Neural Network associated with recognition of Facial Expressions of Basic Emotions

Rehmat Khan, Rohit Raja
Shri Shankaracharya Engineering College,CSVTU
Bhilai(C.G.), India.

***Abstract*—The science of image processing, helps t to recognize the human gesture for general life applications. For example, observing the gesture of a driver when he/she is driving and alerting him/her when in sleepy mood will be quite useful. Human gestures can be identified by observing the different movements of eyes, mouth, nose and hands. The face is a rich source of information about human behavior. The proposed method will recognize the facial expression from a well captured image. The approach for Facial Expression Recognition System is based on PCA and Neural Network. For any Facial Expression Recognition, it is necessary to extract the features of face that can be possibly used to detect the expression. For Feature Extraction the Principal Component Analysis will be used. After extracting the features the eigenvectors will be generated this will be further fed into the Neural Network for Expression Recognition. The paper briefly describes the schemes for selecting the image and then processing the image to recognize the expressions.**

***Index Terms*— Eigen faces Eigen Vector, Eigen Value, Neural Network, Back Propagation, Facial Expression Recognition System, FERS.**

I. INTRODUCTION

FACIAL expression is one of the most powerful, natural, and immediate means for human beings to communicate expression of their emotions and intentions. The face can express emotion sooner than people verbalize or even realize their feelings. The need for reliable recognition and identification of facial users is obvious.

Mehrabian[11] pointed out that 7% of human communication information is communicated by linguistic language (verbal part), 38% by paralanguage (vocal part) and 55% by facial expression. Therefore facial expressions are the most important information for emotions perception in face to face communication. For classifying facial expressions into different categories, it is necessary to extract important facial features which contribute in identifying proper and particular expressions. Recognition and classification of human facial expression by computer is an important issue to develop automatic facial expression recognition system in vision community. Further facial expressions can be ambiguous. They have several possible interpretations. Facial expression recognition should not be confused with human emotion recognition as is often done in computer vision. Facial expression recognition deals with classification of facial motion and facial feature deformation in to abstract classes that are purely based on visual information.

In this paper, we proposed a computational model of facial expression recognition, which is fast, reasonably simple, and accurate. The proposed approaches have advantages over the other face recognition schemes in its speed and simplicity, learning capacity and relative insensitivity to small or gradual changes in the face image.

The method of facial Expression Recognition System consists of four components: input image, image processing, component analysis or feature selection and Expression Recognition. Image processing consists of scaling and image rendering to prepare the face for expression recognition. The process of expression recognition involves processing images by extracting the facial features, and then using an algorithm to identify the expressions made based on the movements of the feature made. The working of project can be understood by the diagram as shown in Fig1. In the Figure there are total 5 modules. The Input image, Image Preprocessing, Feature Extraction (Using the PCA algorithm), Classification (Using the Backpropagation Neural Network algorithm) and output.

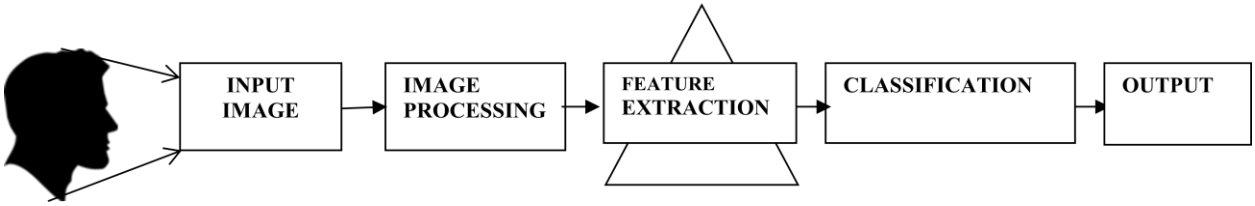

Fig 1 Working of FERS

In the first module, the image of the face will be taken as input. Then the image processing will be performed which will convert the image into the desired resolution and color and thereafter in the next module the feature extraction will be performed, For feature extraction the PCA[12] algorithm will be used. The PCA algorithm will generate the Eigen faces for each of the image and through these Eigen faces; the system will generate the Eigenvectors. These Eigen vectors will be sent into next module for Database training. For training, the Backpropagation algorithm of Neural Network[7] will be used. The flowchart of Facial Expression Recognition System is shown in Fig. 2.

As shown in the flowchart (Fig. 2), the database is trained using the backpropagation Neural Network. The trained database consists of the Extracted features of the face using the PCA[12]. These Extracted features has some known meaning for different Expressions as shown in Table 1[11].These extracted features with some known meaning are compared and with the help of Neural Network the expressions are recognized.

II. Psychological Basis for Recognizing Facial Expression

Table 1 summarizes the result of Ekman and Friesen [11], on the universal cues for recognizing the six principal emotions. These cues describe the peak of each expression and thus they provide a human interpretation of the static appearance of the facial feature. For Example: A description such as "Brows are raised" means that the human interpretation of the location of the brows relative to the other facial features indicates that they are not in neutral state but higher than usual. The viewer uses many cues to deduce such information from the image. Unfortunately the performance of humans in arriving such descriptions is far better than what can be currently achieved by computers if only static images are considered. These descriptions seem rather instinctive to human but are quite difficult to translate into computational procedures.

The basic human expressions are Neutral, Happy, Sad, Disgust, Surprise and Anger.

Fig. 3 Basic Human Expressions

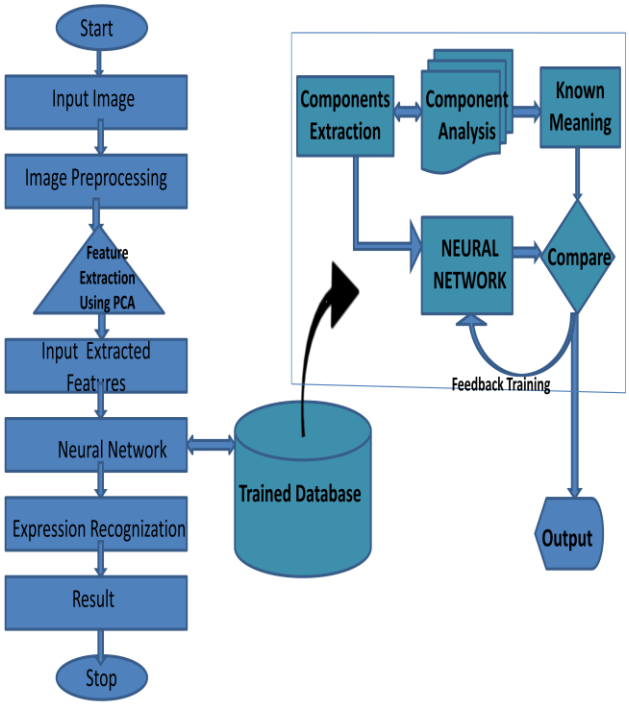

Fig. 2 Flowchart of FERS

II. FACIAL COMPONENT EXTRACTION- (PCA)

Feature Extraction is a process where the required feature for expression recognition is extracted. Here in this paper, for feature extraction we are using PCA algorithm. Principal Component Analysis (PCA) is a statistical technique used for dimension reduction and recognition, & widely used for facial feature extraction and recognition. PCA is known as Eigen Space Projection which is based on linearly Projection the image space to a low dimension feature space that is known as Eigen space.

Many PCA-based face-recognition systems have also been developed in the last decade. In this paper we are using PCA along with Neural Network for more efficient results. When using the PCA, there is no need to calculate the facial features like lips, cheeks, etc. But rather, the whole face is considered as the principal component for facial expression recognition. In this project we are first calculating the Eigenfaces for each of the different expressed image. After calculating the Eigenfaces, of each image, the eigenvector will be calculated. With these Eigenvectors, a threshold value will be calculated for each of the facial expression.

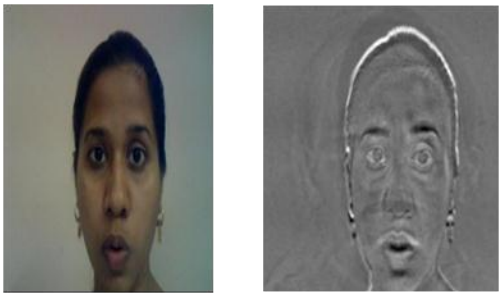

Fig 4 Face Image and its Eigenface

II. TRAINING AND CLASSIFICATION- (BPNN)

The training and classification is done using the Backpropagation Neural Network[7]. During training, the network is trained to associate outputs with input patterns. When the network is trained, it identifies the input pattern and tries to output the associated output pattern. In order to train a neural network to perform some task, we must adjust the weights of each unit in such a way that the error between the desired output and the actual output is reduced. This process requires that the neural network to compute the error derivative of the weights (EW). In other words, it must calculate how the error changes as each weight is increased or decreased slightly. The back propagation algorithm is the most widely used method for determining the EW. The power of neural networks is realized when a pattern of tokens, during testing, is given as an input and it identifies the matching pattern it has already learned during training.

The Back Propagation Neural Network is designed based on the facial components extracted as above. The neurons in the layer are fully interconnected with weight. The training in Backpropagation Neural Network involves three stages. The feedforward of the input training pattern, then calculation and backpropagation of associated error and then adjustment of weights, to detect the facial expression in the image.

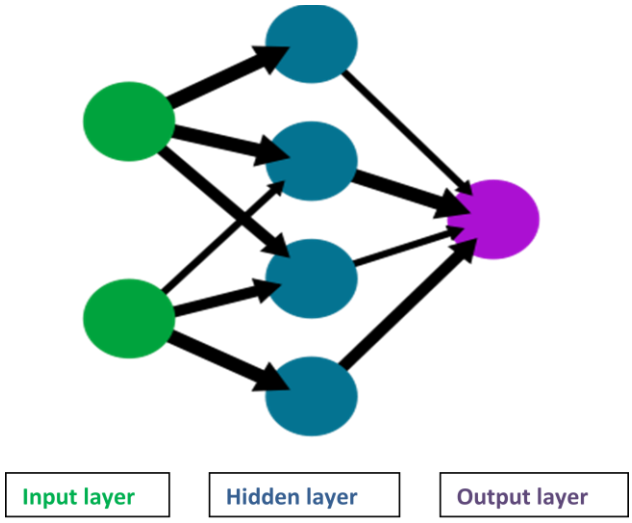

Fig 5 A simple Neural Network

II. RECOGNITION

After the completion of training, the network is ready to recognize expression presented at its input. For recognizing the expression of a face two options are provided. If user wants to recognize the gesture of existing image, then it can be loaded from memory. And other option is to capture the live image. Image is captured from the web cam. The recognition process is implemented as per the outline given in the flow chart in fig. 2.

III. CONCLUSION AND FUTURE WORK

Facial expression recognition is challenging problem and there is still a lot of work that needs to be done in this area. Over the past ten years, facial expression recognition has received substantial attention from researchers in biometrics, pattern recognition, computer vision, and cognitive psychology communities. This common interest in facial recognition technology among researchers working in diverse fields is motivated both by the remarkable ability to recognize expression. Applications of facial expression recognition can be found in security, tracking, multimedia, and entertainment domains. This project will be able to recognize the human facial expression using the Backpropagation Neural Network. But still, there lies a task which is quite complicated-the generation of threshold value. It is a tedious task to decide the best threshold value to generate the tokens. So as a next process or the future work is to determine the best threshold value, so that without the interaction of user the system can generate the tokens.

Table 1 The cues for facial expression as suggested by Ekman and Friesen[11]

Emotion	Observed Facial Cues
Surprise	Brows Raised(curved and high) Skin Below brows stretched Horizontal across Forehead Eyelids opened and more of the white of the eye is visible Jaw drops open without tension or stretching of the mouth
Fear	Brows raised and drawn together Forehead wrinkles drawn to the center Upper eyelid is raised and lower eyelid is drawn up Mouth is open Lips are slightly tensed or stretched and drawn back
Disgust	Upper lip is raised Lower lip is raised and pushed up to upper lip or is lowered and slightly protruding Nose is wrinkled Cheeks are raised Brows are lowered
Anger	Brows lowered and drawn together Vertical lines appeared between brows Eyes have a hard stare and may have a bulging appearance Lips are either place firmly together with corner straight or down or are open, tensed in squarest step.
Happiness	Corners of lips are drawn back and up Mouth may or may not be parted with teeth exposed or not Cheeks are raised Lower eyelids show wrinkles below it, and may be raised but not tensed
Sadness	Inner corners of the eyes are drawn up Skin below the eye is triangulated, with inner corner up. Upper lid inner corner is raised Corner of the lips is drawn up or lip is trembling

.

REFERENCES

1. K. Susheel, Shitala,Vijay, R C Tripathi, "Real Time Face Recognition Using Adaboost Improved Fast PCA Algorithm"- IJAIA, Vol.2, No.3, July 2011

2. Avinash Kaushal, J P S Raina, "Face detection using Neural Network and Gabor Wavelet Transform", IJCST Vol. 1, Issue 1, September 2010

3. Jagdish Lal Raheja, Umesh Kumar, "Human facial expression detection from detected in capture image using back propagation neural network"- IJCSIT,Vol.2,No.1,February 2010.

4. Amit Kumar, Prashant Sharma, Shishir Kumar, "Face Recognition using Neural Network and Eigen values with Distinct Block Processing"- IJCTT,Vol.1,2010.

5. Irene Kotsia and Ioannis Pitas,, "Facial Expression Recognition in Image Sequences Using Geometric Deformation Features and Support Vector Machines"- IEEE Transactions On Image Processing, Vol. 16, No. 1, January 2007.

6. Shishir Bashyal, Ganesh K. Venayagamoorthy , "Recognition of facial expressions using Gabor wavelets and learning vector quantization"- Engineering Applications of Artificial Intelligence ,12 November 2007

7. L. Ma and K. Khorasani, "Facial Expression Recognition Using Constructive Feed forward Neural Networks", IEEE Transactions On Systems, Man, And Cybernetics—part B: Cybernetics, Vol. 34, No. 3, June 2004

8. Ming-Hsuan Yang, David J. Kriegman, and Narendra Ahuja, " Detecting faces in Images:A survey", IEEE Transactions On Pattern Analysis And Machine Intelligence, Vol. 24, No. 1, January 2002

9. Mehrabian, A. (1981) Silent messages: Implicit communication of emotions and attitudes.Belmont,CA.(http://www.businessballs.com/mehrabiancommunications.html)

10. [Mitchell, 1997] Mitchell, T.M., 1997. Artificial neural networks. In Mitchell, T.M. Machine learning. McGraw-Hill Science/Engineering/Math. pp.81-126.

11. P.Ekman and W.Friesen, The Facial Action Coding System , Consulting psychologists Press, SanFrancisco, CA,1978

12. R.Q.Feitosa ,M.M.B.Vellasco, Facial Expression Classification Using RBF AND Back-Propagation Neural Networks