Facial Expression Detection using Facial Expression Model

Hari Prasad Mal
Research Scholar,
School of Computer Science & Engineering,
VIT University, Vellore, India-632014
hari.mhp@gmail.com

Dr. Swarnalatha P.
Associate Professor,
School of Computer Science & Engineering,
VIT University, Vellore, India-632014
pswarnalatha@vit.ac.in

***Abstract*—Facial expressions are the facial changes indicating internal state of human being, objectives or communal conversation. Subject to the change of emotions on the face, any persons face is the most important mode of conveying and deducing affective states of human ones. On the fly facial expression detection has become a major research area as it plays a key role in Human Computer Interaction. Facial expression detection has major application in areas of social interaction as well as social intelligence. This paper represents the various techniques used in facial expression detection along with system.**

Keywords—Facial Expression Detection; HCI; Social Intelligence;

I. INTRODUCTION

In the recent years, many improvements have been accomplished in the areas like face aspects, face tracing and it predicted the attention in facial expression revealing field. Facial emotions are created as a result of distortions of facial features due to the constriction of facial muscles. The facial expressions are inspected for recognizing the basic human emotions like fear, anger, sadness, happiness, surprise and disgust. These expressions can vary between individuals. There are four major steps include for the recognition facial expression. Face recognition and regulation stage distinguishes the face and illumination effect is reduced. Next stage is feature abstraction which abstracts the features and irrelevant information about face are excluded in feature selection method. Final stage is ordering where the facial languages are categorized in to six basic emotions. Approaches like PCA [1], Linear Discriminant Analysis [2], and Independent Component Analysis [3] constitute a major part in the facial expression detection techniques. All these methods are goes under the category of 1-dimensional representation.

Therefore 2- dimensional Principal Component Analysis [4] is introduced. As these methods are applicable only for black and white gray balance images, Global Eigen Method [5] and Sub pattern extended 2-dimensional Principal Component Analysis [6] (E2DPCA) can be stretched by outdated approaches to color space. Multi-linear Image Examination [7] introduced tensor conception which allows more than one factor variation in contradiction to PCA. Tensor concept is also used in Color Subspace Linear Discriminant Analysis [8] but in color space it simply improves the accuracy. In order to achieve greater performance, the other technique called Gabor Filer Bank [9] is mostly used to outperform over all present methods. The Local Gabor Binary Pattern technique [10] has significantly improved recognition rate as compare to Gabor filter bank method. Many studies have revealed that the overall performance is enhanced by color component embedding. Nonetheless if RGB color space is used, then the accuracy depends on the angle and light source which in turn reduces the detection act. Thus RGB shade space is nevertheless appropriate for color statistics processing. Perceptual constant color schemes can talk this problem. To overcome the said problem, a novel tensor perceptual framework [11] for facial expression recognition is presented in this paper to achieve better accuracy. This is done on perceptual color space and can be examined under slight variations in illuminations.

II. TECHNIQUES USED FOR FACIAL EXPRESSION RECOGNITION

A. Principal Component Analysis

Principal Component Analysis (PCA) is also known as the Eigen face approach is one of the popular methods for facial expression recognition [1]. The substantial role of PCA is to minimize the dimensionality for effective face indexing and retrieval. In addition to this, PCA uses linear projection, which makes best use of maximizing the projected sample scattering [2]. In this, the identity of the person is the only varying factor. CA faces difficulty if other factors similar perspective, lighting are diverse.

B. Fisher's Linear Discriminant

Under severe variation in facial expression and enlightenment Fisher‟s Linear Discriminant (FLD) is extra appropriate. FLD decreases the smattering of predictable sample since it is a class specific method [2]. Error rate is reduced when compared to PCA.

C. Independent Component Analysis

Both PCA and LDA generate spatially global emotional routes. But for actual facial expression detection spatially restricted feature routes is needed. Therefore ICA generates

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statistically independent basis vector [3]. The average detection proportion is enhanced. But ICA is computationally wealthy than PCA.

D. 2Dimensional Principal Component Analysis

In PCA, feature extraction is done based on 1D vectors. Therefore the image matrix needs to be converted into route. 2DPCA uses 2D matrix instead of 1D route[4]. The detection proportion of 2DPCA is higher than PCA. But the disadvantage is the storage required for 2DPCA is higher than PCA as the 2DPCA needs more number of coefficients for image representation.

E. Global Eigen Approach using Color Images

Conventional facial expression recognition techniques like principal component analysis, Linear discriminant analysis etc uses lonely the luminance statistics in appearance images.The color information in face images uses by Global Eigen Approach[5]. RGB color space does not provide any improvement in recogniton rate. In HSV color space method, H component is eliminated as it minimizes the recognition proportion. high recognition rate provided by YUV colorspace.

F. Sub pattern Extended 2-Dimensional PCA

The recognition proportion of PCA is low and has small model scope problem. On behalf of gray facial expression detection, 2DPCA is extended to Extended 2DPCA. The drawback of this method is that it is not suitable for hue images. Consequently Sub pattern extended 2-Dimensional PCA (SpE2DPCA) is introduced for color face recognition [6]. This method has the higher recognition rate than E2DPCA, 2DPCA, PCA as well as the problem in PCA of small sample size is also excluded.

G. Multilinear Image Analysis

Facial expression recognition needs different attributes such as expressions, pose, lighting, to be taken care of. But the conventional PCA addresses only variations in single factor. Multilinear image analysis is used multilinear algebra[7]. In this, the thought of "Tensor faces" is functional, which isolates the several features used in the formation and representation of an image. This method provides recognition rate higher than the PCA approach. Multilinear image analysis does not incorporate the color information.

H. Color Subspace Linear Discriminant Analysis

The 1DLDA AND 2DLDA are extended in color space to improve the face recognition accuracy. A 3-D color tensor is used to generate color LDA subspace[8]. The Horizontal unfolding used in this method increases the rate of recognition for 2DLDA whereas vertical unfolding improves upon the recognition proportion for 2DPCA.The concert appraisal of several color spaces is not done.

I. 2D Gabor filter bank

The Gabor filtering is considered as one of the most vital feature extraction system in facial expression recognition [9]. Gabor filter bank performs better in terms of recognition rate than the other approaches like principal component analysis, Linear discriminant analysis etc[11]. The basic limitation of gabor filter is its bandwidth limitation i.e. Supreme bandwidth is limited to one octave. Gabor filters cost high and low frequency information since it is band pass in nature.

J. Local Gabor Binary Pattern

Appearance based features are being used for face recognition since it encodes specific details nearly about human faces. The facial image is separated into sub blocks and similarities in between sub blocks is acquired [10]. A significant benefit of Local Binary Pattern (LBP) is its illumination tolerance. LBP is obtained from gabor filters for feature vector generation in Local Gabor Binary Pattern (LGBP) method. LGBP achieves better performance than gabor filter technique [11]. All these techniques have enhanced the performance of the facial expression recognition system considerably by incorporating tensor concepts and color component. The color spaces like RGB do not provide provision for head pose and lighting variations.

TABLE I
COMPARISON BETWEEN FACIAL EXPRESSION TECHNIQUES

Name	Method	Performance	Disadvantages
Low-Dimensional Procedure for Characterization of Human Faces	Principal Component Analysis	Recognition rate is low	Only single factor can be varied
Eigen faces vs. Fisher faces : recognition using class specific linear Projection	Fisher's Linear Discriminant	Recognition rate higher than PCA	Global feature vectors are generated
Two-dimensional PCA: A new approach to appearance-based face representation and recognition	2-Dimensional Principal Component Analysis	Recognition rate is higher than PCA	Storage requirement is higher than PCA
The importance of the color information in face recognition	Global Eigen Approach using Color Images	YUV color space has highest recognition rate	RGB color space does not provide any improvement in recognition rate
A novel hybrid approach based on sub-pattern technique and E2DPCA for color face recognition	Subpattern Extended 2-Dimensional Principal Component Analysis	Recognition rate higher than PCA,2DPCA	Variation in lighting, pose are not considered
Face Recognition using a Color Subspace LDA approach	Color Subspace Linear Discriminant Analysis	Recognition rate is higher than 2DPCA and LDA	Variation of performance in color spaces is not evaluated

To improve the performance in varying conditions, perceptual color space like CIELab and CIELuv is used. The color images are represented using 3D matrix. In order to obtain 3D matrix, a 2D filtering operation is applied on 3D array, which is difficult in nature. As a solution to this problem, 2D filters need to apply three times over the three color components of images. Instead of doing this, tensor concept is utilized. The filtering operation is straightway applied to the tensor i.e produced from the color image.

This paper presents a Tensor Perceptual Color Framework (TPCF) [11] where color image components are horizontally unfolded to 2D tensors using tensor concepts and multilinear algebra. Log-gabor filters are employed for feature abstraction since it overcome the limitations of gabor filter based technique. Mutual information quotient method is utilized for feature selection. The Multiclass linear discriminant analysis classifier is used to obtain the classification of the selected features. TPCF n effectively recognizes the facial expressions under different conditions.

Comparison among all above methods is depicted in Table I.

III. IMPLEMENTATION

Facial expression recognition can be regarded as a explicit case of object-class revealing. In object-class recognition, the task is to discover the places and sizes of all objects in an image that belong to a given class. Cases include upper torsos, striders, and cars. Face recognition can be viewed as a more common case of face localization. In facial expression localization, the task is to find the positions and sizes of a known digit of faces (usually one).

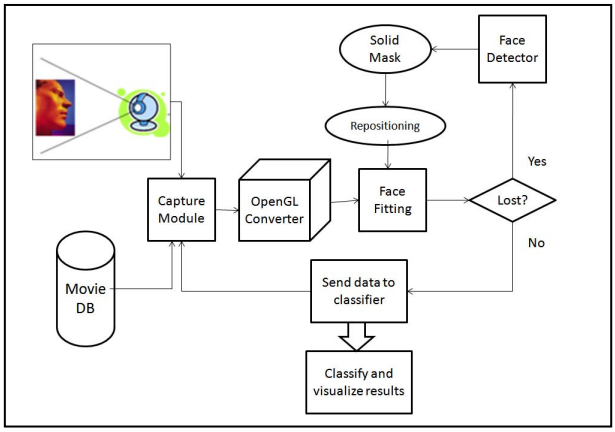

Fig 1.Implementation of Facial Expression Detector

In facial expression detection, one does not have this further information. Early face-detection algorithms concentrated on the detection of anterior human faces, while newer algorithms try to solve the more common and hard problem of multi-view facial expression detection. That is, the detection of faces that are either turned along the axis from the face to the observer (in-plane rotation), or turned along the vertical or left-right axis (out-of-plane rotation). The latest algorithms considers changes in the image or video by factors like face lighting, appearance, and pose.

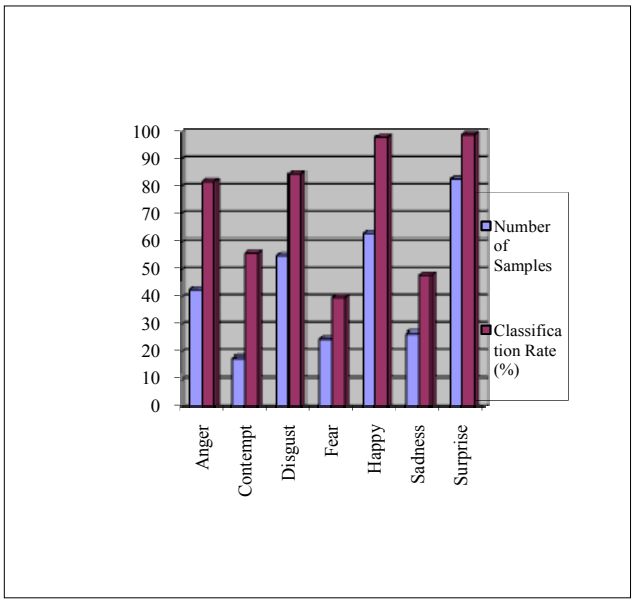

Fig 2 .Relation between number of sample images and classification rate

In order to make the information retrieved from the face and facial expressions available for usage, the facial gestures should be described. The Facial Action Coding System (FACS) is the most commonly used system for facial behaviour analysis in emotional research. Another way of describing facial actions is in model-based approaches, geometrical terms, by using the Facial Animation Parameters (FAPs) that describe the face motion.

IV. RESULT & DISCUSSSION

Facial feature motion is more subtle, and the temporal boundaries for expression are difficult to determine in cases like spontaneous facial expression. If small changes in the Facial Expressions are not extremely Subtle, then the SIFT Flow can capture these changes. If a Facial Expression is acceptable for an Application, then it is possible to Sample the data based on the Appearance Change and to learn the Temporal Boundary. On the other hand, if the application needs to capture subtle information and multiple labels are required, one can consider learning the relation between different labels and the appearance feature.

V. CONCLUSION AND FUTURE SCOPE

This Paper presents the System which describes facial expression recognition. When we pass a surveillance video through facial expression detector model, we get emotional sequences of different images. This sequence is called as single Emotional Avatar Image representation. A large rigid head motion is compensated by adopting SIFT flow technique which aligns the face images. SIFT flow technique generates the higher classification rate.

This method is measured on the basis of recognition rate in which higher the recognition rate, provides better performance. Our findings are listed below.

- The tensor perceptual color framework has the highest recognition rate and has highest performance.

- Additional study can be laid down in the trend of allele of gene identical to the geometric factors of the facial expressions.
- The genetic property development framework for facial expressional method can be deliberate to suit the necessity of diverse security models such as criminal exposure, governmental confidential security breaches etc.

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