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RESEARCH ARTICLE

FACE RECOGNITION USING SOM NETWORK

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ABSTRACT

This paper presents novel technique for recognizing faces. From the last two decades, face recognition is playing an important and vital role especially in the field of commercial, banking, social and law enforcement area. It is an interesting application of pattern recognition and hence received significant attention. The complete process of face recognition covers in three stages, face detection, feature extraction and recognition. Various techniques are then needed for these three stages. Also these techniques vary from various other surrounding factors such as face orientation, expression, lighting and background. The Self-Organizing Map (SOM) Neural Network has been used for training of database and simulation of FR system. In this paper the feature extraction methods discrete wavelet transform (DWT), discrete cosine transform (DCT) simulated in MATLAB are explained.

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INTRODUCTION

Face recognition is a challenging and interesting research topic in the field of pattern recognition which has been found a widely used in many applications such as verification of credit card, security access control, and human computer interface. There is no technique that provides a robust solution to all situations and different applications that face recognition may encounter. Face recognition has several characteristics that are advantageous for consumer applications. In addition to, the need for an automatic face recognition system especially at the border control, like airports is becoming very important to strengthen the security. Generally, feature extraction and classification criterion are the two basic operations of any face recognition system. The features are extracted from the human face images. Feature extraction in the sense of some linear or nonlinear transforms of the face images with subsequent feature selection is commonly used for reducing the dimensionality of these images so that the extracted features are as representative. There is a problem of extracting features from a human face which becomes a barrier to apply the practical applications, since it is influenced by the lighting condition, illumination changes, various backgrounds and individual variations. In recent years, several methods for feature extraction have been proposed (Turk and Pentland, 1991; He *et al.*, 2005; Bai *et al.*, 2009; Hafed and Levine, 2001; Ekenel and Sankur, 2005). The principle component analysis (PCA)) (Turk and Pentland, 1991) and linear discriminant analysis (LDA) (He *et al.*, 2005) are regarded to be the well known feature extraction methods. PCA linearly projects the image space along the direction of maximal variance into a low-dimensional subspace. These methods are statistical linear projection methods which largely rely on the representation of the training samples. The major drawback with these techniques are the performance drop of face recognition whenever face appearances are subject to variations by factors such as illumination, expression, pose, accessories and aging.

Moreover, they require intensive computations in determining the basis space for a large number of images and when adding new images to a facial image database. On the other hand, multi-resolution techniques have been used for feature extraction in many face recognition systems (Ekenel and Sankur, 2005; Garcia *et al.*, 2000; Shen and Bai, 2006; Kim *et al.*, 2006). Among them, the most popular are the discrete wavelet transform (DWT). DWT has been used in various face recognition systems in order to extract multiple sub-band face images. These sub-band images contain coarse approximations of the face as well as horizontal, vertical and diagonal details of faces at various scales. These wavelet-based methods focus

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on the sub-bands that contain the most relevant information to better represent the face image.

The DCT has several advantages over the PCA. First, the DCT is data independent. Second, the DCT can be implemented using a fast algorithm. The discrete cosine transform (DCT) represents an image as a sum of sinusoids of varying magnitudes and frequencies. The DCT has the property that, for a typical image, most of the visually significant information about the image is concentrated in just a few coefficients of the DCT. For this reason, the DCT is often used in image compression applications. The remainder of the paper is organized as follows: In Section 2, Two proposed face recognition method is briefly explained. The SOM neural network system is described in Section 3. Experimental results and conclusions are presented in Sections 4 and 5, respectively.

Face Recognition Method

Face recognition method is a combination of various other technologies and their features and characteristics makes face recognition a better performer depending upon the application. Face recognition works under three phases- Detection, Extraction and Recognition. A block diagram of the proposed face recognition system is shown in Figure 1. An explanation of each phase of face recognition is given in the next sections.

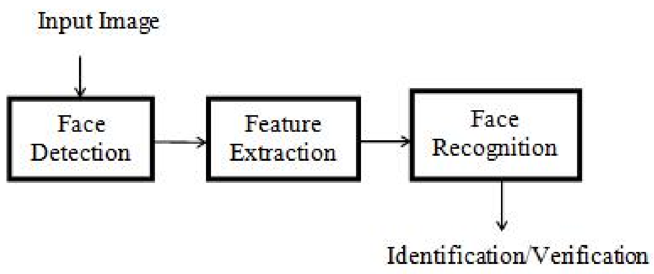


Figure 1. Block diagram of the face recognition system

Preprocessing

Face detection is a fundamental part of the face recognition system because it has ability to focus computational resources on the part of an image containing face. Face detection involves the separation of image into two parts; one containing the face and the other containing the background. Many face detection techniques have been proposed in the past decade. They can be classified into geometry-based face detectors and color-based face detectors. Among the geometry based face detectors, a method examines the triangle relationship between eye and mouth regions to identify the face region.

In addition to, the traditional eye detection methods can be simply and efficiently implemented for frontal face images but can be difficult for complex images. Moreover, skin color has been proven to be an effective image feature for face detection. The automatic face detectors based on skin color are relatively fast and therefore are beneficial for consumer applications such as real-time face recognition embedded in a smart home environment. In the preprocessing stage of the proposed system, a facial region based on skin color detection is cropped from an input image. The obtained facial region is then resized into an 8×8 pixel image to make the face recognition system scale invariant. After then, histogram equalization is applied to enhance the image brightness and contrast.

Feature Extraction

In search result there are so many technique available for facial extraction. We are dealing with feature extraction methods which is based on the transforms such as the DWT, DCT. Also commonly represent the face images with a large set of features. The features of every image stored in our data based are extracted and then stored into the feature vector. Once the feature vectors for all existing images are developed the new database consist of all feature vectors is formed and then stored inside our storage device. To retrieve all images that are similar to the target image, we must extract the features of the target image and compare it with all features vectors. Discrete cosine transform (DCT) is a powerful transform to extract proper features for face recognition. After applying DCT to the entire face images, some of the coefficients are selected to construct feature vectors.

Self Organizing Map (SOM)

Overview

The self-organizing map, developed by Kohonen, groups the input data into cluster which are, commonly used forum supervised training. In case of unsupervised learning, the target output is not known (Sivanandanam *et al.*, 2005).

In a self-organizing map, the neurons are placed at the nodes of a lattice that is usually one or two dimensional. Higher dimensional maps are also possible but not as common. The neurons become selectively tuned to various input patterns or classes of input patterns in the course of a competitive learning process. The locations of the neurons so tuned (i.e., the wining neurons) become ordered with respect to each other in such a way that a meaningful coordinate system for different input features is created over the lattice. A self-organizing map is therefore characterized by the formation of a topographic map of the input patterns in which the spatial locations of the neurons in the lattice are indicative of intrinsic statistical features contained in the input patterns, hence the name "self-organizing map" (Simon Haykin, 1999). The algorithm of self-organizing map is given below:

Algorithm of Self Organize

- Select network topology;
- Initialize weights randomly; and select D(0)>0;
- While computational bounds are not exceeded,

Do

1. Select an input sample(i_1);

2. Find the output node j* with minimum

$$\sum_{k=1}^{n} \left(i_{1,k}(t) - w_{j,k}(t)\right)^2;$$

3. Update weights to all nodes within atopological distance of D(t) from j*,

Using $wj\ (t+1)= wj(t) + \eta(t)(il(t)-wj(t))$;

where $0< \eta(t)= \eta(t-1)=1$;

4. Increment t;

End while.

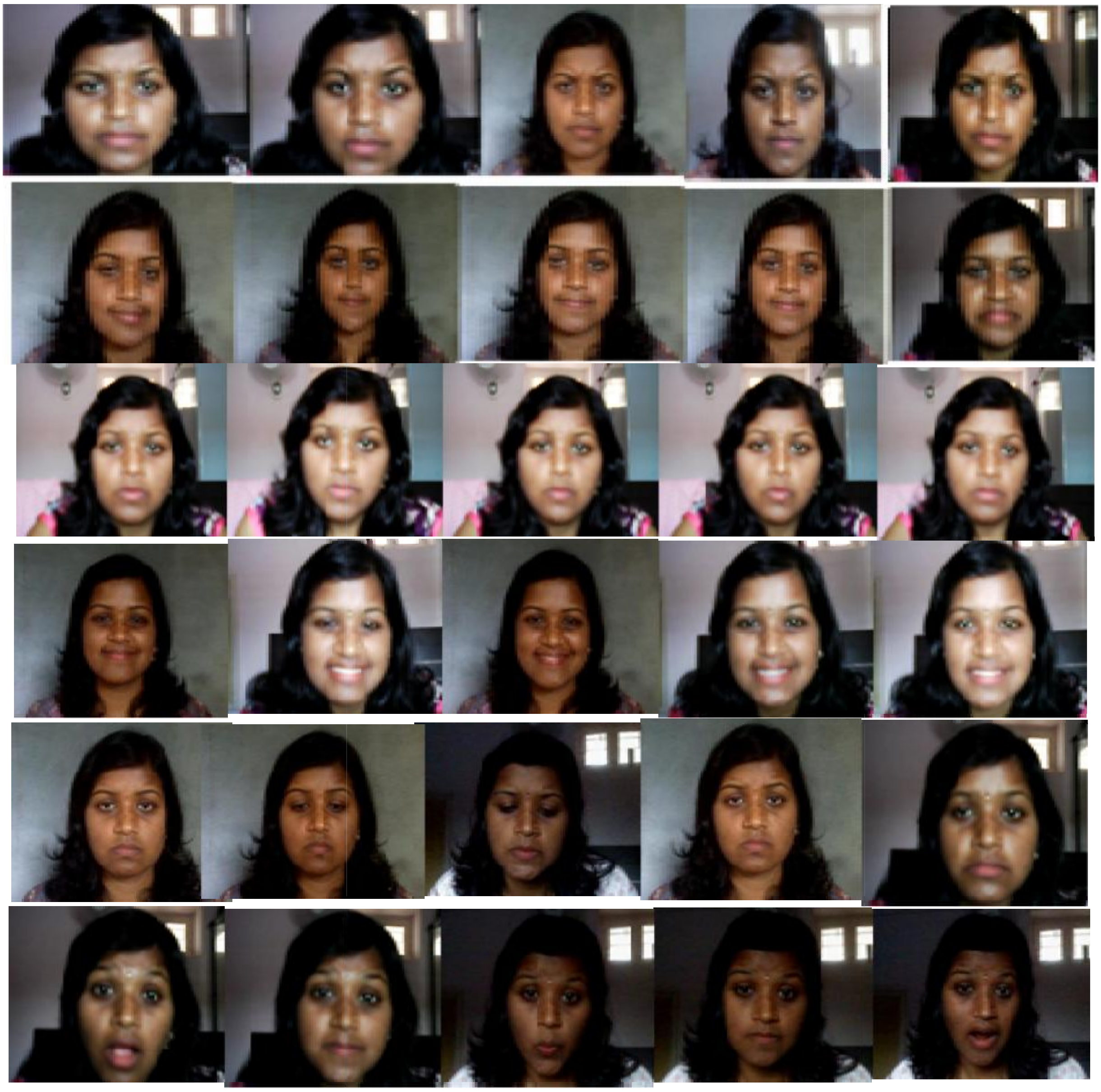
Training

In the training phase, DCT vectors, DWT vectors are presented to the SOM one at a time. For each node, the number of "wins" is recorded along with the label of the input sample. The weight vectors for the nodes are updated as described in the learning phase. By the end of this stage, each node of the SOM has two recorded values:

Table 1. Comparison table of face recognition time b/w two methods at different epoch

Image	Epoch	Method → / Time ↓	DWT	DCT
S01	100	Training time	4.6851	5.9940
		Execution Time	21.9060	115.7445
S01	500	Training time	24.7147	24.8952
		Execution Time	44.8569	43.3684
S01	1000	Training time	46.0579	46.2868
		Execution Time	58.5632	59.6358

the total number of winning times for subject present in image database, and the total number of winning times for subject not present in image database (Zi Lu and You Wei, 2004).



Testing

During the testing phase, each input vector is compared with all nodes of the SOM, and the best match is found based on minimum Euclidean distance, as given in (3.5) (Nagi, 2007). The final output of the system based on its recognition, displays if the test image is "present" or "not present" in the image database.

Experimental Result

Image Database

A face image database was created for the purpose of benchmarking the face recognition system. The image data baseis divided into two subsets, for separate training and testing purposes. During SOM training, 30 images were used, containing six subjects and each subject having 5 images with different facial expressions. Figure 2. Shows the training and testing image database constructed. The face recognition system presented in this paper was developed, trained, and tested using MATLAB™2012.

Validation of Technique

The pre-processed grayscale images of size 8 × 8 pixels are reshaped in MATLAB to form a 64 × 1 array with 64 rows and 1 column for each image. This technique is performed on all 5 test images to form the input data for testing the recognition system. Similarly, the image database for training uses 30 images and forms a matrix of 64 × 30 with 64 rows and 30 columns. The input vectors defined for the SOM are distributed over a 2D-input space varying over [0 255], which represents intensity levels of the gray scale pixels. These are used to train the SOM with dimensions [64 2], where 64 minimum and 64 maximum values of the pixel intensities are represented for each image sample. The resulting SOM created with these parameters is a single-layer feed forward SOM map with 128 weights and a competitive transfer function. The weight function of this network is the negative of the Euclidean distance [13]. As many as 5 test images are used with the image database for performing the experiments. Training and testing sets were used without any overlapping. In the table no. 1 comparison of face recognition time between two methods at different epoch is given.

Conclusion

This paper present's a novel face recognition technique that uses features derived from DCT and DWT, along with a SOM-based classifier. The system was evaluated in MATLAB using an image database of 30 face images, containing six subjects and each subject having 5 images with different facial expressions. After training for approximately1000 epochs the system achieved a recognition rate of 100% for 5 consecutive trials.

A reduced feature space, described for experiment, dramatically reduces the computational requirements of the methods. DWT feature extraction method gives better results compared to DCT methods. This makes our system well suited for high speed, low-cost, real-time hardware implementation.

REFERENCES

Bai, Y., Lianwen Jin, L. and Huang, Q. 2009."Novel face recognition approach based on steerable pyramid feature," IEEE International Conference on ICIP2009, Cairo, Egypt, pp. 4165-4168.

Ekenel, H. K. and Sankur, B. 2005. "Mult-Resolution face recognition," Image and Vision Computing, vol. 23, pp. 469–477.

Garcia, C., Zikos, G. and Tziritas, G. 2000. "Wavelet packet analysis for face recognition," Image and Vision Computing, vol. 18, no. 4, pp. 289–297.

Hafed, Z. M. and Levine, M. D. 2001. "Face recognition using the discrete cosine transform," International Journal of Computer Vision, vol. 43, no. 3, pp. 167-188.

He, X., Yan, S., Hu, Y., Niyogi, P. and Zhang, H. 2005. "Face recognition using Laplacian faces," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 27, no. 3, pp. 328-340, 2005.

Kim, D., Jeon, I., Lee, S. Y., Rhee, P.K. and Chung, D. J. 2006. "Embedded face recognition based on fast genetic algorithm for intelligent digital photography," IEEE Transactions on Consumer Electronics, vol. 52, no. 3, August 2006.

Lin, D. 2006. Facial expression classification using PCA and hierarchical radial basis function network, *J. Inf. Sci. Eng.* 22 (5), 1033–1046.

Nagi, J. 2007. "Design of an Efficient High-speed Face Recognition System", Department of Electrical and Electronics Engineering, College of Engineering, Universiti Tenaga Nasional, March 2007.

Shen, L. and Bai, L. 2006. "A review on Gabor wavelets for face recognition," Pattern Analysis and Applications, vol. 9, no.2, pp. 273-292,

Simon Haykin, Neural Networks, LPE, pp. 465-466

Sivanandanam, S.N., Sumathi, S. and Deepa, S. N. Introduction to Neural Networks using MATLAB 6.0, TMH, pp 20

Turk, M. A. and Pentland, A. P. 1991. "Face recognition using eigenfaces," Proc. of IEEE Conference on Computer Vision and Pattern Recognition, pp. 586-591, June.

Zi Lu, Y. and You Wei, Z. 2004. "Facial Expression Recognition Based on Wavelet Transform and MLP Neural Network", in Proc. 7th International Conference on Signal Processing, ICSP 2004, Vol. 2, Aug 2004, pp. 1340-1343.

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