

Expression Recognition System Based on Artificial Neural Network for User Fatigue Detection

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Abstract. This paper presents expression recognition system using machine learning of artificial neural network. First, the face image is obtained by using the characteristics mask of Haar-like. Second, we set the feature description for determining the degree of matching geometric image using expression edge components and texture image using LBP histogram. Finally, the neural network classifier is configured as MLP(*Multi-Layer Perceptron*) and three kinds of expressions of Anger, happiness, expressionless(*neutral*) are recognized by error backpropagation algorithm. The proposed method according to the simulation result is excellent recognition rate than conventional methods. Furthermore, the recognition of the three expression was above the 75%.

Keywords: Expression Recognition, Error Back-Propagation, LBP, Perceptron Haar-like Feature

1 Introduction

Depending on development of information & communication technologies and improvement of the performance of the computer hardware, Studies to understand the human has been actively conducted. Especially, the field of biometrics using computer vision is a high utilization studies. Because it can analyze value of personal information based on human-computer interaction and be applied to real problem. The purpose of this study has also been developed to identify the user emotions about the suitability of the 3D image viewer fatigue measurement through expression recognition.

Many ways to identify their expression have been studied by using image and expression recognition method can be classified into a model-based and image-based approach [1]. There are model-based expression recognition methods of active appearance models detecting the feature point and identifying the movement of the facial muscles in recognized faces image.

Cheon [2] recognized the expression obtained by analyzing the movement of characteristic points in active appearance model. Edwards [3] was designed a statistical model based on changes in facial morphology by typing 122 points in the around facial features. Image-based expression recognition method, such as Gabor

wavelet, PCA(*Principle Component Analysis*), LBP(*Local Binary Pattern*) has been actively studied.

In this paper, we are using ‘Haar-like’ features to recognize faces in images. And After neural network classifier is learned as extracted LBP histogram and Edge information in face image. The trained classifier is used to recognize the facial expression. Furthermore, we reduce the complexity of the emotion recognition and shortened processing time by using the only three kinds of expression category of Anger, Happiness and expressionless(*neutral*).

In the first chapter of this study speaks introduction, second chapter speaks face recognition, feature extraction method and neural network learning procedure, third chapter speaks proposed overall system in this paper and proposed method of applying the extracted feature to the artificial neural network classifier, fourth chapter speaks simulation result and fifth chapter speaks conclusion.

2 Related Work

In this paper, neural network is learned from the three expressions of anger, happiness and expressionless(*neutral*) for identifying a user’s fatigue. The expression recognition sequence proceeds to face detection step in the image, feature extraction stage in the recognized face image and the last step in analyzing and recognizing the extracted feature.

2.1 Face recognition using Haar-like Feature

Generally, when taking a photograph of the face. Not only face area but other objects and around the background are taken. If it separately extracts only the face area from the image, we can reduce processing time through facial recognition set of ROI(*Region of Interest*) and increase the reliability by removing unnecessary information prior to feature extraction like background image .

In this paper, we use ‘Haar-like’ feature for face recognition. ‘Haar-like’ mask can be a quick operation. Because the only required operation is sum in the process of obtaining a feature value. Furthermore, due to the detection of feature in the local region of the image, it is a little robust feature descriptor to occlusion. So, it has high reliability for face recognition than simple color-based face recognition algorithm or projection method. [4]

information. (b) of [Fig. 3] shows the neural network architecture used in this paper. Error backpropagation learning algorithm was used for learning a neural network. And it was learned using symmetric sigmoid function after input value of the LBP histogram and edge map pixels is normalized. Error backpropagation learning algorithm is defined as a method of learning the weights in the direction to minimize the error using difference between the result value and the target value to be generated by the weight value. When learning the weights, it updates weight by propagating the error in the reverse side from output layer using the delta rule. The proposed neural network architecture consists of 2048 of input node, 66 of hidden node and 3 of output node.

4 Simulation result

The input image used in the expression recognition was used for the front face of Japanese woman JAFFE database that does not have a beard and not wear glasses [5]. JAFFE database contains seven expressions with ten Japanese female models and is learned for neural network of 30 data by selecting specific expressions of anger, happiness, expressionless(*neutral*). The experiment was conducted using a Leave-one-out method and [Fig.3] illustrates a neural network input value according to expressions.

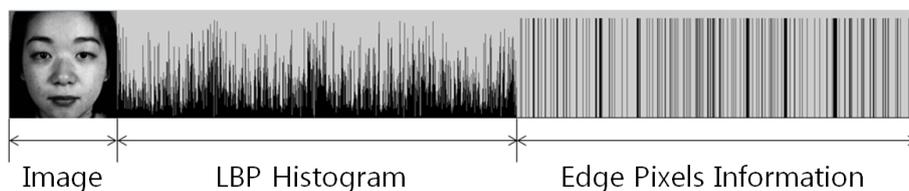


Fig. 3. Neural Network Input Values

We compared with expression recognition rate of Zilu & xieyan [7] using LBP histogram and adaboost and Park [6] expression recognition rate applying LBP histogram after optimized block weight. [Table 1] is a specific facial expression emotion recognition rate obtained by applying the proposed method.

Table 1. The expression recognition by emotions (Unit : %)

Emotions	Expressionless(<i>neutral</i>)	Happiness	Anger
Block weight optimization(Park)	73.2	73.6	83.6
LBP + adaboost(Zilu & xieyan)	73.6	76.1	85.4
Proposed Method	75	80	83

When the result of the recognition rate of the proposed method can be seen that more than 75%. Therefore, we can be known that a high efficiency of the proposed method considering the workload. The average facial expression recognition rate of the

proposed method is 79.3% and when compared to 78.4% of Park expression recognition rate, we can be known that the improvement was 1.13%. And we also can be known that improvement was 3.15% comparing with average expression recognition rate of Zilu & xieyan.

5 Conclusion

This paper was proposed for face recognition and expression recognition using feature extraction method. For detail, frontal face recognition using 'Haar-like' feature and feature extraction using texture descriptor obtained the LBP histogram of recognized face and geometric features obtained canny edge detection in the face image was used. To recognize expression, type the two features were entered in the artificial neural network classifier and it was learned through error backpropagation learning algorithm. The learning data is a front face image used in JAFFE database, three expressions of expressionless(*neutral*), happiness and anger was classified. Although considered a low workload, we have identified a better performance than the conventional method and it is necessary to study a method for treatment by applying the proposed algorithm using extracting only a specific part that affects the expression rather than the entire face image.

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