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**Research Article**

# IMPLEMENTATION OF ARTIFICIAL NEURAL NETWORK IN NANO SCALE ENVIRONMENT

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**ABSTRACT**

Facial recognition systems are computer-based security systems that are able to automatically detect and identify human faces. Facial recognition has gained increasing interest in the recent decade. Over the years there have been several techniques being developed to achieve high success rate of accuracy in the identification and verification of individuals for authentication in security systems. This project experiments the concept of neural network for facial recognition that can differentiate and recognize face of image. This face recognition system begins with image pre-processing and then the output image is trained using Fuzzy c-means clustering (FCM) algorithm. FCM network learns by training the inputs, calculating the error between the real output and target output, and propagates back the error to the network to modify the weights until the desired output is obtained. After training the network, the recognition system is tested to ensure that the system can recognize the pattern of each face image. The purpose of this project is to recognize face of image for the recognition analysis using Neural Network and capture the brainwaves of the emotion recognition. This project is mainly concern with facial recognition systems using purely image processing technique**.**

**Keywords:** ANN, Face recognition, FCM.

## INTRODUCTION

Human often use nonverbal cues such as hand gestures, facial expressions, and tone of the voice to express feelings in interpersonal communications. Unfortunately, currently available human–computer interfaces do not take complete advantage of these valuable communicative media and thus are unable to provide the full benefits of natural interaction to the users. Human–computer interactions could significantly be improved if computers could recognize the emotion of the users from their facial expressions and hand gestures, and react in a friendly manner according to the users' needs and preferences. The phrase affective computing is currently gaining popularity in the literature of human–computer interfaces.

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The primary role of affective computing is to monitor the affective states of people engaged in critical/accident-prone environments to provide assistance in terms of appropriate alerts to prevent accidents. Li and Ji proposed a probabilistic framework to dynamically model and recognize the users' affective states so as to provide them with corrective assistance in a timely and efficient manner.Picard et al. stressed the significance of human emotions on their affective psychological states. Rani et al. presented a novel scheme for the fusion of multiple psychological indices for real-time detection of a specific affective state (anxiety) of people using fuzzy logic and regression trees, and compared the relative merits of the two schemes. Among the other interesting applications in affective computing, the works of Scheirer Conati Kramer, and Rani et al. deserve special Mention Apart from human–computer interfaces, emotion recognition by computers has interesting applications in computerized psychological counselling and therapy, and in the detection of criminal and antisocial motives. The identification of human emotions from facial expressions by a machine is a complex problem for the following reasons. First, identification of the exact facial expression from a blurred facial image is not an easy task. Second, segmentation of a facial image into regions of interest is difficult, particularly when the regions do not have significant differences in their imaging attributes. Third, unlike humans, machines usually do not have visual perception to map facial expressions into emotions.

This Project provides an alternative scheme for human emotion recognition from facial images, and its control, using fuzzy logic. Audiovisual stimulus is used to excite the emotions of subjects, and their facial expressions are recorded as video movie clips. The individual video frames are analysed to segment the facial images into regions of interest. Fuzzy C-means (FCM) clustering is used for segmentation of the facial images into three important regions containing mouth, eyes, and eyebrows. Next, a fuzzy reasoning algorithm is invoked to map fuzzified attributes of the facial expressions into fuzzy emotions. The exact emotion is extracted from fuzzified emotions by a demoralization procedure similar to defuzzification (fuzzy decoding).The proposed scheme is both robust and insensitive to noise because of the nonlinear mapping of image attributes to emotions in the fuzzy domain. Experimental results show that the detection accuracies of emotions for adult male, adult female, and children of 8–12 years are as high as 88%, 92%, and 96%, respectively,

outperforming the percentage accuracies of the existing techniques . This project also proposes a scheme for controlling emotion by judiciously selecting appropriate audiovisual stimulus for presentation before the subject. The selection of the audiovisual stimulus is undertaken using fuzzy logic. Experimental results show that the proposed control scheme has good experimental accuracy and repeatability.

A face recognition system [6] is a computer vision and it automatically identifies a human face from database images. The face recognition problem is challenging as it needs to account for all possible appearance variation caused by change in illumination, facial features, occlusions, etc. This paper gives a Neural and PCA based algorithm for efficient and robust face recognition. Holistic approach, feature-based approach and hybrid approach are some of the approaches for face recognition. Here, a holistic approach is used in which the whole face region is taken into account as input data. This is based on principal component-analysis (PCA) technique, which isused to simplify a dataset into lower dimension while retaining the characteristics of dataset.

**GLOBAL VS. LOCAL FEATURES**

Over the past few years, the holistic/appearance based face recognition approaches have been more dominant and superior in performance compared to the component based approaches. Holistic approach includes an intimate relation between the features of a face and their geometrical rotation. The argument over the usage of hybrid of holistic and component based approach also had taken place. Further it is possible to assume that the representation of any visual pattern can be done with the help of holistic-to-feature continuum, where using it may lead to finding a few objects that may be weighted more towards a holistic representation, while the other objects may be weighted towards a feature representation.

When fast and efficient recognition of faces is required, it noticed that the holistic approach is dominant, but it does not provide good result when it finds variation in face image because of the differences in head pose, position, size, facial expression, and illumination. Henceforth, face image provides a wide spectrum of spatial information, ranging from coarse to very fine details to the viewer. Here, the fine spatial information is associated with image details and coarse spatial information corresponds with less detailed aspects which are large.

To make use of both holistic and component based face recognition methods advantages, hybrid face recognition methods have been developed [3, 4, 5, 6, 7, 8]. The hybrid approach uses both local regions and the whole face in recognition process. Modular Eigen faces, shape-normalized and hybrid local features methods come under this category has been developed.

**PREPROCESSING**

Image pre-processing is a significant step before applying any other technique on images. Image preprocessing can be of different kinds, for noise removal, smoothing, thresh holding, background removal etc., it can be rightly said that the kind of preprocessing required is greatly dependent on the application under consideration. In many applications involving face recognition, the inputs are first binarized to form a two level image based on the threshold value. It is usual to pre-process the scanned images to do the image enhancement in the presence of noise and other types of distortions that occur during the scanning process. In this preprocessing stage, the image is enhanced, resized and binarized to make the image clear and accurate. It is necessary to employ the non linear technique for processing the face images prior to binarization [2,3] There are several methods available for thresholding image to produce binary image. An experimental performance evaluation of several such techniques may found in [2]. These methods include fixed global threshold, Otsu threshold and other techniques. The input grayscale pixels are denoted by Xi € {0, 1}. The corresponding output binarization pixels are denoted by bi € {0, 1} where 0 refers to „black' and refers to 'white'[2]. Image enhancement is necessary to remove noise by filtering the image, adjust the contrast of the image and enhance the edge of the face image before binarization process and training the facial recognition. Edge enhancement can be achieved by noise presents in the input images but tend to smooth the edge details [3]. In this project, the global image threshold using Otsu's method will be chosen as the technique to binarized the face images. This method finds the global threshold t that minimizes the infraclass variance of the resulting black and white pixels of the image.

Where;

Xi = Input grayscale Pixel
Bi = Output binarization Pixel

**SKIN COLOR SEGMENTATION**

FOR SKIN COLOR SEGMENTATION, FIRST WE CONTRAST THE IMAGE. THEN WE PERFORM SKIN COLOR SEGMENTATION. THEN, WE HAVE TO FIND THE LARGEST CONNECTED REGION. THEN WE HAVE TO CHECK THE PROBABILITY TO BECOME A FACE OF THE LARGEST CONNECTED REGION. IF THE LARGEST CONNECTED REGION HAS THE PROBABILITY TO BECOME A FACE, THEN IT WILL OPEN A NEW FORM WITH THE LARGEST CONNECTED REGION. IF THE LARGEST CONNECTED REGIONS HEIGHT & WIDTH IS LARGER OR EQUAL THAN 50 AND THE RATIO OF HEIGHT/WIDTH IS BETWEEN 1 TO 2, THEN IT MAY BE FACE.

**FACE DETECTION**

FOR FACE DETECTION, FIRST WE CONVERT BINARY IMAGE FROM RGB IMAGE. FOR CONVERTING BINARY IMAGE, WE CALCULATE THE AVERAGE VALUE OF RGB FOR EACH PIXEL AND IF THE AVERAGE VALUE IS BELOW THAN 110, WE REPLACE IT BY BLACK PIXEL AND OTHERWISE WE REPLACE IT BY WHITE PIXEL. BY THIS METHOD, WE GET A BINARY IMAGE FROM RGB IMAGE.

THEN, WE TRY TO FIND THE FOREHEAD FROM THE BINARY IMAGE. WE START SCAN FROM THE MIDDLE OF THE IMAGE, THEN WANT TO FIND A CONTINUOUS WHITE PIXELS AFTER A CONTINUOUS BLACK PIXEL. THEN WE WANT TO FIND THE MAXIMUM WIDTH OF THE WHITE PIXEL BY SEARCHING VERTICAL BOTH LEFT AND RIGHT SITE. THEN WE CUT THE FACE FROM THE STARTING POSITION OF THE FOREHEAD AND ITS HIGH WILL BE 1.5 MULTIPLY OF ITS WIDTH.


**Fig. 1: Remove the unwanted portion from the image**


**Fig. 2: Shows width of the face**

In the figure, X will be equal to the maximum width of the forehead. Then we will have an image which will contain only eyes, nose and lip. Then we will cut the RGB image according to the binary image.

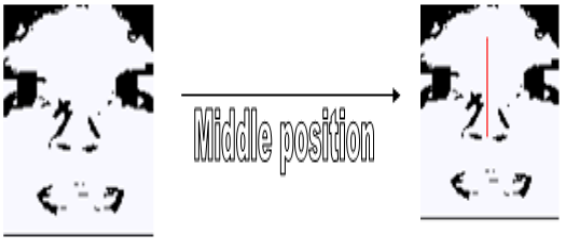


**Fig. 3: Shows an mid position of the image**

**EYES SEGMENTATION**

For eyes detection, we convert the RGB face to the binary face. Now, we consider the face width by W. We scan from the W/4 to (W-W/4) to find the middle position of the
two eyes. The highest white continuous pixel along the height between the ranges is the middle position of the two eyes


**Fig.4: Shows detection of the eye region**

Then we find the starting high or upper position of the two eyebrows by searching vertical. For left eye, we search w/8 to mid and for right eye we search mid to w – w/8. Here w is the width of the image and mid is the middle position of the two eyes. There may be some white pixels between the eyebrow and the eye. To make the eyebrow and eye connected, we place some continuous black pixels vertically from eyebrow to the eye. For left eye, the vertical black pixel-lines are placed in between mid/2 to mid/4 and for right eye the lines are in between mid+(w-mid)/ 4 to mid+3*(w-mid)/ 4 and height of the black pixel-lines are from the eyebrow starting height to (h- eyebrow starting position)/4. Here w is the width of the image and mid is the middle position of the two eyes and h is the height of the image. Then we find the lower position of the two eyes by searching black pixel vertically. For left eye, we search from the mid/4 to mid - mid/4 width. And for right eye, we search mid + (w-mid)/ 4 to mid+3*(w- mid)/ 4 width from image lower end to starting position of the eyebrow. Then we find the right side of the left eye by searching black pixel horizontally from the mid position to the starting position of black pixels in between the upper position and lower position of the eye br. And left side for right eye we search mid to the starting position of black pixels in between the upper position and lower position of right eye. The left side of the left eye is the starting width of the image and the right side of the right eye is the ending width of the image. Then we cut the upper position, lower position, left side and the right side of the two eyes from the RGB image.

**Lip Segmentation**

For lip detection, we determine the lip box. And we consider that lip must be inside the lip box. So, first we determine the distance between the forehead and eyes. Then we add the distance with the lower height of the eye to determine the upper height of the box which will contain the lip. Now, the starting point of the box will be the ¼ position of the left eye box and ending point will be the ¾ position of the right eye box. And the ending height of the box will be the lower end of the face image. So, this box will contain only lip and may some part of the nose. Then we will cut the RGB image according the box. for each index, there are 6 control points for lip Bezier curve, 6 control points for left eye Bezier curve, 6 control points for right eye Bezier curve, lip height and width, left eye height and width and right eye height and width. So, by this method, the program learns the emotion of the people.

**ARTIFICIAL NEURAL NETWORK**

The ANN is a suitable application for recognition process. An artificial neural network is a non linear and adaptive mathematical module inspired by the working of a human brain. It consists of simple neuron elements operating in parallel and communicating with each other through weighted interconnections.

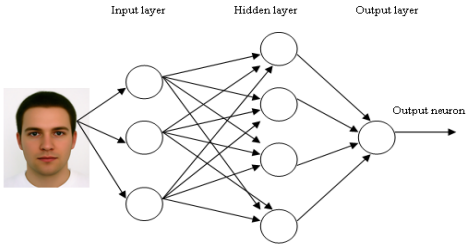


**Fig. 5: Architecture diagram for ANN**

**EXPERIMENT AND RESULTS**

**Fig. 6: Shows the output of the unmasking the face**

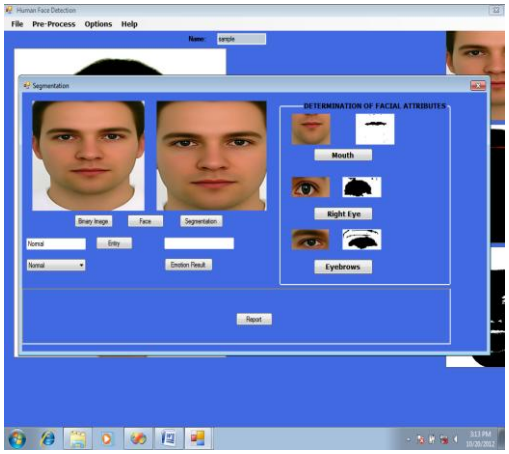


**Fig. 7: Shows the output of the segmented images**

**CONCLUSIONS**

Every application has its own merits and demerits. The project has covered almost all the requirements. Further requirements and improvements can easily be done since the coding is mainly structured or modular in nature. Changing the existing modules or adding new modules can append improvements. Further enhancements can be made to the application, so that the search results functions very attractive and useful manner than the present one.

**REFERENCES**

1. J. C. Bezdek, "*Fuzzy mathematics in pattern classification*," Ph.D. dissertation,Appl. Math. Center, Cornell Univ., Ithaca, NY, 1973.
2. B. Biswas, A. K. Mukherjee, and A. Konar, "*Matching of digital images using fuzzy logic*," AMSE Publication, vol. 35, no. 2, pp. 7–11, 1995.
3. M. T. Black and Y. Yacoob, "*Recognizing facial expressions in image sequences using local parameterized models of image motion*," Int. J.Comput. Vis., vol. 25, no. 1, pp. 23–48, Oct. 1997.
4. sexC. Busso and S. Narayanan, "*Interaction between speech and facial gesturesin emotional utterances: A single subject study*," IEEE Trans. Audio, Speech Language Process., vol. 15, no. 8, pp. 2331–2347, Nov. 2007.
5. I. Cohen, "*Facial expression recognition from video sequences,*" M.S.thesis, Univ. Illinois Urbana-Champaign, Dept. Elect. Eng., Urbana, IL,2000.
6. I. Cohen, N. Sebe, A. Garg, L. S. Chen, and T. S. Huang, "*Facial expression recognition from video sequences: Temporal and static modeling*,"Comput. Vis. Image Underst., vol. 91, no. 1/2, pp. 160–187, Jul. 2003.
7. C. Conati, "*Probabilistic assessment of user's emotions in educational games*," J. Appl. Artif. Intell., Special Issue Merging Cognition Affect, vol. 16, no. 7/8, pp. 555–575, Aug. 2002.
8. G. Donato, M. S. Bartlett, J. C. Hager, P. Ekman, and T. J. Sejnowski,"*Classifying facial actions*," IEEE Trans. Pattern Anal. Mach. Intell.,vol. 21, no. 10, pp. 974–989, Oct. 1999.
9. P. Ekman and W. V. Friesen, *Unmasking the Face: A Guide to Recognizing Emotions From Facial Clues*. Englewood Cliffs, NJ: Prentice-Hall,1975.
10. I. A. Essa and A. P. Pentland, "*Coding, analysis, interpretation and recognition of facial expressions*," IEEE Trans. Pattern Anal. Mach. Intell., vol. 19, no. 7, pp. 757–763, Jul. 1997.
11. W.A.Fellenz, J. G. Taylor, R. Cowie, E. Douglas-Cowie, F. Piat, S. Kollias, C. Orovas, and B. Apolloni, "*On emotion recognition of faces and of speech using neural networks, fuzzy logic and the ASSESS systems*,"in Proc. IEEE -INNS-ENNS Int. Joint Conf. Neural Netw., 2000,pp. 93–98.
12. J. M. Fernandez-Dols, H. Wallbotl, and F. Sanchez, "*Emotion category accessibility and the decoding of emotion from facial expression and context,*" J. Nonverbal Behav., vol. 15, no. 2, pp. 107–123,Jun. 1991