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Human Face Recognition Using Wavelet Transform And Artificial Neural Network

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ABSTRACT-
This paper represents human face recognition using Wavelet Transform and Artificial Neural Network. Among the classifiers used for face recognition Artificial Neural Network acts as a reliable classifier. Pre-processing, feature extraction and classification rules are three crucial issues for face recognition. This paper presents a hybrid approach to employ these issues. For pre-processing and feature extraction steps, we apply wavelet transform. During the classification stage, the Neural Network is explored to achieve a robust decision in presence of wide facial variations. This proposed method indicates that the high speed recognition over PCA based method which is widely used for feature extraction.

Keywords— Face recognition, Hybrid system for face recognition, Face feature extraction, Artificial Neural Network, Wavelet Transform.

I. INTRODUCTION

Face detection has always been one of the most interesting and challenging field to work on. Till now various techniques or approaches have been proposed Face recognition has become an important issue in many applications such as security systems, credit card verification, criminal identification etc. Even the ability to merely detect
faces, as opposed to recognizing them, can be important. Although it is clear that people are good at face recognition, it is not at all obvious how faces are encoded or decoded by a human brain. Human face recognition has been studied for more than twenty years. Developing a computational model of face recognition is quite difficult, because faces are complex, multi-dimensional visual stimuli. For face identification the starting step involves extraction of the relevant features from facial images. A big challenge is how to quantize facial features so that a computer is able to recognize a face, given a set of features. There are some major steps need to be considered for performing an automatic face recognition system namely preprocessing, feature extraction and classification. These steps are shown by using a block diagram in figure 1. At first, the face images are collected together which is known as face database and then the next step is preprocessing step which allows to to enhance the image quality because the images may taken at different situations. Images may be degraded with noise and poor illumination. So it is necessary remove the noise and normalize the color of images. The third and fourth steps are used to reduce the dimension and extract important
features from face images and save those features for classification purpose. The last step consists of classification method which allows to recognize an unknown face image depending on the extracted features of the database in previous step.

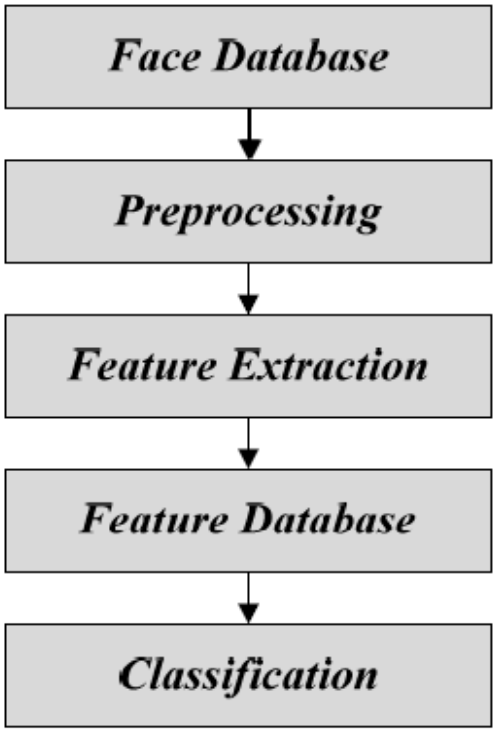

Figure 1: Block diagram for Neural Network based face Recognition system

II .PROPOSED SYSTEM

This proposed system implements a human-face recognition system using Wavelet transform and Artificial neural network. The principle aim of this research project is to investigate alternative methods to be used for face recognition, in particular the use of wavelets.

Methodology

The face recognition system is structured into three sections namely

- The Image Acquisition and Analysis Section
- The Feature Extraction Section
- The Neural Network Classifier

The image acquisition and analysis section :

The photograph of a person's face is captured such that the head pose is aligned normally. The image is pre-processed using digital image enhancement techniques, if necessary. Since this image is usually in the JPEG (Joint Photographic Expert Group) format, it is converted to PGM (Portable Gray Map) format. The wavelets are placed in the region of importance, i.e. the inner face region. The image is processed with the wavelet transform with an optimal number of frequencies and orientations and a representation is obtained.

The feature extraction section:

Features that are of importance are extracted from the complete list of features obtained from the above mentioned section. These features are a vector of values that are automatically saved to a parameters file.

The neural network classifier

The features saved into the parameters file are fed to the neural network. The neural network can be configured to be in either "Training/Learning mode" or in "Recognition mode". Depending upon its mode, the neural network undergoes training or outputs a recognition label.

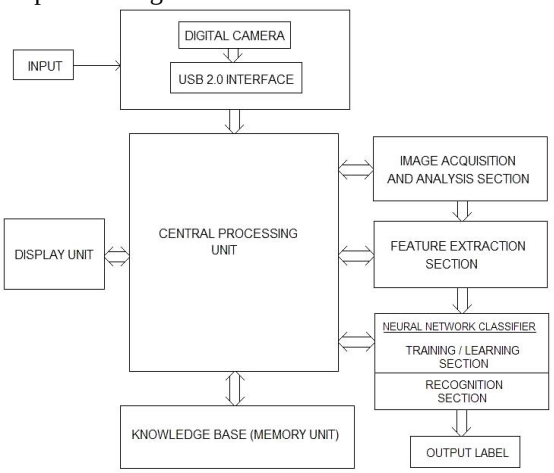

Figure 2: Block diagram depicting the various modules in the face recognition system.

III. IMAGE ACQUSITION AND FEATURE EXTRATION USING WAVALET TRANSFORM

The facial photograph of the subject is captured. The image is converted into the PGM format. The image is enhanced if required. This constitutes the reprocessing step. The image enhancement is carried out using Digital Image Enhancement techniques. The image is fed to the program by specifying the image filename at the command line. The display routine displays the facial image of the subject on the screen as figure 3.

In order to create the wavelet, we identify feature points on the face. We choose the corners of the eyes and corner of the lips as shown below. These points are selected by mouse clicks.

Once these four points have been identified the program execution is resumed by right-clicking on the image.The program calculates the dimensions of the inner region of the face depending upon the ratios of the distances between the above placed points. The wavelet is then placed on the inner region of the face. A selection of 8 X 8 points gives the ideal trade off between image representation and computational speed. The wavelet points are as shown below.

The set of frequencies are chosen from $1/64\sqrt{2}$ to $1/2\sqrt{2}$ in multiples of 2. Thus we have a set of 6 frequencies. The number of orientations is chosen to be 10. The orientations are chosen from $-\pi$ to π in steps $2\pi/10$. Total number of iterations is 64 * 6 * 10 (*P*Q*R*). The reconstruction of the image takes place Successive images of the reconstruction process are shown in the figure below:

The final reconstructed image is obtained as shown below

This image is written and named appropriately by the program; specifying the number of wavelet points, number of frequencies used and number of different orientations chosen. For the above mentioned parameters that we have chosen, the image is named as "rec wa=64 f=6 a=10.pgm". As the reconstruction process takes place, the projections (weights) are calculated as given in equations 3.3a and 3.3b. These weights are stored in an array. This array is bubble sorted and the highest 50 projections (in terms of magnitude) and corresponding frequencies and orientations are chosen. These 150 parameters form the feature vector which is fed to the neural network.

IV. THE NEURAL NETWORK CLASSIFIER

Training of Neural Networks

Neural networks have been trained to perform complex functions in various fields of application including pattern recognition, identification, classification, speech, vision and control systems.

One ANN is used for each person in the database in which face descriptors are used as inputs to train the networks [3]. During training of the ANN's, the faces descriptors that belong to same person are used as positive examples for the person's network (such that network gives 1 as output), and negative examples for the others network. (such that network gives 0 as output). Fig.3 shows schematic diagram for the networks training.

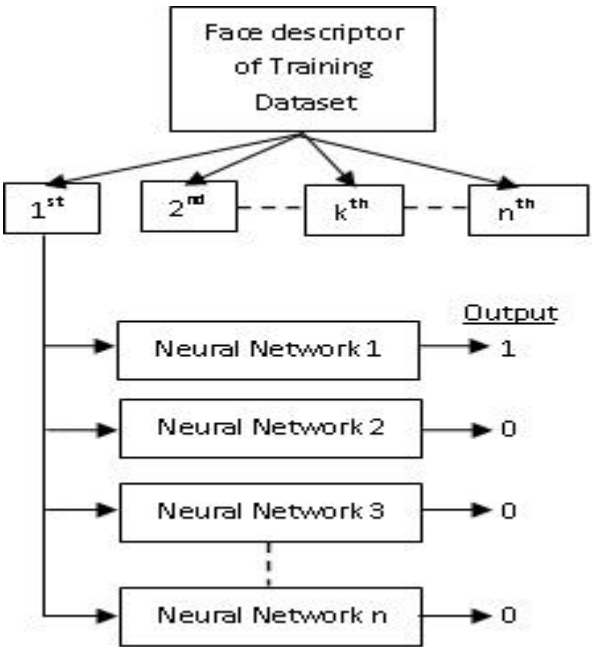

Figure 3: Training of Neural

Simulation of ANN for Recognition

New test image is taken for recognition. These new descriptors are given as an input to every network; further these networks are simulated. Compare the simulated results and if the maximum output exceeds the predefined threshold level, then it is confirmed that this new face belongs to the recognized person with the maximum output (fig. 4).

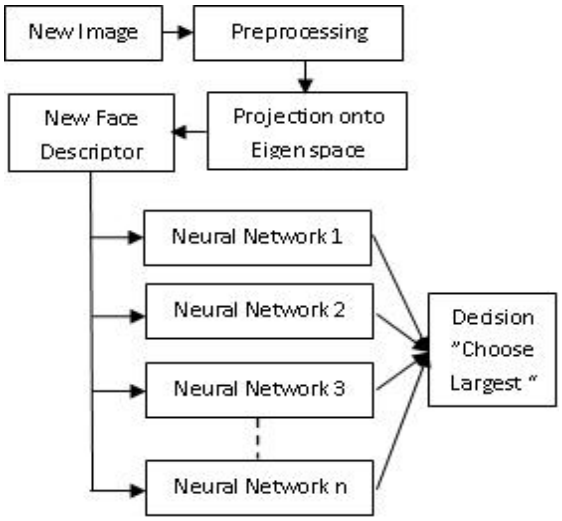

Fig. 5 – Testing of Neural Network

V. CONCLUSION

This paper presents a hybrid approach for face recognition by handling three issues put together. For preprocessing and feature extraction stages, we apply wavelet transform. During the classification phase, the Neural Network is explored for robust decision in the presence of wide facial variations. The experiments that we have conducted on the database indicated that the combination of Wavelet and ANN exhibits the most favorable performance, on account of the fact that it has the lowest overall training time, the lowest redundant data, and the highest recognition rates when compared to similar so-far-introduced methods.

Our proposed method in comparison with the present hybrid methods enjoys from a low computation load in both training and recognizing stages. As another illustration of the privileges of our introduced method, we can mention its great precision.

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