Facial Expressions with Some Mixed Expressions Recognition Using Neural Networks

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Abstract- Facial feature extraction is the essential step of facial expression recognition. The automatic facial impression evaluation applies for wide area use. The important facial feature vectors for expression analysis are analyzed. The extracted feature vector loads all known feature vectors and trains the NN using as input training vectors while PCA is used for dimensionality reduction. The method is effective for both dimension reduction and good recognition performance in comparison with other proposed methods as shown in experiment results.

I INTRODUCTION

The concept of Facial expression system is in use since 1872 .Feelings, emotions and needs can effectively be expressed through face expressions. Facial expressions deliver rich information about human emotion and play an essential role in human communications. The necessary commands to social robots are through gestures, voice commands and facial expressions. In order to facilitate a more intelligent and natural human machine interface of new multimedia products, automatic facial expression recognition had been studied worldwide in the last ten years [2]. There were many algorithms proposed to recognize facial expression and still a lot of work is going on but didn't provide optimal efficiency to recognize mixed expressions. This paper provides a method for recognizing the facial expression with a good feature extraction technique and including some mixed expressions recognition [8]. The facial expression recognition using neural networks, as shown in fig1

Figure 1: Neural Network

The second section involves the existing system and some of its limitations. In the third section the proposed module is discussed. The need and the method of the proposed module is explained with the algorithm. The results obtained are presented in the final section.

Figure 2: Preprocessed JAFFE database

II. EXISTING SYSTEMS

The commonly used facial expression recognition system is based on Gabor filters. The existing systems are based on the Gabor filters [10] and some limited facial expression recognition [8][4]. Generally 5 frequencies

and 8 orientations of Gabor filter bank is often used to extract the Gabor features. A geometric approach for facial expression recognition exists with control fiducially points. The Euclidean distance computation in which the Euclidean distance is estimated between fiducially points sequentially and finally the total sum of distance is taken. These distance values are stored in database and comparison is made to select the best matching template [4].

$$d = \sqrt{(x1 - x2)2 + (y1 - y2)2}$$

Where x1 and y1 refer to co-ordinate of point 1 and x2 and y2 refer to co-ordinate of point 2. Thus the value d refers to Euclidean distance between point 1 and 2. In general, refer to distance between point i and j. Thus 12 distance values can be obtained for the 13 control points. These 12 distance values are then summed up and the sum is stored as the 13th value. Thus, for an individual, these 13 values are stored as characteristic values [4].

$$d = \sqrt{(Xi - Xj)2 + (Yi - Yj)2}$$

In this way, for all the users during enrolment, the distance values are computed and stored in an array.

Limitations of Existing systems

The time involved extracting feature and the dimensions of Gabor feature vector are prohibitively high. Moreover there are deficiencies of the existing system, such as the image database to further examine. The method is also limited as the effectiveness of extraction expression feature is completely dependent on the effectiveness of pre-processing of the raw image. Thus the systems did not provide the expected accuracy [2]. The geometric approach limits only on the fiducially points which may vary for different expressions and will not provide more accuracy for mixed expressions.

III. PROPOSED WORK

The proposed work is based on algorithms called" Gradient descent back propagation with adaptive learning rate". The main purpose of this algorithm is to improve the recognition accuracy of the facial expressions and thus providing the highly secured facial expression recognition system [8][3]. The proposed system consists of three modules namely feature extraction, feature expression matching and database creation for calculating the required information from the face image and to store it in the database. The matching phase involves only the detection of the facial expression and all the other processes are done internally and the final value is compared with the template stored in the database. The complete pictorial representation of our system is given below and each module is explained subsequently.

FEATURE EXTRACTION

The steps involved in feature extraction are

1. Acquire the training set of images and calculate Eigen face [2][7]which determine face space. Eigen faces is one of the most thoroughly investigated approaches to facial expression recognition. It is also known as Karhunen-Loève expansion, Eigen picture, eigenvector, and principal component. Low level procedure for human face characterization used the principal component analysis to represent the face efficiently.
2. In this technique the face image can be constructed based on the small collection of weights for each new face and the Eigen picture [7].

```
feature_vector = double(ingresso(:));
```

This function simply returns vector version of input image. The face matching depends on the known feature vectors and by training the Neural network using input training vectors and reduced PCA space.

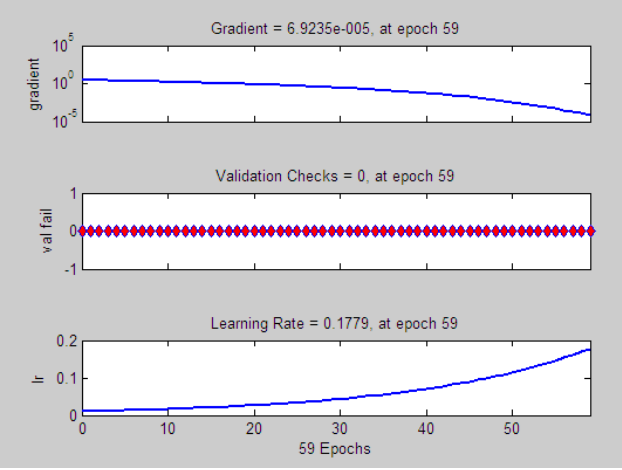

Figure 3: Training state matrice(:,ii) = features_data{ii,1}{1};

This function is used to represent the matrix of total Eigen values and Eigen vectors of input image. The Eigen values are sorted by order and only M' of them are taken. we calculate the Eigen face components of the normalized input i.e. the input
image is projected into face space.

```
pesi = Vtrue'*(features{1}-media);
```

Thus weights describing each face is constructed by placing face image over the Eigen picture and is calculated using

```
pc = Vtrue'*(features_data{ii,1}{1}-media);
```

These vectors are normalized to a [-1,+1] interval for a better Neural network convergence.

FACIAL EXPRESSION MATCHING

The matching phase involves only the detection of the facial expression and all the other processes are done internally and the final value is compared with the template stored in the database. The steps involved in this are [8][9]

1. The input image is determined to be a face by checking its face space and by calculating its corresponding Eigen faces.
2. The stored data is matched with input image data and result is provided.

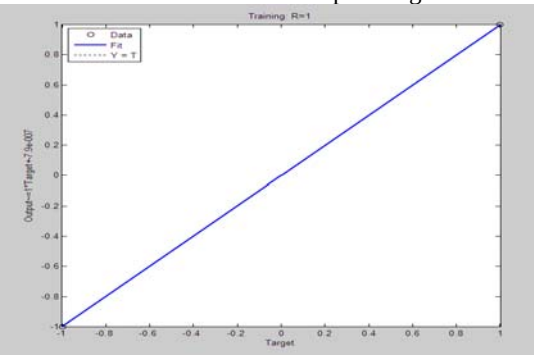

Figure 4: Regression plot

DATABASE CREATION

A facedatabase.dat database is created and data stored according to facial expressions like anger, disgust, fear, surprise etc,. The feature matching is done based upon this and result is provided [5][6].

This algorithm attempts in overcoming the drawbacks of the existing facial expression system. The problems with the existing system are as follows:

1. As the images include a large quantity of background area, the above results are influenced by background, mostly the illumination factor.
2. The mixed facial expressions which is promising in the human face is missing.

The main objective of the this algorithm is to form highly non-linear decision boundaries in the feature space by using neural networks.This is achieved by performing training of the net vectors with the known vectors.

IV. RESULT AND DISCUSSIONS

The proposed system was tested on databases[3] namely Cohn-KanadeAUCoded(CMU),MMI,JAFFE,BelfastNaturalistic(BND).The JAFFE database consist of 213 images of 7 facial expressions (6 basic facial expressions + 1 neutral) posed by 10 Japanese female models enrolled in *.tiff* format Each image has been rated on 6 emotion adjectives by 60 Japanese subjects included. The proposed system yields an excellent recognition rate .The system reduces the illumination and the orientation of the input image and thus increasing the overall accuracy of the system. The only constraint is that the input image should be clear if it has to orientally normalize.

Table 1 Results of Facial Expression Recognition

Databases	***Existing system %***	***Proposed system %***
CMU	80.13	83.32
MMI	82.2	83.12

JAFFE	83	85.13
BND	84.1	86.12

CONCLUSION

In this paper we proposed Facial Expression Recognition and some mixed expression (for example, happiness and surprise, fear and disgust) recognition method using neural networks and PCA. The existing system has illumination and recognition accuracy drawbacks. The proposed system is independent of effectiveness of preprocessing of input image. Thus the proposed system overcomes these problems and provides a maximum accuracy of 85.3%.

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