Age Classification from Face Images by Neural Networks

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Abstract

In this paper, in order to achieve high-accurate age estimation, we paid attention to the edges that consist of all wrinkles in a face and also a neck. In particular, this method uses the value of gray scale in an edge image. Therefore, the feature values of gray scale are fed into input units of a neural network for age estimation. In order to show the effectiveness of the proposed method, the proposed age estimation method was applied to an age estimation system using real images. For the simulation results, the rate of a classification divided by age was approximately 90% *as the whole.*

1 Introduction

Human beings are sasily able to distinguish person's age from an image of the face. In some cases, we can discem even identical twins. This ability has not been realized at computer vision. If it can be mounted in a computer, it may be applicable to many fields. Research on " age estimation, gender estimation and expression estimation from face images " has increased recent years. In particular, its application to age estimation is expected. For example, it can think that it is one of the technologies which are useful for the marketing investigation of examining a purchaser and a passer-by and so on[1].

The next two information is important for gender estimation and age estimation from face images. One is shape information based on the frame of a face and the face muscle, and the other is texture information (such as soaks, the wrinkle and freckles) [2]. This method needs using the feature point extraction and carries out estimation paying attention to the form of portions which constitute faces, such as an eye, a nose, and a mouth. However, it is difficult to extract these portions with high accuracy. There is a method which uses Gabor characteristics and a line shape distinction analysis as the research of paying attention to the automation without giving it a characteristics point [3, 4]. However, it is not easy that an age is estimated from a face image such that 20-59 years old is handled as one generation.

Therefore, this research aims at age estimation in large application area. When shape characteristics are used, the child of 10 years old and under can be distinguished from the adult. Age estimation is tried toward the HOIP face image data base which collected face images of 15-64 years old. Density histogram in which the value of the edge intensity of the vertical direction in an image and the horizontal direction is more than 100 is computed by using the edge information, and feature data is produced.

Neural networks are advanced parallel systems, which are excellent especially in the problem related to pattern recognition. Therefore, NN is used in order to avoid the difficulty of the threshold value determination in many dimensions. By using neural networks, the differences of feature data between ages are clarified and are discriminated [5].

2 Image data

In this paper, we perform some simulations using the following databases of the face images.

2.1 HOIP data base of the face images

HOIP data base of the face images was built as a base of the research of face image processing in Human and Object Interaction Processing (HOIP) in Japan. The characteristics of this data base are that photography directions are fixed. 300 Japanese images of 15-65 years old are divided into the interval of 5 years, each of which is composed of 15 persons. An image is the BMP file which consists of 635 $\times$ 480 pixels. Moreover, photography conditions are set

Figure 1. The samples of HOIP's image data.

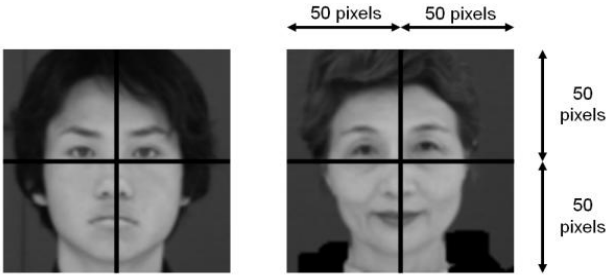

Figure 2. Normalization of the face image.

Figure 3. An edge extracted image.(Sobel filtering)

as fixed; that means the same lighting condition, subjects, and camera position. The sample image of the front face is shown in Fig. 1.

2.2 Normalization of an image data

In order to perform computer simulations, it is need to normalize original face images. The procedure of normalization is described in below.

At first, the center of a face image is adjusted at the intersection of two lines; the horizontal which passes along under the both eyes, and the vertical line which passes through the middle of the eyebrows are crossed as shown in Fig.2. The center of position of an image is extracted. Then the line joining both eyes is moved so that it may become parallel to the horizon. Next, in order to reduce information other than a face, an image is cut out as shown in Fig. fig:ndata. Then, it is changed into the size of 100 $\times$ 100 pixels.

3 Proposed method

The proposed method in this research is as follows:

1. A target image is normalized in the upper 100 $\times$ 100 pixel area from the neck as shown in Fig. 2.
2. The acquired face image is converted into a gray scale image.
3. Median filter is applied to the gray scale image, and a noise removal is done.
4. An edge is detected by the sobel filter as shown in Fig. 3.
5. A skin color area is extracted from the original image by the method of using threshold values (Fig. 4).
6. As for feature data are fed into the input units of NN, the pixels which have the value with edge intensity of more than 100 in the vertical direction and the horizontal direction are summed.

4 Computer simulations

4.1 Input data

This research is done by using the full color images of the BMP file. These subjects don't wear their glasses in an image to use this time. The total of the images is 252 sheets and another image of the same subject isn't contained. 10

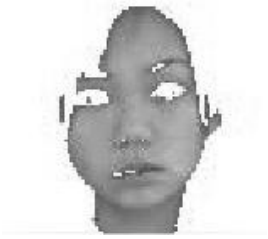

Figure 4. An skin color extracted image.

Figure 5. An image used as data.

sheets of total 120 sheets are used as the learning data for each age generation, and the remaining data are used as the test data of computer simulations (Table 1).

4.2 Structure of NN

A NN model used for the age estimation in this study is shown in Fig. 6. In this study, NN is used for age classification. It is a three-layered NN. BP method is adopted for learning. All data, the number of pixels, are used as input features in the input layer. The numbers of pixels are fed into the input units. The hidden layer has twenty units and the output layer has six units to classify six generations.

4.3 Experimental result

The result is shown in Table 3. The rate of an average accurate classification is 84.1%, which shows the classification of each age by using NN. In the details, the best rate of classification of 10's and 50's are 100.0%, and the worst rate of classification of 60's is 66.7%.

4.4 Comparative experiments 1

Simulation was done in the same way as a comparative experiment by using the image of only the face area. The example of an image to use in this simulation is shown in

Table 1. The details of the image data.

Gender	Age	Learning data	Test data
M	10's	10	5
M	20's	10	9
M	30's	10	12
M	40's	10	17
M	50's	10	9
M	60's	10	1
F	10's	10	5
F	20's	10	18
F	30's	10	17
F	40's	10	19
F	50's	10	18
F	60's	10	2
Total		120	132
		252	

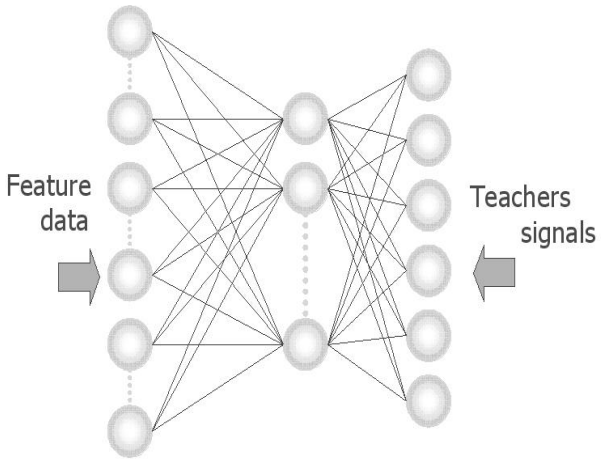

Figure 6. A NN model (Three-layer class type).

Table 2. Experimental condition.

Layer	The number of units
Input	100+100
Hidden	20
Output	6

Table 3. Experimental result

	10′s	20′s	30′s	40′s	50′s	60′s	Rate
10′s	100	0	0	0	0	0	100.0
20′s	11.1	70.1	18.5	0	0	0	70.4
30′s	0	6.9	89.7	3.4	0	0	89.7
40′s	0	0	11.1	75.0	13.8	0	75.0
50′s	0	0	0	0	100	0	100.0
60′s	0	0	0	0	33.3	66.7	66.7

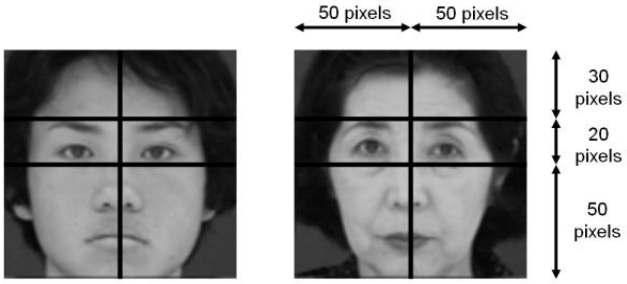

Figure 7. The sample image of comparative experiments 1.

Fig. 7. A result is shown in Table 4. The validity of the proposal method could be confirmed from this result as well.

4.5 Comparative experiments 2

On the other hand, an experiment was done by using the data on the different lighting condition. An experiment went by using 17 sheets of images in the 20's.

As shown in Table 5, an experimental result obtained the high recognition of 88.2%. It can be said that it is effective from this result even if it encounters the image in which a lighting condition is different.

5 Conclusion

The method in which an age was estimated at from the face images was proposed by using Neural Networks, and the verification of the validity was done by using the real image in this paper.

It paid attention to the wrinkle of the skin as the characteristics by which an age was estimated, an edge from

Table 4. The result of comparative experiments 1.

	10′s	20′s	30′s	40′s	50′s	60′s	Rate
10′s	90.0	10.0	0	0	0	0	90.0
20′s	0	81.5	18.5	0	0	0	81.5
30′s	0	3.4	89.7	10.3	0	0	89.7
40′s	0	2.7	2.8	91.7	2.8	0	91.7
50′s	0	0	0	7.4	81.5	11.1	81.5
60′s	0	0	0	0	33.3	66.7	66.7

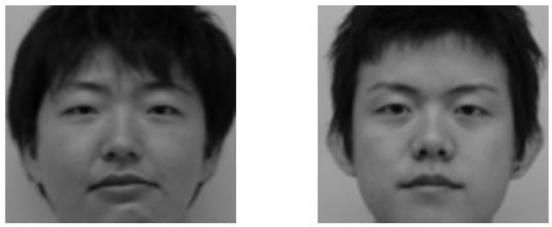

Figure 8. The sample image of comparative experiments 2.

Table 5. The result of comparative experiments 2.

	10's	20's	Rate(%)
20's	11.8	88.2	88.2

the face image was detected, and the value of edge intensity was made as characteristics data. It is shown that much amount of characteristics are contained in the part on the high value of the edge intensity from the experiment result. It was found out that the image which covered not only a face area but also a neck area was more effective. In conclusion, it is confirmed that the proposed method works very well.

From now on, age estimation from images with the emotion will be done in the next step, and also the gender estimation.

References

[1] S. Akamastu: “Computer Recognition of Human Face”, *IEICE Trans. on*, Vol.D-II-J80, No.8, pp.2031-2046, 1997. in Japanese

[2] H. Kwon, Niels da Vitioria Lobo: “Age Classification from Facial Images”, Computer Vision and Image Understanding, Vol.74, No.1, pp.1-21, 1999. *IEEE*, pp.861-864, 1990.

[3] B. Moghaddam and M. Yang, “Gender classification with support vector machne”, Proc. F&G2000, pp.306-311, Mar. 2000.

[4] M. Lyons, J. budynek, A. lane, and S. Akamatsu,“Classifying facial attributes using a 2-d gabor wavelet representation and discriminant analysis”, Proc. F&G2000, pp.202-207, Mar. 2000.

[5] S.Y.Kung: *Digital neural networks*, PTR Prentice-Hall (1993)