A Survey on Various Facial Expression Techniques

Md. Sarfaraz Jalil, Joy Bhattacharya

Abstract— Human Action and Expression plays a vital role for the recognition of faces in various applications. Since various technique are implemented for the recognition of various facial expressions. But here in this paper a complete survey of all these techniques implemented for facial expression is analyzed and discussed here so that on the basis of their various advantages and limitations a more improved and efficient technique is implemented in future. The proposed methodology implemented in future can be compared on the basis of number of facial features extracted and their accuracy of recognition.

Index Terms— FACS, Facial expressions, Gabor filter, Feature Extraction.

1 INTRODUCTION

Visual communication is very important for humans as social beings. The pioneering study on emotion messages revealed from human faces was from Darwin's work [1]. Then Ekman defined six basic emotions which are claimed to be universally associated with distinct facial expressions [2]. These six basic emotions are: happiness, sadness, surprise, fear, anger, and disgust. Although the question about whether these basic emotions are indeed universal still remains an open question, most of the vision-based facial expression studies rely on Ekman's definition about the universal categories of emotions. The Facial Action Coding System (FACS) is a human observer-based system that has been developed to facilitate objective measurement of subtle changes in facial appearance caused by contractions of the facial muscles [3]. Via 44 action units, FACS is able to give a linguistic description of all visibly discriminable expressions. Automatic facial expression systems can be applied to human-computer interaction, stress monitoring systems, low-bandwidth videoconferencing, human behavior analysis, etc [4]-[18]. Thus in recent years, the research of developing automatic facial expression recognition systems has attracted a lot of attention from many different fields. While an overview of the early works in facial expression analysis can be found in [19], a more recent and complete overview is referred to [20]. The approaches to facial expression recognition can be roughly divided into two classes: geometrical feature-based approaches and appearance-based approaches [16]. The geometrical feature-based approaches rely on the geometric facial features which present the shapes and locations of facial components such as eyebrows, eyes, canthus, nose, mouth etc. Experimental results exhibited that the facial features cannot always be obtained reliably because of the quality of images, illumination, and some other disturbing factors. As for the appearance-based approaches, the whole-face or specific regions in a face image are used for the feature extraction via optical flow or some kinds of filters. Some approaches focus on the discrimination of facial expression at the level of emotion prototypes but some other approaches are able to discriminate expressions at a fine-grained level via the recognition of action units [12]. Some approaches can fully automatically recognize expressions from image sequences but some approaches still need to manually label some feature points before the recognition procedure. With few exceptions, most proposed approaches have used relatively limited data sets. Detailed comparisons of the existing approaches were provided in the review article [20].

2 LITERATURE SURVEY

Deformation Extraction	Geometric Features	Appearance Features
Image Based	Gabor Filter	Local Gabor Filter Bank, Fiher's Linear decomposition.
Model Based	Point Distribution Model	Feature point Tracking
Motion Extraction	Active contour	Gabor Filter Bank
Sequence Based	PCA, Gabor Filter Bank & AdaBoost	Haar like features, Multimodal facial feature tracking, Candid Grid Node

Table 1: Facial Expression Extraction Methods

Geometric Feature Extraction

Geometric Extraction is to detect and track changes of facial components in near frontal Face images. Tian et al. develop multi-state models to extract the geometric facial features. A three-state lip model describes the lip state: open, closed, tightly closed. A two-state model (open or closed) is used for each of the eyes. Each brow and cheek has a one-state model. Some appearance features, such as nasolabial furrows and crows-feet wrinkles, are represented explicitly by using two states: present and absent.

Model Based:

Automatic Active Appearance Model (AAM) mapping can be employed to reduce the manual preprocessing of the geometric feature initialization. Xiao et al. [21] performed the 3D head tracking to handle large out-of plane head motion and track nonrigid features. Once the head pose is recovered, the face region is stabilized by transforming the image to a common orientation for expression recognition [22].

Image Sequence:

Given an image sequence, the region of the face and approximate location of individual face features are detected automatically in the initial frame. The contours of the face features and components then are adjusted manually in the initial frame. After the initialization, all face feature changes are automatically detected and tracked in the image sequence. The system groups 15 parameters for the upper face[23] and 9 parameters for the lower face[24], which describe shape, motion, and state of face components and furrows. To remove the effects of variation in planar head motion and scale between image sequences in face size, all parameters are computed as ratios of their current values to that in the reference frame.

Title	Year	Author	Method	Database
A New Facial Expression Recognition Method based on local Gabor filter bank and PCA plus LDA	2005	Hong-Bo Deng,Lian-Wen Jin,Li-Xin Zhen,Jian – Cheng Huang	PCA plus LDA	JAFFE
Automatic Facial Expression Recognition using facial animation parameters and mulitstream HMMS	2006	Petar S. Aleksic, Member, IEEE, and Aggelos K. Katsaggelos, *Fellow, IEEE*	Multistream Hidden Markov Models	Cohn Kanade
A Region Based methodology for facial expression recognition	2006	Anastasios C. Koutlas, Dimitrios I. Fotiadis	Neural Networks	JAFFE
Automatic Recognition of Facial Actions in Spontaneous Expressions	2006	Marian Stewart Bartlett, Gwen C. Littlewort, Mark G. Frank, Claudia Lainscsek, Ian R. Fasel, Javier R. Movellan	SVM & ADABoost	RU-FACS
Boosting encoded dynamic features for facial expression recognition	2009	Peng Yang , Qingshan Liu , Dimitris N. Metaxas	Adaboost	Cohn-Kanade

3 Conclusion

The various techniques implemented for the facial features expressions recognition are analyzed here and their various limitations and advantages and usages in the real life. The various limitations of these techniques such as less number of features extracted are challenging issues in the technique. Hence a new and efficient technique is implemented in future.

References

[1] C. Darwin, *The Expression of Emotions in Man and Animals*, University of Chicago Press, 1965.
[2] P. Ekman, *Emotion in the Human faces*, Cambridge University Press, 1982.
[3] P. Ekman and W.V. Friesen, *Facial Action Coding System FACS)*, Consulting Psychologists Press, 1978.
[4] G. W. Cottrell and J. Metcalfe, "EMPATH: Face, gender, and emotion recognition using holons," *Advances in Neural Information Processing Systems*, vol. 3, pp. 564-571, 1991.
[5] T. Darrel, I. Essa, and A. P. Pentland, "Correlation and

interpolation networks for real-time expression analysis/synthesis," *Advances in Neural Information Processing Systems (NIPS) 7*, MIT Press, 1995.

[6] I. A. Essa and A. Pentland, "A vision system for observing and extracting facial action parameters," *Proc. Computer Vision and Pattern Recognition*, pp. 76-83, 1994.

[7] K. Mase, "Recognition of facial expression from optical flow," *IEICE Trans.*, vol. E74, no. 10, pp. 3474-3483, 1991.

[8] K. Matsuno, C. Lee, and S. Tsuji, "Recognition of human facial expressions without feature extraction," *ECCV*, pp. 513-520, 1994.

[9] D. Terzopoulos and K. Waters, "Analysis and synthesis of facial image sequences using physical and anatomical models," *IEEE Trans. Pattern Anal. Machine Intell.*, vol. 15, pp. 569-579, 1993.

[10] Y. Yacoob and L. D. Davis "Recognizing human facial expressions from long image sequences using optical flow," *IEEE Trans.on Pattern Analysis and Machine Intelligence,* vol. 18, no. 6, pp. 636-642, 1996.

[11] M. Rosenblum, Y. Yacoob, L.S. Davis, "Human Expression Recognition from Motion Using a Radial Basis Function Network Architecture," *IEEE Trans. on Neural Networks*, vol. 7, no. 5, pp. 1121-1138, 1996.

[12] J. F. Cohn, A. J. Zlochower, J. J. Lien, and T. Kanade, "Feature-point tracking by optical flow discriminates subtle differences in facial expression," in *Proceedings of the 3rd IEEE International Conference on Automatic Face and Gesture Recognition,* pp. 396-401, 1998.

[13] G. Donato, M. S. Bartlett, J. C. Hager, P. Ekman, and T. J. Sejnowski, "Classifying Facial Actions," *IEEE Trans. On Pattern Analysis and Machine Intelligence*, vol. 21, no. 10, 1999.

[14] J. J. Lien, T. Kanade, J. Cohn, and C. Li, "Detection, tracking, and classification of action units in facial expression," *Journal of Robotics and Autonomous Systems*, vol. 31, Issue: 3, pp. 131-146, 2000.

[15] Y. l. Tian, T. Kanade, and J. F. Cohn, "Recognizing Action Units for Facial Expression Analysis," *IEEE Trans. On Pattern Analysis and Machine Intelligence*, vol. 23, no. 2, 2001.

[16] Y. l. Tian, T. Kanade, and J. F. Cohn, "Evaluation of Gabor-Wavelet-Based Facial Action Unit Recognition in Image Sequences of Increasing Complexity," in *Proceedings= of the Fifth IEEE International Conference on Automatic Face and Gesture Recognition,* pp. 229-234, 2002.

[17] M. S. Bartlett, J. C. Hager, P. Ekman, and T. J. Sejnowski, "Measuring Facial Expressions by Computer Image Analysis," *Psychophysiology*, vol. 36, pp. 253-263, 1999.

[18] T. Kanade, J. Cohn, and Y. Tian, "Comprehensive Database for Facial Expression Analysis," in *Proceedings of the Fourth IEEE International Conference on Automatic Face and Gesture Recognition,* pp. 45-63, 2000.

[19] A. Samal and P.A. Iyengar, "Automatic Recognition and Analysis of Human Faces and Facial Expressions: A Survey," *Pattern Recognition*, vol. 25, no. 1, pp. 65-77, 1992.

[20] M. Pantie and L. J. M. Rothkrantz, "Automatic analysis of facial expressions: the state of the art," *IEEE Trans. On Pattern Analysis and Machine Intelligence*, vol. 22, no. 12, pp. 1424-1445, 2000.

[21] [21] Xiao, J., Moriyama, T., Kanade, T., Cohn, J.: "Robust full-motion recovery of head by dynamic

[22] Templates and re-registration techniques". Int. J. Imaging Syst. Technol. (2003).

[23] Moriyama, T., Kanade, T., Cohn, J., Xiao, J., Ambadar, Z., Gao, J., Imanura, M.: "Automatic recognition of eye blinking in spontaneously occurring behaviour". In: Proceedings of the 16th International Conference on Pattern Recognition (ICPR '2002), vol. 4, pp. 78–81 (2002).

[24] Yingli Tian, Takeo Kanade and Jeffrey F. Cohn," Recognizing Upper Face Action Units for Facial Expression Analysis". Consultant Pschologists Press.

[25] Ying-li Tian , Takeo Kanade, Jeffrey F.Cohn," Recognizing Lower Face Action Units for Facial Expression Analysis". Consultant Pschologists Press.