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Evaluation of Optimization Methods Ant Colony and Imperialist Competitive Algorithm in Face Emotion Recognition

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Abstract:Facial expression gives important information about emotion of a person. Face emotion recognition is one of main applications of machine vision that widely attended in recent years. It can be used in areas of security, entertainment and human machine interface (HMI). Emotion recognition usually uses of science image processing, speech processing, gesture signal processing and physiological signal processing. In this paper two new algorithms based on a set of images to face emotion recognition has been proposed. This process involves three stages pre-processing, feature extraction and classification. The obtained results show that success rate and running speed in Ant Colony for two emotions fear and angry is better than ICA.

Keywords: Face emotion recognition, Projection profile, Imperialist Competitive Algorithm (ICA) and Ant Colony.

I. INTRODUCTION

Facial expression gives us valuable information about emotion of a person. The important parts for express emotion a person are biometricelements such aseye and lip.Ekman classifications for emotion recognition are sadness, angry, joy, fear, disgust and surprise without consider natural emotion. Inthis paper two new algorithms based on a set of images to face emotion recognition has been proposed. This process involves three stages pre-processing, feature extraction and classification. Firstly a series of pre-processing tasks such as adjusting contrast, filtering, skin color segmentation and edge detection are done. One of important tasks at this stage after pre-processing is feature extraction. Projection profile method to reason high speed and high precision is used to feature extraction. Secondly Ant Colony and Imperialist Competitive Algorithm (ICA) are used to optimize ellipsecharacteristics eyes and lip.

In the third stage by using the obtainedfeatures from optimal ellipse eye and lip can emotion a person according to experimental results and emotions represented by Ekmanclassified. In this study for the validity of research a collection of Indian images including 350 training images and 350 non-training images in seven emotions are used [19].The obtained results show that success rate and running speed in Ant Colony for two emotions fear and angry is better than ICA. The rest of this paper organized as follows. Section 2 is an overview of related works. Parameter setting for Ant Colony and ICA algorithm is described in section 3. Efficiency analysis and results of the method is discussed in section 4 and section 5 contains conclusions.

II. RELATED WORKS

Facial expressions afford important information about emotions. Therefore, several approaches have been proposed to classify human affective states. The features used are typically based on local spatial position or displacement of specific points and regions of the face, unlike the approaches based on audio, which use global statistics of the acoustic features. For a complete review of recent emotion recognition systems based on facial expression the readers are referred to [1]. Mase proposed an emotion recognition system that uses the major directions of specific facial muscles [2]. With 11 windows manually located in the face, the muscle movements were extracted by the use of optical flow. For classification, K-nearest neighbor rule was used, with an accuracy of 80% with four emotions: happiness, anger, disgust and surprise. Yacoob et al. proposed a similar method [3]. Instead of using facial muscle actions, they built a dictionary to convert motions associated with edge of the mouth, eyes and eyebrows, into a linguistic, per- frame, mid-level representation. They classified the six basic emotions by the used of a rule-based system with88% of accuracy. Black et al. used parametric models to extract the shape and movements of the mouse, eye and eyebrows [4].

They also built a mid- and high-level representation of facial actions by using a similar approach employed in [3], with 89% of accuracy. Tian et al. attempted to recognize Actions Units (AU), developed by Ekman and Friesen in 1978 [5], using permanent and transient facial features such as lip, Nasolabial furrow and wrinkles [6]. Geometrical models were used to locate the shapes and appearances of these features. They achieved a 96% of accuracy. Essa et al. developed a system that quantified facial movements based on parametric models of independent facial muscle groups [7]. They modeled the face by the use of an optical flow method coupled with geometric, physical and motion-based dynamic models. They generated spatial-temporal templates that were used for emotion recognition. Without considering sadness that was not included in their work, a recognition accuracy rate of 98% was achieved. A method that extracts region of eye and lip of facial image by genetic algorithm has been suggested recently [8]. Performance optimization algorithms in the classification face emotion recognition are described in Manuscript Acceptance Letter from IJARCS) [9]. Comparing Face Emotions with Genetic Algorithm and Particle Swarm Optimization are described in Manuscript Acceptance Letter from IJARCS) [10].

III. THE PROPOSED METHOD

To get good results we should similareye and lip to regular and irregular ellipse. The main goal of this paper is introducingtwoalgorithms Ant Colony and Imperialist Competitive Algorithm to optimize ellipsecharacteristicseye and lip. Finally will compare the results for two specific emotion fear and angry. One of main reasons for using sobel edge detection filter is high speed and high accuracy. Sobel relations are shown in (1), (2), (3).

$$G_x = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix} * A \ , \ G_y = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ +1 & +2 & +1 \end{bmatrix} * A \ (1)$$

$$G = \sqrt{G_x^2 + G_y^2} \ (2)$$

$$\alpha = \arctan\left(\frac{G_y}{G_x}\right) \ (3)$$

Sobelfilter on the sample image is shown in Fig.1.

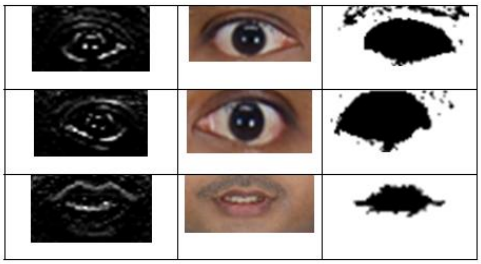

Figure 1. The surprise emotion [19]

A. *Feature Extraction:*

Projection profile is a rapid method for feature extraction. This feature extraction method is implemented with the row-sum and column-sum of white pixels in the image was obtained by sobel filter [8].The template of row-sum along the column show with (M_h) and template of column-sum along the row show with (M_v) and these features defined for each region [8]. These features are defined as projection profile. Allow f (m, n) is shown with a binary image of m rows and n columns [8]. The vertical profile (M_v) with size n is shown by (4) [8].

$$\mathbf{Mvj} = \sum_{i=1}^{m} f(i,j) \ \mathbf{j} = 1,2,3 \ldots \boldsymbol{n} \quad (4)$$

The horizontal (M_h) with size m is shown by (5) [8].

$$\mathbf{Mhi} = \sum_{j=1}^{n} f(i,j) \ \mathbf{i} = 1,2,3 \ldots \boldsymbol{m} \quad (5)$$

The human eye shape is more like an ellipse (we call this as a regular ellipse) and shown in Fig.2.The minor axis of ellipse is a feature of eye and different for each person emotion. The major axis of ellipse with name "a" is different for each person. The regular ellipse is displayed with its minor and major axes and also parameter "a" fixed and "b" calculated by (6) [8].

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 (6)$$

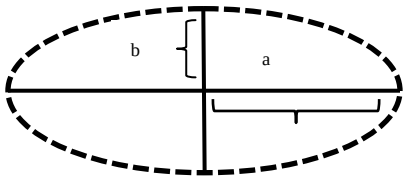

Figure2. The regular ellipse

Person lipis an irregular ellipse and shown in Fig.3.An irregular ellipse has two variable axes. In the irregular ellipse parameter "a" fixed and parameters "b_1" and "b_2" are calculated. In the next section Ant Colony and ICA algorithm adopted to optimize these features.

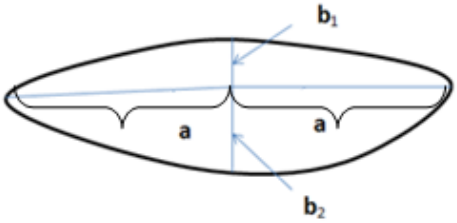

Figure3. The irregular ellipse

Features extracted horizontal and vertical of eye and lip for binary image 8*8are shown in Fig.4.

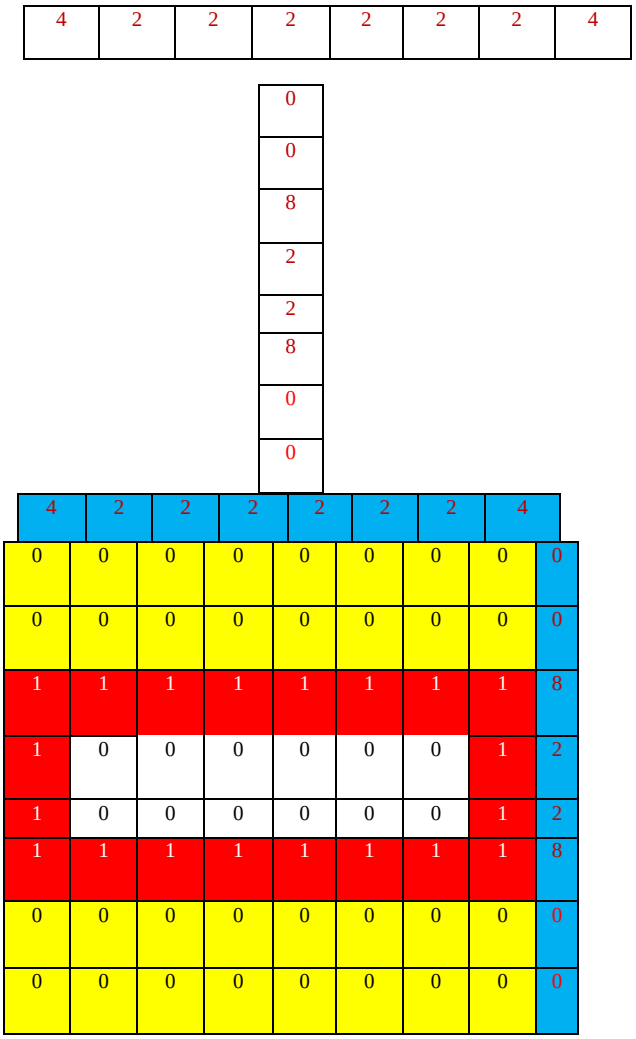

Figure4.Features extracted horizontal and vertical of eye and lip

B. *Parameter Setting for ICA Algorithm:*

Table I. Parameter setting for ICA algorithm

ICA Parameters	
#Countries	200
#Imperialists	20
Revolution Rate	0.3
γ	0.5
β	2
#Iterations	500

C. *Parameter Setting for Ant Colony:*

Table II. Parameter setting for Ant Colony algorithm

Ant Colony Parameters	
#Control Variable	3
#m	128
P	{0,0.01,0.1}
A	[1,2]
#Iterations	500

IV. EXPERIMENTAL RESULTS

In this study for the validity of research a collection of Indian images including 350 training images and 350 non-training images in seven emotions are used [19].The eye and lip features have been given as input to Ant colony and ICA algorithm to find optimized values (ellipse optimum). Optimization process was repeated 20 times for each emotion. Thereupon optimal parameters (x, x_1, x_2) come from optimal ellipsoid axes. With compare Table III and Table IVwe conclude that algorithm Ant Colony for two emotions fear and angry produces betterresultsthan ICA.

V. CONCLUSION AND FUTURE WORKS

An important area, practical, low cost and rapid in emotion recognition is facial expression. Emotion recognition usually uses of science image processing, speech processing, gesture signal processing and physiological signal processing. In this paper two new algorithms based on a set of images to face emotion recognition has been proposed. This process involves three stages pre-processing, feature extraction and classification. Firstly a series of pre-processing tasks such as adjusting contrast, filtering, skin color segmentation and edge detection are done. One of important tasks at this stage after pre-processing is feature extraction. Projection profile method to reason high speed and high precision is used to feature extraction. Secondly Ant Colony and Imperialist Competitive Algorithm (ICA) are used to optimize ellipsecharacteristics eyes and lip. In the third stage by using the features obtained from optimal ellipse eye and lip can emotion a person according to experimental results and emotions represented by Ekmanclassified. The obtained results show that success rate and running speed in Ant Colony for two emotions fear and angry is better than ICA.

Table III. Manual and ICA optimal measured parameters

Emotion	***Manually Computed Mean Value (in pixels)***			***Optimized Mean Value by ICA (in pixels)***			***50 Images For each emotion***	***Duration of Emotion Recognition (sec)***
	b_1	**b_2**	**b**	**x_1**	**x_2**	**x**	**Success Rate**	**Mean Time**
Natural	40	44	25	39.2644	43.2531	24.6188	96%	35
Fear	27	44	21	26.0287	43.9529	20.7024	91%	31
Happy	27	50	20	26.5929	49.4742	19.0393	94%	42
Sad	28	37	22	27.9104	36.4511	21.9633	92%	36
Angry	27	36	19	26.2781	35.8381	18.4120	90%	29
Dislike	37	32	18	36.3409	31.6276	17.8353	95%	33
Surprise	46	60	20	45.6892	59.0180	19.0701	93%	42

Table IV. Manual and Ant Colony optimal measured parameters

Emotion	***Manually Computed Mean Value (in pixels)***			***Optimized Mean Value by Ant Colony (in pixels)***			***50 Images For each emotion***	***Duration of Emotion Recognition (sec)***
	b_1	**b_2**	**b**	**x_1**	**x_2**	**x**	**Success Rate**	**Mean Time**
Natural	40	44	25	39.7854	43.0458	24.0154	93%	27
Fear	27	44	21	26.4514	43.7855	20.7854	98%	29
Happy	27	50	20	26.78411	49.4785	19.1456	92%	45
Sad	28	37	22	27.8712	36.7484	21.7848	90%	32
Angry	27	36	19	26.1201	35.1214	18.1453	99%	37
Dislike	37	32	18	36.4585	31.2145	17.6530	93%	41
Surprise	46	60	20	45.0125	59.4588	19.0748	92%	34

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