ISSN (Online) 2456 -1304

International Journal of Science, Engineering and Management (IJSEM)
Vol 2, Issue 12, December 2017

Facial Expression Recognition Utilizing Local Direction-Based Robust Features for Music Play System

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***Abstract:*-- Emotion Recognition plays a key role in interpersonal relationships. The ability to interpret facial expressions in the social environment allows people to anticipate intentions or situations and respond appropriately. The face recognition technology attracts more and more attention with people's growing interesting in expression information. Face recognition has practical Significance; it has very broad application prospects, such as user-friendly interface between man and machine.**

Recently, ubiquitous healthcare systems have attracted a lot of researchers due to their prominent application the field of human computer Interaction (HCI). The objective of this project is to analyze, interpret and propose an efficient model for emotion recognition. Emotion recognition from facial expressions is generally performed in three steps: face detection, features extraction and classification of expressions. In this project we implements face recognition techniques using Principal Component analysis (PCA) and Linear Discriminative Analysis (LDA).

***keywords:*-- Image-Processing, Principal Component Analysis, Linear Discriminant analysis.**

I. INTRODUCTION

The face is our primary and first focus of attention in social life playing an important role in identity of individual. We can recognize a number of faces learned throughout our lifespan and identify that faces at a glance even after years. Automated facial expression analyzer is very useful for various vision systems, Speech processing, airport security etc. Many algorithms gives the best result to find out the facial expression for example, PCA Algorithm SVD Algorithm GABOR Algorithm. Feature extraction means extracting certain feature points on the face like 1.Eyes 2.Nose 3.Lips 4. Eyes Brows.

A number of novel methodologies for automatic facial expression recognition have been proposed over the last decade. However robust recognition of facial expressions from images and videos is still a challenging task due to the difficulty in accurately extracting the useful emotional features. These features are often represented in different forms, such as static, dynamic, point-based geometric or region-based appearance.

Face acquisition is a preprocessing stage to defect face regions in the input images or sequences. One of the most widely used face detector is the real time face detection algorithm developed by Viola and Jones. Facial Features representation is used to extract a set of appropriate features such as eyes, eyebrow, nose and mouth from original face images for describing faces. The final step is facial expression classification that classifies the facial expressions based on extracted relevant features.

In this proposed project our main aim is the Eigen spaces are created with the help of Eigen vectors and Eigen values. With the help of this space Eigen faces are created and with the help of PCA and LDA algorithm the most matching Eigen face is selected. The databases of 30 persons are generated each person having 10 photographs with different expression like happy, angry, sad neutral, disgust etc. If any expression is not recognize then it consider as a neutral expression. Then play the music based on facial expression.

A. GEOMETRY-BASED FEATURE EXTRACTION

Geometric feature vectors represent the shapes and locations of facial components by encoding the face geometry from the position, distance, angle, and other geometric relationships

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between these components. However Geometric feature based methods require accurate and reliable facial component detection, which is difficult to accommodate in many situation.

B. APPEARANCE-BASED FEATURE EXTRACTION

Appearance based methods apply a single image filter or filter bank on the whole face or some specific region of the face to extract appearance changes. Then, some subspace learning methods, e.g., principle component analysis, linear discriminant analysis are carried out to obtain the subspace representation of the original input.
Finally, matching is performed in the learned subspace. But appearance based methods require all the face images have to carefully be aligned and cropped

II. LITERATURE SURVEY

Several methods have been proposed earlier to detect and recognize the facial features and audio features from an audio signal with certain algorithms. But there are very few systems that automatically generate a playlist based on the expressions detected which make use of some additional hardware like sensors or EEG. Some of which are discussed as below:

In [1] [2], The System classify the expressions some shape models, that are based on a set of characteristics points on the face are being used. However, the distance between the facial landmarks differ for different individuals which makes the system less reliable. Outward appearances include change in composition and hence filters like Gabor wavelets, Local Binary Pattern etc.

In [3], Correlation Method is used. It is one of the simplest method also known as the nearest neighbor method. It returns the similarity score as the angle between two images. The training images and testing images are converted in to column vectors. Comparison of the test image and gallery image is made in a high dimensional space. So, it requires more storage space and hence the recognition time also increases leading to the Disadvantage of correlation method.

In [4] [5], PCA Algorithm is used to extract the facial features and classify the expression of the individual faces. The Detected Expression make use of some additional hardware like sensors or EEG

In [6], Viola-Jones Algorithm is used in this System. Which is the Object Detection Frame work. This algorithm is used in OpenCV which is the real time Computer vision. This system is sensitive to the Lightning Conditions. Multiple detection of same face is performed due to Overlapping.

In [7], Haar-feature facial detection is used. The positive and negative images are trained contains edge features, Line feature, Centre-surround features. The system is computationally complex and slow.

In [8], Intel's Sense Camera is used to capture the user's facial expression. SR300 is the development kit used before Web camera. The disadvantage is the system is highly sensitive to the noise of the image and it covers only spherical domain Space.

In [9], Viola-Jones algorithm and GRAY Level Co-accurate Matrix is used for scanning the files for audio features. The extracted features are given to Probabilistic Neural Network (PNN). So, network need more memory space to share the model.

In [10], Histograms of Oriented Gradients (HOG) and Support Vector Machine (SVM) is used for facial land marking techniques and predicting the mood of the user. The testing phase of the system is slow and there is a poor performance if the number of the features are larger than the Sample features.

III. EXISTING SYSTEM

In Existing Hidden Markov Models (HMMs) is used for pattern recognition. This method focused only on three regions on the face like eyebrows, eyes, mouth. By calculating some distance between those three parts or, by evaluating some animations parameters such as: openness of eyes, width of eyes, height of eyebrows, opening of mouth, and width of mouth is used to classify the facial expression.
A novel FER Approach is proposed in this work using LDPP, PCA, GDA and DBN based on a depth sensor-based video camera images. The LDPP (Local Directional Position Pattern) features are extracted first from the facial expression

ISSN (Online) 2456 -1304

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depth images. Furthermore, the face features are classified by GDA (Generalized Discriminant Analysis). Finally, the features are applied to train a DBN (Deep Belief Network)

A. DRAWBACKS

Emotions are predicted wrongly and the feature value will be vary depends on the image.

IV. PROPOSED SYSTEM

In this project, the train images are utilized to create a low dimensional face space. This is done by performing Principal Component Analysis (PCA) and LDA (Linear Discriminative Analysis) in the training image set and taking the principal components (i.e. Eigen vectors with greater Eigen values). Secondly, the test images also are projected on the face space-as a result, all the test images are represented in terms of the selected Principal Components and then with LDA features the matched face is recognized with the training database.

A. ADVANTAGES

LDA can give you a lower-dimensional representation for the documents and accurate face recognition with training database.

V. SYSTEM IMPLEMENTATION

A. SYSTEM ARCHITECTURE

The Implementation stage involves careful planning, investigation of the existing system and it's constraints on implementation, designing of method to achieve changeover and evaluation of changeover methods.

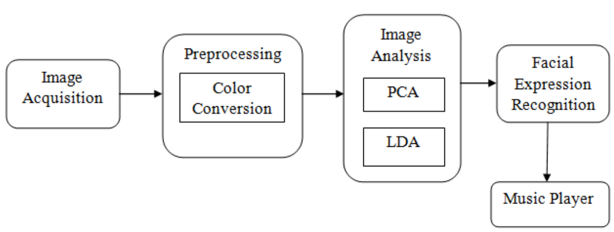

Fig-5.1: Architecture of the System Implementation

B. IMAGE ACQUISITION

In this stage image of the user is captured using the Camera and that image is used for detecting the mood of the user. There are various challenges faced in the image such as brightness, different shades in the image, clarity, etc.

C. PREPROCESSING

Grayscale Conversion In order to retain as much as information of images, the color images are converted into grayscale images. This is the first step of experiment. As color images (RGB images) are composed of 3 channels to present red, green and blue components in RGB space. Pixels in grayscale images are stored as 8–bit integer to represent color into black and white

VI. ALGORITHM

A. PRINCIPAL COMPONENT ANALYSIS

Research in automatic face recognition started in the 1960's. Kirby and Sirovich were among the first to apply principal component analysis (PCA). Turk and Pent land popularized the use of PCA for face recognition. Principle Component Analysis (PCA) is a dimensionality reduction technique that is used for image recognition and compression. It is also known as Karhunen-Loeve transformation (KLT) or Eigen space projection A.

Eigen face approach as proposed by Turk and Pent land, the system was Initialized or trained with the following operations:

1. An initial set of face images were acquired. This was the training set.
2. The Eigen faces were calculated from the training set. Only M Eigen faces corresponding to the M largest Eigen values were retained. These Eigen faces spanned the face space which constituted of the training set.
3. The M Eigen face-weights were calculated for each training image by projecting the image onto face space spanned by the Eigen faces. Each face image then will be represented by M weights- an extremely compact representation. After initialization, the following steps were performed to recognize test images:
4. The set of M weights corresponding to the test image were found by projecting the test image onto each of the Eigen faces.
5. The test image was determined if it was a face at all by checking whether it was sufficiently close to the face space. This was done by comparing the distance between the test image and the face space to an arbitrary distance threshold.

ISSN (Online) 2456 -1304

International Journal of Science, Engineering and Management (IJSEM)
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6. If it was sufficiently close to the face space, compute the distance of the M weights of the test image to the M weights of each face image in the training set. A second arbitrary threshold was put in place to check whether the test image corresponded at all to any known identity in the training set.
7. If the second threshold was overcome, the test image was assigned with the identity of the face image with which it had the smallest distance.
8. For a test image with a previously unknown identity, the system was retrained by adding this image to the training set.

MATHEMATICAL OF PCA

Consider a image of size N x N which can also be converted into one dimension of size N2. In which the length of the each dimension vector is N2. Let us consider that there are Y images of N x N size which can be represented as X1, X2,........Xn, then the mean of the data set is

$$Y = 1/y \sum_{i=0}^{n} Xi \qquad (1)$$

Then the mean image is subtracted from the each image of the set, so as to equalize the data

$$Ki = Xi - n \qquad (2)$$

Then a matrix is formed by concatenating all mean images.

$$F = [K_1, K_2, \ldots\ldots K_n] \qquad (3)$$

A covariance matrix is formed U= FF T having dimensions N2 x N2, which then produces eigenvectors and Eigen values. The Eigen vectors are:

$$FF^1 J_i = \lambda_i J_i \qquad (4)$$

$$F^T FFJ_I = F(\lambda_i J_i) \qquad (5)$$

$$F^T FFJ_I = \lambda i (FJ_i) \qquad (6)$$

FJi is the Eigen vector denoted by Ui and λi is the Eigen value. Ui represent the faces which look hazy and are called Eigen faces. The Eigen faces which have the large eigenvalues account for the most variance of the data set. Each face image is now projected on this face space using

$$\omega_r = U^T (X_r - n), \; r = 1, 2 \ldots n \qquad (7)$$

Where (Xr - n) represents the mean centered image. Therefore above equation can be used for finding the projection of each image.

B. LINEAR DISCRIMINANT ANALYSIS

Linear discriminant analysis (LDA) is a generalization of Fisher's linear discriminant, a method used in statistics, pattern recognition and machine learning to find a linear combination of features that characterizes or separates two or more classes of objects or events. The resulting combination may be used as a linear classifier or, more commonly, for dimensionality reduction before later classification. LDA is also closely related to principal component analysis (PCA) and factor analysis in that they both look for linear combinations of variables which best explain the data. LDA explicitly attempts to model the difference between the classes of data. PCA on the other hand does not take into account any difference in class, and factor analysis builds the feature combinations based on differences rather than similarities. Discriminant analysis is also different from factor analysis in that it is not an interdependence technique: a distinction between independent variables and dependent variables (also called criterion variables) must be made. LDA is a supervised learning method, which utilizes the category information associated with each sample. The goal of LDA is to maximize the between-class scatter while minimizing the within class scatter. Mathematically speaking, the within class scatter matrix S w and between-class scatter matrix S b are defined as

$$S_w = \sum_{j=1}^{c} \sum_{i=1}^{N_j} (x_i^j - \mu_j)(x_i^j - \mu_j)^T$$
$$S_b = \sum_{j=1}^{c} (\mu_j - \mu)(\mu_j - \mu)^T$$

Where x_i^j is the ith sample of class j, μ_j is the mean of class j, μ is the mean image of all classes, c is the number of classes, and Nj is the number of samples of class j. One way to select W lda is to maximize the ratio det |Sb det | Sw |. If Sw is nonsingular matrix then this ratio is maximized, when the transformation matrix W lda consists of g generalized eigenvectors corresponding to the g largest eigenvalues of Sw -1Sb . Note that there are at most c-1 nonzero generalized eigenvalues, and so an upper bound on g is c-1.

ISSN (Online) 2456 -1304

International Journal of Science, Engineering and Management (IJSEM)
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VII EXPERIMENTAL RESULTS

The implementation is carried out in Matlab2013a or above. Here, for the facial expression recognition purpose testing was carried out on dynamic images to achieve real time performance. The images were taken through the inbuilt camera for various individuals. We have 50 images in training data set. And 47 images in test data to test.

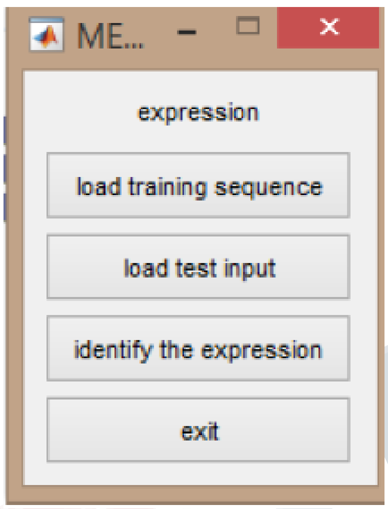

Fig 7.1: Dialog box to select an operation

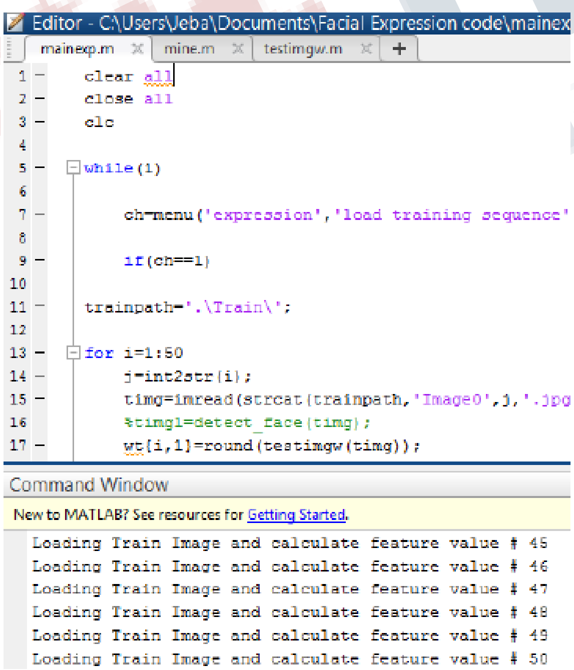

Fig 7.2: Process of training the data

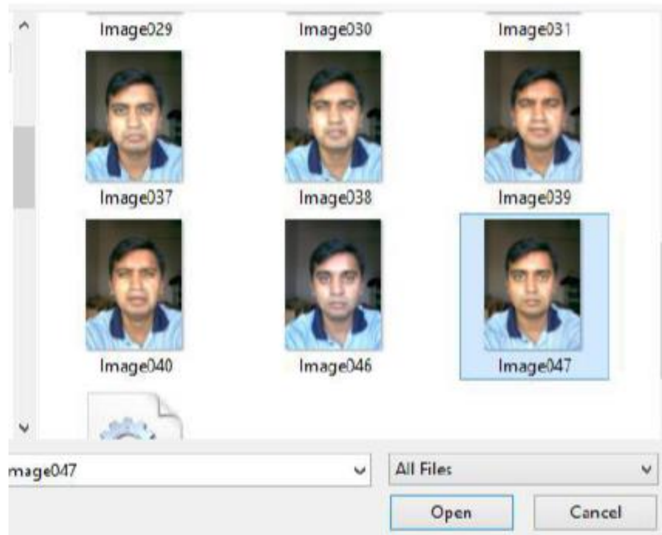

Fig 7.3: Input Image for identifying expression

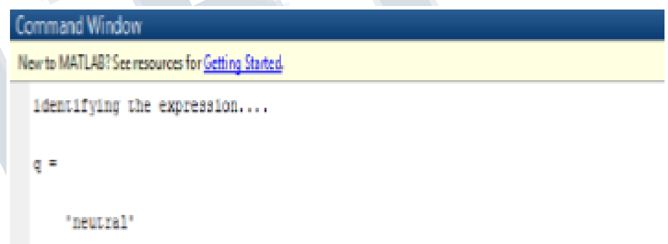

Fig 7.4: The Expression

VII .CONCLUSION

In this paper, we observe many techniques such as Eigen face PCA, LDA, Principal component analysis with singular value decomposition etc., with the use of appropriate Datasets for detection of Human Facial expression and their recognition based on accuracy and computational time. Some methods we see contain drawbacks as of recognition rate or timing. To achieve accurate recognition two or more techniques can be combined, then features are extracted as per need and to evaluate results final comparison is done. The success of technique is dependent on pre-processing of the images because of illumination and feature extraction.

VII FUTURE SCOPE

Every application has its own merits and demerits. Further requirements and improvements can easily be done since the coding is mainly structured and modular in nature. Changing existing modules and adding new features can append improvements. We will continue our studies on aspects:

(i) Real time person input image can be loaded using Webcam
(ii) This application can be developed in Android Mobile.

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