

# Facial Expression Recognition using Neural Network –An Overview

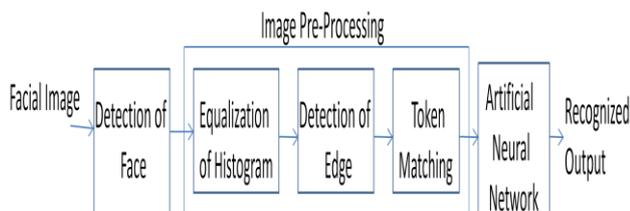
Pushpaja V. Saudagare, D.S. Chaudhari

**Abstract:** In many face recognition systems the important part is face detection. The task of detecting face is complex due to its variability present across human faces including color, pose, expression, position and orientation. So using various modeling techniques it is convenient to recognize various facial expressions. In the field of image processing it is very interesting to recognize the human gesture by observing the different movement of eyes, mouth, nose, etc. Classification of face detection and token matching can be carried out any neural network for recognizing the facial expression. This paper reviews various techniques of facial expression recognition systems using MATLAB (neural network) toolbox.

**Keywords:** face recognition, neural network, and facial expression recognition.

## I. INTRODUCTION

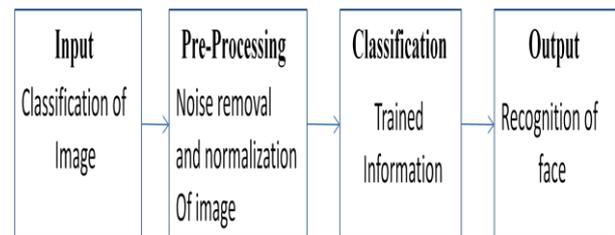
Human communication has two main aspects; verbal (auditory) and non-verbal (visual). Facial expression, body movement and physiological reactions are the basic units of non-verbal communication. By using mathematical algorithm a machine can describe the interpretation of human facial characteristics. An input sensing device such as web-cam, it reads the human body movements and communicates with the computer. The mathematical algorithm interpreted with the human gesture and it is based on artificial intelligence techniques. The block diagram of gesture recognition arrangement is as shown in Figure 1.



**Figure 1: Block Diagram of Gesture Recognition Arrangement**

In the gesture recognition arrangement each box treated as one module. First the web-cam captures the image and gives to the face detection block which can detect the face from the captured image.

Image pre-processing block is a combination of three modules such as histogram equalization, edge detection and token matching. Their output is then provided to the training module, it stores the information which comes from the image pre-processing block and then it trains the network which produces the recognized output [1]. Human face varies from one person to another due to gender, age and other physical characteristics. Therefore the detection of face is more challenging task in computer vision. Figure 2 shows the generic representation of face detection arrangement.



**Figure 2: A Generic Representation of Face Detection Arrangement**

In the face detection, the input block stores the captured image which finds the face area from the image. The face area provides to the pre-processing block which removes the unwanted noise and it also normalize the image. The output is provided to the trainer module, trains the image and decides whether the image belongs to the face class or not and finally it will provide the information about the recognition of face [8].

In the image pre-processing block, firstly use the histogram equalization to enhance the image quality. It is then followed by edge detection process; it plays an important role for identifying the points in the digital image at which the image brightness changes sharply. For implementing this result four algorithm we used i.e. prewitt, sobel, prewitt diagonal and sobel diagonal. After this procedure the thinning is applied to reduce the width of edge to single line. After the thinning process the token divides the data set into the smallest unit for subsequent processing [1].

The neural network performs the very important role for recognizing the facial expression. The artificial neural network is an information processing paradigm that is inspired by the way of biological nervous system.

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**Pushpaja V. Saudagare**, Electronics and Telecommunication Dept. Amravati University, GCOE Amravati, India. (email : [pushpaja.saudagare@gmail.com](mailto:pushpaja.saudagare@gmail.com))

**Devendra S. Chaudhari**, Electronics and Telecommunication Dept, BE, ME, from Marathwada University, Aurangabad and PhD from Indian Institute of Technology, Bombay, Mumbai, India. (email:[chaudhari.devendra@gcoea.ac.in](mailto:chaudhari.devendra@gcoea.ac.in) )

## Facial Expression Recognition using Neural Network –An Overview

An ANN is configured for a specific application such as pattern recognition or data classification through a learning process. Learning system involves adjustments to synaptic connections that exist between the neurons. For analyzing any type of information, trained neural network treated as an 'expert' system. The neural network has an ability to do task based on data given for training and it also creates its own organization during learning time. Artificial neurons are a device with many inputs and one output. After getting the inputs from the pre-processing block the neural network trains the network by using different modeling techniques and provides the recognized output. For implementation of face detection and neural network involve the image processing toolbox and neural network toolbox of MATLAB.

### II. FACIAL EXPRESSION RECOGNITION - AN OVERVIEW

The importance of facial expression system is widely recognized in social interaction and social intelligence. The system analysis has been an active research topic since 19th century. The facial expression recognition system was introduced in 1978 by Suwa et. al. The main issue of building a facial expression recognition system is face detection and alignment, image normalization, feature extraction, and classification. There are number of techniques which we use for recognizing the facial expression.

Some of the researchers [1] introduced the system can recognize the different human gesture in color image. In this paper Viola and Jones describe the face detection technique using Add Boost Haar classifier. After performing the pre-processing operation the recognition is performed, the simplicity and robustness of the system is significant. Depending on threshold value the researchers system can recognize the facial expression. The approach of this system can be adapted to real time and it briefly describes the schemes of capturing the image and to recognize the gestures.

In the field of neural network, back propagation method mostly used for recognizing the facial expression [6]. The paper proposes the different techniques to extract the features such as forehead, mid forehead, mouth, and cheek. These extracted features provide us the different recognized output using back propagation method. The experimental results show that the back propagation algorithm or method can recognize the appropriate facial expression than other methods. These networks are most widely used and the work is considered as a main part of artificial neural network.

In an efficient algorithm for motion detection based facial expression recognition using optical flow proposed an efficient algorithm for facial motion detection. This technique is based on optical flow technique which extracts the necessary motion vectors. Optical flow reflects the image changes due to motion during the interval of time. This algorithm works on frames of segmented image and

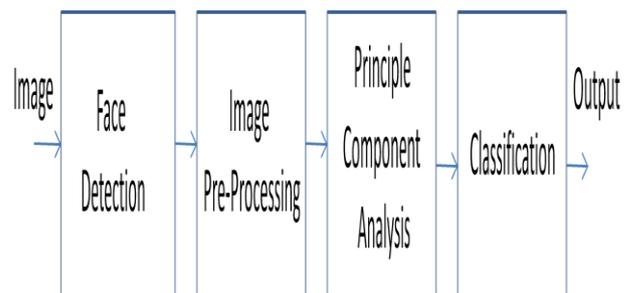
gives us their result which is depending on motion vectors. The strongest degree of similarity determines the facial emotions. The algorithm examine the work on the basis of Action unite (AU) coded facial expression database. By using this method the matching can recognize the facial expression. There are four types to recognize that expression. The first type uses emotion space to recognize facial expression. The second type is to recognize facial expression of an image frame by using optical flow. The third type is to use active shape models to recognize facial expression. The fourth type is to recognize the facial expression by using neural network [3].

The paper proposes an automated facial expression recognition system using neural network [5]. Facial expression recognition provides an important behavior for the study of emotion. In this paper radial basis function network (RBFN) and multilayer perceptron (MLP), these two neural network models describe the automated facial expression recognition method. The author introduced the point counter detection method; by using this method the system can extract the features from the face.

Face is a complex multidimensional visual model and for developing a model for face recognition is difficult task. This paper presents coding and decoding methodology for face recognition. For face recognition there are many types of database images available of an individual face with different condition (expression, illumination, etc). In this paper [2] discussed that the method of eigenfaces are calculated by using Principal component analysis (PCA). There are two types of methodology introduced by author-feature extraction using principle component analysis and feed forward back propagation neural network method.

### III. METHDOLOGY

In this article the system proposed four stages: face detection, pre-processing, principle componenet anaysis (PCA) and classification as shown in Figure.

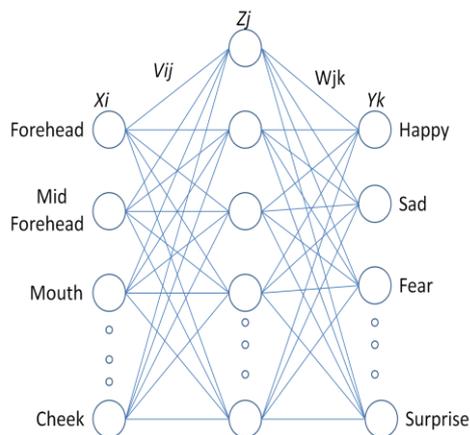


**Figure 3: Architecture of Facial Expression Recognition System**

The first stage is face detection method. In this method the database of images are allmost identical enviournment of distance, background, etc. the collection of all the images includes different poses of several neutral, anger, happiness, etc. expressions.

For creating any type of database some images used for training and some for testing, both of which include number of expressions [5].

The proposed technique is depend on coding and decoding method. First the information is extracted, encoded and then matched with the database of model. Next is the pre-processing module, in this the image gets normalized and it also remove the noise from the image. In eigenface library the database image set divides into two sets- training dataset and testing dataset. The eigenfaces are calculated from the training set. These training set images are matched with the best eigenfaces, which have the largest eigenvalues. For calculating those eigenvalues the principle componenet analysis algorithm (PCA) used [2]. At the last stage of architecture the neural network trained the function in various field of application. The Artificial Neural Network (ANN) can be used for the database in which the face descriptors are used as a input to train the network. For all positive result the network shows 1 in output and for all negative result 0 is present in output. If the new database is obtained for training then first the neural network match all the new result to the pre-built dataset and match the maximum threshold values and provide the output. Then it is conformed that the new facial expression is belong to the recognised person with the maximum output.



**Figure 4: Architecture of feed-forward back propagation neural network**

The figure gives an example of feed-forward backpropagation neural network, in which the input layer composed of neurons. These neurons provide the data of forehead, mid forehead, and mouth to the next layer of neuron. The next layer is called a hidden layer which calculate the values and provided to the output layer, where the system provides the different expression as a output.

#### IV. CONCLUSION

In this paper the automatic facial expression recognition systems are overviewed. The neural network approach is based on face recognition, feature extraction and categorization. The approach of facial expression recognition method involve the optical flow method, active shape model technique, principle componenet analysis algorithm (PCA) and neural network technique. The approach does provide a practical solution to the problem of facial expression

recognition and it can work well in constrained enviournment.

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#### AUTHOR PROFILE



**Pushpaja V. Saudagare** received the B.E. degree in Electronics Engineering from the H.V.P.M. College of Engineering Amravati University in 2009, and she is currently pursuing the M. Tech. degree in Electronic System and Communication (ESC) at Government College of Engineering, Amravati.



**Devendra S. Chaudhari** obtained BE, ME, from Marathwada University, Aurangabad and PhD from Indian Institute of Technology, Bombay, Mumbai. He has been engaged in teaching, research for period of about 25 years and worked on DST-SERC sponsored Fast Track Project for Young Scientists. He has worked as Head Electronics and Telecommunication, Instrumentation, Electrical, Research and incharge Principal at Government Engineering Colleges. Presently he is working as Head, Department of Electronics and Telecommunication Engineering at Government College of Engineering, Amravati.

Dr. Chaudhari published research papers and presented papers in international conferences abroad at Seattle, USA and Austria, Europe. He worked as Chairman / Expert Member on different committees of All India Council for Technical Education, Directorate of Technical Education for Approval, Graduation, Inspection, Variation of Intake of diploma and degree Engineering Institutions. As a university recognized PhD research supervisor in Electronics and Computer Science Engineering he has been supervising research work since 2001. One research scholar received PhD under his supervision.

He has worked as Chairman / Member on different university and college level committees like Examination, Academic, Senate, Board of Studies, etc. he chaired one of the Technical sessions of International Conference held at Nagpur.

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He is fellow of IE, IETE and life member of ISTE, BMESI and member of IEEE (2007). He is recipient of Best Engineering College Teacher Award of ISTE, New Delhi, Gold Medal Award of IETE, New Delhi, Engineering Achievement Award of IE (I), Nashik. He has organized various Continuing Education Programmes and delivered Expert Lectures on research at different places. He has also worked as ISTE Visiting Professor and visiting faculty member at Asian Institute of Technology, Bangkok, Thailand.

His present research and teaching interests are in the field of Biomedical Engineering, Digital Signal Processing and Analogue Integrated Circuits.