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Survey on Facial Expression Recognition and Approaches

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ABSTRACT: Face expression recognition plays a major role in image processing. It's because, the facial expression of the person is also one of the ways of communication, to predict the mind of the person. Detection of facial expression of each person is really a challenging task nowadays. But, it can be probably performed through the computer by using some of the techniques like, preprocessing human face posture, feature extraction, and find changes in facial expression. Facial expression can be categorized by fear, happy and sad. These expressions are identified by eyes open and mouth stretched. This paper describes the methodology for facial recognition in digital image processing. This paper consists of some of the techniques for recognition of human facial expressions from a sequence of images.

KEYWORDS: Principal Component Analysis; Gabor wavelet; Bandlet transform; Face recognition; Local Binary Pattern, Support Vector Machine; Features Extraction.

I. INTRODUCTION

Human face is also one of the most powerful tools for communications. Not only for humans, have even the animals needed a nonverbal communication. It can admire the mind of the person through their facial expression. So, the human face is also a tool for interaction with the parameters of emotions and thoughts. Researcher assures that, the facial expression reflects the actual of feeling the person than the vocal part and the spoken message. Every people have different kinds of expressions and appearance. Even a non-familiar person can guess a feeling of the other person. Moreover, it is a difficult task for finding the expression of an individual by computer

The analysis of the facial expression contains an application like image retrieval, face animation etc. Facial expression helps for the interaction between persons during their conversation to predict their feelings and emotions. It already described that the facial expression recognition through the computer is very difficult. It's because faces and their expression are varied for each and every person. Some of the challenges in the face recognition analysis are a pose, occlusion, and illumination. The proposed system describes that; facial expression of the person can be recognized using some of the techniques in image processing.

Facial Expression Recognition

Every recognition system contains two phase: training phase and Recognition phase. It is because the dataset for the complete system should be named for its further process. It should be handled in training phase and the labeled data are further used in its recognition phase.

The first step is to convert the given image to its grey scale and reduce dimensions. Identify the facial parts and need to label for each part of the face for each expression. It is because of the length of our facial parts depends upon our facial expressions. So, every dataset pictures are labeled sequentially in training phase.

The next process is to generate a histogram for each pixel using Local Binary Pattern (LBP). LBP is a technique which divides the image into cells like 16x16 and generates the histogram for each cell and finally combines every cell to form a histogram for a given input image.

After generating a histogram for an image, the next process is to identify the object, which means to detect the parts of the face for recognition. So, here the usage of a wavelet is called Gabor Wavelet. Among the wavelet family, Gabor wavelet contains the impressive application of object recognition which can be used for identifying face

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expressions. By using Gabor wavelet, the facial parts can be recognized. It also returns the output as extracted features values for particular detected parts.

To detect the expressions from the input image, the extracted features of each part from dataset were compared with extract features generate for given input image. Some facial features are detected by mouth and eye. Using those facial parts expressions for corresponding face image can be detected. There are many methods for feature extraction. Among those methods, Gabor and an LBP method play a vital role and produce a successive and optimal output.

The extracting features on both phases, recognition phase tests the image with the features extracted from training phase. And the final step is classification. The extracted features are classified and it compares with the features of a training phase and finally computes the results as expressions like Happy, sad, fear, angry, etc,.

II. RELATED WORK

Unsoo Jang, Euichul Lee et al [1] had presented an article on Performance analysis of pixel-based face recognition methods. It deals with following methods. a) Illumination Normalization technique which can be used to normalize the light condition in the given image by the light condition through converting the original image into blur image. b) Next tool is PCA Tool which means Principal Component Analysis that can be used as a linear transformation of data from high dimensional to a low dimensional data.

M. Shamim Hossain, Ghulam Muhammad et al [2] had proposed an emotion recognition system with different databases. The article describes the combination of bandlet transform and LBP. Bandlet transform is a technique used to detect face area. While comparing wavelet transform family, bandlet transform proceeds about the geometric structure of an image. So, it accepts the input as a color image is converted into grey scale image. But the disadvantage of bandlet transform, while using geometrical structure is producing high computation complexity.

Xiayang Tan, Bill Triggs et al [3] describes the fusion LBP features sets and Gabor wavelet. This article discussed that while combining two local face representation techniques like Gabor wavelet and Local Binary Pattern gives a better result than either alone. It is because LBP captures each and every pixel in an image and Gabor wavelet used for identifying the shape of the object. Since both the methods are high dimensional. We cannot concatenate them directly. It leads to the problem of “curse of dimensionality”. For many dimensionality reductions, image processing contains many techniques like Principal Component Analysis (PCA), Independent Component Analysis (ICA).

Michael Lyons and Shigeru Akamatsu et al [4] concludes that similarity in facial expression image can be computed using Gabor coding and the semantic coding are computed by human expression ratings which are compared using rank correlation. It is a technique which can be used to compare similarity in spaces but not in categorization performance.

Faten Bellakhdhar, Kais Loukil, Mohamed ABID et al [5] proposed an article of face recognition approach by Principal Component Analysis (PCA) and Support Vector Machine (SVM). It proceeds with the combination of magnitude and phase of Gabor to extract feature and PCA for recognition whereas SVM for classification. While gaining more information, PCA is an effective algorithm and it is most commonly for reducing dimensionality as mentioned before.

Sangita gudadhe et al [6] proposed an article on recognition of human facial expression through Component Analysis. It deals with the methodology of PCA and 2DPCA. It says that PCA is a powerful tool for analysing data. To extract feature through PCA, the existing system introduced a straightforward image projection technique called two-dimensional principal component analysis (2DPCA). The 2DPCA technique is used for extracting features for facial images through the database. The major advantage of 2DPCA over PCA is to evaluate covariance matrix accurately and it takes only less amount of time to calculate corresponding eigenvectors.

III. RECOGNITION TECHNIQUES

A. *Local Binary Pattern*

LBP is an operator which takes pixels from its local neighbourhood, and calculate the threshold value with the centre pixel value and it should be considered as the resultant value as a binary value. LBP feature vector can be processed by I) Dividing the window into cells. II) Each pixel is followed and compared by clockwise or counter-

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clockwise III) While comparing the values with the centre value, the possible output values are 0 and 1. IV) If the centre pixel value is greater than the comparing value, then the output value is 0, otherwise, the output value is 1. V) By using those cells and with the output values, the histogram for each cell can be generated. VI) Finally, the concatenation of histogram for each cell results in the histogram for the given image.

B. *Principal Component Analysis*

PCA is a mathematical tool which is used for applied linear algebra. It is a non-parametric method for choosing relevant data from datasets. PCA is a technique which follows the procedure orthogonal linear transformation that can be use to transfer the highest variance data into the new coordinate system which can be called as a first principal component. Similarly, the second highest variance can be shifted to the second coordinate system and vice versa. The important role of PCA is to decrease the dimensionality of the given image by as much as possible.

C. *Support Vector Machine*

Support Vector Machine (SVM) is a classifier which can be used to classify the given input data. SVM can be applying to the image to identify the object through classification. Before passing to SVM, the image might have gone through some of the filters to extract features on corresponding images. It performs classification by separating hyperplane. It classifies and separates the data and labelled them for training data. Finally, the algorithm produces an output as optimal hyperplane which separates and categories the shapes in the given input image.

D. Gabor Wavelet:

Gabor wavelets provide the optimal resolution for both spatial domain and frequency domain. It is because it extracts features through the basic like biological motivation, mathematical and empirical motivation. The advantages of Gabor wavelet transform is kind of image analysis applications and some of the applications in face recognition, texture classification etc. Gabor wavelets are mostly used for feature extractions, and also for textures, remote sensing images and for landscape images. The applications for Gabor wavelets are edge detection, filter design and for object recognition.

E. Bandlet Transform:

Bandlet transform is commonly used for face detection. But it does not detect only face in the image, rather than that it detects the area of the face. This means that the face image area contains a geometrical structure like identity, gender, the emotion of the face, etc. While comparing to wavelet transform Bandlet transform detects the geometrical structure of the image. So that it can improve the representation of the image. The problem in representing geometric structures leads to high computation complexity. But the bandlet transform overcomes it by calculating geometric structure using bandlet bases.

METHODS	DESCRIPTION
Local Binary Pattern	The LBP operator can be used for labels the image pixel with corresponds to the center value and produced the resultant value as a binary value.
Principal Component Analysis	Principal Component Analysis is a data compression techniques which can be used mostly used for dimension reduction. That can be performed from high dimensionality to low dimensionality.
SVM	SVM is a classifier used for image classification in image processing. It can be applied to the image for recognition through classification.
Gabor Wavelet	Gabor wavelet is a wavelet which can be used for texture analysis. It is because of its optimal localization properties in both spatial and frequency domain.
Bandlet transform	Bandlet transform comes on the basis of orthonormal which can be adapted for geometric boundaries. The main goal of bandlet transform is to perform smooth functions on smoothly bounded domains.

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IV. SIMULATION RESULTS

The LBP and Gabor wavelet methods were used for facial emotion recognition. The Jaffe database is used for the process of analysing the face detection and emotion. Feelings like happy, sad, surprise, cry and disgust situations are considered. While comparing to other techniques like, PCA, SVM and Bandlet Transform, the combination of both LBP and Gabor wavelet provides a better results. The accuracy level of those techniques were analysed and compared.

Fig. 1. Expiremental Images

Fig. 1 shows the images that are taken from the database called Jaffe database. These images were used for facial recognition and to declare the expressions of the face like happy, sad, tensed, surprise etc.

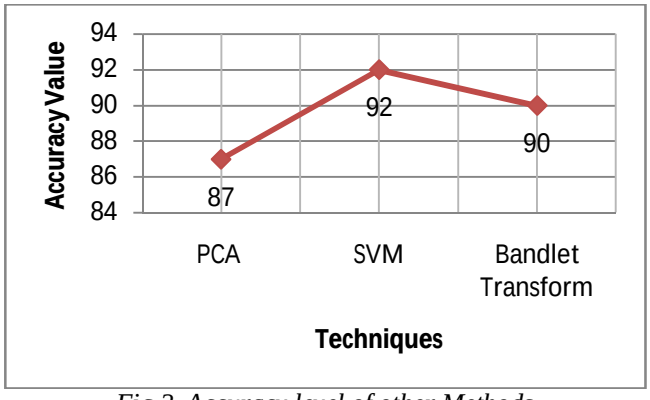

Fig.2. Accuracy level of other Methods

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The accuracy level of the techniques like PCA, SVM, and Bandlet Transform are calculated and found the values as 87, 92 and 90 as mentioned in the fig. 2.

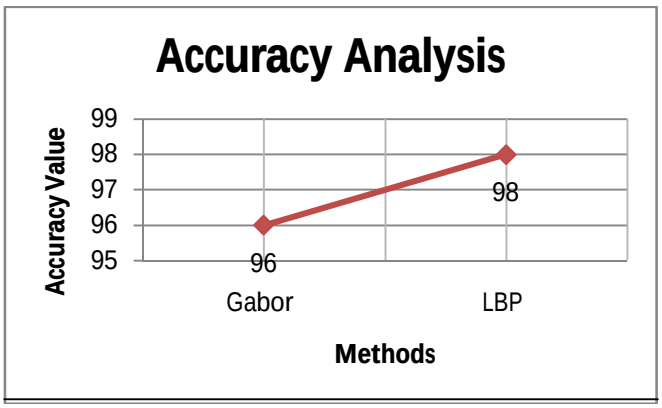

Fig.3. Accuracy Level of LBP and Gabor Wavelet

Similarly, the fig. 3 shows the accuracy level of the techniques of LBP and Gabor wavelet and concludes the value as 98 and 96.

By comparing the accuracy value of these techniques from fig 2 and fig 3, it concludes that LBP and Gabor wavelet itself provides a maximum accuracy level than other techniques. So, it is clear that the combination of both techniques provides a better result than any other.

V. CONCLUSION

In this survey paper, various techniques for facial expression recognition like LBP, PCA, SVM, Gabor wavelet and Bandlet transform are discussed. By comparing with other techniques, the combination of LBP and Gabor wavelet provides accuracy results than either alone. Because the optimal recognition values depend on feature extractions for the features are extracted and recognized using recognition techniques.

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