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A New Algorithm for Facial Expression Recognition Using Features of Facial Patches

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***Abstract*— facial expression recognition have important role in human computer interactions. The main applications are clinical purpose, age detection, gender classification, driver safety, health detection etc. In most case LBP, PCA algorithms are used for the detection of facial expressions. The existing systems are based on geometric and appearance based features. The geometric features track the shape and size of the facial components. This paper proposes a new algorithm for facial expression recognition using features of salient facial patches. Viola - Jones algorithm is used for face detection. Land mark detection algorithm is used for land mark detection. SVM classifier is used for the classification of extracted facial patches into different categories. The appearance features from these patches are fed to a multi class classifier to classify the images into six basic expressions. The algorithm is developed and tested with CK+ and JAFFE database.**

Key words : Facial Expression , land mark detection, facial patches, QDA.

I. INTRODUCTION

FACIAL expression is on or more motions or positions of the skin of the face. These movements convey the emotional state of an individual to observers. Facial expressions are the form of nonverbal communication, means of conveying information between human. The facial expression analysis depends up on the accurate detection of facial features. The facial features include geometrical and appearance features. Also the facial features are different for each and every person. The facial features are changed during the emotion so analyzing these active patches helps for the recognition of facial expressions.

Facial expression recognition is an important issue in the field of human computer interactions, computer vision deals with processing of images, to create structured information, which helps the computer system to take appropriate decisions [1]. The main problem exist during the facial expression recognition is the detection of appropriate facial features. SVM is used for the classification purposes, when SVMs' is used for low resolution images it didn't affected the classification rate [2]. There are mainly three methods for facial expression recognition a) appearance based b) geometric based c) using facial patches. In characteristic of appearance based method is that the facial features are selected using pixel intensity values in an image directly [3] that means the object recognition from light-fields. In geometric based method [4] the recognition of expression by tracing the shape and size of facial landmarks using multiclass support vector machines. The main problem of this method is that it requires accurate detection of facial landmarks, any errors occurs during the detection of face will affect the overall performance of the system. In the method of recognition using facial patches [5], the facial patches are depending on the position of facial landmarks, are extracted which are active during the emotion. The facial patches are eyes, eyebrow corner, nose, lip corner. The main and initial step of this method is the face detection using Viola Jones algorithm. This algorithm also used for object detection in real time system. This paper proposes a novel framework for expression recognition using features of selected facial patches. Recognition process includes segmentation and thresholding. This method have better performance, hence providing solutions for expression recognition in low resolution of images and significantly less execution time. The expressions are come out from the human during the emotion elicitation, these facial expressions depends not only on the facial features but also on speech and body language. All experiments are done in based on six basic expressions they are anger, fear, happiness, surprise, disgust and sadness. The facial expression classification systems are mainly divided in to two categories; person dependent and person independent. In the first category the system trains on facial expression of certain persons and recognize the expression for the same persons but in the second one the persons in the training phase differ from the testing one. Automatic facial expression recognition is a difficult task.

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Humans can adopt expressions voluntarily or involuntarily and the neural mechanism controlling the different expressions in each and every situations. In the film industry the facial expressions have an important role in their action.

Face detection and face recognition is rapidly growing field of research due to the continuous increasing interest in application of human behavior analysis and technologies for human computer interactions. The future scope of this paper is that the extracted facial patches and classifies them according to age, gender and race.

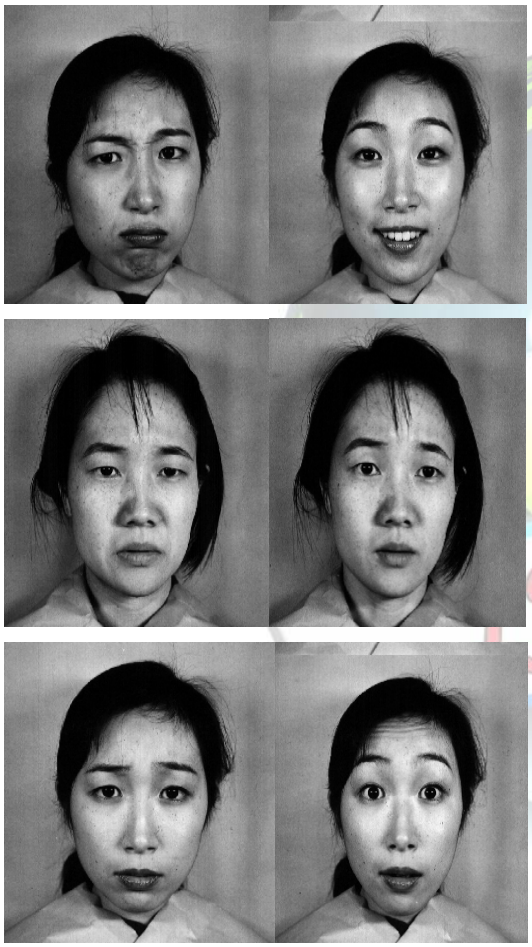

Fig1.basic expressions

II. RELATED WORK

A number of novel methodologies of automatic facial expression recognition have been proposed over the last decade. Classification scheme are two types 1) static 2) dynamic. For static classification Naïve Bayesian classifiers and tree augmented naïve (TAN) Bayes classifiers are used. In the case of dynamic classification, hidden Markov model is used. Happiness and surprise were detected with accuracy 86% and 93%, other expressions were found to be mismatched with one another [6].

According to White hill et al SVM (support vector machines) and Gabor filters can be used for the automatic expressions recognition. It proposes automatic facial expression recognition for intelligent tutoring systems [8]. Main drawback of that method is that the accuracy is comparatively less. Gabor wavelet labeled elastic graph matching and Eigen face are used for facial feature detection. These techniques are fully automatic and have potential applications for both intelligence tutoring systems and standard classroom environments [10].

In this system of dynamics of facial expression recognition the facial action units (Aus) and their temporal models from long, profile –view face image sequence. Though there are many advantages in using a facial action coding system, it cannot recognize full range of facial behavior [10]. In the particle filtering method track 15 facial points in an input face-profile sequence, and introduce facial action dynamics recognition from continuous video input using temporal rules. The disadvantage of this approach is that confusion arises during the identification of action units for each pair of expression [11]. Facial expression recognition using facial characteristic points and Gini index. Although it gives promising results for expressions like surprise, fear and happiness, for expressions like sadness anger and neutral gives comparatively lower recognition rate [12]. In some facial expression recognition methods, active appearance models are employed, features are extracted using trained AAM and a SVM is build from it and these are further cascaded to improve overall performance [13]. In some other case use both geometric and appearance based models for facial expression recognition. In the geometric based method consider the shape and size of the facial features. In the appearance based method the skin, luminance contrast, brightness are considered. This method is robust in performance. This approach also shows comparatively lesser accuracy in detecting expressions like anger disgust and sadness. K-nearest neighbor classifier may be used to classify gender; it shows high performance [14]. In this paper we propose facial expression recognition from facial patches.

III. PROPOSED METHODOLOGY

Changes in facial expressions involve contraction and expansion of facial muscles which alters the position of facial landmarks. Along with the facial muscles, the texture of the area also changes. This project attempts to understand the

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contribution of different facial areas toward automatic expression recognition.

Image segmentation and thresholding are the main process in this paper. Image segmentation is the process of partitioning a digital image into multiple segments (known as pixels).The goal of segmentation is to simplify or change the representation of an image into something that is more meaningful and easier to analyse. Image segmentation is typically used to locate the facial patches in images. The result of image segmentation is a set of segments that collectively cover the entire image. Each of the pixels in a region are similar with respect to some characteristic or computed property, such as colour, intensity, texture. Adjacent regions are significantly different with respect to the same characteristics. Thresholding is that find out the particular value of these facial patches. After the above 2 steps avoid the fake detection of facial patches and improve the localisation of active patches. During the landmark detection mark facial patches and extract the active facial patches. Using QDA classifier the extracted facial patches are classify according to the expressions.

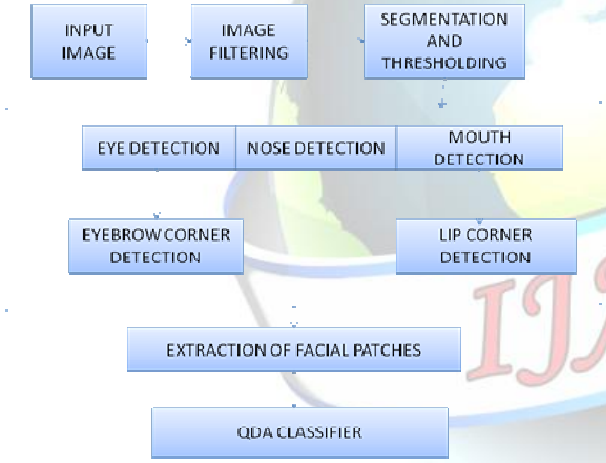

Fig2. Overview of proposed system

A. FACE DETECTION

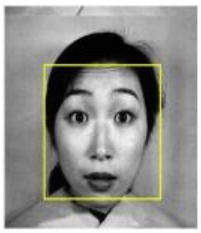

Fig3 : Face Detection

Face detection is done using Viola-Jones algorithm. A preprocessing is done to remove noise from the input image, after that face is detected using Viola-Jones algorithm. This algorithm is also used for the object detection in real time system. Face-detection algorithms focus on the detection of frontal human faces.

B. LANDMARK DETECTION

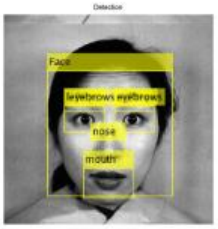

Fig 4 : Landmark Detection

Land marks detection means detect the actual position of eyes, nose and mouth in a face. For accurate detection of facial expression, landmark detection is necessary. Haar features are used to detect facial landmarks and are measured in terms of the relative variation distance between the estimated and the ground truth landmark positions. The actual position of landmarks is adjusted by adjusting the threshold value. The size of the face is defined as the distance between the center of the mouth and the midpoint between centers of the eyes.

C. EYEBROW CORNER DETECTION

Fig 5 : Eyebrow corner detection

To detect the eyebrow corner, region of interest (ROI) is selected around the eye region. Haar-classifier is used to find eye region which returns a rectangular region around the left and right eyes to locate the actual position of eyebrows. A horizontal edge detector is used for the eyebrow corner detection.

D. LIP CORNER DETECTION

Fig 6: Lip corner detection

Sobel edge detector is used for the lip corner detection. The algorithm returns a rectangular box around the mouth region to locate the actual position of mouth. Morphological dilation operation and Sobel edge operator is applied and thereby lips corners is identified. . A ROI based on the location nose is selected for eliminating false detections of

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nose. Proper thresholding eliminate false detection of landmarks

E. EXTRACTION OF ACTIVE PATCHES

Fig 7 : Extraction of active patches

Active facial patches are extracted using LBP.

$$\sum \mathbf{LBP}(x,y) = \sum_{k=0}^{7} (i_n - i_c)2\text{^n}$$

i_c is the pixel value at co-ordinate (x,y). i_n are the pixel value co-ordinates in the neighborhood of (x,y).

$$S(x) = \begin{cases} 0, x < 0 \\ 1, x \geq 0 \end{cases}$$

n is the number of labels produced by LBP operator.

F. LEARNING AND TRAINING FOR EXPRESSIONS

Support Vector machines are used for training purposes (SVM). LBP is used for high resolution images and LDA is used for low resolution images. Training is implemented using SVM. In this method the input image is filtered to eliminate noise, if present. The second step is the segmentation and thresholding of face, after that facial landmarks detection. By the localization of facial landmarks, the facial patches are identify then marked facial patches are trained using SVM and QDA classifier is used for classification purpose.

IV. EXPERIMENTS AND DISCUSSION

The proposed method works well on CK+ and JAFFE database. It shows the effectiveness of the proposed system. Experimental results show that when number of facial patches increase, accuracy of facial expression also increases. A SVM classifier is used in the training stage, and is coupled with LBP histogram. QDA classifier has better performance.

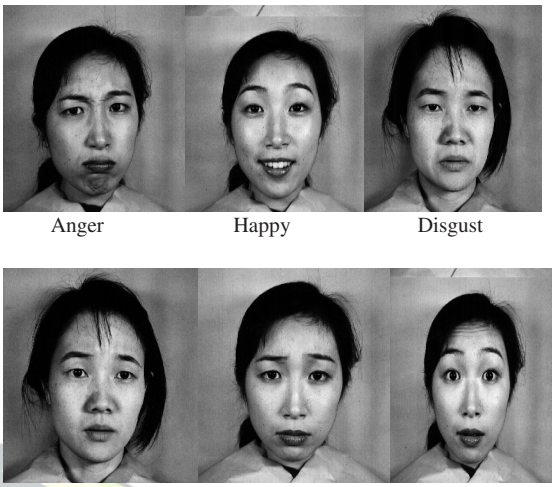

Fig 8 : Experimental results

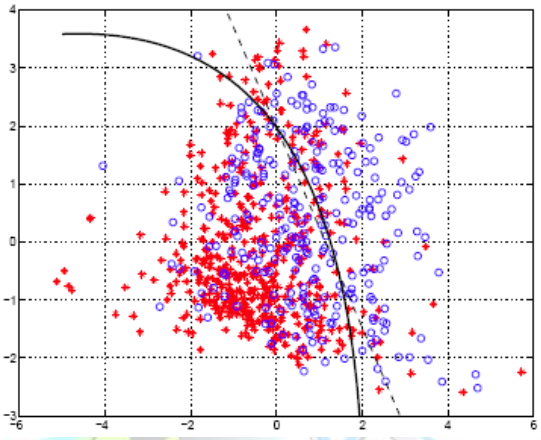

Fig 9 : QDA classifier

V. CONCLUSION

This paper has presented an efficient method to identify facial expression using features of facial patches. Face detection is done using viola jones algorithm. Different edges operators are used for the landmark detection. Training is implemented using SVM (support vector machine). QDA (Quadratic Discriminate Analyzer) classifier provides with higher classification rate. The proposed system works efficiently on CK+ and JAFFE database. This method requires less execution time and providing solution for expression recognition in low resolution images. This system also has future scope in age and gender classification.

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