

# A Survey on Facial Gesture Recognition

Priya Dosodia<sup>1</sup>, Amarjeet Poonia<sup>2</sup>

<sup>1</sup>Department of Computer Science, Govt. Mahila Eng. College, Ajmer, India

<sup>2</sup>Department of Information technology, Govt. Mahila Eng. College, Ajmer, India

**Abstract:** Recently the facial expression recognition has gained broad concentration and fast progress. In this paper, we give a review for the latest advancement of the domestic and international facial gesture recognition technology. Facial Expression Recognition system includes three steps: face detection, expressional feature extraction and expression classification. We concentrate on the method feature extraction of basic gesture which use Gabor filter. We are going to study various Gabor filter technologies, for performance comparison in subject independent facial gesture recognition system. Facial gesture recognition has been a very important topic for research in computer pattern recognition and currently there are several methods of facial gesture recognition system which have different recognition rate. This recognition rate is affected by datasets, feature extraction method and classifier for face recognition. To utilize the information carried by facial gestures, automated reliable, valid, and efficient methods are essential. So, in this paper we will do comparative analysis that helps in improving performance.

## I. INTRODUCTION

Human face is important to identify human identity and the emotion or gestures of the person. Human brain have a strong power to store millions of face patterns which a person see in their entire life and can identify the pattern which are like to the pattern which have been seen earlier for a single moment even after a long duration of separation of phase. In this way, most of the scientist and philosopher now pay attention on pattern recognition. There are several applications that rely on facial gesture recognition system. These applications include areas such as computer aided learning, machine based HR interviews, HRI (human robot interaction), psychology, HCI (human computer interaction) and auto crime diagnosis. In HRI or HCI, we try to improve interaction between human and computers or robots and make them socially aware. In computer aided learning, a computer should be capable to understand state of a student and then behave accordingly. [1]

The research goal of facial gesture recognition is how to consistently, efficaciously employ its conveying information. It is a typical problem that recognition system's property is determined by the represented facial gesture feature. The essential step of facial gesture recognition is detection of facial feature key-points. In the facial gesture recognition process, feature extraction step is very important. If insufficient and bad features are provided, then even the best classifier could be unsuccessful to attain accurate recognition. Gabor filters are used mostly because it has been proved to be valuable, effective for gesture recognition due to its better-quality, capability of multi-scale representation. [2]

## II. FER ARCHITECTURE

FER architecture consists of four stages. Each stage has their own value and importance, but feature extraction stage is the most important stage. These stages are Image Data Acquisition, Pre-processing, Feature Extraction, Classification. Its methodology and working is shown in figure 1.

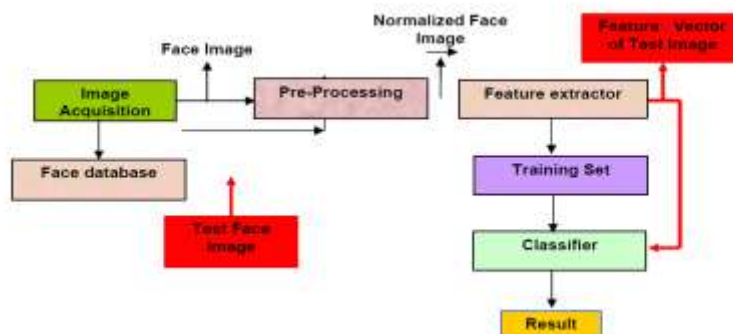


Figure 1. Typical Facial Expressions Recognition System

### A. Expression Database and image preprocessing

Here we take the input data which is either sequences of video or static image, where each has different feature extraction techniques. Research done in this area has indicated that at least six emotions are universally connected with distinct facial gestures. The second stage is image preprocessing which normalizes the input face where it adjust the shape, angle, contrast, brightness etc. and enhancing the quality features of input face image. After that we extract the set of features which is used to describe the emotion expression and with suitable algorithm we can classify these expressions. The experiments are performed here is done by using jaffe Database. A list is given in table 1 which is showing the meaning of seven different expressions. [3]

Table1. Basic Facial Expressions [10]

Expression	Textual Description
Fear	In this, Eyebrows are pulled and raised together, with the inner eyebrows being bent upward. The eyes are tense and alert.
Disgust	Eyebrows and eyelids are relaxed. Also, there is raised and curled upper lip, frequently asymmetrically
Happiness	Eyebrows are relaxed, with the mouth being open and its corners pulled back toward the ears.
Surprise	Eyebrows are raised. The upper eyelids are wide open, the lower one is relaxed. Also, the jaw is opened.
Sadness	Inner eyebrows are bent upward. Also, the eyes are slightly closed & the mouth is relaxed.
Anger	Inner eyebrows are pulled together downwards, with the eyes wide open. Also, the lips are pressed against each other or opened to expose the teeth
Neutral	Relaxed face muscles. Eyelids are tangent to the iris. The mouth is closed and lips are in contact.

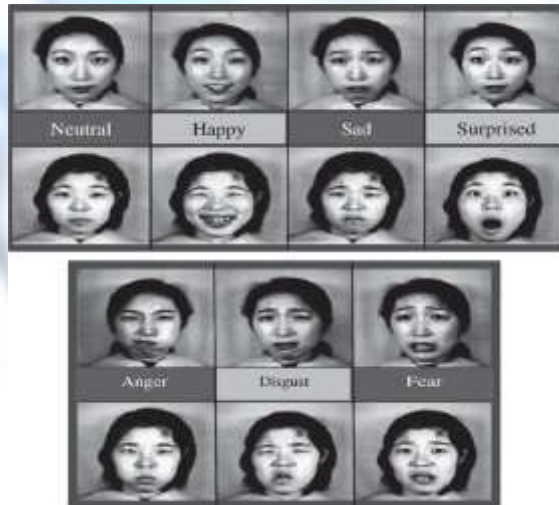


Fig.2. Sample expressions of two expressers from the JAFFE database

This database is effectively used because of its stability over culture and availability of respective facial expression databases. eng et al. [4] classifies the selection of features used for gesture recognition into two main categories: geometric features and non-geometric features. Some of the scientists use geometric features can be found in [5], [6],[7] and [8]. In some research papers like [9] have used both geometric and temporal information to deal with various aspects of gesture recognition.

### B. feature extraction

The feature extraction stage is a key component of any pattern recognition system. The feature extraction process converts the information that is pixel data which is got from preprocessing into a higher-level representation of size, shape, motion,

texture, color and spatial configuration of the face or its components. In the Following subsections, we are going to describe the feature extraction techniques. [11]

### 1) Gabor Filters

Gabor filters is much known because of its functionality and it has been successfully used to FER. Orientation and frequency are the most important parameter of a Gabor filter. Those features which share same orientation or frequency are chosen and used to differentiate between different facial gestures depicted in images. A Gabor filter is a function attained by modulating the amplitude of a sinusoid with a Gaussian function [12]. The images are convolved with the two dimensional Gabor filters to extract Gabor features as follows:

$$\psi(x, y, \lambda, \theta) = \frac{1}{2\pi s_x s_y} e^{-\frac{1}{2}(\frac{x_1^2}{s_x^2} + \frac{y_1^2}{s_y^2})} e^{j\frac{2\pi x_1}{\lambda}} \quad (1)$$

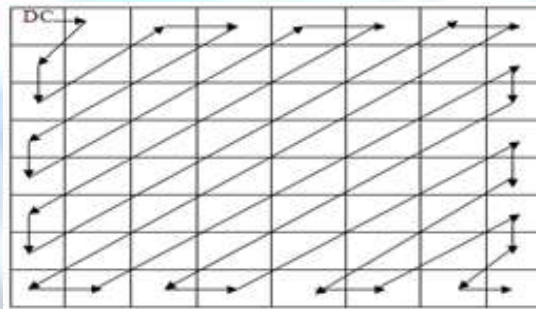
(x, y), the pixel position in the spatial domain.  $\lambda$ , Wavelength or a Reciprocal of frequency of pixels.  $\theta$ , Orientation of a Gabor filter.  $s_x, s_y$ , Standard deviation of the x & y directions. The parameters  $x_1$  and  $y_1$  are calculated as following equation (2) and (3)

$$x_1 = x \cos \theta + y \sin \theta \quad (2)$$

$$y_1 = -x \sin \theta + y \cos \theta \quad (3)$$

### 2) Discrete Cosine Transform (DCT)

DCT is basically a technique which is used for image compression. It compresses the image by removing the data and information which is not necessary. The DCT transform an image from the time domain to the frequency domain. Here, it selects the features from the frequency domain in zigzag manner on which classifier works. [3]



Zigzag Scanning of DCT Coefficient Matrix

$$F(u, v) = \frac{\Lambda(u)\Lambda(v)}{4} \sum_{i=0}^7 \sum_{j=0}^7 \cos \frac{(2i+1) \cdot u\pi}{16} \cdot \cos \frac{(2j+1) \cdot v\pi}{16} \cdot f(i, j)$$

$$\Lambda(\xi) = \begin{cases} \frac{1}{\sqrt{2}} & \text{for } \xi = 0 \\ 1 & \text{otherwise} \end{cases}$$

### 3) Discrete Wavelet Transform (DWT)

Discrete Wavelets transform are applied to the whole-face in a image to extract a features or pattern. Meihua Wang, Hong Jiang and Ying Li [13] proposed a method of feature extraction for facial gesture recognition depended on DWT. Images have Low frequency coefficients and high frequency coefficient. DWT selects Low frequency coefficients from images. Low frequency sub band does not affected by noise. Result and study has proven that DWT has higher recognition rate.

### 4) Principal Component Analysis (PCA)

It is also recognized as Karhunen-Loeve Transform (KLT) or the Hotelling Transform. It can extract the most essential abstract facial features by the Eigenface/ Fisherface calculations which are basic strength of PCA. [3]

### **C. Classification**

Feature Classification is the next very important and responsive, sensitive stage in the gesture recognition system. It is called sensitive because even the little changes in the movements of the features in facial gestures may alter the emotion. Many classification tools have been used in FER system which is explained below:

#### **1. Support Vector Machine (SVM)**

Support Vector Machine (SVM) is a successful classifier because it easily applies on various pattern recognition tasks [14]. SVM is based on statistical learning theory so it is able to deal with both linear and nonlinear classification problems. SVM classifier maps the input into a higher dimensional feature space by using several kernel functions. After that it attempts to discover the optimal separation hyperplane in the feature space with the maximum margin.

#### **2. K-Nearest Neighbors (K-NN)**

The K-Nearest Neighbors (K-NN) method is known as a classical classification algorithm. In this classifier, the input feature vector is classified based on the class. After getting input feature vector, this algorithm finds K closest feature vectors which represent different emotions. Then it uses the sum of absolute difference vector distance measurement. The input vector is assigned by expression represented by the majority of the K nearest feature vectors. [11]

### **III. PROPOSED WORK**

We have studied facial gesture recognition, but many of them do not work in the deficiency of light. So proposed work is to overcome the following deficiencies:

- 1) Developing the image processing techniques which can work in 'uneven lighting' so it become easy to identify the facial features.
- 3) Improve the recognition rate.

### **IV. CONCLUSION AND FUTURE WORK**

This study provides the architecture of facial expression recognition where it gives the comparative analysis of different techniques. It shows the pitfalls which should be overcome. FER system should be able to find facial gesture even in the presence of occlusion, which is its future work. No one techniques has given near to 100 % recognition rate, so it should be improve by the combination of various techniques.

### **REFERENCES**

- [1]. Jorge García Bueno, Miguel González-Fierro, Luis Moreno, Carlos Balaguer , "Facial Gesture Recognition using Active Appearance Models based on Neural Evolution", In International conference on LBR, Pp.-133-134, IEEE, 2012.
- [2]. Jun Ou, Xiao-Bo Bai, Yun Pei ,Liang Ma, Wei Liu, "Automatic Facial Expression Recognition Using Gabor Filter And Expression Analysis", In 2010 Second International Conference on Computer Modeling and Simulation.
- [3]. N. U. Khan, "A Comparative Analysis of Facial Expression Recognition Techniques ", 2013 3rd International Advance Computing Conference (IACC), IEEE, 2013.
- [4]. Z. Zeng, M. Pantic, G. I. Roisman, and T. S. Huang. A survey of affect recognition methods: Audio, visual, and spontaneous expressions. IEEE Transactions on Pattern Analysis and Machine Intelligence, 31(1):39–58, 2009.
- [5]. Y. Chang, C. Hu, R. Feris, and M. Turk. Manifold based analysis of facial expression. Image and Vision Computing, 24(6):605–614, 2006.
- [6]. M. Pantic and M. S. Bartlett. Machine analysis of facial expressions. In K. Delac and M. Grgic, editors, Face Recognition, pages 377–416. I-Tech Education and Publishing, 2007.
- [7]. S. Lucey, A. B. Ashraf, and J. F. Cohen. Investigating spontaneous facial action recognition through aam representations of the face. In K. Delac and M. Grgic, editors, Face Recognition, pages 275–286. I-Tech Education and Publishing, 2007.
- [8]. Y. Hu, Z. Zeng, L. Yin, X. Wei, J. Tu, and T. S. Huang. A study of non-frontal-view facial expressions recognition. In Proceedings - International Conference on Pattern Recognition, 2008.
- [9]. M. F. Valstar, H. Gunes, and M. Pantic. How to distinguish posed from spontaneous smiles using geometric features. In Proceedings of the 9th International Conference on Multimodal Interfaces, ICMI'07, pages 38–45, 2007.
- [10]. Pandzic, I. & Forchheimer R. (Ed.) (2002). MPEG-4 Facial Animation: the Standard, Implementation and Applications, Wiley.
- [11]. Reza Azmi, Samira Yegane, "Facial Expression Recognition in the Presence of Occlusion Using Local Gabor Binary Patterns", 20th Iranian Conference on Electrical Engineering, (ICEE2012), May 15-17, Tehran, Iran.



- [12]. T. S. Lee, "Image Representation Using 20 Gabor Wavelets ", IEEE Trans. Pattern Analysis and Machine Intelligence, Vol. 18, pp.959-971,1996.
- [13]. Meihua Wang, Hong Jiang and Ying Li," Face Recognition based on DWT/DCT and SVM ", IEEE International Conference on Computer Application and System Modeling 2010.
- [14]. Seyedehsamaneh Shojacilangari, Yau Wei Yun, Teoh Eam Khwang ," Person Independent Facial Expression Analysis using Gabor Features and Genetic Algorithm", IEEE, 2012.

