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An Elegant Human Face Expression Investigation by Means of Neural Network

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Abstract — **Facial expression plays a principal role in human interaction and communication since it contains critical and necessary information regarding emotion. The task of automatically recognizing different facial expressions in human-computer environment is significant and challenging. In this paper, we report our experiments on feature-based facial expression recognition within an architecture based on Hopfield Network. 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 Hopfield Network for Expression Recognition**.

Key Words — **Facial Expression, facial Expression Recognition System, Feature Extraction (PCA algorithm), Classification (Hopefield Neural Network algorithm)**

I. INTRODUCTION

The science of image processing helps 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 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. Identifying human facial expressions has become an important field of study in recent years because of its inherent intuitive appeal and also due to possible applications such as human computer interaction, face image compression, synthetic face animation and video facial image queries

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 organization of the paper is as follows: Section 2 covers literature review. Section 3 reports on the proposed approach to address the problem, Section 4 reports on the initial analysis of experimental data, and finally Section 5 gives some final remarks and indications for the continuation of the work.

II. LITERATURE REVIEW

The literature has some works related to facial expressions recognition, such as Multi-layer Perceptron [13], FRS using Back propagation neural network [15], and also works that apply the Hopfield network to detect face expressions [14] and nominal color coding of classified images[5]. Among many recognition subjects, face recognition has drawn considerable interest and attention from many researchers for the last two decades because of its potential applications, such as in the areas of surveillance, secure trading terminals, Closed Circuit Television (CCTV) control, user authentication, HCI Human Computer Interface, intelligent robot and so on. A number of face recognition methods have been proposed [6] [7] and some related face recognition systems have been developed. In this paper we proposed a computational model of face recognition, which is fast, reasonably simple, and accurate in constrained environments such as an office or a household. 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. Ma et al. [1] propose facial expression recognition using an MLP architecture allied to image compression techniques, optimization algorithms such as quasi-Newton and pruning methods. In an attempt to simplify this approach, and yet keeping the rate results between 95% and 100% of recognition, a Hopfield neural network can be used for further processing. Ma et al.'s work recognizes the facial expression on each image that is given to the neural network. 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 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.

III. METHODOLOGY

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: Face Detection, 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 Face Detection, Image Preprocessing , Feature Extraction (Using the PCA algorithm), Classification (Using the Hopefield Neural Network algorithm) and output.

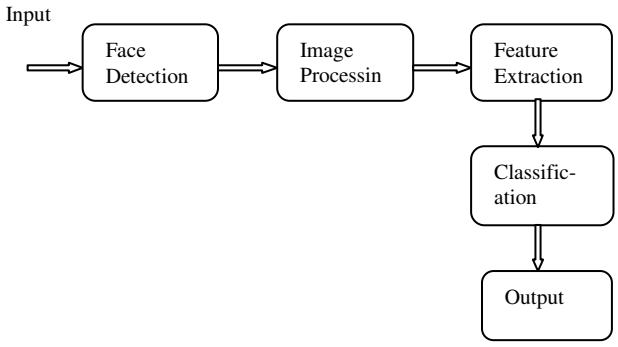

Fig 1: Facial Expression Recognition System

A.Face Detection : The first stage is face detection method. In this method the database of images are almost identical environment 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 first stage is face detection method.

B. Image Processing: In this module, 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, Image pre-processing takes the form of signal conditioning (such as noise removal, and normalization against the variation of pixel position or brightness), together with segmentation, location, or tracking of the face or its parts.

C. Feature Extraction: For feature extraction the PCA [1] 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.

D. Classification: The database is trained using the Hopfield Neural Network. The trained database consists of the Extracted features of the face using the PCA [1]. These Extracted features has some known meaning for different Expressions. These extracted features with some known meaning are compared and with the help of Neural Network the expressions are recognized. The Hopfield Type Network is a multiple-loop feedback neural computation system. The neurons in this network are connected to all other neurons except to them selves , that is there are no self-feedbacks in the network. 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.

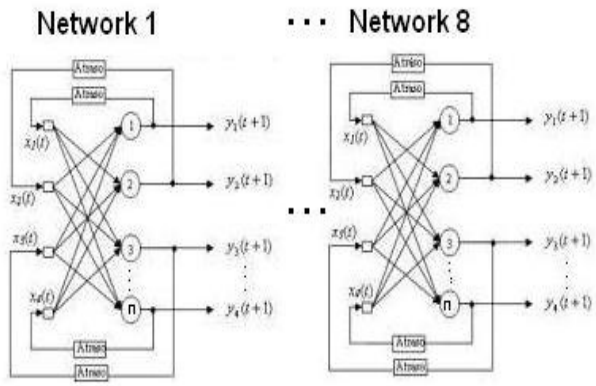

Fig 2: Architecture of Hopfield Network

IV. EXPERIMENTAL EVALUATION

We evaluated our system on the JAFFE facial expression recognition database. The task was to classify each of the video sequences into one of the six standard expression classes: happiness, anger, disgust, sadness, fear and surprise.

The JAFFE database contains 213 images of 10 Japanese female models. Their images are labeled by emotions: six basic emotions (anger, disgust, fear, joy, happy, sad and surprise) are considered.

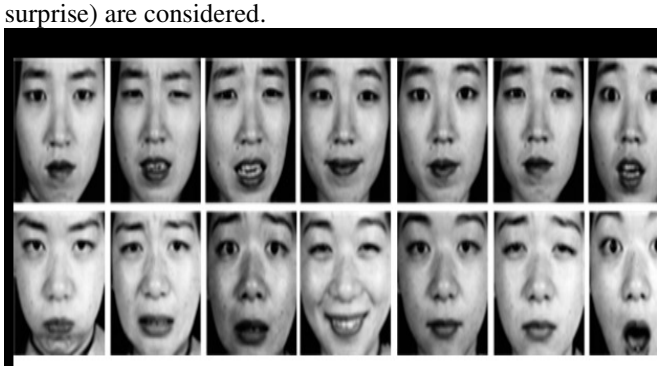

Fig 3: Some sample images from the JAFFE database

The efficiency plots for three sets of images are shown in Figure 4. From the figure, it is shown that there is a slight decrease in the performance of recognizing the expression 'Fear' compared to others. The expression 'Surprise' has better performance of nearly 100%. The performance ratios for surprise and disgust are almost same

Emotion	Accuracy(in percentage)
Anger	83.1
Disgust	95.3
Fear	78.2
Joy	83.9
Sorrow	89.4
Surprise	98.8
Total Accuracy	**86.8**

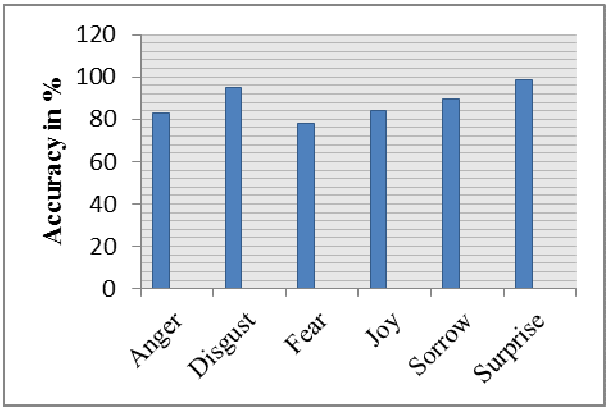

Fig 4: Efficiency Plot

V. CONCLUSION

This paper is dedicated to the challenging computer vision task of subject-independent emotion recognition from facial expressions; the task difficulty is due to significant variability of facial images among individuals for the same emotion. In this paper present model of Face Recognition System using the concept of Hopfield Neural Network and digital image processing has been discussed. The model is implemented and evaluated for the database JAFFE with 6 classes corresponding to the facial expression of happiness, sadness, surprise, anger, disgust, fear. Performed tests demonstrate acceptable results, with low computational cost and easy implementation. The efficiency can be increased by better technique of scaling, efficient technique of edge detection such as advanced edge detection technique and feature extraction.

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