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Facial Expression Recognition Using Facial Movement Features

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Abstract: This paper present an approach to recognize human face expression and emotions based on some fuzzy pattern rules. Facial features for this specially eye and lips are extracted an approximated into curves which represents the relationship between the motion of features and change of expression. This paper focuses the concepts like face detections, skin color segmentation, face features extractions and approximation and fuzzy rules formation. Conclusion based on fuzzy patterns never been accurate but still our intension is to put more accurate results.

Keywords: Face Detection, Skin Color Segmentation, Face Futures, Curve Formation and Approximation, Fuzzy Patterns.

I. INTRODUCTION

Facial expression analysis has been attracted considerable attention in the advancement of human machine interface since it provides natural and efficient way to communicate between humans [2]. Some application area related to face and its expression includes personal identification and access control, video phone and teleconferencing, forensic application, human computer application [5]. Most of the facial expression recognition methods reported to date or focus on expression category like happy, sad, fear, anger etc. For description of detail face facial expression, Face Action Coding System (FACS) was design by Ekman[8]. In FACS motion of muscles are divided into 44 action units and facial expression are described by their combination. Synthesizing a facial image in model based image coding and in MPEG-4 FAPs has important clues in FACS. Using MPEG-4 FAPs, different 3D face models can be animated. Moreover, MPEG- 4 high level expression FAP allows animating various facial expression intensities. However, the inverse problem of extracting MPEG-4 low and high level FAPs from real images is much more problematic due to the fact that the face is a highly deformable object [1].

II. LITERATURE REVIEW

Designer of FACS, Ekman himself as pointed out some of these action units as unnatural type facial movements. Detecting a unit set of action units for specific expression is not guaranteed. One promising approach for recognizing up to facial expressions intensities is to consider whole facial image as single pattern [4].

Kimura and his colleagues have reported a method to construct emotional space using 2D elastic net model and K-L expansions for real images [7]. Their model is user independent and gives some unsuccessful results for unknown persons.

Later Ohba proposed facial expression space employing principle component analysis which is person dependent [9].

III. PROPOSED METHOD

This project consists of following phases:

A. The Face detection based on skin color
B. Face extraction and enhancement
C. Face features extraction
D. Curve formation using Beziercurve.
E. Fuzzy Patterns

A. The Face detection based on skin color

Skin color plays a vital role in differentiating human and Non-human faces.

From the study it is observe that skin color pixels have a decimal value in the range of 120 to 140.

In this project, we used a trial and error method to locate skin color and non skin color pixels.

But many of the times, system fails to detect whether an image contains human face or not (i.e. for those images where there is a skin color background).an image is segmented into skin color and non-skin color pixels with the equations

$120 \leq |Pxy| \leq 140$----------eq. 3.1.1

where Pxy = *pixel at position* xy

The skin pixels values are set to 1(i.e. #FFFF) and nonskin pixels are set to 0(i.e. 0000). The pixels are collected andsetas per equation

If

$\lim_{i \to 1} n(\int_1^3 120 \leq Pxy \leq 140) = 1$------- eq3.1.2

Else

$\lim_{i \to 1} n(\int_1^3 140 \leq |Pxy| \leq 120) = 0$-------eq3.1.3

where n =*total number of pixels of input image*

The resultant image becomes as

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Original Image Skin and non-skin pixels

Fig. 1 (Phase I)

Fig 3 Image with skin color and after dimension enhancement

B. Face Extraction and Enhancement

Literature review point out that, FACS system technique is based on face features extractions like eye, nose, mouth, etc. In this project, we minimize the number of features (i.e. only eyes and mouth) but given the more weightage for fuzzy rules formations from these extracted features. Face extractions consist of following steps

- Let W and H are the width and height of skin and non-pixel image as shown in fig 3.1.1
- Read the pixel at position (0,H/2) which is a middle of i.e. left side of image.
- Travers a distance D1 = W/6 in horizontal direction to get the start boundary pixel of skin region.
- Travers a distance D2= H/6 from a pixel position (W/6, H/2) in upward directions. Same may do in downward direction and locate the points X1, X2.
- Travers a distance D3=W/3 from the point X1 and locate the point X3. Same do from the point x2 and locate the point X4.
- Crop the square image as shown.

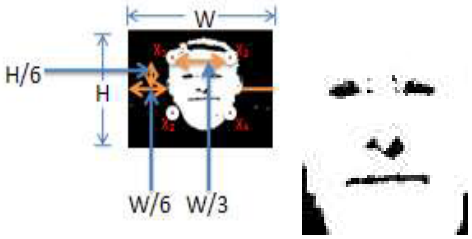

Fig 2 Face recognition

After face extraction white region pixels (i.e. skin pixels) are filled with skin color. A resultant image with skin color and after enhancement becomes as

C. Face Features Extraction

Figures Human face is made up of eyes; nose, mouth and chine etc. there are differences in shape, size, and structure of these organs. So the faces are differs in thousands way.

One of the common methods for face expression recognition is to extract the shape of eyes and mouth and then distinguish the faces by the distance and scale of these organs.

The face feature extractions consist of following steps

- Let W and H are width and height of an image shown in Fig 3.2.3
- Mark pixel Pi (W/2, H/2) as centre of image.
- Travers a distance H/8 from the pixel Pi towards upward and mark a point K1.
- Travers a distance W/3 from the point K1 towards leftward and mark a point K2.
- Travers a distance H/10 towards downward from the point K2 and mark a point K3.
- Travers a distance W/4 from the point K3towards right and mark the point K4.
- Travers a distance H/10 from the point K4 toward up and mark the point K5.
- Same steps are repeated for extracting the right eye and mark the point N2, N3, N4, and N5.
- Travers a distance H/8 from the point Pi towards downward and mark the point M1.
- Travers a distance W/6 towards left and right from the point M1 and marks the point M2 and M3.
- Start with the point M2 traverse a distance H/10 towards downward and mark the point M4.
- Travers a distance W/6 from the point M4 towards right and mark the point M5. Same may do from point M5 and mark the point M6.
- Travers the distance H/10 from M6 towards up that meets to the point M3.

See the below image.

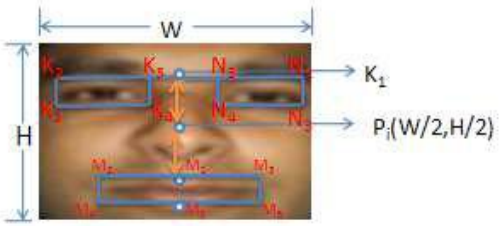

Fig 4. Feature Extraction

- Dist $|P_i - K_1| = H/8$
- Dist $|K_1 - K_2| =$ Dist $|M_1 - M_2| =$ Dist $|M_1 - M_3| =$ Dist $|M_4 - M_5| =$ Dist $|M_5 - M_6| = W/3$
- Dist $|K_2 - K_3| =$ Dist $|K_4 - K_5| =$ Dist $|N_2 - N_3| =$ Dist $|N_4 - N_5| =$ Dist $|M_2 - M_4| =$ Dist $|M_1 - M_5| =$ Dist $|M_3 - M_6| = H/10$
- Dist $|K_3 - K_4| =$ Dist $|K_5 - K_2| =$ Dist $|N_3 - N_4| =$ Dist $|N_5 - N_2| = W/4$

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D. Curve formation using Bezier curve

Figures Eyes and mouth as shown in fig 3.3.1 are locatedandextracted. Bezier curve formed from this eyes andmouth asper the equation

$Q(t) = \sum_{i=0}^{n} P_i B_{i,n}(t) = 0$ ……..eq. 3.4.1

Where each term in the sum is the product of blending function Bi,n(t) and the control point Pi. The Bi,n(t) is called as Bernstein polynomials and are defined by

$Bi, t = C_i^n (1-t)^{n-i}$ ……eq. 3.4.2

Where C_i^n is the binomial co-efficient given by:

$C_i^n = \frac{n!}{i!(n-1)}$ ……..eq. 3.4.3

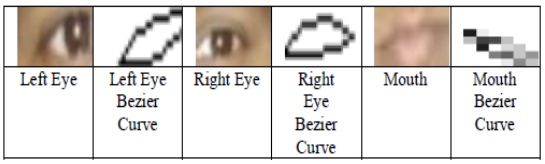

Fig 5. Bezier Curve

Once the Bezier curve formed features points are located as shown in below image.

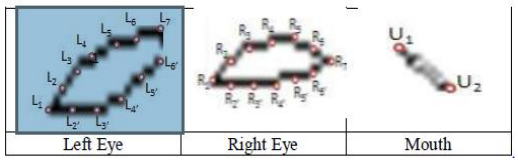

Fig 6. Feature Point Location

The feature point distance for left and right eye is measured with

$Z = \int_i^n \sum_i^6 (e^{Hi} sinw_i - e^{H\,i'} cosw_i)$ ……..eq. 3.4.4

$where Z = featurepointdistance$

$n = numberoffeaturepoints$

For left eye Hi = Li and for right eye Hi. = Ri.

The feature point distance for mouth is measuredwith

$Z' = \int_i^n \sum_{i=1}^2 (e^{H\,i} sinw_i/2 - e^{H\,i'} \cos w_i/2)$ …...eq.3.4.5

An expression id generated from an average of Zand Z' as below.

id= (Z+Z')/2……eq.3.4.6

E. Fuzzy Patterns

It is found that expression recognition from the still image never gives a correct output. A one expression id may also false into more than one expression domain. This project forms some fuzzy patterns for expressions. See the set theory diagram below

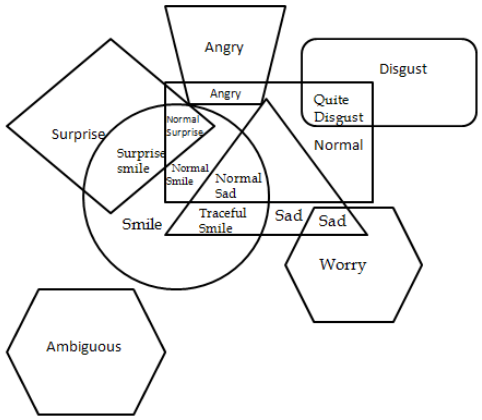

Fig 7. Fuzzy Expression Patterns

IV. CONCLUSION

This paper proposes a new approach for recognizing the category of facial expression an estimating the degree of continuous facial expression change from time sequential images. This approach is based on personal independent average facial expression model.

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