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HUMAN FACIAL EXPRESSION DETECTION

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Abstract- Human Facial Expression Detection has different applications in the real world. We present a method to identify facial expressions taken from camera and build a parallel facial expression recognition system. A statistical technique such as PCA is used for dimensionality reduction and recognition and widely used for facial feature extraction and recognition. To test and evaluate the performance, experiments are performed using real database. Client/Server technique is used to reduce the processing time of each frame from the video. The five principal emotions to be recognized are: Happy, Sad, Anger, Disgust, along with Neutral.

***Keywords*- Facial Expression, PCA (Principle Component Analysis), SVD (Singular Value Decomposition), Feature Extraction, Face Expression Recognition (FER).**

1. INTRODUCTION

The face is primary focus of attention in society, playing an important role in conveying identity and emotion. Human ability to identify faces is remarkable. We can identify thousands of faces learned throughout our lifetime and identify familiar faces at a glance even after years of separation.

Nowadays face recognition technology is taking lot of importance and it is one of the most imperative topics in the field of face research. In order to accomplish this technology the key is to recognize human facial expressions by computer. Face recognition technology recognizes the human by his/her face image. Face recognition technology automatically analyses the features of the face in the digital image.

Computational model of face expression recognition are interesting because they can contribute not only the theoretical insights but also to practical applications. It is well recognized that facial expressions are the most expressive indicators that displays human emotions. In a natural interpretation, we can easily detect the human expressions. Computer used to recognize face expressions could be applied to a lot of wide variety of problems, including criminal identification, security systems, image and film processing, and human computer interaction. For example, to be able to model particular face, distinguish it from a large number of stored models, this makes it possible to improve criminal identification.

Developing computer model of face recognition is quite difficult, because faces are complex, multidimensional visual stimuli. Face recognition is very high level task for which computational approaches are very big limited on corresponding neural activities. Previous work on face recognition tells us that there is not importance of aspect of face stimulus. Assuming predefined measurements were sufficient due to that information theory approach can help us understanding information of face images. Features may or may not relate to our intuitive notation of face features such as eyes, nose, lips, and hair etc. Our aim is to develop a computational model of facial expression detection that is fast, simple and accurate in limited environment such as an office or a house. Plan is based on information theory approach which decomposes face images into small set of characteristics called “Eigen faces” like the principle components approach, which extracts relevant information in a face image and captures the variations in a collection of the face images. It compares one face with data base of models encoded similarly by using Principle Component Analysis to reduce the dimension of set or space so that the new basis, describe the typical “models” of the set. In our case models are a set of training faces. Components in this face space basis will be uncorrelated and maximize the variance accounted for in the original variables.

2. PROPOSED METHODOLOGY

Face expression recognition generally consists of three major parts:

1. Image Preprocessing
2. Feature Extraction
3. Face Expression Recognition

1. Image Preprocessing

Image preprocessing is preprocessing the image values, more precisely, the pixels in the case of digital images. The preprocessing can change the image representation from one color space to another color space. Image preprocessing is also used to increase or decrease image brightness, contrast and other morphological operations. Here we have to prepare the image, resize the image, do the lightning compensation, extract skin, and remove the noise from the image that enables

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us to extract the required features leaving out unwanted features, and to find skin color blocks. In this project we are making use of a database named 'Real Database' which has two sets of images namely trained database and test database. Trained database consists of 50 images, whereas the test database consists of 31 images which are to be preprocessed for feature extraction.

In the resize image part, we are resizing all the images that are present in the database which are of size 640*480 to 280*180 to maintain uniformity among the images, and reduce the efforts of extracting unwanted features. In the lightning compensation we are adjusting the contrast, sharpness, and brightness of the image, to make all the images have similar light and color properties. The image adjust function is used for adjusting the light properties and color properties. Extract skin is the phase of preprocessing where the RGB image is converted into gray scale image. At this stage the image is converted to equivalent gray scale image from the true color image RGB. RGB must be an M-by-N-by-3 array.

Noise removal is done to remove the unwanted features such as unwanted objects present in the background of the image which may lead to wrong results if retained. Noise removal is the integral part of the preprocessing because indirectly the feature extraction part starts at this stage. The last stage in the preprocessing is finding the skin color blocks, where we find the region properties of the image dividing the image into required number of regions, to extract features from each region.

2. Feature Extraction

Feature extraction process can be defined as the procedure of extracting relevant information from a face image. This information must be valuable to the later step of identifying the subject with an acceptable error rate. The feature extraction process must be efficient in terms of computing time and memory usage. The output should also be optimized for the classification step.

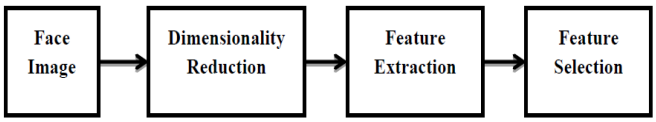

Fig. 1: Feature Extraction Process

The face image is given to dimensionality reduction block as shown in fig.1 for maintaining uniformity and to reduce the efforts of extracting unwanted features. PCA method is used for dimension reduction and extracting features from the image. The face extraction process will extract the relevant information, so that it can be used by feature selection block to identify the subject.

- **Principal Component Analysis:**

Principal Component Analysis (PCA) is the method used here to extract features from the images. In the image the face region is extracted by finding the four facial binding points on the face. From these four facial binding points we then extract the eye and the mouth region. We use the eye and mouth region to calculate the Eigen features. Every pixel variation in the eye and mouth region will give an Eigen feature. The extracted Eigen features are then passed for PCA to reduce the number of features based on dominance. The PCA gives us the top 100 highly varying Eigen features and eliminates the other lesser dominant features.

For the implementation of the proposed expression recognition system the database samples, are trained for the knowledge creation for classification. During the training phase when a new facial image is added to the system, the features are determined and aligned for the database formation. These databases consist of the image index and its corresponding features extracted. The feature table is created for the entire database image and passed for recognition.

- **Singular Value Decomposition:**

SVD is another method used to extract features from the images. The singular value decomposition is an outcome of linear algebra. It plays an interesting and fundamental role in many different applications. SVD in digital image processing applications provides a robust method of storing large images as smaller, more manageable square ones. This is accomplished by reproducing the original image with each succeeding nonzero singular value. Furthermore to reduce storage size even further, images may approximate using fewer singular values.

3. Face Expression Recognition

The last part of the FER system is based on machine learning theory; precisely it is the classification task. The input to the classifier is a set of features which were retrieved from face region in the previous stage. The set of features is formed to describe the facial expression. Classification requires supervised training, so the training set should consist of labeled data.

Once the classifier is trained, it can recognize input images by assigning them a particular class label. The most commonly used facial expressions classification is done both in terms of Action Units, proposed in Facial Action Coding System and in terms of universal emotions: Happy, Sad, Anger, Disgust and Neutral. Three principal issues in classification task are: Choosing good feature set, Efficient machine learning technique and Diverse database for training. Feature set should be composed of features that are discriminative and characteristic for particular expression.

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Machine learning technique is chosen usually by the sort of a feature set. Finally, database used as a training set should be big enough and contain various data. The following Fig. 2 demonstrates the proposed methodology for Facial Expression Recognition.

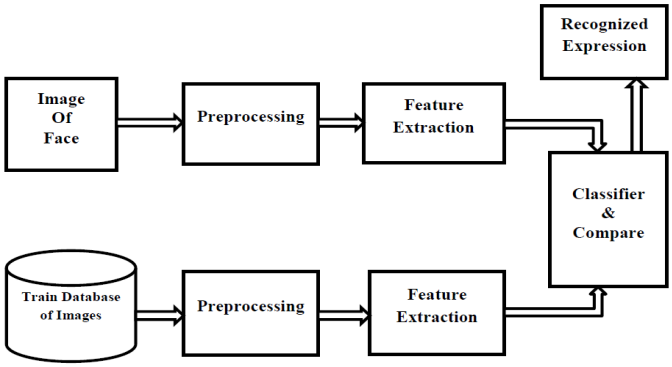

Fig. 2: Methodology of Facial Expression Recognition.

Classifier:

The task of classification is to assign the feature vector to its corresponding class, usually solved using a classifier. That is, given the chosen features represented in a feature vector, it is the classifier that maps the feature space span to a set of discrete labels. There are several ways for mapping this could be performed. When designing a classifier there are two main fundamental approaches, the generative and discriminative model. The generative model involves modeling the classes, usually by means of statistical methods. The discriminative approach focuses on discriminating between the classes. Here in this project the classifiers used are two algorithms: PCA and SVD. The input to the classifier is a set of features which were retrieved from face region in the previous stage. The set of features is formed to describe the facial expression. Classification requires supervised training, so the training set should consist of labeled data.

The database used for facial expression system is Real Database. There are 31 test images and 50 train image Real Database. All images are resized to a uniform dimension of 280x180. Each image has been rated on 5 emotions. There are 31 test images in training dataset which are compared with 50 train images in training dataset to recognize facial expressions. The facial expression database is maintained of all the 50 train images which consist of train image name and its expression. The test data is loaded and projected on the feature space. The feature matrices of train images and testing images are passed to the classifier unit for the classification of a given face query with the knowledge created for the available database. Then Euclidean distance based matching classifier is used for finding the closest match.

Eucl_Dist = sqrt ((Test Image - Train image)*(Test Image -Train image))

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3. SOFTWARE REQUIRED: MATLAB 7.8

MATLAB (**mat**rix **lab**oratory) is a numerical computing environment and fourth-generation programming language. Developed by Math Works, MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, Java, and Fortran. Although MATLAB is intended primarily for numerical computing, an optional toolbox uses the MuPAD symbolic engine, allowing access to symbolic computing capabilities. An additional package, Simulink, adds graphical multi-domain simulation and Model-Based Design for dynamic and embedded systems. MATLAB application is built around the MATLAB language, and most use of MATLAB involves typing MATLAB code into the Command Window (as an interactive mathematical shell), or executing text files containing MATLAB codes, including scripts and/or functions.

4. RESULT

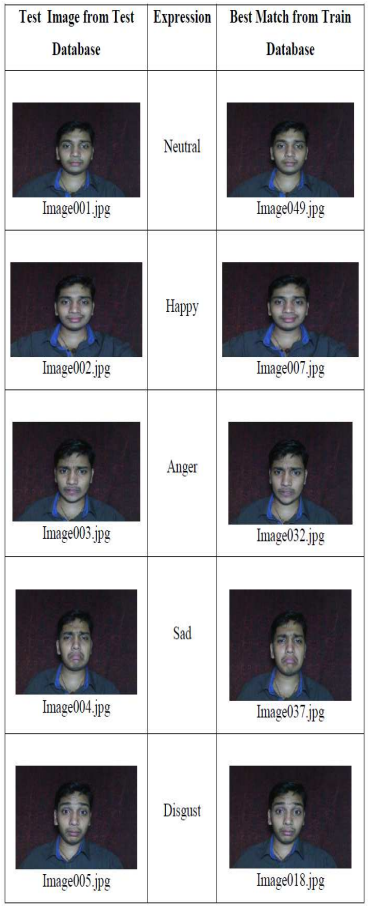

Fig.3: Result

5. CONCLUSION & FUTURE WORK

The Human Facial Expression Detection system can detect and recognize facial expressions by making use of real database using PCA & SVD techniques and comparing the time complexity of the two techniques. Computer that recognizes facial expressions could be applied to a lot of wide variety of problems. This system can be very helpful in criminal identification, security systems, image and film processing, and human computer interaction. For example to be able to model particular face, distinguish it from a large number of stored models. This makes it possible to improve criminal identification. With still more R&D on this system one can increase the reliable ratings over the drawbacks.

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BIOGRAPHY

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