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Face expression recognition on real-time images using ANN

Ashwini Rao
Student, CSE Dept., Jaipur National University, Jaipur

***Abstract*- This paper proposes the face expression recognition system using artificial neural network on real-time images. This system is designed and implemented using MATLAB. This system accomplishes facial expression recognition through 2 phases. In the first stage the image is captured and then expression is recognized. Then in the next stage feature is extracted and then compared with the training samples. The last stage classifies the given output and shows the facial expression recognition results. It then determines whether the person's picture is happy, sad or angry and so forth. To improve the adequacy of the result, the ability of the database and the number of inputs should be increased.**

Keywords—Face Detection; Expression; Recognition; ANN

1. INTRODUCTION

Face recognition is a part of a wide region of pattern recognition technology. Recognition and particularly face recognition covers a range of activities from many strolls of life. Face recognition is something that people are especially great at science and innovations have conveyed numerous comparable errands to us. Face recognition is a type of biometric software application that can identify the specific individual in a digital image by analyzing and comparing patterns. That process procedure incorporates for the most part three-task a*cquisition, normalization and recognition. By the term acquisition we mean* the detection and tracking of face-like image patches in a dynamic scene. *Normalization is* the segmentation, alignment and normalisation of the face images, and finally r*ecognition that is* the representation and modelling of face images as identities, and the association of novel face images with known models.

A Durmuúolu, Y Kahraman proposed geometry-based features were used for face expression recognition. The best performance was found by CFS+ANN. Features were determined to define geometric structure of face by calculating distances between each point which are located on components of face.

In face recognition system S Dominic et.al has provided a variety of photos related to each criminal in the database. By using Artificial Neural Network (ANN) algorithm the content of pictures that is input face, is automatically identified by the software. This approach of identifying image from a whole lot of images is used to understand the criminal from a wide collection of criminal list.

On the other hand, M Owayjan , R Achkar , M Iskandar proposes the face recognition system with Expression Recognition using Artificial Neural Networks .The system is able to detect the face expressions in a percentage which vary between 55% and 80%. However, the bigger the number of inputs is, the better the results will be. Moreover, more useful features can be implemented making it easier to manage and more accurate.

Human Face Detection in Still Image using Multilayer Perceptron was proposed by R. Vapenik et.al. ANN used in this paper was of type Multilayer perceptron and was focused primarily on detection of human faces; recognition was not to be considered. One of the critical steps of the whole process was testing to which was related finding the optimal settings of parameters that directly influence the detection process.

In the paper A Hybrid Neural Network Using ICA and CGA for Skin Detection in RGB Images; proposed by S Khosravi and A Chalechale, used the imperialist competitive algorithm (ICA) and continuous genetic algorithm (CGA) to detect skin. First the combined ICA-ANN, continuous genetic algorithm (CGA) and gradient descent algorithm were proposed and their performance was tested on images in RGB color spaces.

The next section in this paper presents the approach of the framework that was outlined and developed in this study. The originality and contribution in this work are through the use of the Viola-Jones object detection algorithm for face detection, and the design and development of an Artificial Neural Network (ANN) using Multi-Layer-Perceptron (MLP) with back propagation algorithm for features extraction and classification of the facial expressions. A detailed description of the face detection using the Viola-Jones object detection algorithm and the facial expression recognition using Artificial Neural Network are presented, followed with the results of the testing of the developed system. The paper ends with a few conclusions and future works.

2. Algorithms for face recognition

As mentioned in the introduction but also in other parts of the report, there are numerous algorithms can be utilized for face recognition. The vast majority of them depend on similar strategies and techniques. Some of the most popular are Principal component analysis and the utilization of eigenfaces.

2.1 Principal Component Analysis

Under the encompassing face recognition strategy, the principal component analysis also called karhunen-loeve transformation is utilized as the standard method for statistical pattern recognition process for dimensional reduction and feature extraction; it helps in reducing redundancy while preserving the most intrinsic information content of the pattern (en.wikipedia.org/wiki/Image processing). A face image which appears in 2-dimension of size N x N can also be considered as N2 one dimensional vector.

The fundamental thought of principle component being the vector recognition is a linear combination of original face images which best accounts for face image distribution including the whole image space length N2, describes an N x N image while characterizing subspace face image called "face space".

Therefore, as these vectors being the eigenvectors of the covariance matrix corresponding to the original face images and face like in appearance are referred to as "eigenfaces".

2.2 Radial Basis Function Networks

Radial Basis Function (RBF) network has its own structure and function, its functionality in mapping is similar to the multi-layer neural network.

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RBFN performs a local mapping, in which only nearer inputs to respective field produce activation.

The calculated Eigen vectors are then used as input to artificial neural network classifier using RBFN. Artificial neural networks (ANNs) provide another suite of nonlinear algorithms for feature extraction (using hidden layers) and classification. In the base paper (M Owayjan, R Achkar, M Iskandar, 2016), they have used Multi-Layer Perceptron (MLP) with back propagation algorithm for features extraction and classification.

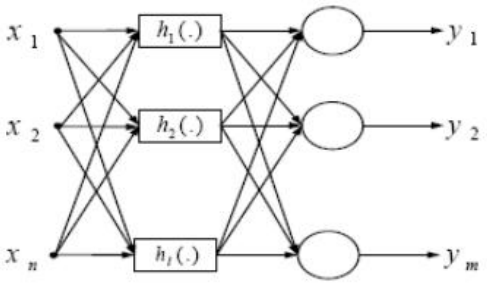

Fig 1.RBF network structure

In this thesis, Radial Basis Function is used. Though the Radial Basis Function (RBF) network has its own structure and function, its functionality in mapping is similar to the multi-layer neural network.

2.3 The algorithm

1. Acquire the face image.
2. The acquired face is detected using Viola-Jones algorithm.
3. Once the edges are detected, it is then cropped and dimensionality is reduced.
4. Feature extraction is done using PCA.
5. Face vector is obtained and this vector is used as input to the artificial neural network classifier (RBFN) for recognizing face image.
6. Face is then stored in a database.
7. Steps 1) to 6) is repeated for testing image.
8. Then Images are compared if matched show the result.
9. Else show the error message.

2.4 Flow chart

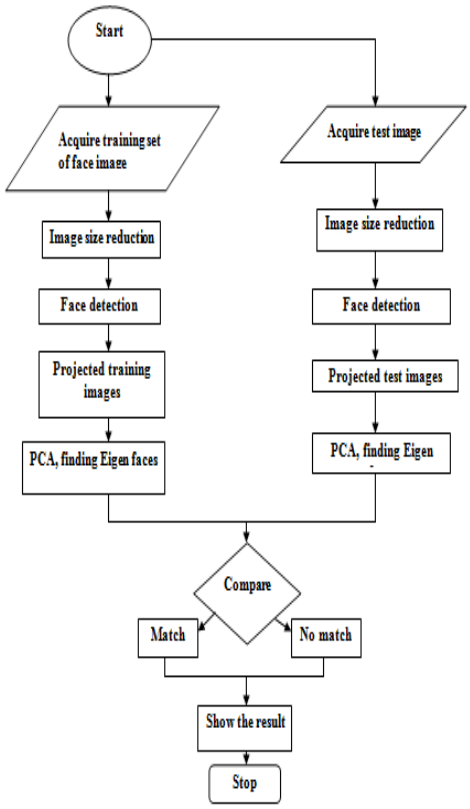

Fig 2.Flow chart of proposed system

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3.1 Proposed Work

3.1 Image acquisition

As this thesis objective is to recognize the face on moving images, Images here are acquired using live web camera. Once the image is captured from the live cam, it is then detected using Viola-Jones algorithm which is very well known for its edge detection. Fig 3 represents the GUI of the system.

Here, the Fig 4. represents the face detection. When the area of an image is much larger compared to that of a face, the region of the image where the face is located is cut out from the image and then it is used in the process of face recognition. By utilizing cropping procedure only main face can be separated and the redundant data around the face, which break down the performance of recognition, can be evacuated.

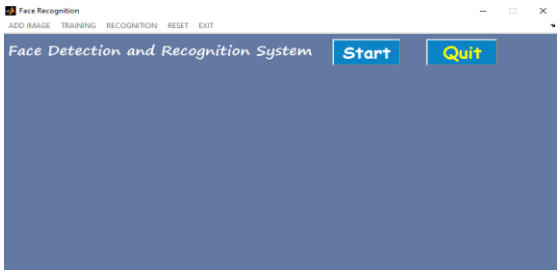

Fig 3.GUI for Face recognition System

3.2 Face Detection

The image is cropped and re-sized which is then stored in the database. We have to extract the features of these faces. It is generally believed that we human beings put different emphasis on different parts of face e.g. eyes, nose, cheeks, forehead and other remaining parts. The existing approaches feature extraction techniques put same emphasize on all parts of a face and results in redundancy of image data from discrimination point of view.

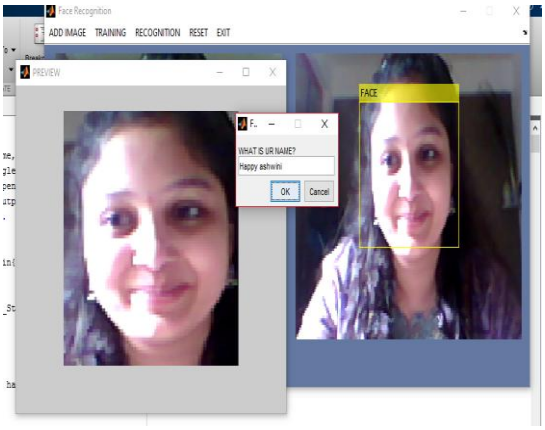

Fig 4.Face detected on live web cam

This technique experiences undesirable equivalent weightage on entire face segment of the picture impacts recognition rate. In the proposed approach of feature extraction, four different facial segments are extracted manually from pre-processed face image (all face images to be trained or tested in recognition process are cropped by utilizing same corner points, "imcrop" function in MATLAB is being utilized for cropping required part from each face image).

Finally the eigenvectors is obtained. Eigenfaces can be extracted out of the image data by means of a mathematical tool called Principal Component Analysis (PCA).

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Fig 5.Image stored in database

3.3 Classification

The calculated Eigen vectors are then used as input to artificial neural network classifier using RBFN. Artificial neural networks (ANNs) provide a new suite of nonlinear algorithms for feature extraction (using hidden layers) and classification. In the base paper (M Owayjan, R Achkar, M Iskandar, 2016), they have used Multi-Layer Perceptron (MLP) with back propagation algorithm for features extraction and classification.

In this thesis, Radial Basis Function is used. Though the Radial Basis Function (RBF) network has its own structure and function, its functionality in mapping is similar to the multi-layer neural network.

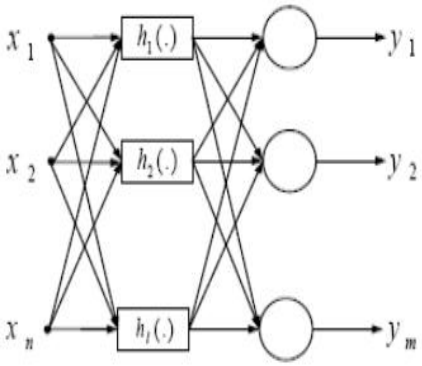

Fig 6.RBF network structure

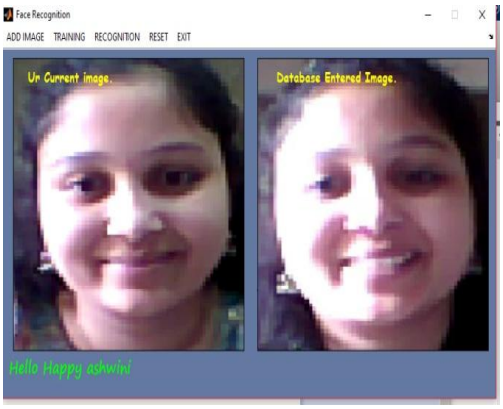

Fig 7.Face expression recognized for real-time image (Happy)

The above figure Fig 7 represents the results for the face expression recognized for moving image on colored background. Similarly, faces are recognized for different expression such as Sad, Surprise and so forth. The system was also tested for still images with colored background and the output for it is shown in the figure given below.

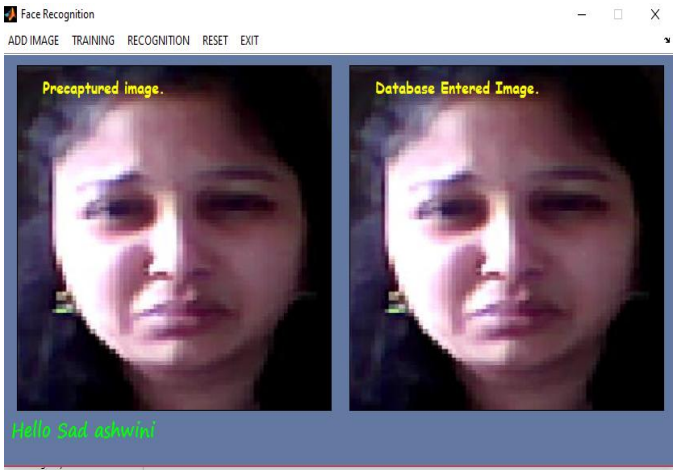

Fig 8.Face recognized for still image (Sad)

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4. Results

The implementation was done on MATLAB. Initially, 60 images for different persons with different face expressions were tested on the system after training on 40 images. Expressions such as Happy, Sad, Angry, Surprise, and Neutral are considered in this thesis. The below given Table 1. represents the no. of faces recognized and recognition rate of the system. The results are summarized in Fig. 9.

Expressions	No. of Faces recognized	Recognition Rate
Happy	26	65%
Sad	23	58%
Angry	21	53%
Surprise	20	50%
Neutral	32	80%

Table 1. Recognition rate

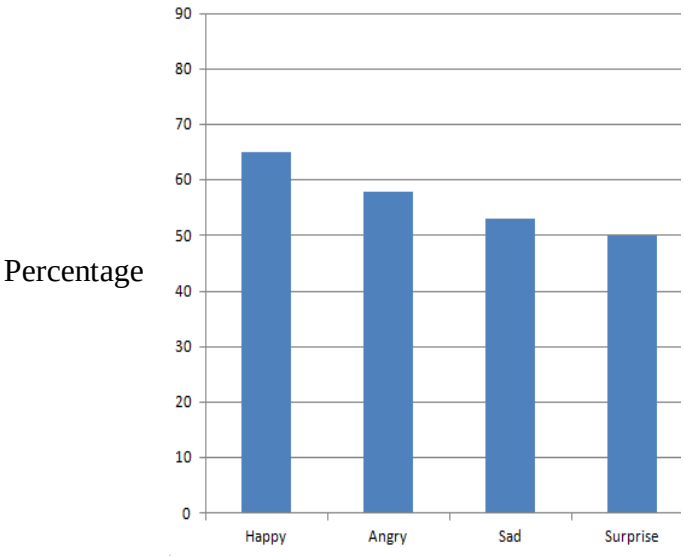

Fig 9.Results of the system