Discrete Wavelet Based Image Identification Using Neural Network

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Abstract: In this paper, we propose a face detection algorithm based on Discrete Wavelet Transform (DWT) using Radial Base Function (RBF) Neural Network. DWT technique is used to decompose the image into sub images. We have used the Principal Component Analysis (PCA) technique for relevant feature extraction from the image. Finally, we proposed RBF neural network for face Recognition.
Keywords: Face Recognition, DWT, PCA Technique, RBF Neural Network.

I. INTRODUCTION

Face recognition system is used to create a data for identity of human face such as identity card, voting in electoral system, bank transaction and food distribution system etc. There are many applications of face recognition system, which are used in entertainment field, information security and biometric system.

In this paper, we propose a Principal Component Analysis (PCA) technique, which is used for relevant feature extraction from the images. A feature numerically represents some properties of the images. It also reduces the size of sample by extracting the most differentiating information. The major steps in face recognition process include the feature extraction, selection of training process, and selection of suitable and sufficient number of training sample and accuracy assessment. Discrete wavelet Transform (DWT) has been used to decompose the object image into sub-band image [3]. It can reduce the feature space. DWT can be applied on the discrete signal containing samples. It has an advantage over the Fourier transform.

There are two classifiers: Supervised and Unsupervised. In Supervised Classification, user is required to collect sample of objects. The sample data is divided into training samples and testing samples [7]. The classification system is trained using training samples. Once the system is trained the results are tested using the testing samples. The acceptability of results depend on how accurately of human faces are estimated

In Unsupervised classification, the results are based on the software analysis of an image without user providing sample data. In this paper, a content based object supervised classification system has been developed using DWT and PCA techniques over RBF artificial neural network.

II. DISCRETE WAVELET TRANSFORM

Discrete wavelet transform is powerful tool to decompose images into multiple sub-band images [1]. An image is decomposed into four components LL, LH, HH, HL on applying level one 2-D DWT. LH, HL, and HH are the finest scale horizontal, vertical, and diagonal wavelet coefficients of the image respectively while LL is the

approximate image. The DWT is implemented by applying a series of filters. Figure1 [2] depicts that input image is filtered through low pass and high pass analysis filters respectively. The output is sub sampled by a factor of 2. The analysis and synthesis process results in the decomposition of the signal into low and high frequency bands.

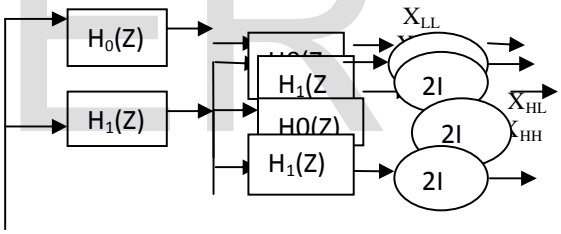

Figure 1: 2-D wavelet decomposition of an image

III. PRINCIPLE COMPONENT ANALYSIS

The task of feature extraction is to extract most relevant information from the original data and represent it in lower dimensionality space. Extraction of important features is a critical part of the image classification process [4]. The image features can be divided into four categories [5] visual features, statistical features, algebraic features, and transform coefficient features. Visual features include edges, contours, texture etc. Histogram is an example of statistical image features. The algebraic features represent the intrinsic attributes of the image. Principle component analysis (PCA) which is based on Kohenen Leave (KL) transformation is most widely recognized method for algebraic feature extraction. The objective of PCA is to reduce dimensionality preserving the randomness as much as possible [8]. This procedure provides a set of eigenvalues and eigenvectors. Only a few eigenvalues are

able to represent the most important characteristics of the image. The PCA approach is widely recognized and used for feature extraction. However if image is large the size of data vector is large and covariance matrix becomes very large making it unfeasible the computation of eigenvectors and eigen values.

IV. RBF NEURAL NETWORK

A Radial Basis Function (RBF) neural network has an input layer, a hidden layer and an output layer. The neurons in the hidden layer contain Gaussian transfer functions whose outputs are inversely proportional to the distance from the centre of the neuron [9].

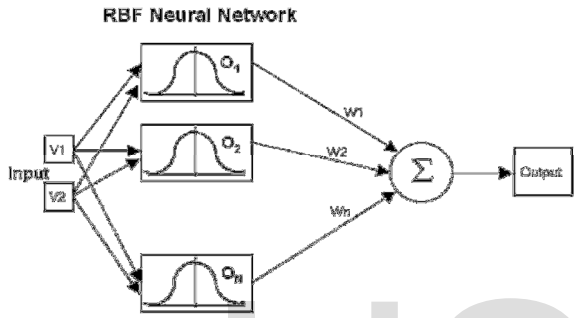

Fig 2: RBF Neural Network

1. Input layer – There is one neuron in the input layer for each predictor variable. The input neurons standardize the range of the values by subtracting the median. The input neurons then feed the values to each of the neurons in the hidden layer.
2. The hidden layers provide a set of functions that constitute an arbitrary basis for the input patterns. The hidden layers are known as radial centers and represented by the vector. Transformation from input space to hidden space is nonlinear [10], whereas transformation from hidden unit space to output space is linear.
1. Summation layer – The value coming out of a neuron in the hidden layer is multiplied by a weight associated with the neuron (W_1, W_2, ...,W_n) in this figure) and passed to the summation which adds up the weighted values and presents this sum as the output of the network.

V. PROPOSED METHODOLOGY

An image classifier using RBF artificial neural network has been developed. The implemented method can automatically detect objects in the given image [6]. The method is tested for the images containing the single object only. Firstly the input image is smoothed to remove the noise contents in it. After smoothing operation the image is decomposed in subband images by applying DWT. The feature vector obtained so is fed to RBF neural network to perform the face recognition. The detailed methodology is given below.

- Convert the input image to gray scale image
- Normalize the size of the image
- Apply Gaussian filter to smoothen the image to reduce the noise contents in images.
- Apply 2-D DWT to decompose the image into subband images.
- Now obtain features from the decomposed images. To extract the most relevant features, PCA is used.
- The features obtained from the images are arranged in a vector called feature vector.
- The feature vector is used as input to RBF artificial neural network.
- Create an artificial neural network with input neurons as per the size of the feature vector.
- The number of neurons in input layer is equal to the number of elements in the feature vector. The number of neurons in the output layer is equal to the number of classes of the objects.
- Train the RBF ANN using the training samples.
- When training is over, the system is ready to perform classification. Now test samples are used to evaluate the performance of the ANN based classifier.

VI. FACE DATASET

The dataset consists of images of three different persons like John, Marry, and Admina. Out of the available images of each object are used for the training of the network and rest are used for the testing and experimenting process. Some of the images of each object are shown in these figures.

Figure 3: John's Image data set

Figure 4: Marry's Image data set

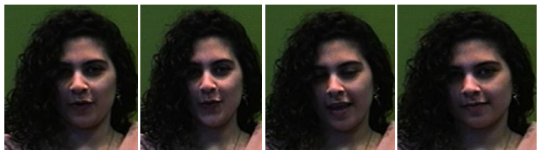

Figure 5: Admina's Image dataset

VII. EXPERIMENT AND RESULT

The results of the face recognition are reported in this section. In this section, we demonstrate the experimental results of the proposed method in terms of confusion matrix. The proposed face recognition technique has been tested on a dataset created by our own captured images and images taken from several standard datasets. The dataset consists of three persons (John, Marry, Admina).
Confusion matrix for the proposed method employing on feature set of object as discrete wavelet transform coefficients is given in Table 1. We have also evaluated the confusion matrix of method used by Javed and Shah [11] and Farzem and Shirani [12], and results are given in Table 2 and 3 respectively [7].

Table 1: Confusion Matrix [11]

	John	Marry	Admina
John	17	0	0
Marry	0	12	2
Admina	1	0	18

Table 2: Class wise Accuracy Table

Name	Total sample	Success Sample	Accuracy
John	17	16	94.1%
Marry	14	12	85.7%
Admina	19	18	94.7%

VII. CONCLUSIONS

The goal of this paper is to recognize face using discrete wavelet transform. This method is fast and reliable. This paper is an effort to suggest the best classification in the terms of accuracy using RBF Neural Network. The feature extraction using PCA technique is very fast and accuracy is very high. The overall accuracy of RBF Neural Network is 91.4% of the face recognition method.

REFERENCES

[1] Xiaotian Wu, Wei Sun, 2013. Secret image sharing scheme with authentication and remedy abilities based on cellular automata and discrete wavelet transform. The Journal of Systems and Software, 86, 1068–1088.

[2] Eleftherios Kofidis1, Nicholas Kolokotronis, Aliki Vassilarakou, Sergios Theodoridis, Dionisis Cavouras, 1999. Wavelet-based medical image compression. *Future Generation Computer Systems,* 15, 223–243.

[3] Weibao Zoo, 2007. Image Classification Using Wavelet Coefficients in Low-pass Bands. In:Proceedings of *International Joint Conference on Neural Networks*, Orlando, USA, 12-17.

[4] Mrs.N.G.Chitaliya, Prof.A.I.Trivedi, "*Feature Extraction using Wavelet-PCA and Neural network for application of Object Classification & Face Recognition*", Second International Conference on Computer Engineering and Applications, IEEE 2010.

[5] Zi-Quan Hong, 1991. Agebric feature extraction of image for recognition. *Pattern Recognition*, 24(3), 211-219.

[6] Manish Khare, Alok Kumar Singh, Rajneesh Kumar,Srivastava Ashish Khare, "An Approach towards Wavelet transform based Multiclass object classification" IEEE 2013.

[7] Qing Liu, Guangmin Wu, Jianming Chen*,Guoqiong Zhou,"*Interpretation Artificial Neural Network in Remote Sensing Image Classification*" IEEE 2012.

[8] Soo Beom Park, Jae Won Lee, Sang Kyoong Kim. Content-based image classification using a neural network. *Pattern Recognition Letters*, 2004.

[9] Zhang Caiqing1 Qi Ruonan2 Qiu Zhiwen3,"Comparing BP and RBF Neural Network for Forecasting the Resident Consumer Level by MATLAB", 2008 International Conference on Computer and Electrical Engineering.

[10] Tiantian Xie, Hao Yu and Bogdan Wilamowski, "Comparison between Traditional Neural Networks and Radial Basis Function Networks", IEEE 2011.

[11] O. Javed, and M. Shah, "Tracking and object classification for automated surveillance", proceeding of IEEE European Conference on Computer Vision, Vol. 4, pp. 343-357, 2002.

[12] M. Farzem, and S. Shirani, "A robust multimedia watermarking technique using Zernike transform", in proceeding of fourth IEEE workshop on Multimedia Signal Processing, pp. 529-534, 2001