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Eigen Based Facial Expression Using Mouth Feature

Prasad M[1], Ajit Danti[2]
Department of Computer Applications[1&2]
Bapuji Institute of Engineering and Technology[1]
Davanagere-4
JNN College of Engineering[2]
Shimog-4
India

ABSTRACT
Facial expressions plays very important role in the human mood analysis. Various facial expressions viz happy, disgust, anger, sad, surprise and normal are recognized using Eigen based facial appearance of person. In this paper facial expressions are recognized using only mouth feature because mouth plays very dominant role in the recognition process. Computational cost and the dimension of the feature set is reduced by applying PCA method only on the mouth feature not on entire face. The experimental results demonstrate the efficiency of the proposed approach.
Keywords:- Facial expression, Eigen Face, PCA, mouth feature

I. INTRODUCTION

In recent years, the research for developing automatic facial expression recognition systems has attracted a lot of attention from the research community in the human mood analysis. Facial expressions are classified into happy, disgust, anger, sad, surprise and normal. These expressions play very important role in the analysis of human mood such as state of human mind during interview, criminal investigations and forensic analysis.

Facial expression recognition involves three steps face detection, feature extraction and expression classification. Facial expression classification plays very important role in the study of human mood. Many researchers have done work in this research area yet efficient and robust facial expression system need to be developed. Because changes of facial expression mainly exist in eyes and mouth, eyes and mouth are treated as mutual independent elements [10].

Facial expression recognition based on Local Binary Patterns features. Different classification techniques are examined on several databases [1]. Basic principle of Adaboost milti-expresion classification algorithm and demonstrate the process of training and testing in detail

The most expressive way humans display emotions is through facial expressions. Method for expression recognition based on global LDP features and local LDPv features with SVM decision-level fusion, which can retain the influence of global facial face and while highlight the local region with more contribution on expression changes [7]. Deriving an effective facial representation from original face images is a vital step for successful facial expression recognition. There are two common approaches to extract facial features: geometric feature-based methods and appearance-based methods [13]. Accuracy of facial expression recognition is mainly based on accurate extraction of facial feature components. Facial

feature contains three types of information i.e texture, shape and combination of texture and shape information [14]. Face is represented based on statistical local features, local binary patterns (LBP) for person independent expression recognition.

Method to identify the facial expressions of a user by processing images taken from a webcam. This is done by passing the image through 3 stages - face detection, feature extraction, and expression recognition [12]. The combination of SUSAN edge detector, edge projection analysis and facial geometry distance measure is best combination to locate and extract the facial feature for gray scale images in constrained environments and feed forward back-propagation neural network is used to recognize the facial expression [8]. To attain successful recognition performance, most current expression recognition approaches require some control over the imaging conditions because many real-world applications require operational flexibility. In particular, research into automatic expression recognition systems capable of adapting their knowledge periodically or continuously has not received much attention [5]. A system that performs these operations accurately and in real time would form a big step in achieving a human-like interaction between man and machine [11].

LBP is used for texture analysis along with Support Vector Machine for low resolution and better performance [2]. One of the fundamental issues about the facial expression analysis is the representation of the visual information that an examined face might reveal [15]. For successful facial expression recognition, deriving an effective facial representation from original face images is a crucial step. There are two common approaches to extract facial features: geometric feature-based methods and appearance-based methods [4, 9]. Multiple face region features are selected by Adaboost algorithm. Face is divided into sub regions by Adaboost based on multiple region orthogonal component principle component analysis features like eyes, mouth and nose. The region combination were used as input to AdaBoost classifier, this at each stage chooses the best such combination before changing the weights for next iteration [6]. Susan operator is used to locate corners for different feature point to increase Accuracy [3]. Despite 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 [16, 17, 18, 19, 20].

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 Eigen faces. Each Eigen face 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 [21, 22, and 23] by its Eigen face coefficients.

In this paper an approach to the problem of classification of facial expression is used for the analysis of emotion and mood of a person using mouth feature. The rest of the paper is organized as follows. Section I gives brief introduction, Section II presents methodology followed, section III gives experimental results and analysis, section IV presents conclusion and future scope and last section gives references used.

II. PROPOSED METHODOLOGY

Principal Components Analysis (PCA) is a technique used to identifying patterns in data, and highlight their similarities and differences. Normally patterns are hard to find in data due to their high dimensionality, for which PCA is used for analyzing data.

If several images that are close to each other in the PCA space, that indicate that the images resemble but differ slightly from each other. The direction of these variations is important which are called as Principal Components. PCA extracts directions in cloud shape. If the cloud is shaped like a football, the main direction of the data would be a midline or axis along the length of the football. This is called the first component, or the principal component. PCA will then look for the next direction, orthogonal to the first one, reducing the multidimensional cloud into a two-dimensional space.

Using PCA a subset of principal directions (principal components) are found in a set of training faces. Then mouth features are projected into this principal components space and get feature vectors. Comparison is performed by calculating the distance between these vectors. Usually comparison of mouth image images is performed by calculating the Euclidean distance between these feature vectors.

A. Facial Expression Recognition

Automatic recognition of facial expression normally adheres to a classical pattern recognition model. In which important steps are image acquisition, preprocessing, size normalization, edge detection, feature extraction, classification, post processing etc.

In this paper static images used for facial expression recognition. However, color images convey emotional cues such as blushing.

Read a gray scale or color image and normalized to a size of 100x80 size. Then pre-process by signal conditioning such as noise removal, and normalization against the variation of pixel position or brightness, together with segmentation, location, or tracking of the face and mouth part. Expression representation can be sensitive to translation, scaling, and rotation of the head in an image. To counteract the effect of these unwanted transformations, the facial image may be geometrically standardized prior to classification. This normalization is usually based on references provided by the eyes or mouth. Segmentation is concerned with the demarcation of image portions conveying relevant facial information.

Face segmentation is often anchored on the shape, motion, color, texture, and spatial configuration of the face or mouth components. The face location process yields the position and spatial extent of faces in an image; it is typically based on segmentation results. A variety of face detection techniques have been developed. However, robust detection of faces or their constituents is difficult to attain in many real-world applications.

In edge detection process uses the Sobel method to detect edges but there are various edge finding methods such as Prewitt method, Roberts method. All these methods approximate to the derivative. It returns edges at those points where the gradient of is maximum. Then the image is adjusted for contrast to enhance the edges.

In feature extraction process, edge pixel are converted into a higher-level representation of shape, motion, color, texture, and spatial

configuration of the mouth components. The extracted representation is used for subsequent expression classification. Feature extraction generally reduces the dimensionality of the input space. The reduction procedure must retain essential information such as high discrimination power and high stability.

B. Applying PCA

By means of PCA one can transform each original image of the training set into a corresponding Eigen face. An important feature of PCA is that one can reconstruct any original image from the training set by combining the eigenfaces. Principal component Analysis applied on the set of manually cropped mouth images from the given face images using matlab toolbox as follows.

[Coeff, Score, latent, tsquare] = princomp (X)

Where X is n x p data matrix. Rows of X correspond to observations and columns to variables. Each column represent features of one mouth image. Coeff is a p x p matrix, each column containing coefficients for one principal component. The columns are in order of decreasing component variance. Score represent X as principal component space. Rows of score correspond to observation, columns to components. Latent represent Eigen values of the covariance matrix of X. It is the variance of Score

C. Classification

Expression recognition is obtained by the classifier, which often consists of models of pattern distribution, coupled to a decision procedure. A wide range of classifiers, applied to the automatic facial expression recognition problem.

The block diagram of the proposed system is shown in the Fig 1.

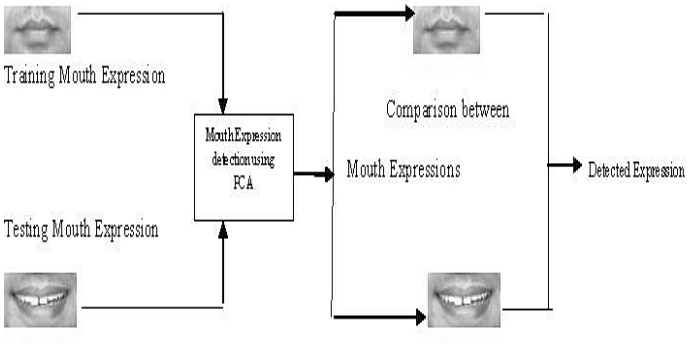

Fig1. The process of feature extraction

III. EXPERIMENTAL RESULTS

Proposed approach is implemented on JAFFE database and own dataset in which 100 images are used for each expression belong to different people. Satisfactory success rate of the expression recognition is tabulated in the Table 1.

Type of Gesture	Happy	Disgust	Anger	Sad	Surprise	Neutral
Happy	98	0	0	0	0	0
Disgust	0	97	0	0	0	0
Anger	0	0	98	0	0	0
Sad	0	0	0	98	0	0
Surprise	0	0	0	0	99	0
Neutral	0	0	0	0	0	100

Table 1: success rate of various facial expressions

IV. CONCLUSION

In this paper, facial expression detection system has been proposed by applying principal component analysis. In this paper instead of entire face only mouth feature is used for the facial expression recognition which in reduced the computational cost of analysis. Proposed approach

is experimented on sample images taken from JAFFE and own dataset and demonstrated the efficacy of the proposed system.

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