Age Estimation based on Facial Wrinkles by using the Gabor filter and SVM

*Sang mi Im, Hye yeon Cho, and TaeYong Kim**

Chung-Ang University / Seoul, Korea
**Corresponding Author (kimty@cau.ac.kr)*

Abstract: Recently, people's interest in their appearance has increased. Hence, beauty of face has become a social issue. In this paper, we present a face-age-estimation system based on facial wrinkles by using a Gabor filter and support vector machine (SVM). First, the system detects the facial area on an image. When a face is recognized, we divide the facial area into five parts: both areas around eyes, both areas around cheeks, and the area around the lips. We then extract specific features from the divided facial area by using the Gabor filter to reduce classifier error. Finally, we use the SVM to classify the extracted features into a range of ages to estimate user age. As a result, our method outperforms previous methods with an average classification accuracy of 76.92%.

Keywords: Gabor feature, SVM, Face recognition

Received Aug. 08, 2016; revised manuscript received Oct.07; accepted for publication Oct. 30, 2016; published online Nov. 30, 2016. DOI: 10.15323/techart.2016.11.3.4.24 / ISSN: 2288-9248.

1. Introduction

In the development of media, society's interest in an individual's appearance is increasing. The appearance comprises the state and characteristics of the facial skin, considering its standard of health and beauty. In recent years, research on face beauty is expected to evolve along with the biosignals of the ubiquitous environment [1],[2],[3]. To measure the face age, face-recognition technologies are required. These include template-based methods, matching pursuit-based methods, and the support vector machine (SVM) approach [4]. We select the well-known SVM engine for the classification or recognition task, and we estimate the face age by using this SVM based on facial wrinkles [5]. The Gabor filter is used to extract the facial features. The Gabor filter has a strong advantage in facial expression recognition [6]. In this study, the features were extracted using the Gabor filter. Therefore, we use the SVM to classify a particular part of the face instead of using the entire face. Based on the classified result, we developed the age-classification sensory system, which displays sound and visual effects to allow users to recognize interesting results.

2. Age Estimation Method

The purpose of the system is to estimate the age with respect to the facial wrinkles The camera roughly determines the position of the face through every frame by using the "Haar-like feature" algorithm. In our experiment, , specific features, such as eyes, cheeks, and mouth are at slightly different positions because of the different face positions in each frame. Therefore, extracting features through the Gabor filter for the entire face is difficult. In this study, we separated each part (eyes, cheeks, and mouth), as shown in Figure 1, to the approximate positions, and proposed SVM learning. We tested the accuracy of SVM classification for each part of the extracted feature and the features extracted from the entire face. In this experiment, we used a nonlinear POLY kernel SVM.

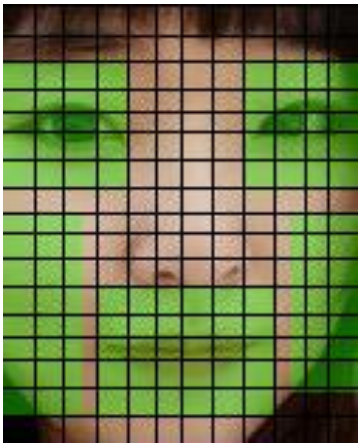


Fig. 1. Extraction of specific features from each part of the face.

A. Feature vector

By using the obtained facial parts, the abovementioned method for feature extraction can be defined as follows [7]. Moreover, a feature is located on $\boldsymbol{x_0}, \boldsymbol{y_0}$ if

$$\boldsymbol{R_j}(\boldsymbol{x_0}, \boldsymbol{y_0}) = \max_{(x,y)\in W_0} \left(\boldsymbol{R_j}(x, y)\right) \quad (1)$$

$$\boldsymbol{R_j}(\boldsymbol{x_0}, \boldsymbol{y_0}) > \frac{1}{N_1 N_2} \sum_{x=1}^{N_1} \sum_{y=1}^{N_2} \left(\boldsymbol{R_j}(x, y)\right) \quad (2)$$

j = 1,...,40

The method extracts features that satisfy formulas (1) and (2).

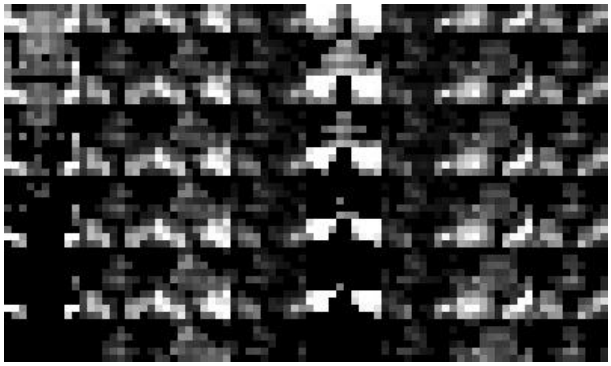


Fig. 2. Images of extracted features of a face

Thus, 100 features were extracted for each of the images obtained by the 40 Gabor wavelets. The SVM is used to separate the extracted features [8].

3. Face Age Estimation System

This section describes the development of the proposed age estimation system based on facial wrinkles. As shown in Figure 2, the GUI is created using GDI+ and the age estimation module is created using the OPENCV library. This system can speak out the age-estimation result to the user by using the FMOD sound library. This system compares the inputted user's age (Age_1) with the estimated age (Age_2) and follows three scenarios. In each scenario, the following results were obtained: (1) If Age_1 < Age_2, the face is classified as a baby face; (2) If Age_1 = Age_2, the face is normal; and (3) If Age_2 > Age_1, the face is classified as an old face.

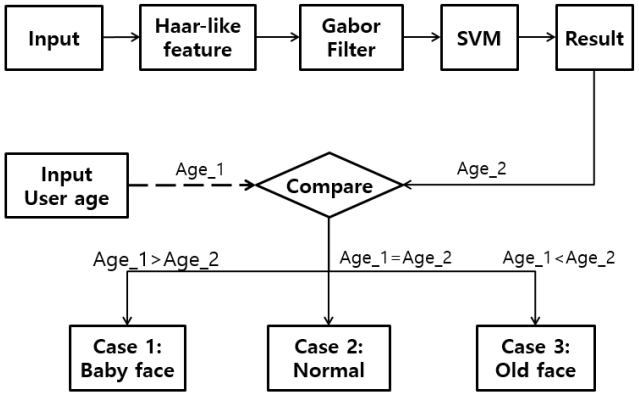
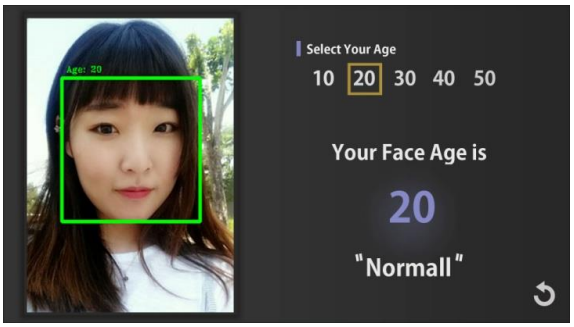


Fig. 3. Age-estimation flow-chart

Figure 3 shows the developed age-estimation system based on facial wrinkles that uses GDI+ and FMOD. This system compares the different reactions, as shown in Figure 2. In Figure 3 (a), the system displays "Your face is normal!" to the user, by considering case 1 in Figure 2. Another reaction is shown in Figure 3 (b), in which the system displays to the user that "You have a baby face!" by considering case 2 in Figure 2. Yet, in another case, the system tells the user "You need skin care!" by considering case 3 in Figure 2.



(a)

(b)

Fig. 4. Final results of the system

4. Experiment Result

As shown in Figure 4, extracting features of the entire face by using the SVM classifier produces low classification accuracy. This is because of the different position of the facial features in every frame (e.g., eyes, cheeks, and mouth). In this study, we partition parts of the face to determine their approximate positions. Next, a specific feature is extracted from each part to reduce errors when using SVM for its classification. The proposed system has an average accuracy of 76.92%, with a higher accuracy rate than when features of the entire face are considered. In addition, the best accuracy our system achieved is 90.91%.

Age group	SVM Classification Accuracy (%)	
	Features from the entire face	Specific features of face
10~19	51.40	72.62
20~29	54.54	90.91
30~39	40.50	81.80
40~49	41.30	70.68
50~	40.20	68.60
Average	45.58	76.92

Fig. 5. Comparison of SVM classification accuracy considering features of the entire face and parts of the face for age estimation.

5. Conclusion

In this study, we proposed an "age-estimation system based on facial wrinkles" to classify learning features in the SVM after extracting features of each part of a face by using the Gabor filter. The error caused by using features from an entire face was resolved by extracting specific features of some parts of the face, hence increasing SVM classification accuracy. In the future, we plan to add a variety of interesting elements to the proposed method for more interaction.

Acknowledgement

This research is supported by the Basic Science Research Program through the National Research Foundation of Korea (RFK), funded by the Ministry of Education, Science and Technology (NRF- 2015R1D1A1A01058394) and by the Chung-Ang University's Cross Functional Team (CFT) Program under Brain Korea 21 PLUS Project in 2015.

References

[1] F. Ahmad, A. Najam and Z. Ahmed, "Image-based face detection and recognition:" state of the art"," *arXiv preprint arXiv:1302.6379.*, Nov, 2013, pp.1-2.

[2] S. Akazaki, H. Nakagawa, H. Kazama, O. Osanai, M. Kawai, Y. Takema and G. Imokawa, "Age- related changes in skin wrinkles assessed by a novel three-dimensional morphometric analysis," *British Journal of Dermatology.*, vol. 147, no. 4, pp. 689-695, Oct, 2002, pp.689-690.

[3] H. Han, C. Otto and A. K. Jain, "Age estimation from face images: Human vs. machine performance," *2013 International Conference on Biometrics.*, pp.1-8, 2013, pp.1-2.

[4] V. Vijayakumari, "Face recognition techniques: A survey," *World Journal of Computer Application and Technology.*, vol. 1, no. 2, pp. 41-50, 2013, p.43.

[5] G. P. Nam, B. J. Kang and K. R. Park, "Robustness of face recognition to variations of illumination on mobile devices based on SVM," *KSII Trans. Internet and Information Systems.*, vol. 4, no. 1, pp. 25-44, 2010, pp25-26.

[6] C. Liu and H. Wechsler, "Gabor feature based classification using the enhanced fisher linear discriminant model for face recognition," *IEEE Trans. Image processing.*, vol. 11, no. 4, pp. 467-476, 2002, pp.467-472.

[7] A. Kaushal and J. P. S. Raina. "Face detection using neural network & Gabor wavelet transform," *IJCST* 1.1, 2010, pp.49-63.

[8] B. Heisele, P. Ho, and T. Poggio, "Face recognition with support vector machines: Global versus component-based approach," *Computer Vision, 2001. ICCV 2001. Proceedings. Eighth IEEE International Conference on*. vol. 2. IEEE, 2001, pp.1-6.

Biography

Sang mi Im was born in Korea in 1990. She received her B.S. degree in computer engineering from Chung-Ang University in 2015. Currently, she is pursuing an M.S. degree in game engineering at the Graduate School of Advanced Imaging Science, Multimedia & Film in Chung-Ang University. Her research interests include Facial Recognition, HCI, and Pattern Recognition.

HyeYeon Cho was born in Korea in 1991. She received her B.S. degree in Media Engineering from the Sogang University in 2015. Currently, she is pursuing an M.S. degree in Art & Technology at the Graduate School of Advanced Imaging Science, Multimedia & Film in Chung-Ang University. Her research interests include Neural Network, Hand Gesture Recognition, and HCI.

Taeyong Kim was born in Korea in 1960. He received his B.S. degree in electronic engineering from the Hanyang University in 1986, and received his M.S degree in electronic communication engineering from the Hanyang University in 1988. He received his Ph.D. degree in electronic calculation from the Pohang University of Science & Technology in 1998. He is currently a full-time professor at Chung-Ang University.