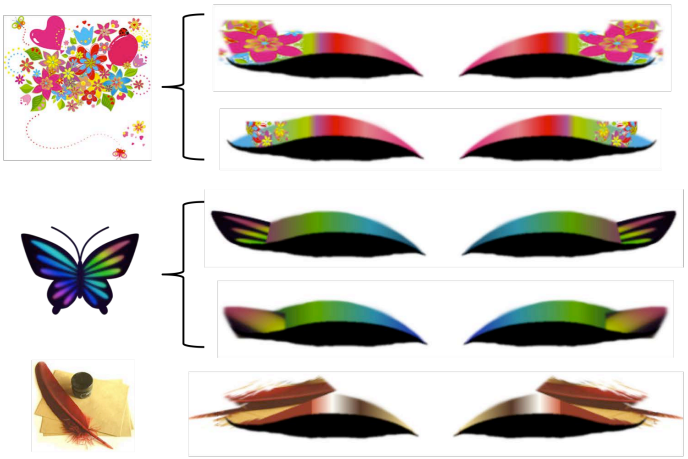

Figure 10. Eye makeup designs generated by participants.

The eyepaint pattern is generated by resizing the feature area image to the mask area rectangle, and by applying the mask pattern as shown in Fig. 8. In addition, our system provides functions to change the size, position, and angle of the eyepaint pattern.

EVALUATION

Usability evaluations were conducted with eight undergraduate and graduate female students ranging in age from 22 to 27. The participants were asked to create eye makeup designs with our application and to print their design on a transfer sheet, cut it, and apply it to their eyelids. The results of their design work are presented in Fig. 10. The average time required to create each of these designs is 2 m 29 s.

Following the trial, we asked the participants to answer a questionnaire. The first two questions ask the participants about their background about makeup; the next three questions ask the participants to evaluate our system. Results of the survey are shown in Fig. 9. The questions asked are:

1. Do you habitually apply makeup?
2. Are you interested in applying artistic eye makeup?
3. Can you detect a relationship between the generated eye makeup design and the selected image?
4. Can you easily apply the transfer sheet makeup to your eyelids?
5. Are you satisfied with the generated eye makeup design?

Six of the eight participants apply eye makeup regularly 5.2 times a week on average (Question 1). More than half of the participants (seven of eight) are interested in artistic eye makeup (Question 2). Because all participants observe a similarity between the designed eye makeup and the original image, our design algorithm appears to be successful (Question 3). Seven of eight participants responded that using the transfer sheet to apply makeup is easy (Question 4). The participant who indicated difficulty in using the transfer sheet said that it is difficult to adjust the position of the sheet on her eyelids. From this answer, it can be deduced that some individuals might require practice to correctly place the transfer sheet, which is similar to the practice required to apply false eyelashes. All participants are satisfied with their generated eye makeup design (Question 5).

We also obtained the following opinions from the participants:

- The system user interface is quite simple; therefore, it is easy to use.
- Applying the transfer sheet makeup on the eyelids was easier and more comfortable than expected.
- The eyepaint needs to have more manually editing functions, such as erasing and painting the eyepaint to respond user's delicate requests.

According to these survey results, iMake has created a new eye makeup method, transforming elaborate artistic eye makeup into casual entertainment.

CONCLUSIONS

We have developed a prototype of the iMake system based on a method for generating eye makeup designs from an image selected by the user. Generated designs can be applied to the user's eyelids by printed on transfer sheets. We performed user tests with results that indicated that the current prototype is practical and feasible.

In future work, we will improve and enhance the following functions: (1)The current prototype generates just one gradation design as a eyeshadow. Although the result is acceptable, some users may want to have alternative designs. Therefore, we support a variety of eyeshadow gradation patterns. In the current prototype, the shape and color of the eyeline are fixed and do not reflect the user's preferences. We will implement new eyeline creation method based on images selected by a user. (2)The current algorithm to generate eyeshadow

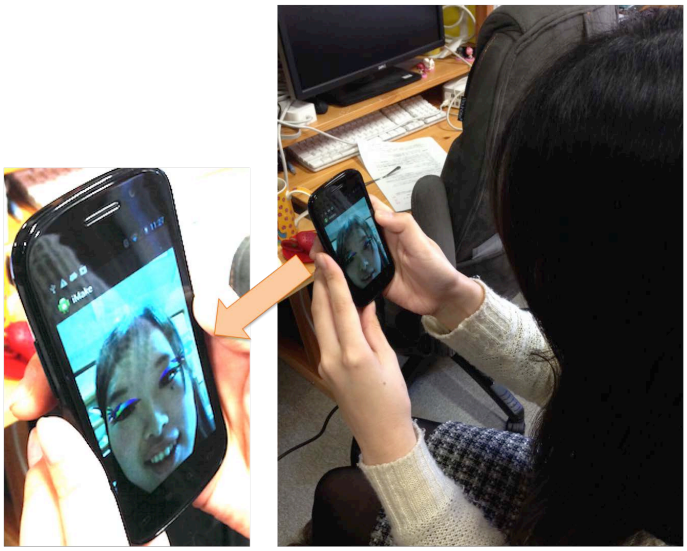

Figure 11. Augmented simulation system.

works only for color images. Monotone or grayscale images should be also supported. We will develop new design creation algorithm for these images. (3)In eyeakeup design, the lower eyelid is an important element in addition to the upper eyelid. We will implement a function to generate lower eyelid designs. (4)We use a commercial transfer sheet for body parts, and find that the thinner and less adhesive sheets would be more suitable for in our application. In the future, we will cooperate with a printing paper manufacturer to develop transfer sheets dedicated to eye makeup.

The current system runs on a PC. We intend to port this system to smartphones, and add an Augmented reality(AR) simulation function. An early stage prototype, shown in Fig. 11, detects the user's eye position and simulates the generated design on the eyelids using a camera and face recognition. The user can confirm the impression the makeup will create when it is applied to his/her face before printing it on a transfer sheet. We also plan to develop a function to consider the user's skin color and eye shape when determining the color, shape, and size of the eye makeup design using the camera and AR user interface.

We believe that the method of generating makeup designs from a user's favorite character or symbol has many potential applications, such as nail, finger ring, cheek, or other body part decorations in addition to eye makeup. This system will provide new entertainment experiences for users by decorating their bodies with easily created and printed transfer sheets. The system could be enhanced to share the experience with a large number of people throughout the Internet.

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