Processing the Shadow of a Hand Image

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Abstract

In the field of the personal authentication system, types of hands are popularly used to certificate the identity of a person. There is an important part in the hand-shape recognition system. That is how to take the photographs of hands. Whether you use a camera or a scanner to take a photograph, there exist some shadow parts around a hand image .As for this part, to judge whether the shadow is true or it is just the hand plays an important role to improve the recognition rate. Actually if we can judge the range of the shadow of the hand image clearly we can raise the probability of the certification. In this paper we focus on the shadow part of hand images. We propose some algorithm to convert an original image into a better image to handle the hand-shape .Firstly, we make the convert the input color image into a grayscale image, then we extract the outline by using Fourier transform, and the true outline of the hand will be determined. Now the recognition methods using biometrics are spread in the world, we believe our project of processing the shadow part will be useful to the recognition system.

Introduction

Image processing technology is the most important part in the recognition system, and in this paper we aim at how to separate the hand region for background. We use a scanner and a digital still camera in our experiments. At first, we take advantage of scanner to get the picture of the hand in the nature station. When we extract the outline of the hand in a grayscale (256continous tone) image, we find it difficult to separate the shadow part .we begin to make another experiment in which we use a digital still camera. In order to see the difference between the domain of the hand and the shadow part of the hand clearly, we try to make RGB histogram to separate to make sure the density difference between the hand and hand's shadow. In the following, we present the results of two experiments. In Experiment 1 we use a scanner, and in Experiment 2 we use a digital still camera.

Experiment 1

Apparatus

Scanner: Lexmark x3470

Image processing software: Adobe Photoshop 7.0

Software development environment: Microsoft Visual C++ 6.0
Microsoft Visual Basic 6.0

Step 1. At first, we use the scanner to get the original images of hands. Second, we trim each original image to get an image of 1,280 x 1,280 pixels. Then we convert its mode to 8 bit grayscale. Fig. 1 shows a sample original image and, just to make the goal clear, an image of a hand finely separated from its background.

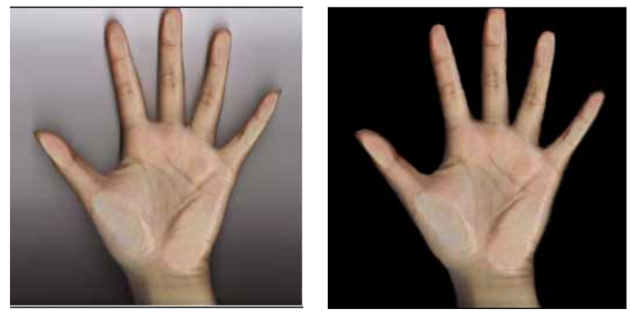

Figure 1. *Scanned image (left) and a hand extracted by using Photoshop.*

Step 2. We binarize each image using one threshold value and calculate the area of a hand by counting the white pixels. We adopted 51 different threshold values ranging from 103 to 153. Fig. 2 shows a sample black-and-white images.

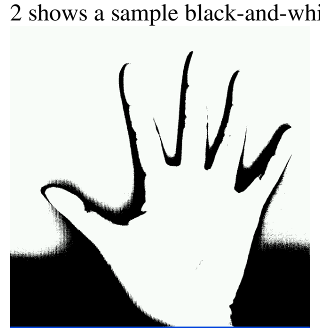

Figure 2. *A binarized image with one threshold.*

Step 3. We binarize each image using two threshold values and calculate the area of a hand by counting the white pixels. We adopted a pair of threshold values which is 140 and 240. Pixels with the brightness value between these threshold values are converted to white.

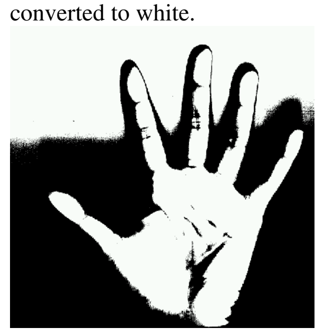

Figure 3. *A binarize image with two thresholds.*

Results of Experiment 1

The area of hand and variance and standard deviation of the area are calculated as shown in Fig. 4. From this statistics and Fig. 2, we can say that the observed area is larger than the actual area of a hand because the outline of a hand is not expressed correctly.

On the other hand, we can see a hand in Fig. 3, and although the observed area is larger than the actual area of a hand, we can say the area of the hand is estimated to be smaller than the actual area because the shadow area over the hand was converted to black pixels in the process of binarization.

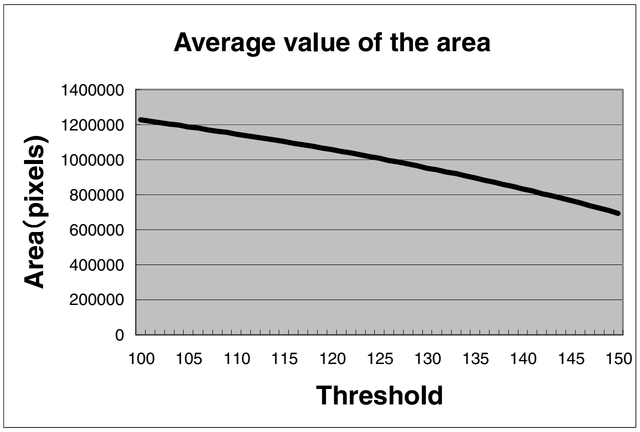

Figure 4(a). *The average value of the area of a hand for each threshold.*

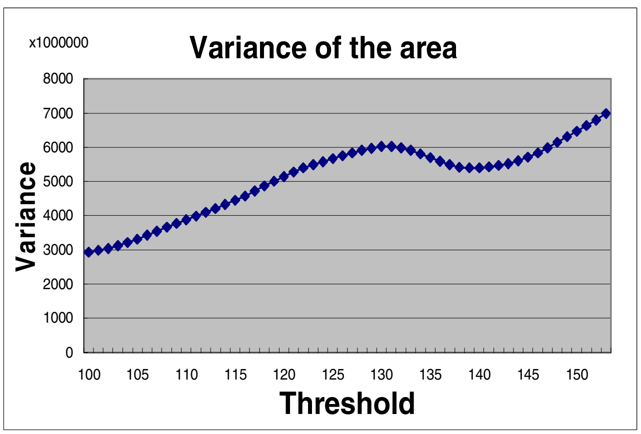

Figure 4(b). *The variance of the area of a hand for each threshold.*

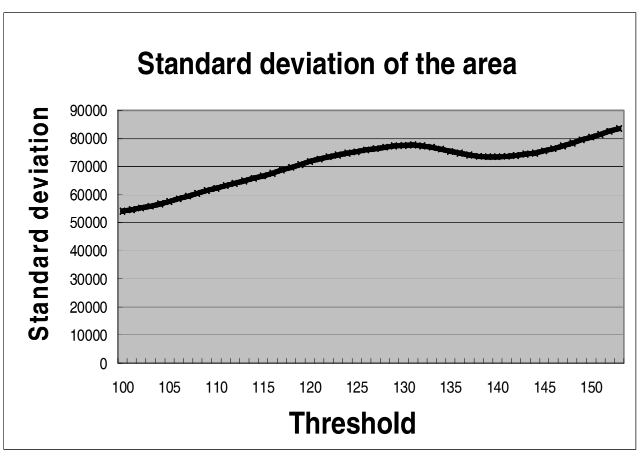

Figure 4(c). *The standard deviation of the area of a hand for each threshold.*

Expreiment 2

One of the primary reasons why we could not separate a hand from its background is that the background of scanned image, by ordinal scanners, is white, whose tone value is not so different from that of a hand. This leads us to the idea that we should take pictures with a digital still camera in front of the blue background.

Apparatus
Digital Camera: Olympus CAMEDIA C-4040Z
Illumination: Copy Lamp 100V 250W
Software development environment: Microsoft Visual Basic 6.0

Step 1. We take photos of a hand with and without using a flash. The hand is on a blue paper, illuminated by a copy lamp. The distance between the camera and the hand is 1.4m, and the angle of the copy lamp is 10 degrees left, 1.4m from the hand. See Fig. 5. The size of original images is 750 pixels in width and 562 pixels in height. See Fig. 6.

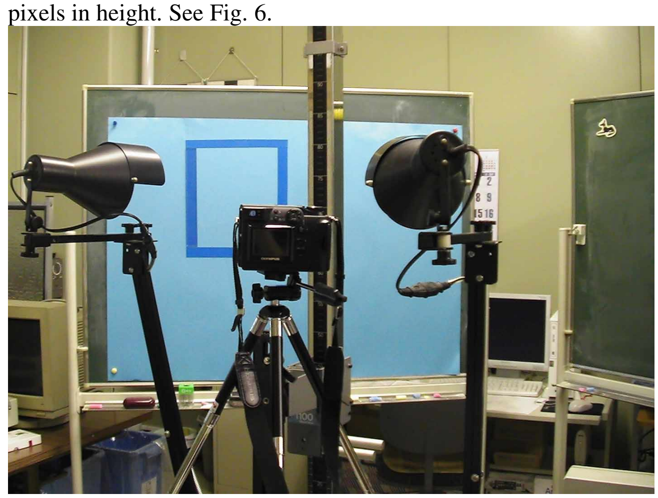

Figure 5. *Experimental apparatus.*

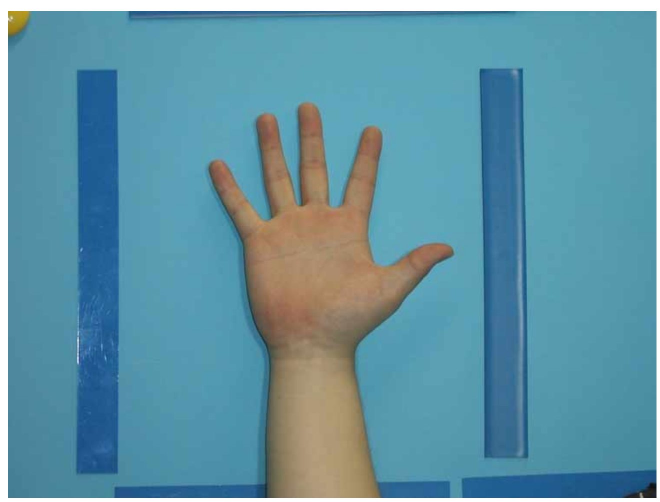

Figure 6. *Original image.*

Step 2. We set the threshold pair (R=150, B=100) and the pixel with the value R > 150 and B < 100 is changed the color to white. Since each color pixel can be expressed by three values (R, G, B), we can check the number of the pixels and take advantage of it to make a density value and use the information of the histogram to extract the part of domain you want. See Fig. 7.

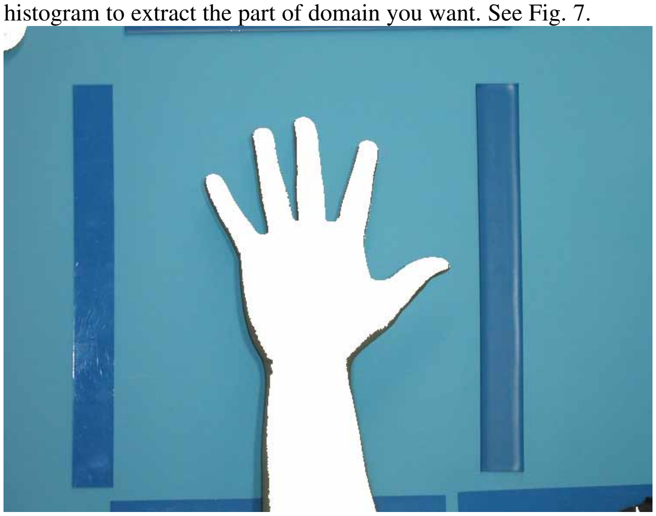

Figure 7. *Hand area whitened..*

Step 3. We trim the surrounding edges that are more than 30 pixels away from the hand (white area). See Fig. 8.

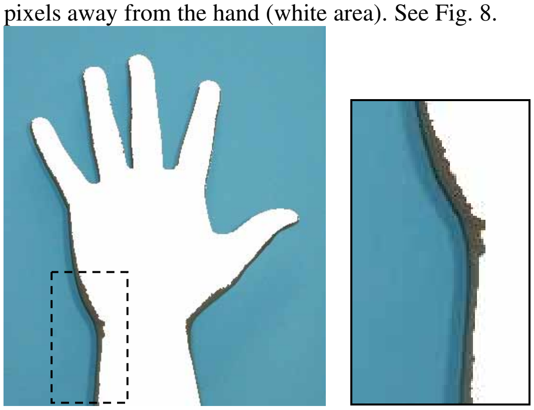

Figure 8. *Surrounding edges trimmed.*

Step 4. In the image we get after Step 3, the shadow part (relatively dark area) contains both a part of the hand and the background. The shadowed hand part and the shadowed background part have different brightness values and the difference between these two tends to be bigger than the one between the lighted background and shadowed background. We make use of this and calculate the maximum gap of brightness value for each row (horizontal line), and then change both lighted and shadowed background color into black. See Fig. 9.

Conclusion

We propose some ideas to make the binarization alogrithm more accurate especially for shadowed area. Since we develop the software to process images input via scanners or digital still cameras, this research will contribute not only to the field of biometrics certification but also to the field of general image processing.

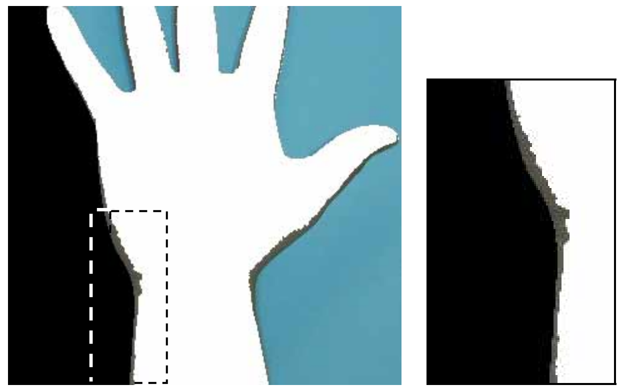

Figure 9. *Blackened from the left edge to the pixel where brightness value jumps most.*

References

[1] Robert Ulichney, Digital Halftoning (The MIT Press, Cambridge, Massachusetts, London, England, 1987).

[2] Reiner Eschbach, Recent Progress in Digital Halftoning II (IS&T, Springfield, VA, 1999).

Author Biography

Lu Ping is a graduate student of Nippon Institute of Technology. She is now studying image processing in Kitakubo Laboratory of Nippon Institute of Technology.