Techniques for Facial Recognition System: Survey

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Abstract : Facial expression recognition is a crucial part in exploration of man-machine interfaces. It helps in identifying human emotions like happy, sad, disgust, fear, anger or surprise. By understanding feelings of person we can prevent some appalling act or danger. Facial recognition system captures images via computer vision to detect human expression. In this paper, firstly the process of facial expression recognition is explained and further survey of latest techniques for Facial expression recognition system is performed on the basis of feature extraction, classification method and recognition rate.

***IndexTerms* – Facial expression, feature extraction, emotions recognition, image processing.**

I. INTRODUCTION

Facial Expression is a significant mode of communicating human emotions. Sentiment Analysis deals with natural language processing to study peoples opinion, attitude or emotions about a product, service, person, circumstances or a thing.

Ages ago, opinions of friends and relatives were used to perform sentiment analysis about any product or services by conducting surveys and polls. For past few years textual format is used to expression sentiments. The topic of spontaneous facial expression recognition was relatively neglected till 2011. But nowadays people prefer in expressing emotions through videos through Instagram, Facebook, etc.

Facial emotions is challenging to determine the state of mind of an individual. Humans cannot keep eye surveillance on an individual, where automated emotion recognition system plays an important role.

Large number of people can be observed in closed area like office and determine emotion of employees and find out whether the employee is having a suitable environment at home as well as office.

Emotion recognition using image involves central step of detection of face. Since human face have influential behavior, hence high degree of inconsistencies which leads to a challenge for face detection. Face detection involves segmentation, extraction and verification of faces and facial features from background images.

After detecting face in video, features are extracted from human face, used to determine emotions expressed in these images. Various datasets or real time data-set is used to determine the identity of the person and train the model to identify the expressions namely happy, sad, disgust, fear, anger or surprise.

II. PROCESS FOR FACIAL RECOGNITION SYSTEM

The process of facial expression recognition is demonstrated in the below figure 1

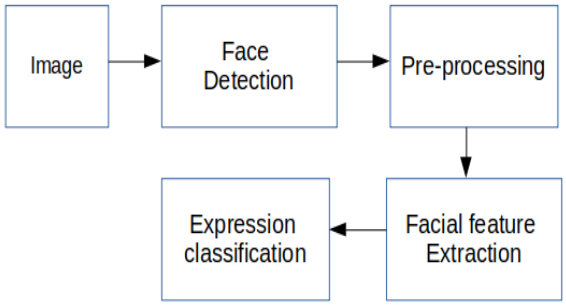

Fig 1: Methodology

2.1 Face Acquisition

Face detection is done by using geometric feature based approach since prime component of face like nose, eyes, lips and chin are required for classification. Viola Jones Object Detection Algorithm is used to extract feature points of face.

Viola Jones is a object detection algorithm works by sliding window across the selected image and evaluate a face model at every location. This algorithm includes four stages[10]. First stage is Haar feature selection used to find consistencies in human faces. There are mainly three haar features i.e. edge features to detect edges is represented by first and second, line feature by third and four rectangle feature to detect a slant line.

The value of any given feature is the sum of the pixels within clear rectangle subtracted from sum of pixels within shaded rectangle. Next stage is to create an integral image to convert the input into a representation.

Third stage is to select the valuable features by performing Adaboost training. During detection window of target size is moved over each section the input image calculating haar features. Object is separated from non-objects by the difference to learned threshold. Hence making a strong classifier from a weak classifier by learning multiple times.

Fourth stage is cascading classifier consist of collection of stages where each stage is an ensemble of strong classifier. If the input to next classifier is a face then previous classifier is selected otherwise a non-face object is detected, previous classifier is

removed. For a single stage classifier false negative rate is considered. Initially false positive are accepted to reduce the number of false negatives in later stage.

2.2 Feature Extraction

For facial emotion recognition, primary components of face are extracted. Among several existing methods for feature extraction Local Binary Pattern(LBP) is used in proposed system.

Local Binary Pattern is a texture descriptor which will effectively summarize the local structure of image[LB]. In LBP entire image window is separated into different units. Since this method operates on 3X3 pixel image, compare each pixel with neighbor pixel. Assign 0 to neighbor pixel if the value of pixel at middle is greater than its corresponding neighbor position otherwise assign value 1. Each cell value is multiplied by corresponding power of 2 (2^n). This step is called histogram calculation. Addition of all histogram values gives the feature vector for the image.

2.3 Expression Classification

Last step of facial expression classification is the classification performed by recognition or interpretation. Classification of face and its features is based on the visual information. Some of the classification methods which gave good results are Support Sector Machine and Nearest Neighbor classifier.

III. LITERATURE SURVEY

Tarious techniques have been developed in the research area of facial emotion recognition. The aim of the paper is to perform survey on the various techniques used in recognition of emotion of a person. To extract facial features Local Binary Pattern, Gabor wavelets, etc. techniques are used. Dataset used are JAFFE, Cohn-Cannade, Indian Spontaneous Expression Database(ISED), 3D dataset, etc.

Jayalekshmi and Mathew [1] discussed about Viola jones algorithm for image classification. Algorithm consists of 4 steps. First step is Haar feature, used to find characteristic consistencies in human face. Second step is to create an integral image for feature calculation. Third one is AdaBoost classifier used to classify image by eliminating unnecessary data of the face. Last step is cascading classifier, helps in processing real time images and rejecting false positive detection of selected portion with a very low computation time. For feature extraction Zernike moments, local binary pattern(LBP) and discrete cosine transformation(DCT). Zernike moments extract geometric characteristics from the image, LBP extracts texture information of image and DCT obtains spectral component distribution of image. All feature vectors are combined together by means of normalized mutual information selection method. Recognition rate of expression classification is 90.1%.

Shamim and Ghulam [2] proposed an emotion recognition system for mobile application. Viola jones algorithm is used to detect face in real-time. Bandlet transform is applied to geometric structure of image by calculating the geometric flow to deal with sharp fetaures of face in the form of bandlet bases. Feature selection is done by Kruskal-Wallis technique and fed into a Gaussian mixture model based classifier for emotion classification. Recognition rate of expression classification is 99.7%.

Mostafa K. Abd El Meguid and Martin D. Levine [3] proposed a system uses PittPatt for feature extraction based on appearance based approach. A collection of random classifier is used for emotion classification. Binghamtom University 3D facial expression database is used for training and expression labeled video database was used for testing. Multiple random forest classifier is used for classification of emotions. Recognition rate of expression classification achieved is 90.17%.

Divya Mangala B.S and Prajwala N.B [4] proposed a methodology to perform emotion recognition using eigen faces based on calculating euclidian distance. In training database all images are considered as one vector by combining the rows of pixels in an original image and stored in single matrix, average is calculated and subtracted from each original image in matrix. Eucledian distance is calculated with respect ot neutral emotion of image. Lastly test image is compared with trained image to get best match of similar facial expression.

Michael and Sam [5] performed a survey on the various techniques for pre-processing, feature extraction and classification on various databases of images. Region of Interest segmentation method, gabor filter and Support vector machine gave remarkable results respectively for pre-processing , feature extraction and classification. JAFFE and CK database are used for efficient performance.

Urvashi and Rohit [6] discussed about the face detection techniques dividing it into two major groups namely feature based and image based techniques. Feature extraction can be performed by geometric based, template based, appearance based and color based approach, describing pros and cons of each technique. Among all, geometry based method provides stable and scalable invariant features.

Octavio *et al. [7]* proposed an architecture which reduces the amount of parameters in convolutional layers using depth-wise separable convolutions after eliminating the fully connected layers. The proposed model has used Recurrent Neural Network for face detection, gender classification and emotion classification. FER-2013 dataset is used for emotion classification with the accuracy of 66% for classification of 6 emotions.

Caifeng et al. [8] evaluated LBP features for person-independent for feature extraction, classifying expression on several databases. In this paper author have formulated boosted-LBP by learning discriminative LBP histograms with Adaboost for all expressions and hence improving the recognition performance and extracting LBP features in low resolution image.

Happy *et al.* [9] proposed a new spontaneous expression database consists of posed expression. The database consist of 428 segmented video clips of 50 participants. Grayscale intensities, Local Binary Pattern, Gabor Wavelets and PHOG derscriptor techniques are used for feature extraction techniques. PCA is used to reducing dimensionality of feature vector. Multiclass Adaboost is used to perform emotion classification.

Yi-Qing Wang [10] interpreted first real-time face detection system using Viola-jones algorithm involving three steps firstly creating an integral image for feature computation, second adaboost for feature extraction and third cascade classifier for efficient computational resource allocation. He proposed algorithmic description with a learning code and a learned face detector for any color image.

Nurbaity *et al.* [11] aims to extract facial features using facial geometry distance measure by searching haar features. Eyes, nose and mouth were detected by voila jones algorithm and eucledian distance is used to calculate the distance between the each face region. Eight persons were classified with respect to their features where naive bayes classifier gave the best result when compared

with multilayer perceptron and support vector machine classifiers. In future more number of persons can be used to compare the result for classification.

Di Huang *et al.* [12] presented a comprehensive study of local binary pattern methodology. Since LBP cannot capture dominant features in a small 3 x 3 neighborhood, Various variations are being described like enhancing the discriminative capability, improving the robustness, choosing the neighborhood, extending to 3D and combining with other features which made LBP a powerful descriptor to represent local structures, making it sensitive to severe lighting changes.

Zavaschi *et al.* [13] presented a method that combines two different feature sets into an ensemble of classifiers. Local Binary Pattern and Gabor filters were used to create the base pool SVM classifiers. A multivariate objective genetic algorithm was used to search for the best ensemble which resulted i minimization of both the error rate and the size of the ensemble. JAFFE and Cohn-Kannade databases are used resulting in improved recognition rate between 5% and 10% over other coxnventional approaches of 88.9%.

Luo *et al.* [14] Proposed a methodology in which facial effective area extracted are based on eight eyes and energy normalization. Principal component analysis is used for global feature extraction and dimensionality reduction. Local binary pattern and Support vector machine is used for local texture extraction and expression classification.

Pawel Tarnowski *et al.* [15] proposed a model based on 121 specific points of the face storing the spatial coordinates of the points. Recorded by kinect device in the form of matrix. Changes in the facial expression describes as Action Units. Kinect device provides six action units derived from Facial Action Coding System. Classification of emotion is performed by 3-NN and Neural network using back propagation algorithm resulting in 3-NN giving higher accuracy.

IV. Gap Identified

Following points needs to be considered for the future research.

1. Recognition performances can be improved by extracting features from specific regions of the face.
2. Wide variations in facial expressions and random head movements scenarios need to be addressed to improve accuracy.
3. Face occlusions and illumination variation needs to considered to improve accuracy.

V. Conclusion

Emotion Recognition is a natural way of delivering emotional states of humans. With increasing application, facial expression recognition system should be more accurate and reliable. Various techniques for expression recognition is discussed in this paper. By this survey, Viola-Jones is suggested by authors for face detection and LBP, PCA, SVM and CNN for emotion recognition. Various databases are used for facial expression recognition whereas JAFFE and Cohn-Cannade are used mainly.

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