A New Digital Face Makeup Method

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***Abstract*—This paper proposes a new method for the application of makeup on the eyes, face, and lips based on several makeup examples. We created two Gaussian weight maps to generate the effect of natural skin makeup. Due to our Gaussian weight map in blending process, our makeup results are natural.**

I. INTRODUCTION

Recently, makeup has received increased attention from people owing to changes in perception on makeup and an increased interest in people regarding their appearances. Though an average man uses makeup less than an average woman, men primarily use it as a tool to correct blemishes, such as minor cases of acne or freckles, to even out the skin tone, or to accentuate the shape of their eyebrows or eyes.

In previous research on virtual makeup, given an input target image, makeup techniques used in one example image are applied to a target image. The method suggested by Guo et al. [1] is the most relevant one for our research. In their method, image channels are converted from RGB to CIELAB and divided into three regions, namely, face structure, skin details, and color. Then, through gradient editing, weighted addition and alpha blending, each layer of an example image and the original image are combined to obtain a natural makeup effect. The method suggested by Guo et al. [1] can be used with one image in which makeup was already applied, as opposed to two images (before and after makeup). However, viewing only one makeup technique limits the possibility to identify various makeup methods. In this paper, we propose makeup techniques using multiple combinations for a natural application from two images (eyes and skin makeup in one image and lip makeup in the other image).

An important feature of our suggested method is natural color conversion while maintaining the details of an original image, such as double eyelids or hair. To maintain edges, Guo et al. [1] preserve the details of skin by separating layers in CIELab color space through weighted least squares [2]. They focused on maintaining details more firmly by keeping strong edges. For the purposes of our experiments, we downloaded face and makeup images from web pages [3, 4].

II. DIGITAL FACE MAKEUP METHOD

This research suggests a virtual makeup system in which makeup techniques extracted from two face images (skin and eye makeup from one image and lip makeup from the other) are applied to one input face image. In this research, the input face image is defined as I; the face image for skin and eyes makeup techniques, E_e ; the face image for lips makeup technique, E_l; the result image that the combined makeup is applied to, R. Figure 1 show input face image I, the example face image for skin and eyes makeup E_e, and the example face image for lips makeup E_l.

(a) (b) (c)

Figure 1.(a) input face image I, (b) the example face image for skin and eyes makeup E_e, (c) the example face image for lips makeup E_l.

Our virtual makeup system can be divided into five stages. First, the example images E_e and E_l are arranged in the form of the face in the image I in order to apply their colors to the image I. Second, Gaussian weighted values are created to apply E_e to I. Third, for lip makeup, E_l is applied to I through the use of the created Gaussian weighted value. The output is result image R. The workflow of our approach is illustrated in figure 2.

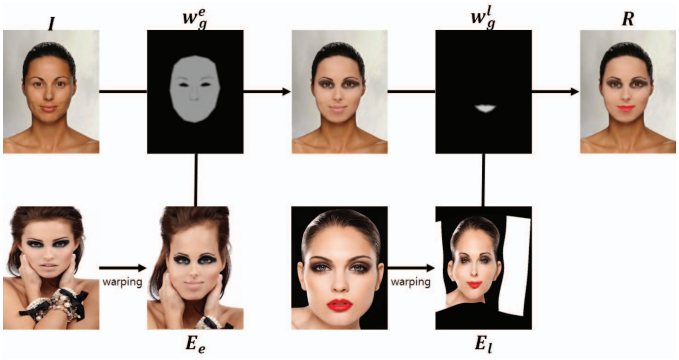

Figure 2. Workflow

For the arrangement of face images, we warped the images E_e and E_l in the form of the face in the image I by using Thin Plate Spline (TPS) [5]. TPS warping uses landmarks. Generally, they can be obtained from an ASM or Active Appearance Model. In this research, landmarks were obtained through the Supervised Descent Method [6]. In our experiments, we used 75 landmarks for each face. We defined each region as follows: eyes as C_1, eyebrows and nose as C_2, lips as C_3, and other facial regions as C_4.

We created a weight map to apply the makeup technique of the warped image E_e to the image I. The created map w^e had weighted values of 0 in the region of eyes (C_1), 0.4 in the

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region of eyebrows and nose (C_2), and 0.8 in the region of face (C_4). Because C_1 is the region of eyes, makeup cannot be applied. Therefore, by setting a weighted value for this region to zero, we kept the value of the image I in that region. To apply the makeup technique of E_e to the image I naturally, we created a Gaussian weight map (w_g^e) by drawing on the Gaussian equation as follows:

$$W_g^e(p) = w^e(p) \cdot \frac{1}{2\pi\sigma^2} e^{\frac{p^2}{2\sigma^2}} \quad (1)$$

where p indexes the image pixel and γ is a weighted value for each facial region representing the value of w^e (where $0 \le \gamma \le 1$). In this paper, the value of σ was set to 5 in all the experiments. In this way, a Gaussian weight map was created.

Using this method, we created another Gaussian weight map (w^l) for lips makeup. In this case, we set weighted values to 0.8 for the region of lips (C_3) and 0 for all the other regions. we created a Gaussian weight map (w_g^l) by drawing on the Gaussian equation as follows:

$$W_g^l(p) = w^l(p) \cdot \frac{1}{2\pi\sigma^2} e^{\frac{p^2}{2\sigma^2}} \quad (2)$$

First, we applied w_g, created for eye and face makeup, to E_e and I in Eq. (1).

$$R_e(p) = w_g^e(p) E_e(p) + (1 - w_g^e(p)) I(p) \quad (3)$$

Next, we completed lip makeup by using Eq. (4) with the image R_e, in which eye and face makeup had been applied. Through this, we obtained the image R.

$$R_e(p) = w_g^l(p) E_e(p) + (1 - w_g^l(p)) I(p) \quad (4)$$

Figure 3 shows the image in which lip makeup was completed.

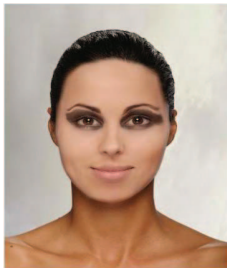
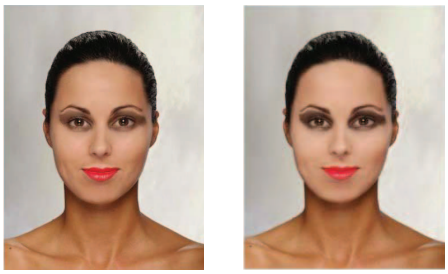


Figure 3. Makeup by E_e and E_l.

III. Result

The user-defined parameter in this experiment is the weighted value (γ) for each region in the weight map. For natural results, we set weighted values to zero (C_1), 0.4 (C_2), 0.8 (C_3), and 0.8 (C_4). However, γ can be modified to have a strong impact on each region. For example, if γ for the image C_4 is set close to 1, it is possible to obtain an image in which skin tone and eye makeup are emphasized. In contrast, if it is set close to zero, the result will be a makeup technique characterized as soft eye makeup with an emphasis on the skin tone of the original image. Figure 4 showed the results of this experiment. As such, it is possible to adjust makeup results in each region according to a user's request by controlling a weighted value in each region.



(a) (b)

Figure 4. Makeup by γ value: (a) C_4 = 0.4, (b) C_4 = 0.8.

IV. Conclusions

In this paper, we proposed a method to apply makeup techniques extracted from two different makeup example images to a target image in a natural manner. The existing digital makeup techniques have a limitation, in that, only one makeup technique obtained from a sample image can be applied to a target image. In our method, the eye and skin makeup can be extracted from one sample image and the lip makeup from another, and both are then applied to the target facial image. It is difficult to generate a natural result because of the difference in lighting of each image and other factors in applying makeup techniques obtained from two different images on to a single image. Hence, a natural blending technique is necessary; we used a Gaussian weight map in order to obtain natural blending results. In this manner, we extracted eye and skin makeup from one example image and lip makeup from the other example image and applied them to one target image.

For users who are unfamiliar with applications such as Photoshop—which are quite complicated—obtaining natural results for virtual makeup on such applications is extremely difficult. In contrast, our proposed method allows users to see the results of makeup application by simply selecting example photographs. We used only front-face images in the experiments because we were unable to find sufficient profile images. In the future, we may be able to extract makeup techniques from all facial directions to apply them to non-front face images as well.

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