A gender identification using shoeprint images

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ABSTRACT

This paper proposes a gender identification using shoeprint images. It is difficult for the proposed method to identify an individual if shoeprint images for identification leaked out. Because the proposed method identifies gender without the faces, the type of dress and the hair types images. Therefore we can use safely the proposed method in public place. In addition, a sensor mat which we developed is reasonable to use mechanical switches arranged in a matrix pattern without pressure switches. We had shoeprint images with the sensor mat. We measure feature parameters from shoeprint images. The feature parameters are length, width and area of shoeprint. Utilizing the feature parameters, we identified gender. In order to verify the gender identification rate of the proposed method, we set up the sensor mat at an entrance of buildings and took shoeprint images of 100 men and 100 women. As a result, we achieved about 86 percent of the gender identification rate.

Keywords: gender identification, shoeprint, sensor mat

1. INTORODUCTION

Marketing is regarded as important recently. An acquisition method of objective data is needed. A system of gender identification is necessary without disturbing traffic of humans entering buildings. Furthermore, the system which an individual cannot identify is necessary.

The conventional method of gender identification was determined by using the person's appearance, the person's dress, the hair type and the face[1,2,3,4,5]. Therefore, the proposed method identifies man and woman from the shoeprint images that an individual is difficult to be identified. The proposed method has a difference in the man's and woman's characteristics by taking images of shoeprints. In this paper, we describe a gender identification system using shoeprint images. Using the sensor mat which we developed, we take shoeprint images. From shoeprint images, we measure feature parameters for gender identification. Those feature parameters are length, width and areas. Based on this strategy, the proposed method achieves gender identification.

The outline of the paper is as follows. In the next section, the feature parameters from shoeprint images are presented. Then, in Section 3 describes the details of a gender identification using shoeprint images. In section 4, the experimental results are described, and finally, in section 5, conclusions are presented.

2. FEATURE PARAMETERS FROM SHOEPRINT IMAGES

In this paper identifies gender using shoeprint images. Using a sensor mat which we developed, we had shoeprint images. We measure the size of shoeprints from the shoeprint images which we got from the sensor mat. The size of the shoeprint to measure is shoeprint length, width and area.

2.1 Sensor mat

We developed the sensor mat to get shoeprint images. The sensor mat had mechanical switches in matrix. Fig.1 shows the sensor mat which we developed. Table 1 shows specifications of the sensor mat.

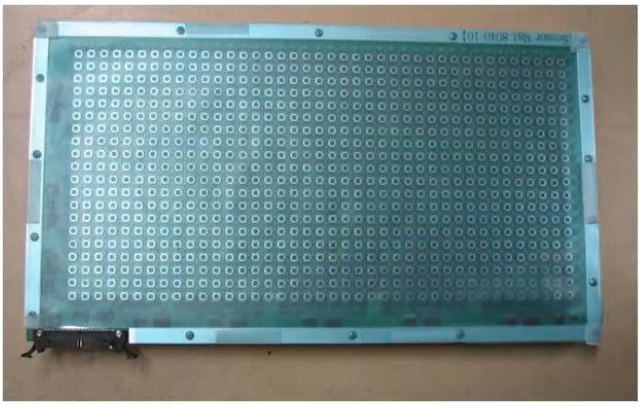


Fig. 1 The sensor mat.

Table 1 Specification of the sensor mat.

Dimension	40×80[cm]
Switch spacing	1[cm]
Sampling rate	30[flames/s]
Output image size	20×40[pixel]

2.2 Overlapped image

When humans pass on the sensor mat, we record shoeprint images from a heel to a tiptoe. Fig. 2 shows the sensor mat output image sequence. We called it "overlapped image" that overlapped those image sequences.

Fig.2 Sensor mat output image sequence.

2.3 Extraction of shoeprint images from image sequence

The sensor mat output image sequence is recorded continuously. The proposed method distinguishes shoeprint images from shoeprint images of other humans, and it is necessary to overlap of image sequence. We scan image sequence to find initial frame, and the initial frame is the frame which changes from an empty frame into the frame which a shoeprint appeared in. The last frame is the frame which changed the appearing frame of the shoeprint to an empty frame. The proposed method pick out the frames from the first frame to the last frame, and the overlapped image had them overlap. Fig. 3 shows the acquisition procedure of the shoeprint images.

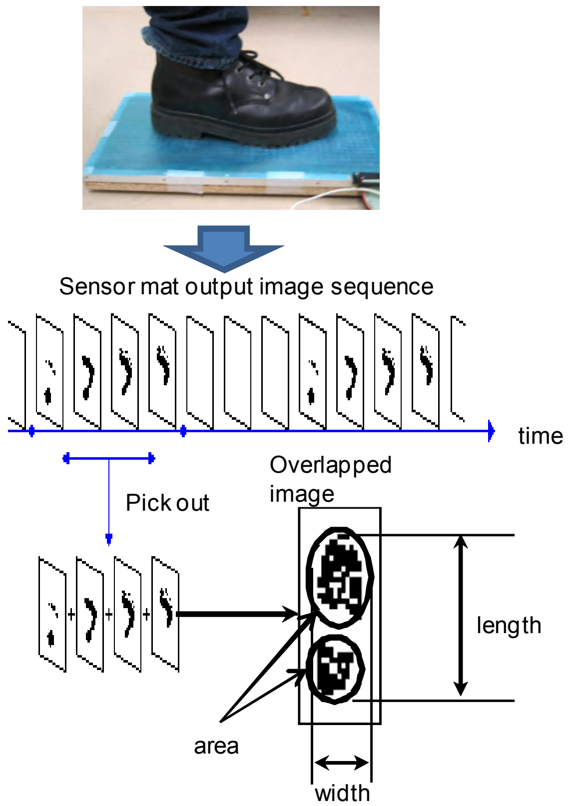


Fig.3 Acquisition procedure of shoeprint images.

2.4 Feature parameters for gender identification

Using the overlapped image of the one shoeprint, we measure feature parameters for gender identification. We defined the length of the long side of the shoeprint in the overlapped image as length, and length of the narrow side is width. In addition, we defined the sum of the black pixel in the overlapped image as an area.

3. GENDER IDENTIFICATION USING SHOEPRINT IMAGES

3.1 Gender identification using the mean of the feature parameters

We explain basic procedures for gender identification using the mean of the feature parameters. The mean of each feature parameter is the threshold. We gender identify using the threshold. The threshold Y of gender identification consists of three steps: The first step is normalization of feature parameters that we measured from the shoeprint image. The second step is the mean y defined as follows:

$$y(\alpha,\beta,\gamma)=\frac{\left(\sum_{i=1}^{n} X(\alpha_i,\beta_i,\gamma_i)\right)}{n}, \quad (1)$$

where $X(\alpha_i,\beta_i,\gamma_i)$ is length, width and area of the feature parameters. The parameter n is number of sample data. The third step is the threshold Y of gender identification defined as follows:

$$Y = y(\alpha)+y(\beta)+y(\gamma)+\cdots+y(m), \quad (2)$$

where m is number of the feature parameters. For example, the sum of feature parameters Z of gender identification the following definition can be utilized:

$$Z = Length(\alpha)+Width(\beta)+area(\gamma) \quad (3)$$

The gender identification of unknown Z is predicted according to the following rule:

$$Z \ge Y \quad Men \qquad Z < Y \quad Women. \quad (4)$$

4. EXPERRIMENTAL RESULTS

The proposed method is applied to the shoeprint images which we set up sensor mat at an entrance of buildings. Based on the investigation on the shoeprint images of the customers, a population of 100 men and 100 women is applied. The gender identification test is carried out on this population.

4.1 Evaluation of the feature parameters

In order to evaluate the gender identification by proposed method, we calculate the gender identification rate using feature parameters. Fig. 4 shows histograms of normalized feature parameters of (a) length, (b) width, (c) area. Moreover, we fused in two feature parameters (d) length and width, (e) length and area, (f) width and area, and feature obtained by fusing all three feature parameters in Fig. 4. The feature parameters that we compare it when we use feature parameters, and fused with two or three parameters, there is less overlap of the men and women. In addition, Table 2 shows the average and standard deviation of feature parameters. There is a difference in the feature parameter of area to be provided from shoeprint image by the kind of shoes. Because the classification of the shoes putting on such as high heels, sneakers and boots is various in the case of women in particular, the feature parameter of area had much dispersion.

4.1 Gender identification rate

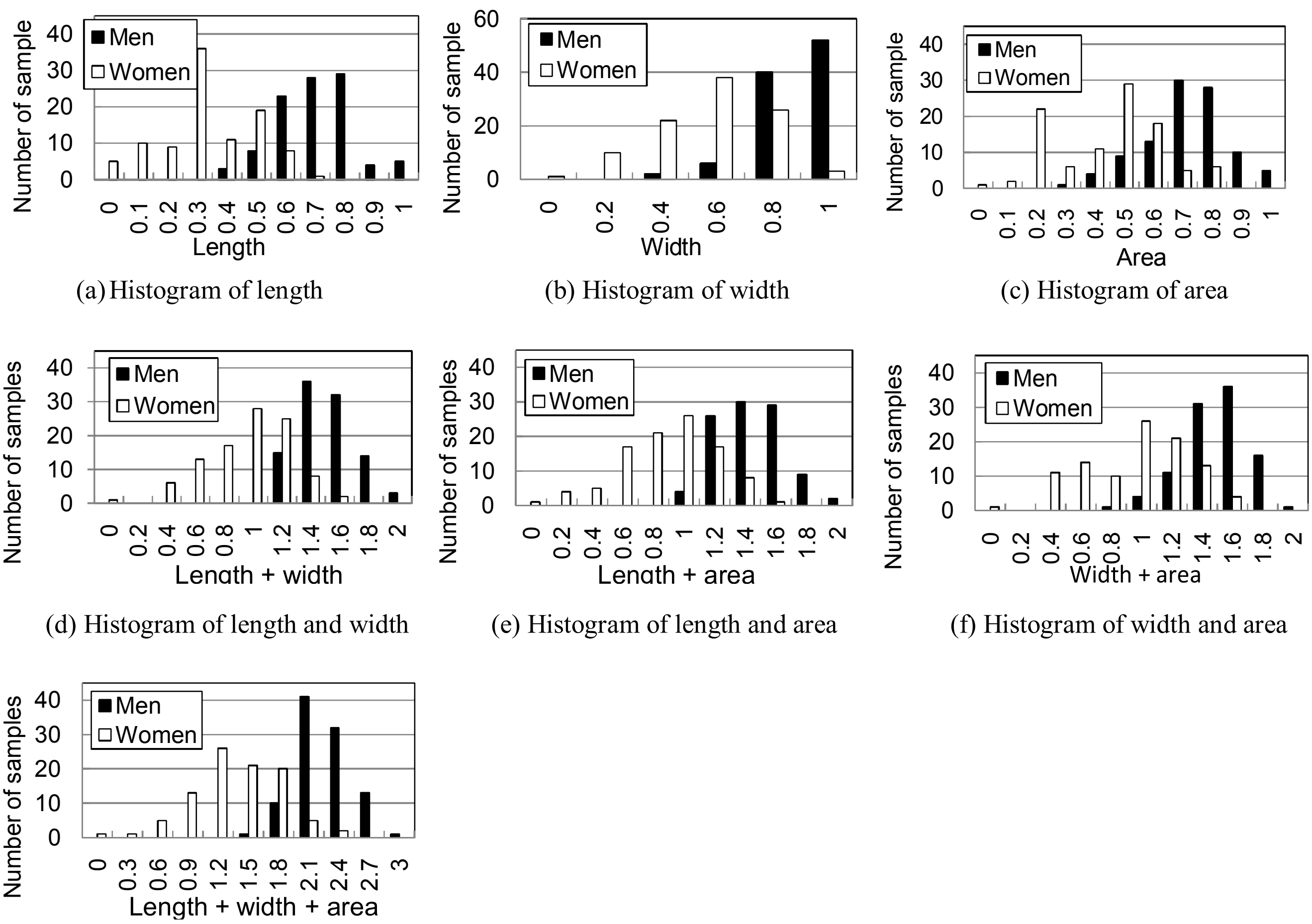
We calculated gender identification rate from the real data of 100 men and 100 women. The threshold used the threshold that we calculated in 3.1 sections. Table 3 shows the gender identification rate using feature parameters obtained by shoeprint images. Each one feature parameter had the gender identification rate from 78% to 81.5%. When we use two feature parameters, identification rate is high than one feature parameter. Furthermore, we had the

Table 2 Distribution of the feature parameters

	Gender	Men	Women
Length	Average[cm]	27.1	23.0
	Standard Deviation	2.03	2.44
Width	Average[cm]	10.5	8.87
	Standard Deviation	0.77	1.04
Area	Average[cm^2]	163	109
	Standard Deviation	27.3	35.8

Table 3 Comparison of the gender identification rate.

Feature parameter(s)	Gender identification rate [%]
Length	81.0
Width	81.5
Area	78.0
Length+width	85.5
Length+area	84.0
Width+area	83.5
Length+width+area	86.5



(a) Histogram of length

(b) Histogram of width

(c) Histogram of area

(d) Histogram of length and width

(e) Histogram of length and area

(f) Histogram of width and area

(g) Histogram of length, width and area

Fig.4 Histograms of normalized feature parameters. (a) length, (b) width, (c) area, (d) length and width, (e) Length and area, (f) width and area, (g) length, width and area.

gender identification rate of 86.5% when we fused in three feature parameters of length, width and area. This result is, when the women put on high heels, she was gender identified man only by feature parameter of length, but she was gender identified woman correctly because the feature parameter of area was small. Based on these results, we can recognize the identification rate improves by using a plurality of parameters.

5. CONCLUSIONS

We proposed a gender identification method for marketing by utilizing the features (length, width and area) of the shoeprint of the men and women. The sensor mat which we developed to take shoeprint images arranges mechanical switches in a matrix pattern and is more reasonable than a pressure mat. We proposed method gender identifies using the feature parameters from the shoeprint images.

By utilizing the proposed method, we realized gender identification rate of 86.5%. In addition, safety is high if shoeprint images leak out, because it is difficult to identify an individual from shoeprint images using the proposed method.

REFERENCES

[1] KANNO Tsuneo, KUMANO Hideki, TERAMATI Yasuaki, NAGAHASHI Hiroshi, "Designing Neural Networks for Recognition of Male and Female Faces Using Genetic Algorithms", IEICE Trans Vol.J80-D-2, No.8 pp. 2251-2253, 1997

[2] YAMAGUCHI Masami, KATO Takashi, AKAMATSU Shigeru, "Relationship Between Physical Traits and Subjective Impressions of the Face : Age and Sex Information", IEICE Trans Vol.J79-A, No.2 pp. 279-287, 1996

[3] Kyoko SUDO, Junji YAMATO, Akira TOMONO, and Ken-ichiro ISHII, "Fusing Multiple Sensor Information for a Gender Determining System", IEICE Trans Vol. J83–D–I No. 8 pp. 882-890, 2000.

[4] Tsuneo KANNNO, Hideki MUMANO, Yasuaki TERAMATI, and Hiroshi NAGASAKI, "Designing Neural Networks for Recognition of Male and Female Faces Using Genetic Algorithms", IEICE Trans Vol.J80-D-II No.8 pp.2251-2253, 1997

[5] Kyoko SUDO, Junji YAMATO, and Akira TOMONO, "Determining Gender Using Morphological Pattern Spectrum", IEICE Trans Vol. J83–D–I No. 8 pp.882-890, 2000