Emotion Recognition Using Human Appearance Model

SHARANYA M R, MUNEESWARAN V

Abstract - Facial Expression gives important instruction about emotion of a person. Facial expression recognition has become one of the major problem in computer vision. In this Project, a personalized pre-processing method is proposed to increase the accuracies of neutral and emotion classification. Supervised methods cannot be accommodate to all appearance lightness across the faces like nose, eye, mouth, in the limited amount of training data. To overcome the shortcomings in the traditional supervised Emotion Recognition(ER) methods in terms of accuracy and speed a light-weight method to classify neutral and emotion classification is proposed. Key Emotion (KE) points over the face will be extracted based on the sensitivity to identify the emotion from the image. This proposed method provides a secure and robust framework to classify the emotions through various images.

Index terms - Edge Detection, Face Detection, PCA, Key Emotion Points, Action Units, Constrained Local Model (CLM).

1 INTRODUCTION

Facial expression resolution is an interesting and challenging problem, and impacts important applications in many areas such as human–computer interaction. It is one of the most powerful, natural and immediate means for human beings to convey their emotions and Intensions. It performance a communicative role in interpersonal relations. Facial expressions can play an important performance wherever humans interact with machines [2]. The Basic emotions include happy, sadness, angry, neutral, surprise. Smiles, for instance, occur in both joy and embarrassment as shown in fig 1.

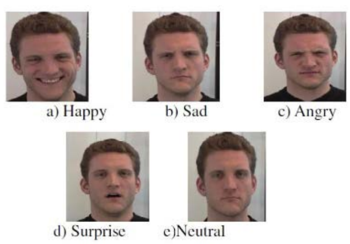

Fig. 1. Basic Facial Expressions.

A. Facial Recognition on Neural Network

Facial recognition is a type of biometric application that can identify a specific individual in a digital image by analysis and comparing patterns. Facial recognition systems are commonly used for security purposes and other application.

- It has a filter at the beginning of the process that scan the whole image, and take each quantity to see if the face exist in each window.
- Merging all this pieces after the filter help the NN to exclude false detections.
- NN has a high level of exactness when the images has lighting conditions.

B. Facial Action Coding System (FACS)

Facial Action Coding System (FACS) segments the visible effects of facial muscle activation into Action Units. Each action unit is related to one or more facial muscles [1]. The Facial Action Coding System (FACS) is a comprehensive, anatomically based system for measuring nearly all visually discernible facial movement. Facial movement is thus described in terms of constituent components, or Action unit [AU's] [5]. The FACS is made up of several such action units. For example:

- AU 1 is the action of raising the Inner Brow.
- AU 2 is the action of raising the Outer Brow.
- AU 26 is the action of dropping the Jaw.

- *Sharanya M R is currently pursuing masters degree program in Computer Science and Engineering in Sri Krishna College of Engineering and Technology, Coimbatore, Tamil Nadu, India, PH-9095933953. E-mail: saranyamrit@gmail.com.*
- *Muneeswaran V is Assistant Professor in Computer Science and Engineering in Sri Krishna College of Engineering and Technology, Coimbatore, Tamil Nadu, India, PH-7402601459. E-mail: muneeswaranv@skcet.ac.in.*

ISSN 2229-5518

However not all of the AUs are caused by facial muscles. Some of such examples are:

- AU 19 is the action of Tongue Out.
- AU 33 is the action of Cheek Blow.
- AU 66 is the action of Cross-Eye.

AU's can be additive or non-additive. AU's are said to be additive if the appearance of each AU is independent and the AU's are said to be non-additive if they adjust each other's appearance. Having defined these, representation of facial expressions develop into an easy job. Each expression can be represented as a combination of one or more additive or non-additive AU's. For example 'fear' can be represented as a combination of AU's 1, 2 and 26. Figs.2 show some examples of upper and lower face AU's and the facial action that they produce when presented in combination.

TABLE I
EXAMPLE OF FACIAL ACTION UNIT POINTS

AU	**Description**	**AU**	**Description**
AU1	Inner Brow Raise	AU15	Lip Corner Depressor
AU2	Outer Brow Raise	AU17	Chin Raise
AU4	Brow Lower	AU18	Lip Pucker
AU5	Eye Widen	AU20	Lip Stretch
AU6	Cheek Raise	AU23	Lip Tightened
AU7	Lids Tight	AU24	Lip Presser
AU9	Nose Wrinkle	AU25	Lips Part
AU10	Lip Raise	AU26	Jaw Drop
AU12	Lip Corner Pull	AU28	Lips Suck
AU14	Dimplier	AU45	Eye Closure

This project focuses on how image processing techniques applied to detect the key emotion points in the image data set. The study of related works are presented in 1.Introduction, 2.System Architecture, 3.Module Description, and finally 4 describes about Conclusion and Future Work.

ISSN 2229-5518

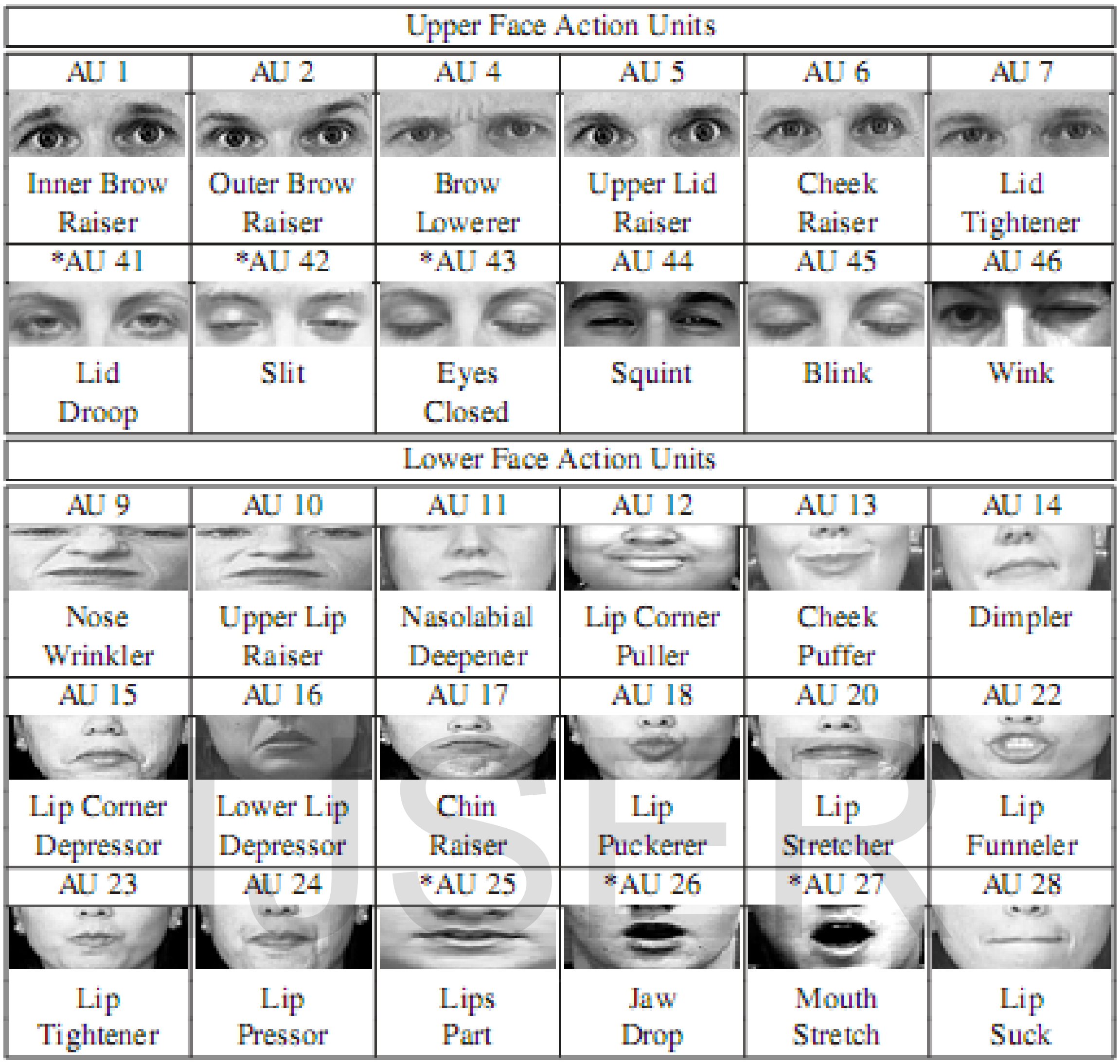

Fig. 2. Some of the Upper & Lower Face AU's and their combinations.

2. SYSTEM ARCHITECTURE

Here we propose an emotion recognition scheme by using various different techniques. Typically an automated face expression recognition system includes a Polaroid for capturing the facial image. It is then pre -processed so as to minimize the environmental and other change in the image. This includes the operations of image scaling and brightness adjustment. After that face, mouth and eye region was identify i.e. feature extraction. Then with the help of eyes and lips aspect we classify five different emotions. A block diagram description of Facial Emotion Recognition (FER) system is shown in ―Fig 3.

ISSN 2229-5518

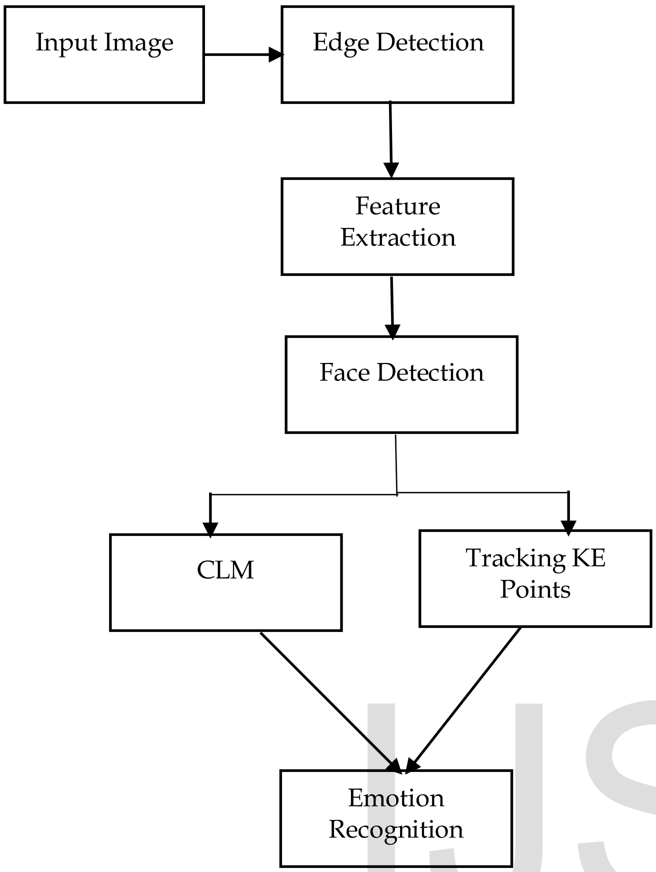

Fig. 3. System Architecture Model.

3. Module Description

A. Edge Detection and Size Reduction

Edge Detection

Edges are detected by using responsibility of image processing tool box in MATLAB. Through edges we got end point of features from the images like eyes, nose and lips. The results of edge detection are shown in —fig.4.

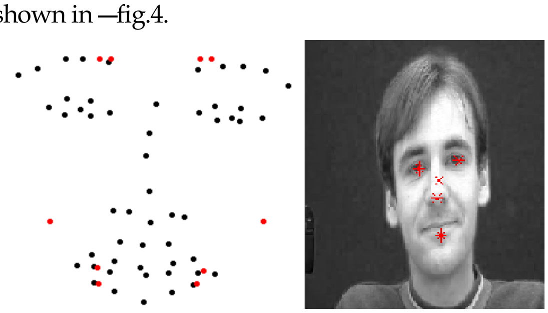

Fig. 4. Showing Results of Edge Detection.

Size Reduction

A technique today commonly used for dimensionality reduction in computer vision particularly in face recognition is principal components analysis (PCA) [8], [9]. Accept a dimensionality reducing linear projection that maximizes the scatter of all projected samples. The feature vectors were distribute to zero mean and further compressed using a linear data reduction method called the Principal Component Analysis. Assuming that the high variance of the data describes interesting dynamics and that low deviation are linked to noise, the reduction of data dimensionality can be achieved by keeping high order principal components and ignoring lower-order ones.

B. Face Feature Extraction

One common method is to extract the model of the eyes, nose, mouth and chin, and then distinguish the faces by separation and scale of those organs. The selection face features is crucial to face recognition [10]. The five features points have been used, all features are in the form of distance.

Feature 1 width of face.

Feature 2 width of left eye.

Feature 3 width of right eye.

Feature 4 width of nose.

Feature 5 width of mouth corners.

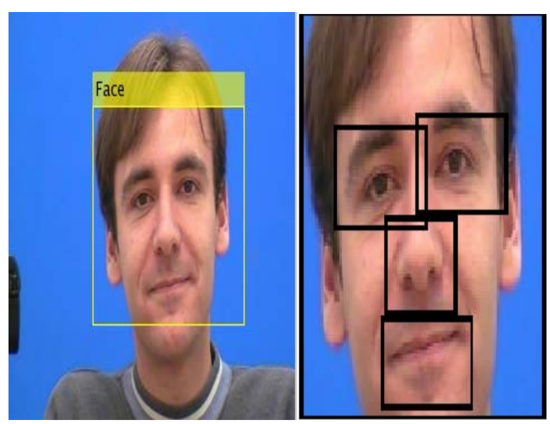

Fig. 5. Showing 5 Vital Features.

These features help in recognition of emotions. Every emotion have different values of feature vectors. The value of feature vector represents absolute between features points.

ISSN 2229-5518

C. Find Skin Color Blocks

There are different skin color regions in human face. In order to mark these regions we store four vertices of rectangle or every field. First, find the leftmost, rightmost, upmost and lowermost points. By these four points a rectangle is created over this region. Thus several skin color blocks called candidate blocks are found. The results are shown in fig 7.

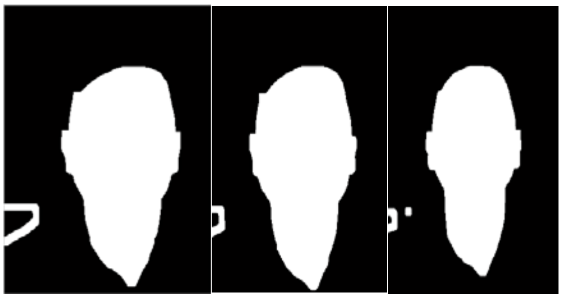

Fig. 6. Result of Face Detection Algorithm.

D. Face Detection

Face localization aims to resolve the image position of a single face; this is a simplified detection problem with the acceptance that an input image contains only one face. The main concern of face detection 0is to identify all image regions which contain a face careless of its orientation, background and lighting conditions. Such task is tricky since faces can have a vast collection in terms of shape, color, size or texture [11]. At present time a lot of automatic access involve detecting faces in an image. By using threshold to separate skin region from an image for face detection was chosen in this algorithm.

E. Constrained Local Model (CLM)

A Constrained Local Model (CLM) is class of methods of locating sets of points (constrained by a statistical shape model) on a target image [5]. The general approach is to

- Sample a region from the image around the current estimate, projecting it into a reference frame.
- For each point, generate a "response image" giving a cost for having the point at each pixel.
- Searching for a combination of points which optimizes the total cost, by manipulating the shape model parameters.
- The best fit is found by finding the shape and pose parameters to minimize:

$$Q(b,t) = \sum_{i=1}^{i=n} R_i(T_t(\bar{X}_i + P_i b)) \quad \ldots\ldots\ldots (1.1)$$

- Q (b, t) is the pixel value in KE points, ∑ are respectively mean and variance function, R is the input image, T is the facial extraction, X is the Key point's extractions, P is the probability function.
- The term "Constrained Local Model" originally referred to a particular type of model, in which the response images were generated by applying normalized correlation with a local patch, where the model patches are modified to fit the current face but constrained by a global texture model.

F. Tracking of KE Points

KE points are generated in the reference shape by adding fixed offsets to a set of stable CLM points.

1. KE points are derived using offsets over stable CLM points in the reference shape. 1 tm is computed between reference and current shapes. KE points in the reference shape are mapped into current shape using 1 tm.
2. By aligning current shape to the previous normalized shape using 2 tm, current normalized shape, devoid of affine variations between two shapes is obtained. "Previous shape" is considered for previous normalized shape at t=1.
3. As the variations between two continuous normalized input shapes are gradual in general, fiducially point tracking is accurate. Hence the transformation matrix between two continuous normalized input shapes is also accurate. 3 tm is computed between previous and current normalized shapes.
4. KE points in the previous normalized shape are mapped to current normalized shape by 3 tm.
5. 4 tm is computed between current normalized shape and aligned/reference shape.
6. As patch extraction is done in the common shape, KE points in the current normalized shape are mapped to the common shape (reference/aligned shape) based on 4 tm.

G. Emotion Recognition

The recognition of emotions is based on the estimate of distances between various features points. In this step comparison between separation

ISSN 2229-5518

of testing image and neutral image is done and also it selects the best possible match of verification image from train folder. It also classifies or recognizes the emotions on the basis other distances calculated. And the final results are visible. In final results best match from training images is also shown and a text file Result.txt is displayed in MATLAB window.

4. IMPLEMENTATION

The experimental result shows that our algorithm can identify 10 emotions in our test image. The identification of emotions this algorithm also shows the distance of test image from neutral image and the best match of test image from trained images. There by our proposed algorithm is suitable for use in real-time systems with high performance. In fig 7. The input image contains only one face. The main concern of face detection is to identify all image regions. To resolve the image position of a single face. One common method is to extract the model of the eyes, nose, and mouth. The five features points have been used, all features are in the form of distance. And finally emotion is display in the system.

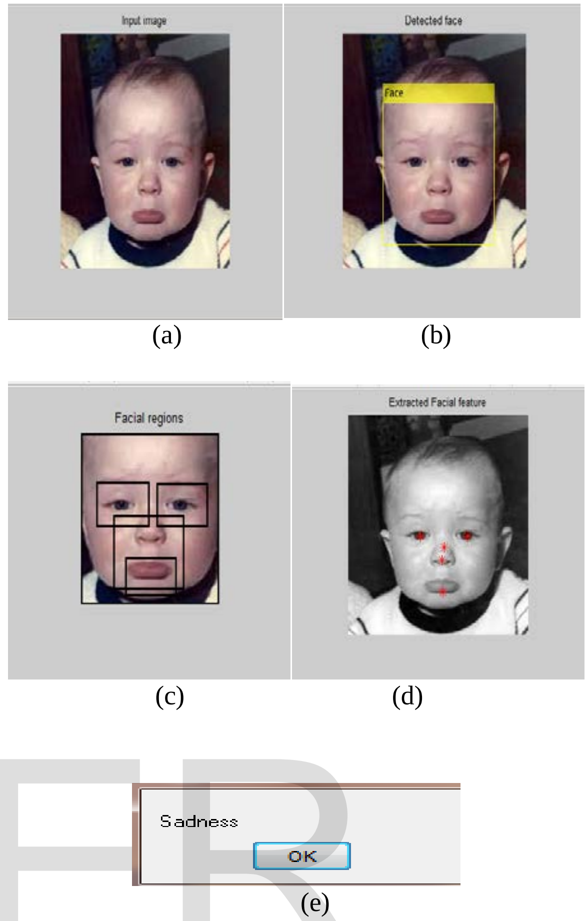

FIG. 7. IMPLEMENTATION RESULT.

TABLE 2
PERFORMANCE OF THE FACIAL EXPRESSION

Area	Overall	Anger	Sadness	Surprise	Neutral
Forehead	0.73	0.82	0.66	1.00	0.46
Eyebrow	0.68	0.55	0.67	1.00	0.49
Low eye	0.81	0.82	0.78	1.00	0.65
Right cheek	0.85	0.87	0.76	1.00	0.79
Left cheek	0.80	0.84	0.67	1.00	0.67
Mouth	0.85	0.79	0.81	1.00	0.81

Table 2 also reveals that the combined facial expression classifier has an accuracy of 85%, which is higher than most of the 5 facial blocks classifiers. Notice that this database was recorded from a single actress, so clearly more experiments should be conducted to evaluate these results with other subjects.

TABLE 3
EMOTION COMPARISON OF ER SYSTEM

Emotion	Child		Younger		Older		Overall
Happy	90	10	100	-	75	25	93%
Sad	95	5	85	15	100	-	80%
Angry	75	25	95	5	90	10	82%
Surprise	80	20	100	-	100	-	99%
Neutral	100	-	100	-	85	15	100%

Table 3 is used to emotion classification system. In our algorithm on our datasets is due to the fact that our database contains various real world challenges like facial biases, pose, lighting variations etc., It is shown that our personalized pre-processor is offering high false positive(F+ve) and low false negative(F-ve) as compared for all the datasets.

5. CONCLUSION

In this paper, we proposed an exact and high speed emotion detection system. The personalized pre-processing method to recover neutral and emotion classification accuracies of traditional offline trained Emotion Recognition (ER) system by exploiting that neutral state of a single user can be learned in a dynamic fashion. A robust framework to determine neutral presence at the KE points. This path, aimed at mobile phone/tablet use cases, reported good accuracy for various challenging situations. In future work, the proposed system to identify the age of a person .This can be used for Id verification, Age proofs, Social networks, banking, etc. The age can be estimated using the Neuron Networks with the identified emotions.

REFERENCES

[1] Krishna Mohan KudirP, Abas Md Said, M Yunus Nayan,"Emotion Detection Using Sub-image Based Features through Human Facial Expressions", International Conference on Computer & Information Science (ICCIS) 2012 volume 1.

[2] Lajevardi, S.M. Lech, "Facial Expression Recognition Using Neural Networks and Log-Gabor Filters", Digital Image Computing: Techniques and Applications IEEE 2008.

[3] Guodong Guo, Charles R. Dyer, "Simultaneous Feature Selection And Classifier Training Via Linear Programming", A Case Study For Face Expression Recognition Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR'03) vol.1 2003, On page(s): I-346 - I-352.

[4] Liyiiig Miit, Yepi .Yiaott A, Kliomsciriit, Rubub Kreidieh Wclrdtt,"A New Facial Expression Recognition Technique Using 2-D Dct And KMeans Algorithm", International Conference on Image Processing (ICIP) in 2004.

[5] L. Ma and K. Khorasani, "Facial Expression Recognition Using Constructive Feed forward Neural Networks", IEEE transactions on systems, man, and cybernetics—part b: Cybernetics, vol. 34, no. 3, June 2004.

[6] S. Gundimada, Li Tao, and v. Asari, "Face detection technique based on intensity and skin color distribution",in 2004 International Conference on Image Processing, Otc. 2004, vol. 2, pp. 1413–1416.

[7] K. P. Seng, A. Suwandy, and L.-M. Ang, "Improved automatic Face detection technique in color images",in IEEE Region 10 Conference TENCON 2004, Nov. 2004, vol. 1, pp. 459–462.

[8] Smith, L.I,"Tutorial on Principal Component Analysis", in 2002.

[9] M. Turk, A. Pentland, "Eigenfaces for Recognition",Journal Cognitive Neuro-science, Vol. 3, 1991, pp.71-86.

[10] Ritesh Vyas, Gourav Garg, "Face recognition using feature extraction and neuro-fuzzy techniques", International Journal of Electronics and Computer Science Engineering in 2012.

[11] Yu-Ting Pai, Shanq-Jang Ruan, Mon-Chau Shie and Yi-Chi Liu,"A Simple And Accurate Color Face Detection Algorithm In Complex Background", Low Power Systems Lab, Department of Electronic Engineering, National Taiwan University of Science and Technology, No.43, Sec.4, pp. 1545 – 1548.

[12] Nidhi N. Khatri, Zankhana H. Shah, Samip A. Patel, "Facial Expression Recognition:A Survey", International Journal of Computer Science and Information Technologies (IJCSIT), Vol. 5(1), 2014, 149-152, 2009.

[13] C. Shan, S. Gong, and PW. McOwan, "Facial expression recognition based on local binary patterns: A comprehensive study", Image and Vision Comput., vo.27, no.6, pp.803-816, 2009.