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Human Facial Expression Based on Mouth Feature using Eigenface

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Abstract: Face Recognition is a field of multidimensional applications. In this paper the PCA features for Feature extraction are used and matching is done for the face under consideration with the test image using Eigen face coefficients. There are two sets of crop mouth pictures. One is used for training purpose and another is used for testing. The test image is assumed to fall in the same class that the closest train image belongs to its, Euclidian distance from the mean of the projected neutral images is calculated.

Keywords: Expression Recognition, Eigen Face, Matching Mouth Detection , PCA

I. INTRODUCTION

Extract relevant information in a crop mouth image [Principal Components] and encode that information in a suitable data structure. For recognition take the sample image and encode it in the same way and compare it with the set of encoded images. In mathematical terms we want to find eigen vectors and eigen values of a covariance matrix of images. Where one image is just a single point in high dimensional space [n * n] , where n * n are the dimensions of a image . There can be many eigen vectors for a covariance matrix but very few of them are the principle one's. Though each eigen vector can be used for finding different amount of variations among the mouth image. In this paper , Eigenface[1] are used to classify cropped mouth expression. A classifier for classifying the expressions of supplied crop mouth into seven basic categories like happy, sad, disgust, fear, anger, surprise and neutral.

The input images are not completely random and in spite of their differences there are patterns which occur in any input signal. Such patterns, which can be observed in all signals could be – in the domain of facial recognition – the presence of some objects (mouth) in any face as well as relative distances between these objects.

By means of PCA one can transform each original image of the training set into a corresponding eigenface. An important feature of PCA is that one can reconstruct reconstruct any original image from the training set by combining the eigenfaces.

The paper is organized as follows, Section 1. Gives brief introduction, Section 2. Describes about survey of existing methods, Section 3. Crop mouth detection system and facial features extraction and data collection, Section 4. Describes on PCA algorithm. Experimental results are given in Section 5. Conclusion and future scope

II. SURVEY OF EXISTING METHODS

In recent years , the research of developing automatic facial expression recognition systems has attracted a lot of attention. The literature survey shows various methods . Despite these different implementations of PCA, their essences are the same, namely, to explain the variance-covariance structure of the data through a few liner combinations of the most popular appearance-based algorithms applied to face recognition [2,3,4,5].

PCA computes the basis of a space which is represented by its training vectors. These basis vectors, actually eigenvectors, computed by PCA are in the direction of the largest variance of the
training vectors called eigenfaces. Each eigenface can be viewed a feature. When a particular face is projected onto the face space, its vector into the face space describes the importance of each of those features in the face. The face is expressed in the face space [6,7,8] by its eigenface coefficients.

PCA technique which is provided by Kirby and Sirovichnot only resulted in a technique that efficiently represents pictures of faces, but also laid the foundation for the development of the “eigenface” technique [9].

The first to attempt to use semiautomated face recognition with a hybrid human-computer system that classified faces on the basis of fiducially marks entered on photographs by hand[10,11]. Combining facial features, which are detected inside the skin color blobs, helps to extend the above type of approach towards more robust face detection algorithms [12,13]. Facial features derived from
gray scale images along with some classification models have also been used to address this problem [14]. A face detection technique based on discriminating feature analysis, statistical modeling of face and non-face classes, and a classifier to detect frontal faces in gray scale images [15].

III. PROPOSED METHODOLOGY

In this paper , Eigenfaces[1] are used to classify facial expression. First we cutting mouth part manually Fig 1. There are two sets of images. One is used for training purpose and another is used for testing. The training pictures are located into the one Folder. The testing pictures are located into another Folder. The pictures are classified in the following expressional classes:

1. Image001 to Image013 = Happy
2. Image014 to Image024 = Disgust
3. Image025 to Image034 = Anger
4. Image035 to Image043 = Sad
5. Image044 to Image047 = Surprise
6. Image048 to Image050 = Neutral

After the cutting, the expression images retain only the major regions of the face. But these images also contain redundant information. For this reason , we adopted the method of cutting main feature blocks to deal with expression images.[16,17]. The cutting size of image is 100 x 80 and then these images are minus corresponding neutral expression.

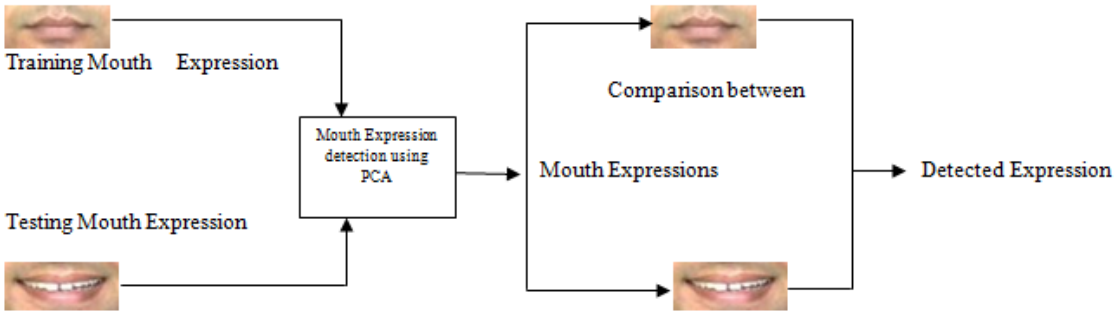

Fig 1. The process of feature extraction

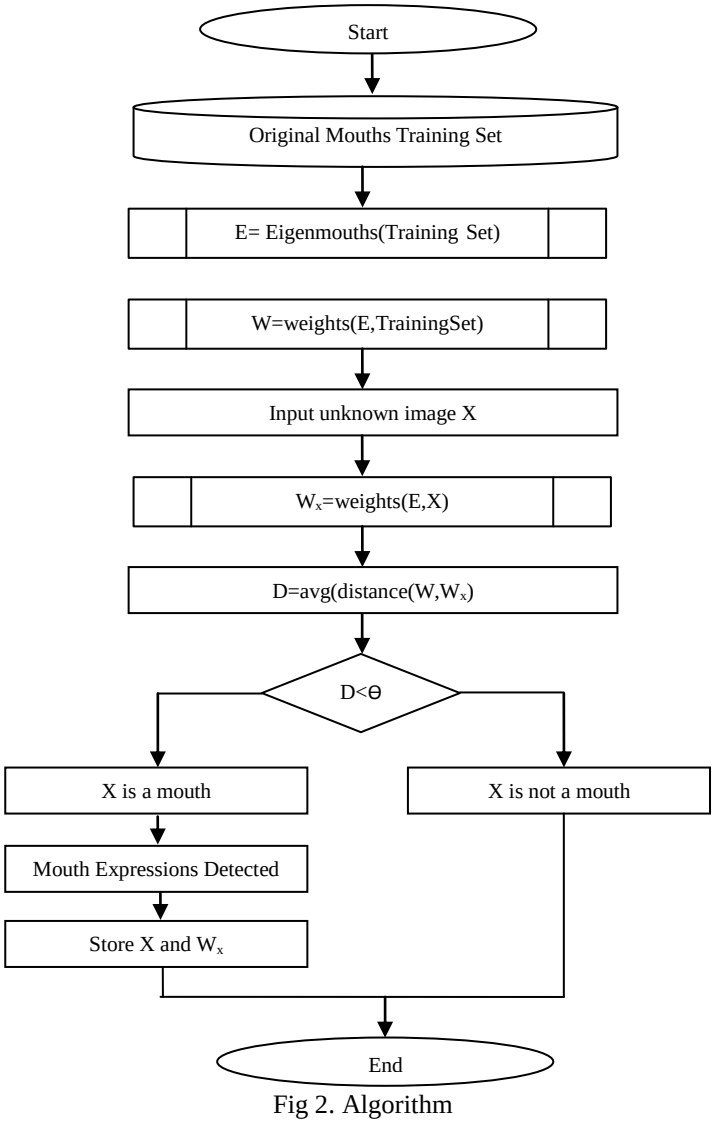

Fig 2. Algorithm

3. Algorithm*:* An algorithm for classifying facial expression. Firstly, a low dimensional mouth space is created by using the train images that are utilized. This is done by performing PCA in the training image set and taking the principal components (i.e. eigen vectors with greater eigen values). The projected versions of all the train images are also created in this process.

Secondly, as a result-the test images also are projected on the mouth space; the selected principal components are used to represent the test images.

Thirdly, the Euclidian distance of a projected test image from all the projected train images are calculated and the minimum value is chosen in order to find out the train image which is most similar to the test image. The test image is assumed to fall in the same class that the closest train image belongs to.

Fourthly, in order to determine the intensity of a particular expression, its Euclidian distance from the mean of the projected neutral images is calculated. The more the distance - according to the assumption - the far it is from the neutral expression. As a result, it can be recognized as a stronger the expression. Fig(2)

IV. DESCRIBES ON PCA ALGORITHM

In order to distinguish different human mouth expression, we denote respectively anger , disgust , fear , happiness, neutral , sad and surprise in our approach . The number of training samples is

In order to distinguish difference human expression, we suppose e_1, e_2, e_3, e_4, e_5, e_6 to denote respectively Happy, Disgust, Anger, Sad, Surprise and Neutral in our approach. The training samples have $n_{i\,,}$ Represent respectively m_{i1}, m_{i2}, $m_{i3,}$….. $m_{im.}$ Therefore the number of training samples is

$$M= \sum_{i=1}^{6} ni \qquad (1)$$

If each training image represents a mxn matrix , the mean of training samples function is given as fallows :

Let's suppose we have M vectors of size N (= rows of image × columns of image) representing a set of sampled images. pj's represent the pixel values.

$$ni = [p1 \ldots pN]T , i = 1, \ldots , M \qquad (2)$$

The images are mean centered by subtracting the mean image from each image vector. Let m represent the mean image.

$$m=1/M \ \sum_{i=1}^{6} ni \qquad (3)$$

And let wi be de ned as mean centered image

$$wi = ni – m \qquad (4)$$

Our goal is to find a set of ei's which have the largest possible projection onto each of the wi's.

We wish to a set of M ortho normal vectors ei for which the quantity

$$\beta i = \frac{1}{M}\sum_{n=1}^{M} (eiT\ wn)2 \qquad (5)$$

The eigenvectors of the covariance matrix are computed and the M significant eigenvectors are chosen as those with the largest corresponding eigen values .From these eigenvectors, the weights for each image in the training set are computed Table I.

Table I performance analysis

No.	**Type of Gesture**	**No. of Input Train Images**	**No. of Output Test Images**	**Recognized**	**Result (%)**
1	Happy	13	5	2	40
2	Disgust	11	5	5	100
3	Anger	10	5	1	20
4	Sad	9	5	4	80
5	Surprise	4	2	2	100
6	Neutral	3	2	1	50

V. CONCLUSION AND FUTURE SCOPE

In this paper, an accurate and high speed facial expression detection system has been proposed from images .One of the major contribution of this paper is proposed method that cropped region from image. In future work, the proposed approach can be applied to detect face, facial expression or other objects recognition for 3D objects using integral imaging technique.

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