

Face Recognition Using Neural Networking Algorithms

Sayed Shareeq Ali^{1,*}, Megha Gupta²

¹Student, Department of Computer Science, Poornima Institute of Engineering and Technology, Jaipur, Rajasthan, India

²Associate Professor, Department of Computer Science, Poornima Institute of Engineering and Technology, Jaipur, Rajasthan, India

Abstract

Face recognition system has become quite popular nowadays. It has gained a good attention in recent few years. Face recognition is practically everywhere, in security system for criminal activities, places like airports and international borders, it is needed for identification of people. In the paper, we discussed about three Neural Networking Algorithms used for FR such as Gabor Filter, Principle Component Analysis with Back Propagation Neural Network and Wavelet Transform and Artificial Neural Network. Here we have done a comparative study on these algorithms.

Keywords: Principle component analysis, back propagation neural network, wavelet transform, artificial neural network, face recognition, Gabor Filter, extraction

***Author for Correspondence** E-mail: 2015pietcssayed@poornima.org

INTRODUCTION

Face recognition is quite important now in our daily life. It is an important task for applications like security systems, card checking, terrorist identification etc. People can remember faces easily. A human being can differentiate an individual face from others depending on number of things/factors. Human face recognition is studied for several years. Creating a system like such is quite difficult, because faces are complex, multidimensional visual stimuli. In recent years, many researchers tried facial recognition systems developed on edges, inter-feature spaces, and neural network techniques. This paper talks about algorithms using neural network for face recognition and explain their working principle.

The organization of this paper is in three parts, the first part talks about the algorithms used for face recognition, the second part is about the advantages and disadvantages of these algorithms and the third section discuss the conclusion.

FACE RECOGNITION TECHNIQUES

The paper discusses about three algorithms

1. Gabor Filter
2. PCA With BPNN
3. Wavelet Transformation and ANN

Face Recognition using Gabor Filter

The process uses Gabor wavelet transform in collecting characteristics point and taking out feature vectors [1].

GABOR TRANSFORM

Mostly used because of its low leak in time-frequency region. It provides us the time-frequency of the signal. In this the pixels are centralized in free area and Fourier's are centralized in time-domain.

The Gabor transform can be explained as

$$G(t, \omega) = \int_{-\infty}^{\infty} e^{-\frac{(\tau-t)^2}{2}} e^{-j\omega\tau} \chi(\tau) d\tau$$

We can visualize that Gabor transform is more like Fourier transform with a Gaussian function. Since the signal is much more concreted, the frequency resolution is much better.

PRINCIPAL GABOR FILTER

In this, filters are orthogonal, constructed as combination of multiple original filters. The filters made in such a way that they are able to accept same or similar recognition rates. There are still some issues which affect some of the attributes and Gabor size presentation of the inputted image pattern. To remove this effect we use orthogonal combination of the Gabor Filter Figure 1 [1].

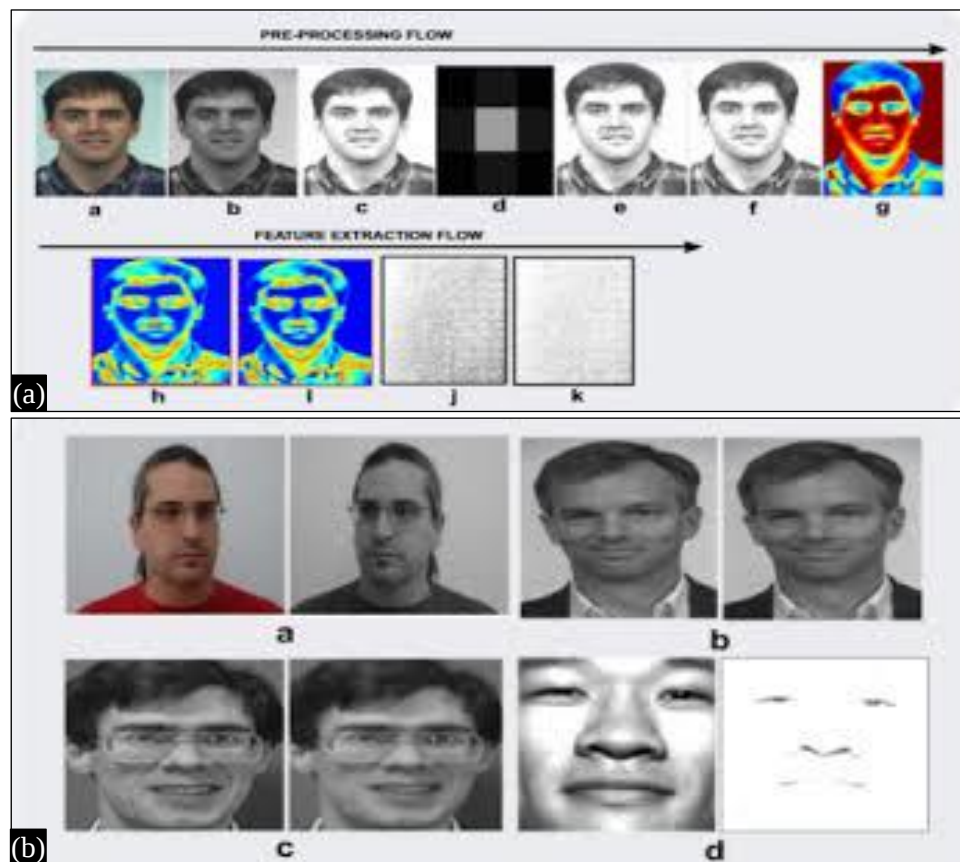


Fig. 1: Face Recognition through Gabor Filter Developed on FeatureExtraction (a) input 1, (b) input 2.

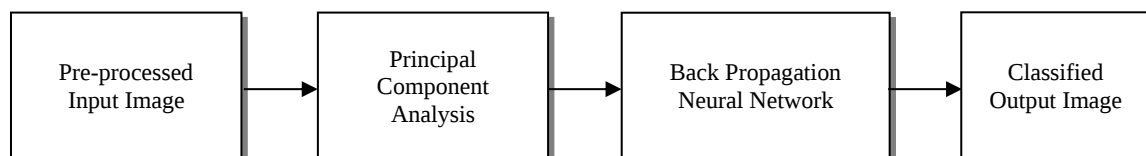


Fig. 2: Basic Block Diagram.

Face Recognition Using PCA with BPNN

PCA is basically used for collecting patterns in multidimensional data. Dimensionality reduction is needed for these:

- i) Removing of dimension of data,
- ii) Collecting salient specific feature,
- iii) Eliminate redundancy [2].

Back propagation is used to train multilayer perceptron's (MLP). This is a connection of multiple units that makes the feeding layer, hidden layer and an extracting layer of computation nodes.

Input signal passes through the connection in straight direction on layer by layer. In this method the recognition is done by PCA and BPNN together. BPNN represent the behavior

of feature vectors and then make use of feature vector for showing decision region correlated to their classes. Patterns are categorized through this decision region as they fall in these regions [2] (Figure 2).

Wavelet Transform and Artificial Neural Network

The process is divided in three parts

- Image possession and Analysis
- Feature Collection and Withdrawal
- NN Classifier

ANALYZE AND FEATURE EXTRACTION USING WAVELET TRANSFORM

Firstly, image of the person is captured. After capturing, first thing is to convert the image

into PGM format. Depending on certain things the image is enhanced if there is requirement of that. Now the image is inserted into the next process by giving filename as argument. Now for creating the wavelet, we have to select feature points on face using mouse (Figure 3).

After the selection of points, the system analyzes the dimension of the inside section of image scaling on ratios of difference between the above extracted points. After this, wavelets are placed on inner section of face. Extraction of points from these selected points gives a benchmark between image presentation and computational speed (Figure 4).

THE NEURAL NETWORK PROCESSOR

Training of Neural Network

NN is trained to do complex processes in different-different applications. Face descriptor are used as input. During training of the ANN, the face descriptor fed images at inside layer and matches images as 0 or 1 value of nodes at output layer (Figure 5).

Simulation of ANN for Recognition

Newly image is given for detection. The descriptors are input to the neural net. Next these networks are processed (Figure 6). The generated results are compared and if the result goes beyond the threshold level, then it is said to be conformed that this face belongs to recognized person [3].

STRENGTHS AND WEAKNESS

Gabor Filter

Strengths

- 1) The effectiveness of system has justified over face database with image of face captured in different conditions and ways.
- 2) Noise reduction is done due to sharp transition in grey values.
- 3) Graph matching of coefficient are achieved using Gabor filter responses [1].

Weakness

- 1) Gabor filter are not orthogonal to one-another; therefore, correlation is probably important.
- 2) The information contained in Gabor face representation is redundant and affect the size of the image [1].

PCA with BPNN

Strengths

- 1) Recognition is easy and effective compared to other approaches.
- 2) Data compression achieved by low dimensional subspace representation.
- 3) Directly using raw input for processing and detection without proper processing.
- 4) No requirement of knowledge about face geometry.

Weakness

- 1) Quite sensitive to scaling; therefore, a low-level preprocessing is required for normalization.
- 2) Face presentation is in least squared sense; recognition rate goes down for recognition under different condition.
- 3) It would be difficult when there exist extreme change in expression and disguise.

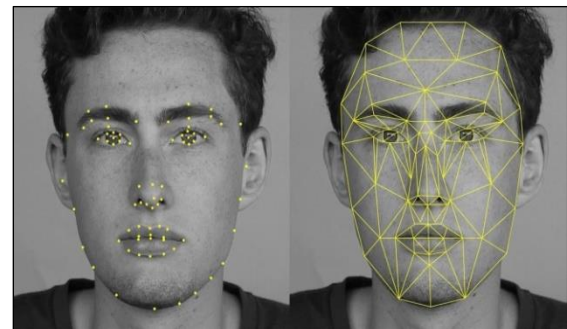


Fig. 3: Selected Feature Point on Face.

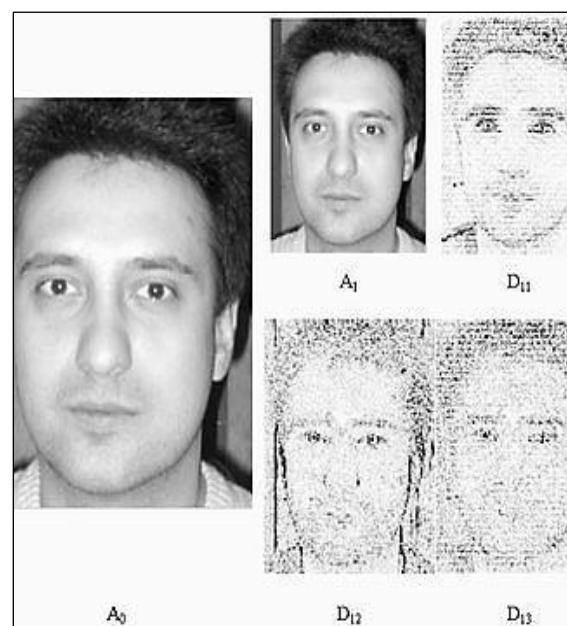


Fig. 4: Image Extraction of Faces.

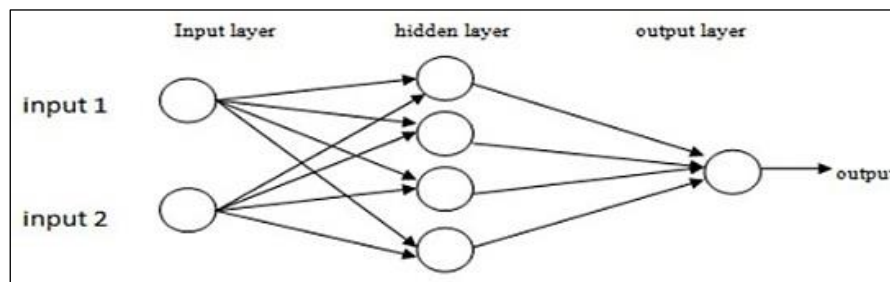


Fig. 5: Neural Network Training.

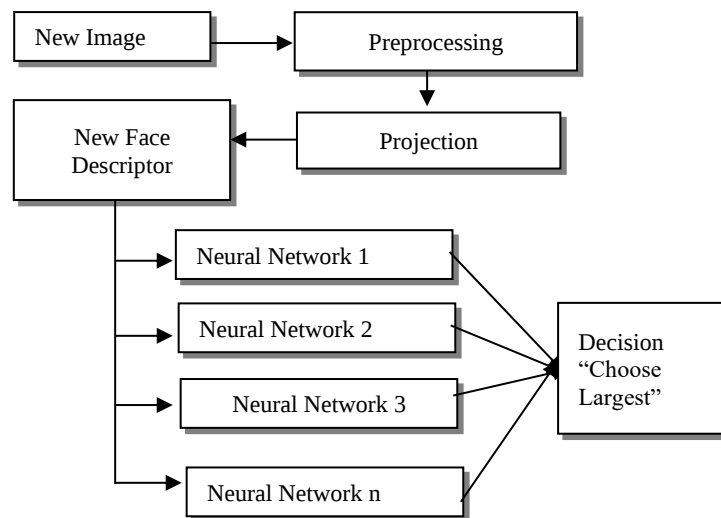


Fig. 6: Testing of Neural Network.

Wavelet Transform and Artificial Neural Network

Strengths

- 1) Speed recognition above PCA method.
- 2) ANN acts as classifier.
- 3) Wavelet and ANN combination shows the best performance, lowest time, lowest unessential data and gives the high detection rates [3].

Weakness

- 1) We cannot use wavelet coefficient directly as it may not extract most discriminative features.
- 2) More unnecessary information present.
- 3) Cannot recover new features which have more discriminative strength [4].

CONCLUSIONS

We compared three different algorithms using neural network for face recognition along with their pros and cons. After the analysis of these algorithms it makes us clear that FR using PCM with BPNN gives us a quite good accuracy. The method gives us the result with almost 90% of

accuracy and the time of execution only few seconds while in the Gabor filter it is to construct a filter of scales and illuminations. Wavelet transform and ANN presents us the best results, lower timing, lower redundant rate, and a great recognition rate. So, it was clear that the face recognition using wavelet transform with ANN was best for face recognition with an accuracy rate for 98%.

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Cite this Article

Sayed Shareeq Ali, Megha Gupta. Face Recognition Using Neural Networking Algorithms. *Journal of Artificial Intelligence Research & Advances*. 2020; 7(1): 23–27p.