Smart Makeup Mirror: Computer Augmented Mirror to Aid Makeup Application

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ABSTRACT
In this paper, we present the system that aids people in wearing makeup easily and make the process enjoyable. The proposed system is the "Smart Makeup Mirror" device, which is an electronic dressing table that facilitates the process of makeup application. In this system, we place a high-resolution camera on top of a computer display. We developed some functions such as "Automatic zoom to a specific part of the face", "Display our face from various angles", and "Simulation of the lighting conditions". People who use this device for applying makeup will obtain highly satisfactory results, while also enjoying the process.

Keywords
Smart Makeup Mirror, makeup support, electronic dressing table, mirror

INTRODUCTION
Most modern women in Japan apply makeup before stepping outdoors. However, many women feel that applying makeup every morning is troublesome. According to a yearly poll of 650 women living in metropolitan areas in Japan and who were in the age group 16-64, in 1999, 51.4% of them felt that applying makeup was troublesome [1]. This figure increased every year and became 63.5% in 2003. 70% or more of these women who thought that applying makeup was "Troublesome" were in their 30s.

In this study, we develop a device that facilitates the application of makeup and makes the process enjoyable. The proposed device is termed the "smart makeup mirror", which is an electronic dressing table that facilitates the process of applying makeup. We are certain that people who use this device for the application of makeup will obtain highly satisfactory results.

SMART MAKEUP MIRROR

A photograph of a woman applying makeup with the help of the smart makeup mirror is shown in Figure 1. In this system, we place a high-resolution camera (Point Grey Research, Grasshopper GRAS-50S5C-C, 1624 x 1224 pixels, 30 fps) on the top of the computer display. The camera is trained on the woman and her image is shown reversed on the screen; therefore, the device functions and assists the woman in applying makeup effectively while looking at her image. In order to realize the functions described later in the paper, we processed the images captured by a camera. We set up a low-resolution camera (Logicool, Qcam Pro for Notebooks QCAM-200V, in 320 x 240 pixels mode, 30 fps) for this image processing. We developed the following seven functions to support the makeup application process.

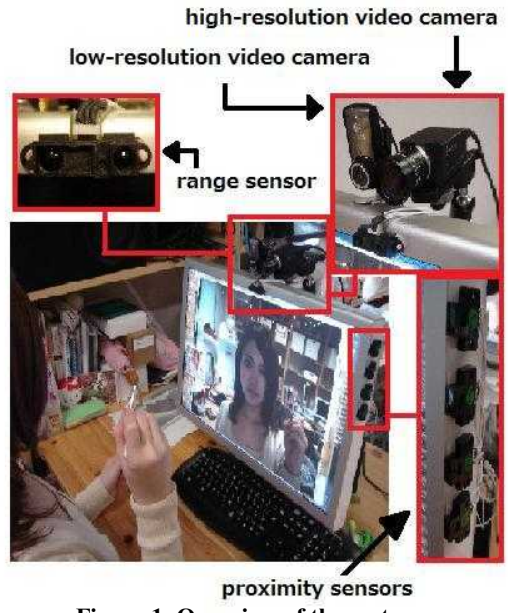

Figure 1. Overview of the system.

MAKEUP SUPPORT FUNCTION

Automatic Zoom and Pan to a Makeup Part

During makeup, we may bring our face close to the mirror to ensure that our makeup is satisfactory and check the makeup near parts such as the eyes and mouth. This is a critical part of applying makeup, is frequently needed, and is often the most troublesome as it requires a strenuous and awkward posture. For this purpose, we developed the

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automatic zoom function at a makeup part. When a user brings the makeup tool, with the attached color marker, near her eyes, the camera recognizes the marker, zooms in, and switches to an enlarged portion of the eye. This enables users to apply makeup without having to physically approach the display.

When we apply makeup to the upper eyelid using a mirror, we want to see our face from below. For this purpose, we raise our head and lower the line of vision. Conversely, when we apply makeup to the lower eyelid, we lower our head below and glance upward. The smart makeup mirror device captures this process of applying makeup to the upper and lower eyelids and displays the magnified image at the lower and upper part of the display.

Intuitive Magnification Rate Control

A professional makeup artist recommends having at least one magnifying glass as it aids in a thorough checkup of the applied makeup [2]. We developed the magnifying glass function in order to provide finishing touches to the makeup process, thereby improving the quality of the applied makeup. The magnification rate of the display image can be increased/decreased by simply and slightly approaching/leaving the display and it therefore aids the makeup process. Similar technique recently used for document browser [3]. This system uses a range sensor to measure the distance between the camera and the face.

Left and Right Reversing Mirror

A professional makeup artist will always recommend the checking of a person's appearance from the viewpoint of another person standing in front, with the help of a left and right reversing mirror [2]. Therefore, we added this functionality to this system as it would display the image captured by the camera as a left and right reversing mirror would.

Profile Check

In everyday life, the face is observed not only from the front but also from the side, beneath, and the diagonal direction. Thus, while applying makeup, we must inspect the face from various angles. In this system, the camera captures the image of our face and displays it for several seconds. Looking at that picture, we can inspect the makeup on the face from various angles. As a result, it became possible for us to check our profile and our view from the back, which is not possible to observe in a usual mirror.

Lighting Mode

The makeup of a user and hence her appearance may appear different under different lighting sources such as sunlight, fluorescent lamps, and incandescent lamps. This system simulates the lighting conditions depending on the surroundings. The lighting conditions are makeup mode, office mode, cloudy mode, clear weather mode, red sunset mode, and candle mode. The present lighting mode is displayed in the title bar of the interface and can be confirmed easily.

Makeup Log

The smart makeup mirror allows us to save the image being displayed using a particular file name and date. By using this function, we capture an image of our face after applying makeup. This will help us to accurately compare the color, brightness, or texture that suits our face by capturing an image every time in the same environment.

Noncontact Operation

While applying makeup, our fingers become dirty and it is undesirable to touch anything using the dirty hand. All the operations of the abovementioned functions are performed by a noncontact operation. Automatic zoom to a specific part of the face and intuitive magnification rate control have already been achieved by noncontact by using a color marker (makeup tool) and the range sensor (position of the body). We attached four proximity sensors to the right of the display. On bringing our hand close to the proximity sensor we can operate the left and right reversing mirror, profile check, lighting mode, and makeup log functions.

CONCLUSIONS AND FUTURE WORK

We have proposed and implemented an electronic dressing table that facilitates the process of applying makeup easy and makes it enjoyable. During the feasibility test with a female subject (23 years old), we have received favorable comments to the system.

The present system saves only the photograph of the face as a makeup log function. In the future, we want to relate the data of the cosmetics used in the saved picture of the face. Additionally, we want to make familiar people such as friends and lover choose the one thought in the completed makeup to suit us. We might be able to find the makeup that suits us as a result.

Acknowledgements

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