Facial Expression Recognition Using Fuzzy Art

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***Abstract*—Recognition of facial emotions has important role in HCI. Recognition of Human's Facial Expression has been very active research area of computer vision. It has the important role in the human-computer interaction (HCI) systems. This paper presents a method for Facial Expression Recognition using Fuzzy Art. Fuzzy c-means clustering method in image segmentation. Segmentation method is based on a basic region growing method and uses membership grades' of pixels to classify pixels into appropriate segments. Images were in RGB color space, as feature space was used L*u*v* color space. 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 method.**

***IndexTerms*—Facial Emotion Recognition, Fuzzy Logic, fuzzy c-means, images segmentation, feature space, Image processing.**

I. INTRODUCTION

Facial expression recognition (FER) is one of the most important subjects in the fields of human-computer interaction, which has wide range of applications such as Telecommunication, Medical, Human Computer Interactions (HCI) and Biometrics. The ideal human computer Interaction system is the one that the computer is able to communicate and respond to the user actions, based on emotional state of human's face. In this way the user will be able to communicate with it more effectively. For this aim, automatic recognition of human's facial expressions has been very active research area of machine vision within the last several years. It began from 1970s, when Ekman and Friesen introduced six universal facial expressions that are happiness, sadness, anger, fear, surprise, and disgust. In addition, they developed Facial Action Coding System (FACS) that is a famous framework which describes human's facial expressions based on action units (AUs).[1] In recent years Many Facial Expression Recognition systems have been developed. FER systems usually extract facial Expression parameters from face image (feature extraction) and fed them to a classifier for identifying the emotion. In Order to recognize expressions of the face precisely, a useful feature extraction method and classification scheme must be chosen. Most of current researches focus on achieving more effective feature extraction and classification methods for better identification of emotions such as fear, surprise, joy, sad, disgust and anger.

Rest of this paper is organized as follows. In section 2, brief review of proposed system is given. In section 3 various modules for face detection are described.

II. PROPOSED SYSTEM

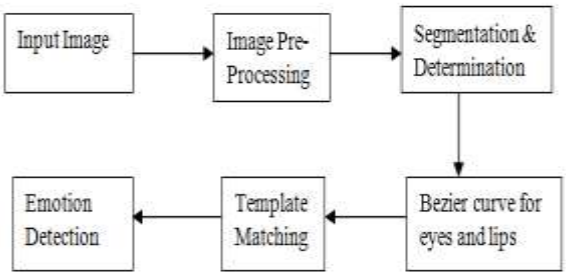

Fig 2.1 flow diagram

The Proposed System provides an alternative scheme for human emotion recognition from facial images, and its control, using fuzzy logic. Fuzzy C-means (FCM) clustering is used for the segmentation of the facial images. Here In first step, we input images in method, that image pre-processed for identifying face area after that segmentation and determination for various regions of face. Fuzzy C-means (FCM) clustering is used for the segmentation of the facial images into three important regions containing mouth, eyes, and eyebrows. The exact emotion is extracted from fuzzified emotions by a denormalization procedure similar to defuzzification. The proposed scheme is both robust and insensitive to noise because of the nonlinear mapping of image attributes to emotions in the fuzzy domain.

III. EMOTION RECOGNITION USING FUZZY C-MEANS

1.Image Pre-Processing

Here, We have to follow a number of steps for getting emotions from an image. In proposed method, first module is focus on image pre-processing. In image pre-processing we convert binary image from RGB image. For converting binary image from

RGB image, we have to calculate the average value of RGB for each picture pixel and if the average value is below than 110, we replace it by black pixel and otherwise we replace it by white pixel.

2.Face Region Detection

Here 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 wewant to find the maximum width of the white pixel by searching vertical both left and right site.

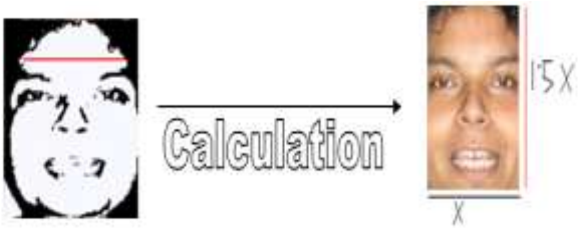

Fig 2: face detection

Then, if the new width is smaller half of the previous maximum width, then we break the scan because if we reach the eyebrow then this situation will arise. Then we cut the face from the starting position of the forehead and its high will be 1.5 multiply of its width as shown fig 2.

3.Segmention and Determination

Fuzzy C means suggest the pre-processing methodology for basic region growing segmentation methodology.As take a look at pictures were used 5 RGB color pictures. These pictures were foremost born-again into L*u*v* color house. Fuzzy c-means methodology was applied to those born-again pictures with extended feature house. Segmentation methodology supported region growing was applied at the tip of segmentation method. Identical methodology was employed in. In was used with easy defuzzi fication rule, in was this methodology increased with thresholding parameter T and in was used with another defuzzification rule. [8]

L*u*v* Color Transformation

Based on psycho-visual experiments were suggested by CIE uniform color spaces, e.g. L*a*b* or L*u*v*. In these color spaces is difference between colors computed using Euclidean distance and here exists difference between lightness and chroma. Values of L*, u* and v* are defined by

$$L^* = \begin{cases} 116 * \sqrt[3]{\frac{Y}{Y_n}} - 16 & \leftrightarrow \frac{Y}{Y_n} > \gamma \\ \beta * \frac{Y}{Y_n} & \leftrightarrow \frac{Y}{Y_n} \leq \gamma \end{cases} \quad (1)$$

$$u^* = 13.L^* \cdot (u' - u'_n)$$

$$v^* = 13.L^* \cdot (v' - v'_n)$$

while values of u′ and v′ are defined by

$$u' = \frac{4X}{X + 15Y + 3Z}$$

$$V' = \frac{9Y}{X+15Y+3Z} \quad (2)$$

and constants β and γ have value

$$\gamma = \left(\frac{6}{29}\right)^3 \approx 0.008856$$

$$\beta = \frac{116}{3} \cdot \left(\frac{29}{6}\right)^2 = \frac{29^3}{27} \approx 903.296296 \quad (3)$$

4.Segmentation Method

Segmentation process consists of several steps. The first of all is input image conversion to chosen feature space, which may depends of used clustering method. In our case is input image converted from RGB color space to L*u*v* color space and L*, u* and v* values are features respectively attributes for fuzzy c-means clustering method.Next step after input image conversion to feature space is applied clustering. In our case, we have chosen fuzzy c-means clustering method, settings are in experiments section.

After these two steps (input image conversion to feature space of clustering method and accomplishing clustering method) is accomplished next segmentation method.[8]

Method 1 (M1)

BEGIN OF M1

Assumptions: Image transformed into feature space, number of clusters c , stop condition ε , fuzziness parameter m .

Step 1: Cluster image in feature space, with next conditions: number of clusters is c , fuzziness index is m and stop condition is ε .

Step 2: Repeat for each pixel a_{ij} of image I .

Step 2.1: Find out, into which cluster C_a belongs pixel a_{ij} at most.

Step 2.2: Find out, whether in the closest surroundings of pixel a_{ij} exists segment R_k , which points belong to same cluster C_a .

Step 2.3: If such segment R_k exists, than pixel a_{ij} add to segment R_k , else create new segment R_n and add pixel a_{ij} to new segment Rn .

Step 3: Merge all segments, which belong to one cluster and are neighbors.

Step 4: Arrange borders of all segments.

END OF M1

Segmentation method used in experiments is based on simple region growing method.

5. EXTENSION FEATURE SPACE OF C-MEANS

The most important part of this segmentation method is extension of feature space. Extension of feature space is based on simple idea, that neighboring pixels have approximately same values of lightness and chroma. But in real images, noise is corrupting the image data or image usually consists of textured segments. Basic segmentation methods based on fuzzy c-means clustering are working as follows:

1. Convert image into feature space of clustering method (usually is used RGB color space, but IHS, HLS, L*u*v* or L*a*b* color spaces are used too).
2. Run fuzzy c-means method on converted image.
3. Use some defuzzification rule or guidelines to classify each pixel to segment. Simple defuzzification rule is based on maximal membership grade of pixel to cluster [1, 4].
   Basic feature space is only color space, e.g. RGB, HIS, HLS or L*u*v* color spaces.
   This feature spaces in combination with clustering methods have one big disadvantage. In clustering process is not involved information about pixels in neighborhood, which results in bad segmentation results, because of noise or texture.
   Extension of feature space is based on involving of neighboring pixels' information. One pixel has 15 instead of 3 features. In simple case [2, 4, 6] has pixel only 3 features (L*u*v* values, Figure 1). In our modification has pixel 15 features, its own L*u*v* values and L*u*v* values of its neighbors. In practical implementation of this extension was used next sequence of pixels: current pixel, up, right, down and left neighbor pixel.[8]

6.Emotion Detection

For emotion detection of an image, we have to find the Bezier curve of the lip, left eye and right eye. Then we convert each width of the Bezier curve to 100 and height according to its width. If the person's emotion information is available in the database, then the program will match which emotion's height is nearest the current height and the program will give the nearest emotion as output. If the person's emotion information is not available in the database, then the program calculates the average height for each emotion in the database for all people and then get a decision according to the average height.

IV.CONCLUSION AND FEATURE ENHANCEMENT

Fuzzy set theory and fuzzy logic offer us powerful tools to represent and process human knowledge in form of fuzzy if-then rules. Because of the uncertainties that exist in many aspects of image processing, fuzzy processing is desirable. In this paper fuzzy C-means facial expression recognition system is introduced which takes a static image as input and gives the expression as output. The emphasis has been to develop a very simple and small but a greatly efficient, fuzzy based algorithm to identify six basic facial expression of a human face. This system evaluates facial expressions through the robust analysis of appropriate facial features. The Proposed scheme repeatability ensures the right selection of audiovisual stimulus. The proposed scheme of emotion recognition and control can be applied in system design for two different problem domains. First, it can serve as an intelligent layer in the next generation human–machine interactive system. Such a system would have extensive applications in the frontier technology of pervasive and ubiquitous computing. This scheme will used in developing emotion sensitive HCI interfaces. Second,the emotion monitoring and control scheme would be useful for psychological counseling and therapeutic applications. This is going to have an impact on our day to day life by enhancing the way we interact with computers or in our surrounding living and work places. In future we can develop this scheme with web camera to capture images of peoples and recognition of their emotions.

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