Facial Expression Recognition: A Survey

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Abstract : Facial expression recognition is a latest topic for research. Facial expression recognition (FER) has an important role in human communication. FER uses in many fields like medical science, security and biometric etc. Face image is a 2D object. It is easy for retina to recognize the face but it is difficult task to implement with artificial intelligence. Face is an image capturing object. Many techniques are exist to identify the face. This paper present a survey of previous research on facial expression recognition methods.

IndexTerms **- Facial Expression Recognition (FER), Gabor wavelet, Viola Jones, JAFFE, Haris Corner, Feature Extraction, Feature Classification**

I. INTRODUCTION

Biometric uses different-different characteristics for recognition like facial image, finger prints, voice and retina. Bio metric recognition is an effective method. Biometric is Singularity (Unique), Universality (for all), Invariant (to capture conditions) and Resistant (to fraud attempts).

Each person have unique face, unique fingerprint, unique voice and unique retina we are uses signature as identity face in bank and other sensitive documents. Now we are using more powerful and high accuracy biometric like retina, fingerprint, face etc. face recognition is based on face images nobody can stolen or forgotten biometric characteristics because they are permanent and their own.

One of the reasons for developing biometric systems has been to complement the use of information known to the user (for example, a secret number or a keyword) or possessed by it (for example, a magnetic card). These traditional methods are based on properties or elements that can be lost, stolen or forgotten. Such problems disappear with the use of biometric characteristics for personal identification, because they are their own and permanent for each individual. This advantage, together with the fact that it can be extracted quickly, makes biometric techniques valuable identification methods and suitable for use in automatic systems. However, these systems currently present problems of precision (in the rates of false acceptance and false rejection), of non-viability for certain disabled individuals who do not have a certain biometric characteristic required by the system, of vulnerability in certain cases and of acceptance by the parties of the users. Despite these drawbacks, biometric recognition constitutes a good additional authentication system. Even the simplest and cheapest biometric solutions can appreciably increase the overall security of a system if they complement traditional recognition methods and adapt flexibly to the characteristics of the particular application for which they are used [2].

The face recognition though being simple to human eyes is a tedious task for computational approaches. The face recognition scheme should possess sufficient parameters to recognize a face and also robust against noise. The easy scheme of face recognition is matching the pixels of test input with database image pixels in their corresponding position. If the total number of pixels matched is larger than the defined threshold percentage of matching, the face is considered to be authentic. But on a practical note, the input images captured are not always in standard position for matching. For example, the images from security cameras placed at higher altitude than the height of a person captures the images that have different face angles. In these input images, the faces are tilt and could not be recognized with easy schemes.

Another problem that arises in face recognition are the quality of images that are given as input. The captured images have variation in actual size of face due to distance from where they are captured and also have varied skin colour tone due to sunlight [1]. Since the quality cannot be assured for input image, the algorithms are expected to perform with high rate of accuracy in given conditions. The solution for first consideration is a secondary step, primary step being the angle of face captured and the computational model used. Since at most of places only 2D face recognition models are installed, hence the accuracy of face recognition is subjected to angle of face or in high rotational cases is dependent of efficiency of observer. The noisy images in 2D computational model, the efficiency of mathematical algorithms are studied in terms of accuracy of detection [2]. Though many researches claim their methods to be robust and having high efficiency, the assumptions they make are not validated in practical world.

II. APPLICATIONS OF BIOMETRICS

Authentication is required in all areas like banking applications, government offices, army, security service etc. Now biometric attendance system is also running in Govt. And private organizations. Thumb impressions and cards are old systems are time consuming. Facial expression is much easy and reliable also there is no need to swap any card or make thumb impression on machine sensors automatically recognize the face and mark present of the employee.

Biometric is also used by police, forensic services, airports, jewelry shops. It is also used to find out the criminals in the crowd and public places.

These days biometric also used for authentication of various web applications and mobile applications, mobile banking, E-commerce etc.

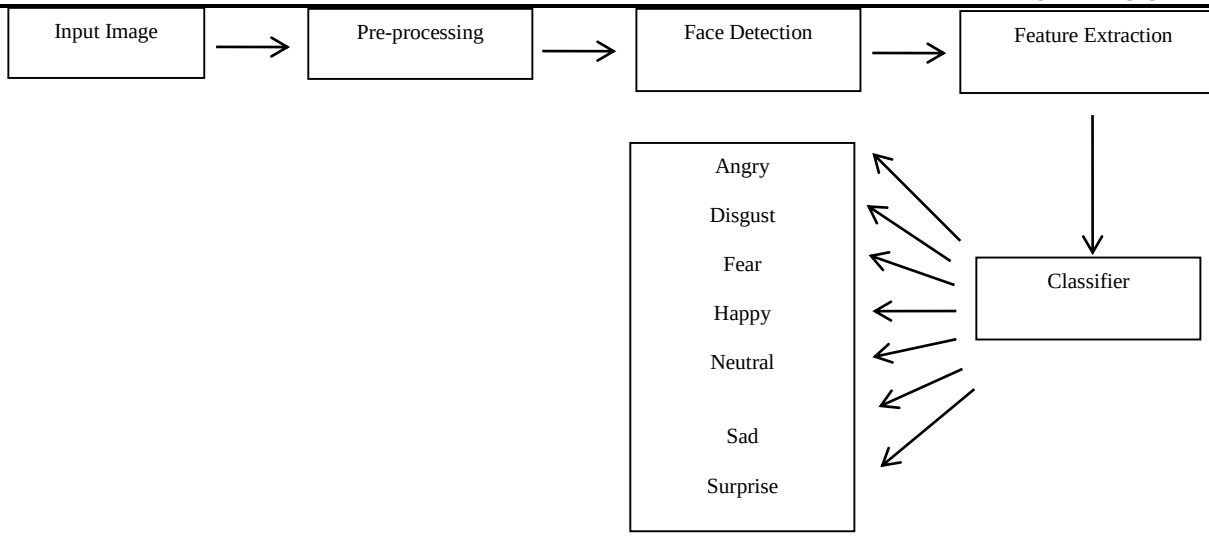

Figure 1: Block diagram of Facial expression recognition

III. LITERATURE SURVEY

This survey is the detailed study of existing methods for facial expression recognition. The research works are categorized according to the nature of method and from old to new. At end, a comparative study is presented.

There are 7 standard facial expressions following table shows the standard expressions

Table 1: Standard Facial Expressions

1	An	Angry
2	Di	Disgust
3	Fe	Fear
4	Ha	Happy
5	Ne	Neutral
6	Sa	Sad
7	Su	Surprise

Mehar et al. (2014) presented a framework for face recognition using PCA. The PCA based approach is more accurate rather than the conventional methods. This paper used CSU and ATT databases with five emotions. 85.5 % accuracy is achieved by this method.

Wang et al. (2006) proposed face recognition technique using image enhancement approach and Gabor wavelet transform. Image enhancement is a preprocessing approach which is achieved by using Logarithm transform and Normalization methods. Then the features are extracted by Gabor wavelet from the pre-processed image. This research paper proposes hybrid approach of LDA and PCA method.94.4% maximum accuracy achieved by this method.

Mehta et al. (2016) presented framework for feature extraction using Log Gabor filter which is used for reducing dimensions of extracted features of PCA. Euclidean distance classifier is used for classification of emotions. The Japanese Female Facial Expression (JFFE) database is used.

Rizk et al. (2002) this paper presented different neural network approaches which is applied for face recognition. PCA, DCT, DRT, and DWT is used for Feature extraction. Testing is performed using ORL face database.

Liu et al. (2003) This paper uses an autonomous Gabor features strategy. In this method the curiosity of Insulin-Like Growth Factor (IGF) technique originates from (a) the autonomous Gabor includes in the stage of feature extraction and (b) in the pattern recognition using IGF features based on PRM (probabilistic reasoning model) strategy. It gives 98.5 % accurate results and used FERET dataset.

Rasied et al. (2005) Introduced a face recognition framework. The singular value decomposition technique is utilized for feature extraction. Back-propagation neural network is used as a classifier for classification process.

Wang et al. (2007) This paper presented spectral feature analysis (SFA) approach for unsupervised nonlinear feature extraction. This method is more beneficial to classical method that are: (1) SFA is unaffected by the small-sample-size problem, (2) unfair data from given information can be removed by this approach, and also can be incorporated demonstrating straight discriminant examination under the SFA system, (3) SFA can find hidden nonlinear structure.

Wang et al. (2008) This paper proposed an approach, neural network classifier for face recognition technique using RBF . This paper focused on the three basic issues which are; (1) face image vector, image-size normalization, and the issue of training for hidden layer neural nodes. This paper used ORL face database.

Pritha et al. (2010) This paper used LoG Gabor filter and singular value decomposition for feature extraction and the neural network is used as classifier. The wrinkles and moles from the face images where removes by the LoG Gabor filter. The SVD is used to create basis for the actual dataset. Yale face dataset is used and achieved 84.85% accuracy.

Hussein (2011) presented an face recognition framework using dimension reduction approach by PCA and Euclidian distance classifier, Squared Euclidian Distance Classifier, Squared Chebyshev distance Classifier and City-Block distance classifier are used. The ORL databases is used.

Zainudin et al. (2012) Proposed a face recognition framework in which the PCA is applied with LDA approach. This method is find-out main components of the faces and measured the shortest distance between them and achieved higher recognition accuracy.

Bashiret al. (2012) Proposed a framework of facial recognition. Using PCA features of face images are extracted. If the face is not correctly recognized after applying PCA, then the other features like colour and moment invariant are extracted. The final phase i.e. Decision Tree method used as classifier. This paper uses feature extraction in two level which increases 2% recognition accuracy.

Siddiqi et al. (2015), Introduces an robust facial expression recognition (FER) system. It is uses stepwise linear discriminant analysis (SWLDA). The hidden conditional random fields (HCRFs) model is used for recognition. It is uses a hierarchical recognition strategy. Publicly available data sets were used. 96.37% accurate results achieved.

Cossetin et al. (2016) This approach combines specialized pair wise classifiers trained with different feature subsets for classification. First it detects and extracts faces from images. Then the face is split into several regular zones. A pair wise approach used as classifiers. The out put of all pairwise classifier is combined using a majority voting rule. Publicly available data set (JAFFE, CK and TFEID) is used. Classification rate of 99.05%, 98.07% and 99.63% were achieved respectively.

Salmam et al. (2016) This paper proposed that Supervised Descent Method (SDM) is used for feature extraction it is performed with three stages. at first, the main positions are extracted of face then the related positions are selected. After that it estimates the distance between the various components of the face.

IV. APPLICATIONS OF BIOMETRICS

The table 2 shown below gives a comparison analysis of various research work conducted by different authors:

S. No.	AUTHOR	YEAR	APPROACH	PRE-PROCESSING	FEATURE EXTRACTION	CLASSIFICATION	Recognition Accuracy (%)
1	Mehta et al.	2016	PCA	Not Specified	Log Gabor filter and PCA	Euclidean distance	93.57
2	Meher et al.	2014	PCA	Not Specified	ATT and CSU Databases	Not Specified	85.5
3	Bashir	2012	PCA	Not Specified	PCA	Decision tree method	96
4	Zainudin et al.	2012	PCA with LDA approach	Not Specified	PCA	Not Specified	70
5	Hussein	2011	Dimension reduction approach by PCA	Not Specified	Not Specified	Euclidean distance, squared chebyshev distance, squared euclidean distance, city block distance	95.2
6	Pritha et al.	2010	Not Specified	Not Specified	Log gabor filter and singular value decomposition	Neural networks	84.85
7	Wang et al.	2008	Image enhancement approach and Gabor wavelet transform	Logarithm transform and normalization methods	Gabor wavelet features	Fisherface method contain LDA and PCA methods	94.2
8	Siddiqi et al.	2015	SW LDA, HCRF	Not Specified	Expression are categorized into 3 major categories	Not Specified	96.37
9	Cossetin et al.	2016	LBP, WLD	Pairwise Classifier	Each pair wise classifier uses a particular subset	SDM, CART	98.91
10	Salmam et al.	2016	SDM	Not Specified	Decision tree for training	CART	89.9

V. CONCLUSION

Application area of Facial Expression Recognition is increases and it requires more reliable and accurate system. In this survey we are compared the results of 10 papers of facial expression recognition. The highest recognition accuracy is 98.91% of Cossetin et al. so there is more work is required in this research. We are needed 100% accurate results for a robust and reliable biometric system.

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