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Research Paper

FACE RECOGNITION USING NEURAL NETWORKS

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Face detection from a long database of face images with different backgrounds is not an easy task. In this work, we demonstrate the face detection system of colored face images which is invariant to the background and acceptable illumination conditions. A threshold level is set to reject the non-human face images and the unknown human face images which are not present in the input database of face images. In this paper, the global features extraction is completed using DTCWT which provides a local multiscale description of images with good directional selectivity, effective edge representation and invariance to shifts and in-plane rotations and PCA which is on based eigenface computation method. The fusion of local DT-CWT coefficients of detail subbands and PCA coefficients are used to extract the facial features which improve the face recognition and the detection part is completed using multi-layered feed forward Artificial Neural Networks with Feed forward network. This algorithm is implemented using MATLAB software. The learning process of neurons is used to train the input face images with 1000 iterations to minimize the error. In this system, face recognition task is completed with improved accuracy and success rate even for noisy face images.

Keywords: Face recognition system, Dual Tree Complex Wavelet Transform (DTCWT), Principal Components Analyses (PCA), Artificial Neural Network (ANN), Neurons, Epochs, Eigenfaces, Mean Square Error (MSE)

INTRODUCTION

Face Recognition System is a computer based digital technology and is an active area of research. The Face Recognition System has various applications like various authentication systems, security systems and searching of persons, etc. These applications are cost effective and save the time. Moreover the face database can be easily designed by using any image of the person. In past few years various face recognition techniques are purposed with varied and successful results. As the brain of human beings create the learning ability to recognize the persons by face even the feature characteristics of the face changes with time. The neurons of the human

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brain are trained by reading or learning the face of a person and they can identify that face quickly even after several years. This ability of training and identifying is converted into machine systems using the Artificial Neural Networks. The basic function for the face recognition system is to compare the face of a person which is to be recognized with the faces already trained in theArtificial Neural Networks

DUAL TREE COMPLEX WAVELET TRANSFORM

The major disadvantages of DWT are shift sensitivity, poor directionality and lack of phase information.

Shift Sensitivity: A transform is shift-sensitive if an input signal shift causes an unpredictable change in the transform coefficients. Shift sensitivity arises in DWT by using down sampling in the implementation of DWT. This is undesirable as DWT failed to distinguish input signal shifts.

Poor Directionality: An m-dimensional transform suffers from poor directionality when the transform coefficients reveal only a few feature orientations in the spatial domain. Two dimensional DWT provides only three spatial orientations: Vertical, Horizontal and Diagonal. Thus DWT leads to a poor representation of images.

Lack of Phase Information: The use of real filters in DWT fails to provide any phase information. It has been found that phase information is very useful in image processing tasks such as edge detection and corner detection. Also phase information is not affected by noise. Hence it should be provided by wavelet transform. The drawbacks of DWT, i.e., shift sensitivity; poor directionality and lack of phase information are removed with the use of Dual Tree Complex Wavelet Transform (DTCWT). DTCWT provides shift invariance and better directional information in 2-D by using Gabor like filters. This directional information in 2-D is given by dividing sub bands into six spatial orientation which are ±15, ±45, ±75. Also use of short linear phase filters leads to perfect reconstruction in DTCWT by introducing limited redundancy 2:1 for 1-D (2m:1 for m-D). It requires more computation (twice of DWT for 1-D and 2m:1 for m-D). The imaginary coefficients of DTCWT provide phase information of signals. We know that most of the structural information of images are contained in the phase. So this property of DTCWT is useful in fusion in order to obtain salient information from source images. The Dual Tree Complex Wavelet Transform (DTCWT) providesall these properties by replacing the tree structure of thewavelet transform with a dual tree as shown in Figure 2. Two fully decimated trees are produced, one for the odd samples and one form the even samples, i.e., at each scale one tree produce the real part of the complex

Figure 1: 2D Signal DTCWT

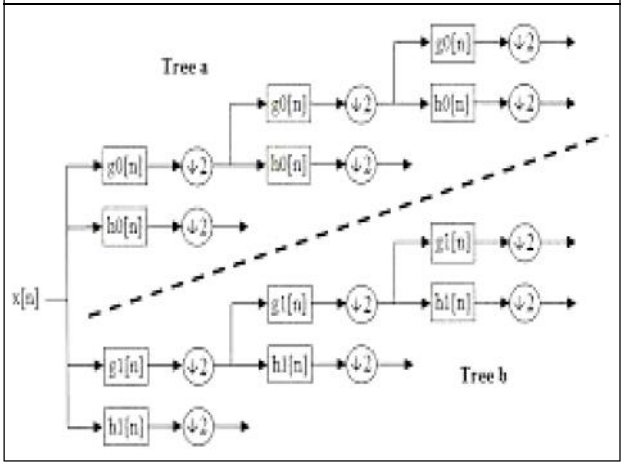
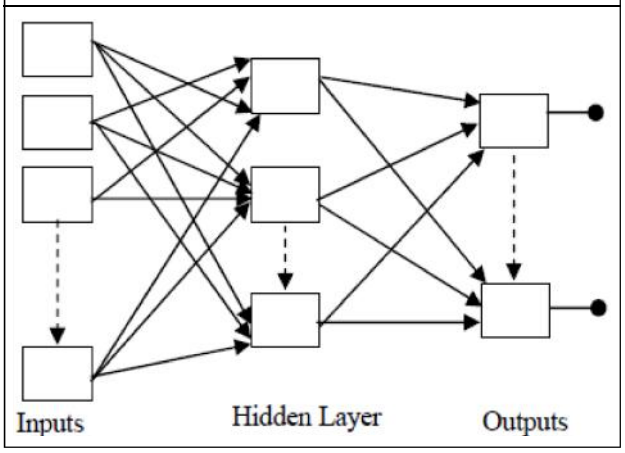


Figure 2: Layer Arrangement in a Neural Network



wavelet coefficients and other produces the imaginary parts. All the filters in DTCWT are real and imaginary coefficients are obtained only when the two trees are combined. Although DTCWT has increased memory requirements and high computational cost, it is much beneficial than DWT and provides improved fusion results over DWT with high directionality, shift invariance and availability of phase information.

Principal Component Analysis (PCA)

A 2-D facial image can be represented as 1-D vector by concatenating each row (or column) into a long thin vector. The purpose of PCA is to reduce the large dimensionality of the data space (image vector) to the smaller intrinsic dimensionality of feature space, which are needed to describe the data economically. This is the case when there is a strong correlation between observed variables It is used for expressing the data in such a way as to highlight their similarities and differences. Using PCA, dimension of data using data compression basics is reduced and precisely decompose the face structure into orthogonal and uncorrelated components know as Eigen faces. The face image is represented as a weighted sum or feature vector of the Eigenfaces which can be stored in a 1-D array. The features are extracted from the LL subband of the DTCWT.

Artificial Neural Networks (ANN)

An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. The key element of this paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurones) working in unison to solve specific problems. ANNs, like people, learn by example. An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurons. This is true of ANNs as well. Advantages of artificial neural network

Adaptive Learning: An ability to learn how to do tasks based on the data given for training or initial experience. Self-Organization: An ANN can create its own organisation or representation of the information it receives during learning time. Real Time Operation: ANN computations may be carried out in parallel, and special hardware devices are being designed and manufactured which take advantage of this capability. Fault Tolerance via Redundant Information Coding: Partial destruction of a network leads to the corresponding degradation of performance.

Most applications require networks that contain at least the three layers-input, hidden,

and output. The input layer receives the data either from input files or directly from electronic sensors in real-time applications. The output layer sends information directly to the outside world, to a secondary computer process or to other devices. Between these two layers there can be many hidden layers. These hidden layers contain many neurons in various interconnected structures. The inputs and outputs of each of these hidden neurons simply go to other neurons. In most networks, each neuron in a hidden layer receives the signals from all the neurons typically from the input layer. After a neuron performs its function, it passes its output to all of the neurons from typically the output layer, providing a feed-forward path. This gives a variable strength to an input. There are two types of these connections. One causes the summing mechanism of the next neuron to add(excite) while the other causes it to subtract (inhibit).

PROPOSED SYSTEM

The proposed system consists of preprocessing stage where the images are converted into standard dimenionality, rgb images are converted into grey images. In this work experimentation is carried on ORL face database which is downloaded from the internet. The database consists of 400 images of 40 individuals in 10 different poses and expressions. In this project expirements are performed on 9 training images and 1 test image for each person. The feature extraction and reduction is done by DTCWT and PCA. The features are extracted from the database created using DTCWT in the eight subbands, then the features from the lowest band (LL) are extracted using Principal Component Analysis (PCA). The type of Artificial Neural Network (ANN) used in this project is multilayered feed forward neural network. The feed forward network uses Leven-Marquardt algorithm to train the features extracted from the database. The query image is selected from the test folder and checked for the correct classification.

Figure 3: Proposed System

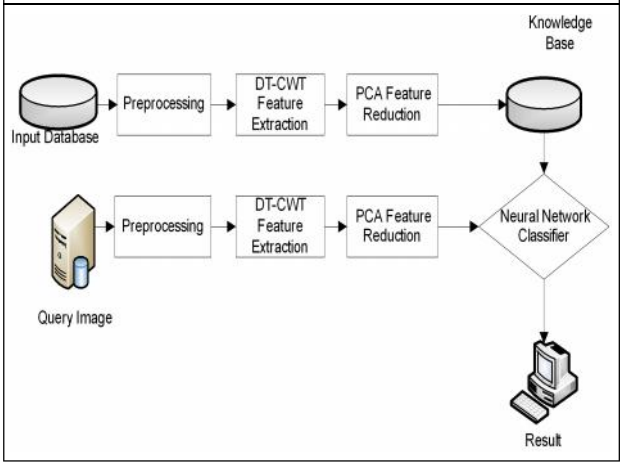
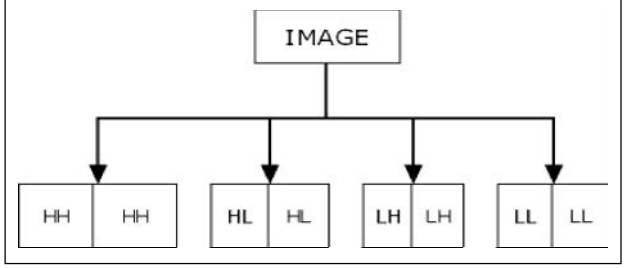


Figure 4: Decomposition of the DTCWT for 2D Image



EXPERIMENTAL RESULTS

Here in this project we are considering ORL database, with nine images of a person for training and one image for testing. The images to be trained are placed in one folder and the images to be tested are placed in a different folder. First the database is created of the train folder and the features are extracted through DTCWT and PCA. Then the Artificial Neural Network is used for training the database

created or the images in the train folder, after the images are trained a query image from the test folder is selected for testing and if the query image and the trained image are of the same person ie both the images are matching with each other then the result will be displayed as recognized user. The simulation is carried out in MATLAB Environment. The face image database used in our experiment is the Oracle Research Laboratory (ORL) face database in which different images of 40 persons are available so total available face images are 400. These face images vary in facial expression and illumination. The accuracy obtained in this project is 90% with 9 images for Training and 1 image for testing of a person.

The Figure 5 is a pictorial representation of various stages of the project execution. It delivers a simple user friendly interface to select the steps like creating database, ANN Training, selecting a query and Exit to be executed. The database is created and the

Figure 5: Main Toolbox

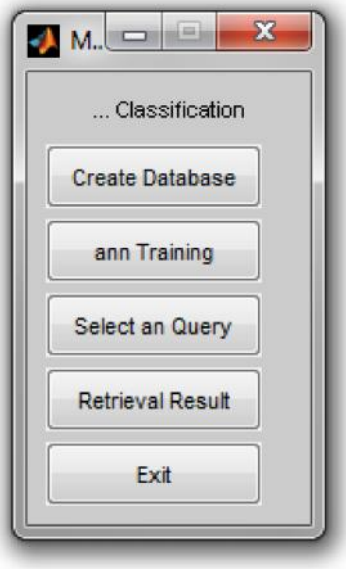


Figure 6: ANN Classifier

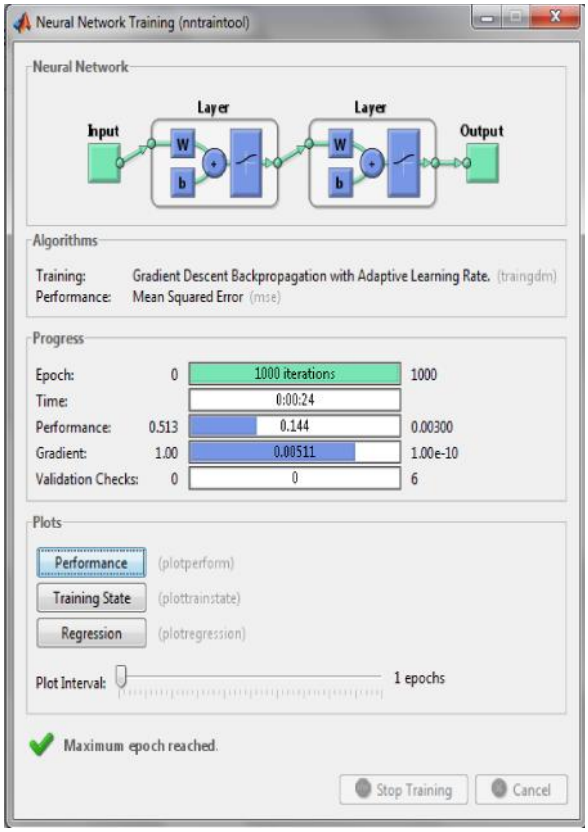


Figure 7: Query Image

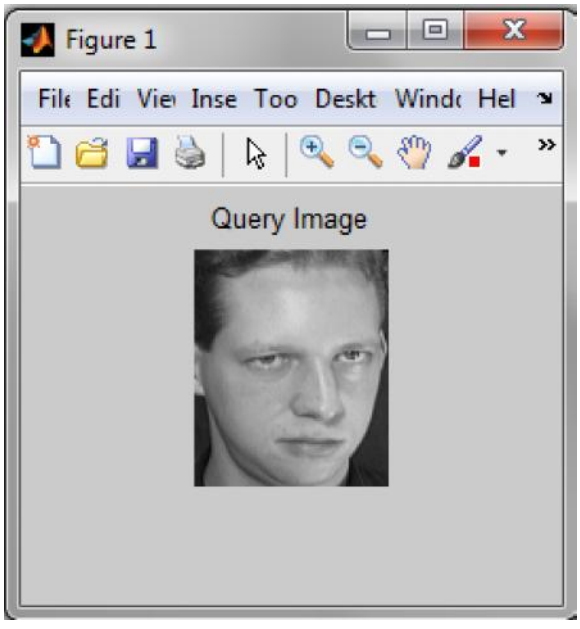


Figure 8: Retrieval Result

Figure 6 ANN classifier is used for training the images of the database. The Figure 7 shows the query image of the first user selected for comparing with the trained images. The Figure 8 shows the output of the recognized person using ANN which compares the features of query image with the database created. The result is displayed as recognized user is user 01. Since the query image has matched with the first user's images.

CONCLUSION

To ameliorate the Face recognition task in this work Complex Wavelets are utilized in contrast to Discrete Wavelet Transform (DWT). Complex wavelet decomposition of image result in eight sub-bands and the feature extraction is carried on LL band using principal component analysis. In this project, novel hybrid approach of fusion of Dual Tree Complex Wavelet Transform (DTCWT) for feature extraction and Principal Component Analysis (PCA) for dimensionality reduction and Backpropagation Feed Forward Artificial Neural Network (ANN) is used for face recognition. Fusion of DTCWT and PCA provides good results and higher accuracy compared to the face recognition using DTCWT and PCA alone. We observe the results of face recognition using this approach are very good and encouraging.

Having analyzed the conventional design of the Face recognition and its backlogs, a new perspective was always expected and an attempt to present such a vision is tried. Future work aims at extracting features from the other seven bands to utilize all the sub-band features in improving the face recognition. How much ever the technology grows to provide a secure system, the thrust of achieving still high rate of authentication never ends and thus sets a stage for us to still improve the design. The face recognition method can be applied to different databases.

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