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Facial Expression Detection Using Implemented (PCA) Algorithm

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Abstract: **Facial expression plays very important role in the communication with in the human beings. It is very important to understand the presence of mind using face expression such as the situation of mind can be read by their mouth, eyes, eyebrows etc. these plays an important role in the classification of human beings. Distinct faces are used to classify the facial expression (like sadness, happiness, fear, disgusting, surprise and anger), Other expression except these are called 'Neutral' expression, identity of these expressions can be identified by the level of its dissimilarities from the neutral expression.**

Keywords**: Principal Component Analysis (PCA), Facial Expression Recognition System.**

I. INTRODUCTION

It is very important for implementing the facial expression recognition system, it is also important to realize that there are many possible methods that exist to represent facial expression. These facial expression can be represent using, pictures, video, cartoon, smiley, active action and facial characteristic points.

Let we take the example of images, these images firstly utilize to create Low dimensional face space. This is done by Performing Principal Component Analysis (PCA) in the image set and taking the principal component (that mean Eigen Vectors with greater Eigen values) in this process the projected version of all images(set of images) are created.

Now the test images are also projected on the face space as the result All these images are represented on the basis of performing principal component Analysis (PCA).

The Euclidian distance of the projected test images from the all projected images which is similar to the test images. The test image is assumed to fall in same class that is the set of images.

In order to determine the intensity of the particular expression, its Euclidian distance from the mean of projected neutral images is calculated.

These images showing the different types of facial expression.

II. LITERATURE SURVEY

Basic principal (PCA)

Principal Component Analysis is the tool for identifying pattern in data and expressing the data in such a way to highlight their similarities and differences. PCA is also the powerful tool for analyzing data.
If there is many image close to each other in PCA, that means the images quite resemble but different slightly from each other. These measurement tell us about what are the difference in these images a set of these images could be snapped by the direction of variations, which are called Principal Components.
To characterize the trends exhibited by this data, PCA extract the direction where the cloud(set of images) is more extended. This is called the principal components. Using PCA we can find the subset of principal directions(that is principal components)in a set of training faces then we project faces into this component space and get the feature vectors. This comparison is done by calculating the distance between these vectors. Mostly the comparison of face images is performed by calculating Euclidian distance between these feature vectors. The angle based distance is also used sometime.

The Performing Principal component Analysis (PCA) can be performed on the set of data using these steps. =>>>

- Get some data.
- Subtract the mean.
- Calculating the covariance matrix.
- Calculating the Eigen vectors and Eigen values of the covariance matrix.
- Choosing components and formatting the feature vectors.
- Driving the new data set.
- Getting the old data back.

Recognition system

The system for facial expression automatically recognized using the form of sequential configuration of processing steps, which makes the classical pattern recognition model, the main steps to proceed:-

(1) Image Acquisition

The images used for facial expression can be used as static or dynamic (that is images in sequences.). An image sequence Contains potentially more information that a still image.

Image Read

A= imread (filename,fmt) It reads a gray scale or color image from the filespecified by the string filename. If the file is not inthe current directory, or in a directory on theMATLAB path, specify the full pathname.

Display Image

B= imshow (I) It display the grays cale image I.

(2) Pre-Processing

Image pre-processing is the process of formation of signal conditioning(such as noise removal, normalization against variation of the pixel or brightness), together with segmentation, location or tracking of face and its parts. This expression can be sensitive to translation, scaling and rotation of the head in an image To combat the effect of these unwanted transformations, the facial may be geometrically standardized prior to classification. This normalization is based on the references provided by the Eyes. Segmentation can be concerned with the demarcation of the Image portions conveying relevant facial expression Face segmentation is often anchored on the shape, motion, color, texture, and spatial configuration of the face or its Components.

Standard Sizing

B= imresize (A, [mrowsncols]) This instruction returns image B that have number of rows and columns specified by [mrowsncols]. Either NUMROWS OR NUMCOLS in which case imresize compute the number of rows or columns automatically to preserve image respect ratio.

Edge Finding

BW=edge (I) It takes a gray scale or binary I as its input, and returns a image BW of the same size as I, with 1's where the function finds edges in 1's or 0's elsewhere. By default, edge usessobel methods to detect edges but the following provides a complete list of all the edge finding.

Methods supported by this function:

- Sable method
- Prewitt method
- Roberts method

These methods find edges using the sable, Pruitt, or Roberts approximations to the derivative. It returns edges at that point where the gradient of I is maximum.

(3) Feature Extraction:

Feature extraction can converts pixel data into a higher-level representation of shape, motion, color, texture, and spatial configuration of the face or its components. The extracted representation isused for subsequent expression categorization. Feature extraction generally reduces the dimensionality of the in put space The reduction procedure should(ideally) retain essential information possessing high discrimination power and high stability. Such dimensionality reduction may mitigate the curse of dimensionality. Geometric kinetic, and statistical or spectral transform-based features are often used as .Alternativere presentation of the facial expression prior to classification.

Performing Pca

[Coeff, Score, latent, tsquare] = princomp (X) X is n b p data matrix. Rows of X Correspond to observations and olumns to variables.

(4) Classification:

Expression categorization is performed by a classifier, which is most consists of models of pattern distribution, coupled to a decision procedure. A wide range of the classifiers, covering parametric as well as nonparametric techniques, has been applied to the automatic expression recognition problem. The two main types of classes used in facial expression recognition are action units (AUs), and the prototypic facial expressions defined by Ekman.

(5) Post-processing:

Post-processing aims to improve recognition accuracy by exploiting domain knowledge to correct classification errors, or by coupling together several levels of classification hierarchy.

Theoretical background

Eigen values and Eigenvectors are depends on the concept of orthogonal linear transformation. An eigenvector is a non - zero vectors the dominant eigenvector is a matrix is the one corresponding to the largest Eigen value of that matrix. This dominant Eigenvector is basically important for many real world applications.

Steps used to find the features for expressions

Organizing the data set- Consider the data having a set of M variables that are arranged as a set of N data vectors. Thus the whole data is put into a single matrix *X* of dimensions M x N.

Calculating the mean

$$\mu = \frac{1}{N}\Sigma^{N}_{x=1} X[m,n] \qquad (1)$$

Where μ_x is the mean of the matrix *X*; m and n are indices and m=1, 2… M and n=1, 2… N Subtracting off the mean for each dimension-

$$X = X - \mu_x (2)$$

The new matrix *X* comprises of the mean-subtracted data. The subtraction of mean is important, since it ensures that the first principal component indicates the direction of maximum variance.

Calculating the covariance matrix

Covariance has the same formula as that of the variance. Assume we have a 3-dimensional data set (*p*, *q*, *r*), then we can measure the covariance either between *p* and *q*, *q* and *r* or *r* and *p* dimensions. But measuring the covariance between *p* and *p*, *q* and *q*, *r* and *r* dimensions gives the value of variance of the respective *p*, *q*, *r* dimension. Variance is measured on a single dimension whereas covariance on multi-dimensions.

For 1-dimension,

$$Cov(x) = \mathrm{Var(x)} = \frac{\Sigma^{N}_{x=1}(x-\mu_x)(x-\mu_x)}{N-1} \quad (3)$$

Where *Var*is the variance matrix;

For 2-dimension say (x, y),

$$Cov(x,y) = \frac{\Sigma^{N}_{i=1}(x-\mu_x)(y-\mu y)}{N-1} \quad (4)$$

Where *Cov(x, y)* is the covariance matrix; µy is the mean of another matrix Y.

Calculating the Eigenvectors and Eigen values of the covariance matrix- For computing the matrix of Eigenvectors that diagonalizes the covariance matrix *C*

$$E{\cdot}Cov{\cdot}E^{-1} = D \quad (5)$$

Where *Cov*is the covariance matrix; *E* is the matrix of all the Eigenvectors of *Cov*, one Eigenvector per column; *D* is the diagonal matrix of all the Eigen values of *Cov* along its main diagonal, and which is zero for the rest of the elements.

The Eigenvector associated with the largest Eigen value displays the greatest variance in the image while the Eigenvector associated with the smallest Eigen value displays the least variance.

III. PROPOSED SYSTEM

The block diagram for the proposed system is represented in Figure shown below.

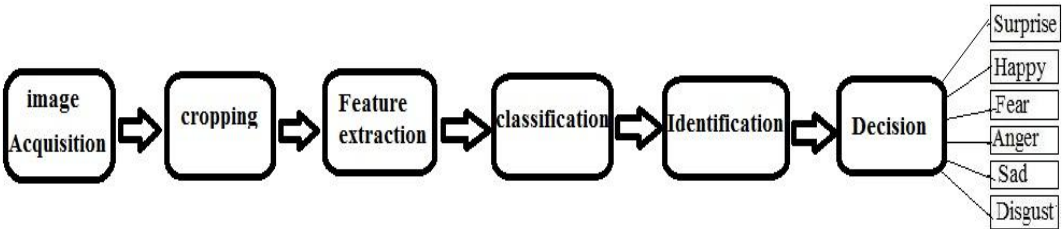
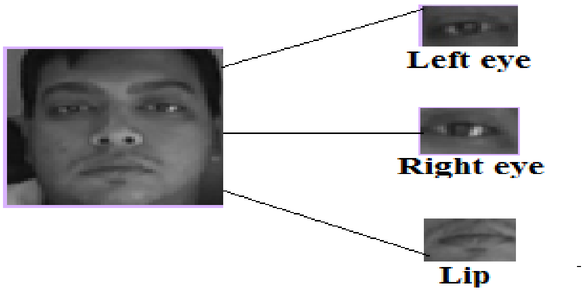


Image acquisition:

Images are acquired using a digital camera. First of all the images are converted into gray-scale images before going to further processing.

Cropping:

Eyes, nose and lip take different shapes for different expressions and significant information is carried by them. So instead of processing the entire face, eyes, nose and lip are processed. Before going for further processing, five significant portions are cropped from the image as shown in Figureshown below and it shall be called as feature image.



Feature extraction:

The cropped images are resized to give the value size 40 by 40 for the left and the right eye, 70 by 60 for the nose, 60 by 90 for the lip and 110 by 95 for the cropped nose and lip together. Eigenvectors are computed from these cropped images. In this work, the universal expressions are set into six classes as the training images. Eigenvectors and Eigenvalues of five different individual segments of the image is computed and stored. For a single class, after the selection of a particular feature, a matrix is obtained which is stored as, say L of dimension P x Q. Similarly for the rest of the features also, Eigenvectors and Eigen values are computed and stored as a matrix.
First the mean centered feature image vectors is obtained by subtracting the mean from the feature image. This image vectors are depicted as matrix only. Then the covariance matrix of each individual feature image is obtained by calculating the covariance of the matrix of each mean centered image vectors, and from each covariance matrix, the associated eigenvectors and Eigen values for the individually extracted features are computed.

Five significant Eigenvectors are considered for further processing which are sorted in the decreasing order of the associated Eigen values of the covariance matrix. With the available eigenvectors of expressions, separate subspaces for all the six universal expressions are created. With the available expression subspaces, the input image could be identified by incorporating a decision making system.

Classification:

The classifier based on the Euclidean distance has been used which is obtained by calculating the distance between the image which are to be tested and the already available images used as the training images. Then the minimum distance is observed from the set of values.

In testing, the Euclidean distance (ED) has been computed between the new (testing) image Eigenvector and the Eigen subspaces for each expression, and minimum Euclidean distance based classification is done to recognize the expression of the input image. The formula for the Euclidean distance is given by.

$$ED = \sqrt{(x2 - x1)^2} \qquad (6)$$

Identification

In this module we can identify the person who is showing their expression in front of the software that mean the database is already made up for this purpose in that data base the identification details of the person are saved and can be utilize at the time of identification of the person. This module is also based on face recognition system because the identification process can be done using facial recognition of the person so that this modules plays very important role in this software.

IV. PROBLEM STATEMENT

Facial Expression Detection means finding the Expression of an image and recognize the which expression it is such as Happy, Sad, Angry, Disgust, Neutral etc. The technique used for Facial Expression Detection is Principal Component Analysis. The Principal Component Analysis (PCA) is one of the most successful techniques that have been used to recognize faces in images.

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One difficulty in face recognition is how to handle the variations in the expression, pose and illumination when only a limited number of training samples are available.

For recognizing face, we need dataset that contain the number of records. But dataset consisting of large no of interrelated variables while retaining as much as possible of the variation present in the dataset.

V. METHODOLOGY

For reducing the dimensionality of the dataset we use PCA (Principal Component Analysis) and this is achieved by transforming a new set of variables which are uncorrelated and ordered.

Original data image contain numbers of variables but while transforming few are retain most of the variable present.

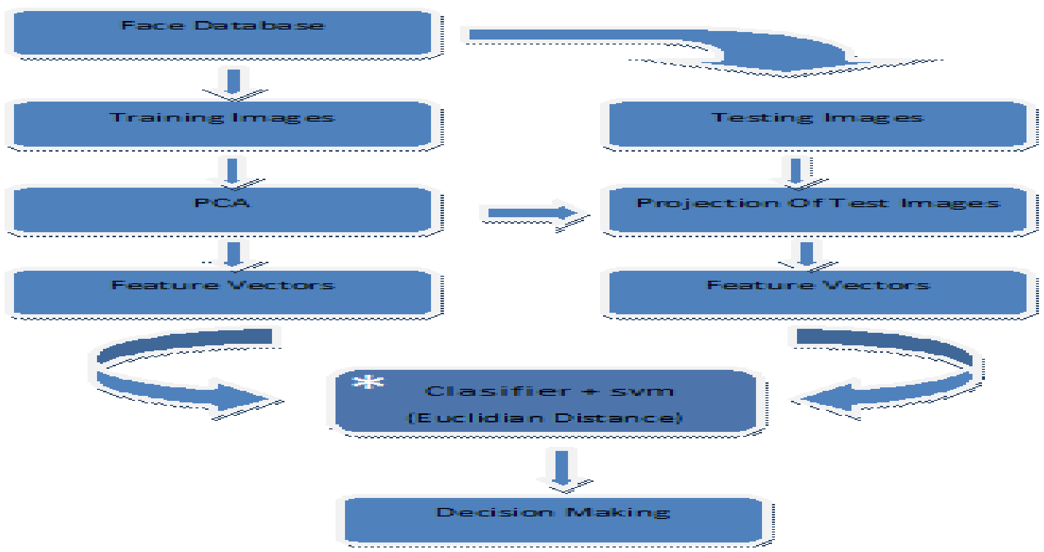
In our system we resolve another issue, we also detect emotion from given image at real time.

To solve this issue we extract features from given image like eyes, nose and lips and compare that extracted features from dataset so that the exact motion is detected and music is played according to the detected emotion.

VI. CONCLUSION

We have implemented the facial expression recognition system using PCA analysis method. This method has been studied using image database system. The experiment results demonstrate that the accuracy of the images has been constructed using Principal component analysis is 91.72% Same way the precision rate obtained is 72.81% in case of PCA Principal Component analysis method.

Flow Chart



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