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A FACE RECOGNITION SYSTEM BASED ON PRINCIPAL COMPONENT ANALYSIS USING BACK PROPAGATION NEURAL NETWORKS

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ABSTRACT

Face recognition has received substantial attention from researches in biometrics, pattern recognition field and computer vision communities. Face recognition can be applied in Security measure at Air ports, Passport verification, Criminals list verification in police department, Visa processing , Verification of Electoral identification and Card Security measure at ATM's. In this paper, a face recognition system for personal identification and verification using Principal Component Analysis (PCA) with Back Propagation Neural Networks (BPNN) is proposed. This system consists of three basic steps which are automatically detect human face image using's BPNN, the various facial features extraction, and face recognition are performed based on Principal Component Analysis (PCA) with BPNN. The dimensionality of face image is reduced by the PCA and the recognition is done by the BPNN for efficient and robust face recognition.

Keyword: *facial images recognition, principal component analysis, Back Propagation neural network*

INTRODUCTION

Within computer vision, face recognition has become increasingly relevant in today's society. The recent interest in face recognition can be attributed to the increase of commercial interest and the development of feasible technologies to support the development of face recognition. Major areas of commercial interest include biometrics, law enforcement and surveillance, smart cards, and access control. Unlike other forms of identification such as fingerprint analysis and iris scans, face recognition is user-friendly and non-intrusive. Possible scenarios of face recognition include: identification at front door for home security, recognition at ATM or in conjunction with a smart card for authentication, video surveillance for security. With the advent of electronic medium, especially computer, society is increasingly dependent on computer for processing, storage and transmission of information. Computer plays an important role in every parts of today life and society in modern civilization. With increasing technology, man becomes involved with computer as the leader of this technological age and the technological revolution has taken place all over the world based on it. It has opened a new age for humankind to enter into a new world, commonly known as the technological world. Computer vision is a part of everyday life. One of the most important goals of computer vision is to achieve visual recognition ability comparable to that of human [1],[2],[3]. Face recognition has received substantial attention from researches in biometrics, pattern recognition field and computer vision communities. In this paper we proposed a computational model of face detection and

recognition, which is fast, reasonably simple, and accurate in constrained environments such as an office or a household. Face recognition using Eigen faces has been shown to be accurate and fast. When BPNN technique is combined with PCA non-linear face images can be recognized easily.

THE PROPOSED SYSTEM

In this papers to design and implementation of the Face Recognition System (FRS) can be subdivided into three main parts. The first part is face image acquisition and face image enhancement in which image filtering, clipping, and edge detection. The second part is to perform various facial features extraction from face image using digital image processing and Principal Component Analysis (PCA). And the third part consists of the artificial intelligence (face recognition) which is accomplished by Back Propagation Neural Network (BPNN). We can see complete working fig .1

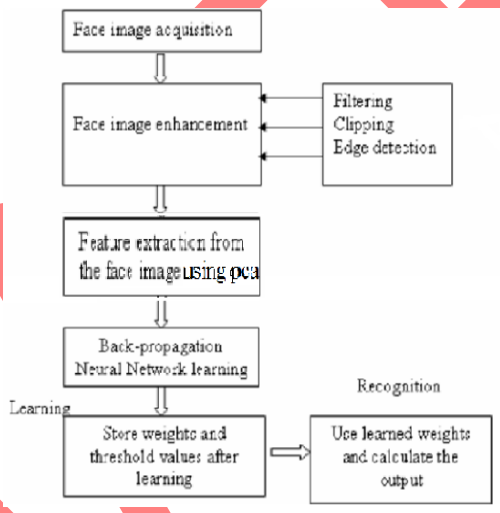

Fig: 1. Face Recognition System by using PCA & Back-propagation Neural Network

Face Acquisition Module

The first stage of any vision system is the image acquisition stage. The face image is captured using the Digital cam. The image is of size 480 X 640. No Physical contact is required with the cam unlike in other biometric methods like fingerprint recognition, retinal scan etc. A proper lighting should be provided and the capturing device should suffice for minimum quality. The same digital cam with a well lit room would provide highly accurate results.

Face Image enhancement

Suitable enhancements should be made to the image pool so as to make the images compatible with the algorithms to be used. In this case the image is first subject to a skin colour algorithm [2] which removes the background and isolates the skin portion from the remaining image. The resulting image is then subjected to a gray scale to minimize the contrasts due to lighting, texture

etc. The image is then scaled so that any image taken using different capturing devices are reduced to the same resolution so that the eigen algorithms can be efficiently applied to them.

Feature Extraction Using in PCA

PCA for feature extraction is done by using a standard algorithm [3] which is as follows

1. We assume the training sets of images are Γ1, Γ2, …Γm
   Where m=no of images.
2. Find the mean face of the images by:
   Ψ=(1/m)Σ Γi. i=1 to m
3. Calculated the mean-subtracted face:
   Φi= Γi- Ψ , i=1 to m
   Mean subtracted matrix A=[Φ1 ,Φ2….. Φm]
4. Covariance matrix=Amp × ApmT
5. Find the eigenvalues λm and eigen vectors Vmm
6. Eigen faces Uk = Σ ΦnVkn ,k=n=1,2,…m
7. Eigen weights Wk = UkT (Γ- Ψ) k=1,2,….m

The training file will contain m eigen weights for each of the m images. This is written in a training file with each of the image name followed by its id and its eigen weights.The training file is train.txt.The identification image also will have m eigen weights for recognition which is written in the file out.txt.

Back Propagation Algorithm

The back propagation algorithm [1] is as follows

1. Set all weights to small random values.
2. The input to each node of the neural network is given by the equation
   α=Є xi wi ,
   Where xi is the input from the previous node and wi is
   the corresponding weight.
3. The output of each node is given by
   y=f(x)=1/1+e-x , which is called the sigmoid function.
4. The output of the output layer is the actual output of the network.
5. The error, desired output-actual output is then propagated back to all the nodes in the network and the weights are updated according to the equation,
   wij(t+1) = wij(t)+ŋμjoj,
   Where wij is the weight from node i to j at time t, ŋ is the learning rate and oj is the output of node j and μj is the error term for node j
   For output nodes,
   μj = koj (1-oj)(tj –oj)
   For hidden nodes,
   μ j = koj (1-oj)Єμk wjk , where μk is the next nodal error term.

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Back Propagation Neural learning

Back propagation is a kind of supervised learning employed by the neural Networks in which the derivative of the error function is propagated back to the contributing neurons in the neural network and the weights updated subsequently. In this application, eigen weights obtained from the images in the image pool are passed as inputs to the neural network and the corresponding user's binary id is given as the desired output of the neural network. The training is repeated until the neural network is able to identify all the images in the training set with error function reduced to an acceptable value. The weights and threshold values which are obtained while training are then stored in a file to be used during recognition.

Recognition

The eigen weights of the image to be identified is passed as the input to the Already trained neural network and the outputs obtained. The outputs of individual neurons of the output layer are then rounded off to the nearest 0 or 1 to form a valid binary id. This binary id is then checked against the database to validate the authenticity and display the details of the face if identified.

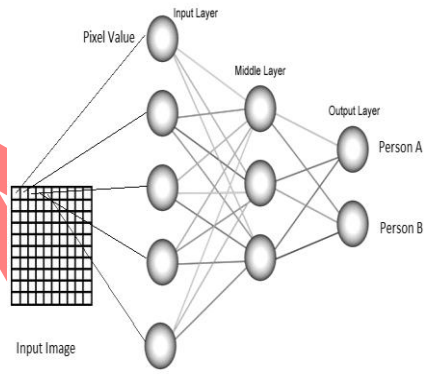

Fig: 2 Outline of Face Recognition System by using PCA & Back-propagation Neural Network.

EXPERIMENTATION AND RESULTS

When BPNN technique is combined with PCA, non-linear face images can be recognized easily. One of the images as shown in fig 3 (a) is taken as the Input image. The Recognized Image by BPNN and reconstructed output image by PCA is as shown in fig 3 (b) and 3 (c).

Fig: 3. (a) Input Image, (b) Recognized Image by BPNN, (c) Recognized Image by PCA method.

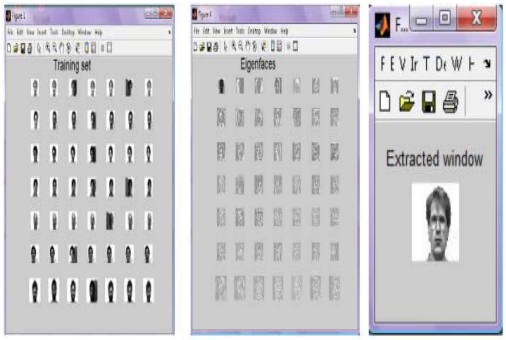

Fig: 4 (a) Training set, (b) Eigen faces , (c) Recognized Image by PCA with BPNN method.

Table1 shows the comparison of acceptance ratio and execution time values for 40, 80, 120,160 and 200 images of Yale database.

No .of Images	Acceptance ratio (%)		Execution Time (Seconds)	
	PCA	PCA with BPNN	PCA	PCA with BPNN
40	92.4	96.5	38	36
80	90.6	94.3	46	43
120	87.9	92.8	55	50
160	85.7	90.2	67	58
200	83.5	87.1	74	67

Table:2 Using BPNN the acceptance ratio and execution time for database images

No .of Images	Acceptance ratio (%)	Execution Time (Seconds)
	BPNN	BPNN
40	94.2	37
80	92.3	45
120	90.6	52
160	87.9	65
200	85.5	71

CONCLUSION

In this paper, Face recognition using Eigen faces has been shown to be accurate and fast. When BPNN technique is combined with PCA, non-linear face images can be recognized easily. Hence

it is concluded that this method has the acceptance ratio is more than 90 % and execution time of only few seconds. Face recognition can be applied in Security measure at Air ports, Passport verification, Criminals list verification in police department, Visa processing , Verification of Electoral identification and Card Security measure at ATM's. Face recognition has received substantial attention from researches in biometrics, pattern recognition field and computer vision communities. In this paper we proposed a computational model of face detection and recognition, which is fast, reasonably simple, and accurate in constrained environments such as an office or a household.

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